# BOSNIA AND HERZEGOVINA

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## Summary of climate change dimensions

Although Bosnia and Herzegovina ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 2000, and its Kyoto Protocol in 2008, research activities and capacity building have not developed sufficiently, as policy on and scientific research into climate change in Bosnia and Herzegovina have been affected by the post-war situation, with a very complex state administration; lack of state and regional level legislation; absence of national, international and inter-sectoral cooperation; etc.

Bosnia and Herzegovina has lacked studies addressing climate changing problems and their regional and local influences on forestry, forest productivity, biodiversity, etc. No models have been developed that could be used for assessing impact on forestry or for evaluating possible national areal changes to plant and animal communities.

The most complete report regarding climate change is the Initial National Communication (INC) of Bosnia and Herzegovina to UNFCCC. The majority of this text derives from that report.

### Forestry

Forests represent one of the major natural resources of the country. Due to their natural and diverse structure, as well as extensive natural regeneration, they represent crucial resources for the further development of Bosnia and Herzegovina. The country itself is geographically optimally positioned in terms of diverse climatic influences (Mediterranean, sub-Mediterranean and middle continental climate zones) and is home to over one hundred tree species. The main species found are fir, spruce, Scots and European pine, beech, different species of oak, and less significant numbers of noble broadleaves, including maples, elms, ash, together with fruit trees (cherry, apple, pear).

Professional development and management in the forestry sector have focused on traditional systems, and has recently (especially following the turbulent post-war period, where forests have been neglected and abused) faced greater demands in terms of contributing more to protecting and enhancing all important forest functions, ranging from economic viability, to social responsibility and environmental and ecological sustainability.

Forests and forest land in Bosnia and Herzegovina encompass an area of approximately 5 073 000 ha (according to data from FAO, 2005; see: www.fao.org/forestry/country/32185/en/bih/), which is around 53% of the total land area. 2 186 300 ha (81%) is under state ownership, while 523 500 ha (19%) is in private ownership.

### Available institutional and expert potential related to climate change and forests and forestry

The Constitution of Bosnia and Herzegovina is an integral part of the Dayton Peace agreement and has created a specific State comprising two entities, the Federation of Bosnia and Herzegovina and the Republic of Srpska. Under this constitutional construction, Bosnia and Herzegovina is a sovereign state with a decentralized political and administrative structure. In addition, a separate District, Brcko, was established within Bosnia and Herzegovina's borders.

Since the Dayton Peace Agreement, environmental issues in Bosnia and Herzegovina have been under the responsibility of entity governments. The competent authorities are the Federal Ministry for Tourism and Environment in the Federation Bosnia and Herzegovina; Ministry for Physical

Planning, Civil Engineering and Ecology in the Republic of Srpska; and Department for Communal Works in the Government of Brcko District.

The Government of Bosnia and Herzegovina is a party to a number of international environmental agreements and conventions, and is fully committed to meeting the requirements stipulated in these agreements. The most important institutions in Bosnia and Herzegovina related to climate protection and participation of Bosnia and Herzegovina as a Non-Annex I Party in the UNFCCC negotiation process were:

- Bosnia and Herzegovina's National Focal Point to the UNFCCC is the Ministry of Physical Planning, Civil Engineering and Ecology of the Republic of Srpska.
- Bosnia and Herzegovina's Committee for Climate Changes and Sub-Committees for Climate Change.
- GEF Political and Operational "Focal Point" for climate change.
- Administrative Committee for Sustainable Development.

The Kyoto Protocol was ratified in 2007. In accordance with the law on meteorological and hydrological activities of Republic of Srpska, the Republic Hydrometeorological Institute of the Republic of Srpska, as the governmental organization, is responsible, *inter alia*, for climate change monitoring, climate data exchange and database management, application studies and climate predictions in the framework of the various scientific and technical programmes of the World Meteorological Organization.

The Bosnia and Herzegovina Federal Institute for Meteorology, as an independent institution, is responsible for administrative and professional tasks related to meteorology; climatology; seismology; and hydrology and water resources; as well as for monitoring of environmental quality, including air; water; soil; collection, processing and publishing of data related to above mentioned activities, etc. Institutions that have a scientific role in and personnel for potential analysis of climate change related to forests and forestry are:

- Faculty of Forestry, University of Sarajevo
- Faculty of Forestry and the University of Banja Luka

Institutions that can also analyse the impact of climate change on forest ecosystems (without technical, technological or economic evaluation) are:

- Faculty of Science University of Sarajevo
- Faculty of Science University of Banja Luka

## Direct climate change impact on biodiversity and ecosystems

Globally, climate change impact on biodiversity is well known and many studies have been published on the topic. However, few studies of climate change influences on agriculture and forestry in Bosnia and Herzegovina have been published. As far as the author of this text is aware, no studies have been conducted nationally that deal directly with the impact of climate change on biodiversity. The sensitivity and adaptation in the biodiversity protection strategy in Bosnia and Herzegovina reflects climate change and its possible influence on some landscape systems in Bosnia and Herzegovina. Therefore, there are no concrete examples for some species, and no models of change in areas have been created for specific ecosystems, nor for plant or animal communities. Based on existing research and available literature, this report evaluates climate change and its possible influence on agro-ecosystems in Bosnia and Herzegovina.

Considering a fast socio-economic development scenario, with balanced usage of energy sources and application of the latest technology in all sectors, versus extreme consumption of energy, with significant differences in projections of future emission of GHGs, in the region of southeast Europe, which includes Bosnia and Herzegovina, by the end of 21st century one can expect an

increase of mean annual air temperature of about 3.5°C compared with the annual average temperature in the last decade of the 20th century. Temperature increases like that would be accompanied by rainfall reduction of 12% annually, with the most reduction during spring and summer, to the extent of 16–24%. Beside these regional climate changes caused by global climate change, significant changes could be expected on a local basis. In that context, applying a scenario of partial application of measures for reduction in GHG emissions on the territory of Bosnia and Herzegovina implies an increase in air temperature of 3–4°C on average by the end of the 21st century. With those thermal conditions, in next few decades one could expect significant reduction in days with snow together with reduced rainfall in the warm half of the year, which would result in reduction of soil humidity and availability of water resources. The reduction in summer rainfall in Bosnia and Herzegovina would be 20% by the end of the century, and using climate models for the worst-case scenario (business-as-usual in level of GHG emissions), the increase in air temperature would be even bigger and the rainfall deficit could reach 40% during the summer. Based on the analysis by Predic (2001) of the frequency and extent of dry periods for the climatology station at Banja Luka for two periods (1962–72 and 1992–2000), which had similar annual precipitation. The work compared soils with a capacity of 50 mm (shallow land) and 100 mm (deep land). Results show that in the period 1962–1970, drought appeared three times, while 1992–2000 it was five times. It is alarming that in 1998, 1999 and 2000 drought appeared every year. Such drought periods are very significant for shallow lands with a water-holding capacity of only 50 mm, which are mostly sandy soils and typical of the area of Bosnian Posavina.

### Climate change impact on ecosystem services

The areas of Bosnia and Herzegovina most sensitive to global climate change are defined in the strategy for the protection of biodiversity, which includes an action plan. The areas sensitive to the pressure of changing climatic conditions are:

- High-mountain ecosystems (above 1600 m) (Bjelasnica, Maglic, Igman, Volujak, Snjeznica, Vlasic).
- Mountain ecosystems (from 900 to 1600 m above sea level) (Klekovaca, Vitorog, Jahorina, Romanija, Kozara).
- Sub-Mediterranean forests and scrub ecosystems (from 300 to 800 m) (Eastern and Western Herzegovina).
- Karst caves, basins and abyss ecosystems (Herzegovina region; the best known is Vjetrenica cave).
- Highland ecosystems (from 600 to 900 m above sea level) (central, eastern, northwest and southeast Bosnia).
- Ecosystems of the Peripannonian area (from 200 to 600 m above sea level) (Kozara, Prosara, Motajica, Trebovac, Majevica).
- Pannonian ecosystems (below 200 m above sea level) (Bosnian Posavina – Lijevce polje, Semberija).

High-mountain and mountain ecosystems, based on research available and assumptions of global climate change in Bosnia and Herzegovina, are exposed to the greatest impact. In terms of forest ecosystems, the most endangered ones are the fir forests, which, taking into account temperature and humidity, have a very narrow ecological zone. In contrast, the beech forests have very broad ecological tolerance, and it is expected that they will become more prevalent in forests that currently are composed of a combination of beech and fir. Ecosystems of sub-Mediterranean forests and scrub, and of karst caves and basins, as a result of global climate change, are expected to be affected by increased soil acidity. Peripannonian and hilly ecosystems are the second most in danger after high-mountain and mountain ecosystems. If we take into account the forecast temperature changes, most pressure would be on the oak forests, both cork oak and English oak. The sessile oak forests are the lowest forests in Bosnia and Herzegovina, and their altitudinal range is from 280 to 860 m (altitude amplitude is very low, at 580 m). Migration of the sessile

oak and English oak to areas of higher altitude is disabled due to their heavy seed. In addition, any increase in temperature is accompanied by an increase in dryness, resulting in slower decay of forest litter. As a result, a layer of raw humus would be formed, leading to the process of subsolation in the soil, and a significant decrease in biodiversity in lower vegetation layers.

A key problem of any impact of climate change on biodiversity and ecosystems in Bosnia and Herzegovina is the slow rate of adaptation of forest ecosystems in comparison with the rate of climate change, which happens very quickly. Defining protection measures for forest ecosystems requires more advanced research into impacts of regional climate changes on the forests, and an analysis of the socio-economic potentials leading to forest degradation.

In Bosnia and Herzegovina, the following main effects of climate change on biodiversity can be expected:

- Shift of vegetation zones (layers) in a horizontal and vertical direction.
- Shift and changes in areas of individual taxa of flora and fauna.
- Extinction of individual species.
- Changes in the quality and quantity composition of biocenoses.
- Fragmentation of habitats.
- Changes in functioning of ecosystems.

At present, no published studies are available that show the situation in the economically important tree species in relation to climate change. So, in the territory of Bosnia and Herzegovina, one cannot confirm exactly what change are likely in terms of increment, yield, mortality, change in stocks, or appearance for economically important trees, such as beech, fir, spruce, black pine, scotch pine and sessile oak.

Research is currently under way on dendrochronological research on fir and spruce, which will show whether there is a tendency for change in growth correlated with specific climatic parameters. Also, a study is currently being written up involving institutions and researchers from the region (Croatia and Slovenia), addressing the impact of climate change on the distribution of individual tree species (including fir, spruce and sessile oak) in southeast Europe.

## Vulnerability of forest ecosystems to climate change

Due to their natural and diverse structure, as well as extensive natural regeneration, forests in Bosnia and Herzegovina represent one of its crucial natural resources. Its diverse soils and climatic influences support over one hundred tree species.

Most of the country is characterized by hot summers and cold and snowy winters. Short and cool summers and long, severe winters are common at higher elevations. The average temperature in January is -1°C, and in July it is 20°C. Along the coastline, temperatures are warmer and in winter there is more rain. Due to the extensive presence of forests in Bosnia and Herzegovina and the variety of climatic conditions to which they are subject, they have major roles in the context of climate change, and are sensitive to its effects. Currently they contribute to global carbon emissions when cleared, overused or degraded; when managed sustainably, they produce fuelwood as an alternative to fossil fuels and they absorb and store carbon in their biomass, soils and products. In the region of Bosnia and Herzegovina projections indicate a rise in temperature of 2–3°C above the current average, with reduction in precipitation of 5–15%, especially in the warm seasons, which would contribute to reducing soil moisture from 15 to 25%. In addition to these changes in precipitation and temperature regimes, studies show the possibility of increased frequency of climatic extremes, such as storms, hailstorms, thunderstorms, destructive high winds, floods, long droughts, heat waves, and extreme high and low temperatures. Reduced snow cover is expected, as well as shifts of climatic zones towards higher altitudes, which influence

forest fire, erosion and other factors that might affect the forest ecosystems. All of these aspects can greatly influence the further development of forests in the country. Forest ecosystems in Bosnia and Herzegovina will be increasingly vulnerable to:

- temperature and precipitation changes;
- increased atmospheric concentrations of carbon dioxide (changes in tree growth and water use);
- altered fire regimes; and
- changes in the range and severity of pest outbreaks.

There is a possibility that climate change can influence the forests in Bosnia and Herzegovina in such ways that it may potentially over time transform entire forest systems, shifting forest distribution and composition.

It has been proven that increased atmospheric carbon dioxide concentrations can have an effect on individual tree productivity, but can also alter leaf chemical composition, affecting herbivore fitness as a result (Saxe, Ellsworth and Heath, 1998). Severe temperatures and climate conditions such as frost and heat stress, as well as changes in the form, timing and amount of precipitation (e.g. snow versus rain, drought versus flood) can affect individual trees, the stand and forest system because as it can lead to greater susceptibility to pests, pathogens and severe weather events. Another significant threat to forest ecosystems is caused by an increase in forest fires. It is estimated that 3000 ha of forest are lost to fires annually in Bosnia and Herzegovina. Increased risk of forest fires due to increased temperatures and changes in precipitation patterns is expected in some parts of Bosnia and Herzegovina, which calls for fire protection capacity to be expanded. All these aspects (weather, pests, pathogens, fire) can in the long term lead to lower productivity and undermine the health status of the forests in Bosnia and Herzegovina.

The fir forests within Bosnia and Herzegovina forests have the potential to be severely affected by climate change as they occupy a very narrow ecological niche. Due to their growth in mixed stands with beech, which has a broader niche, the beech trees have the potential to crowd out the fir within stands due to changes in humidity and temperature. Species with narrow niches will probably face decline or loss and may in the case of Bosnia and Herzegovina start to move to the margins of their habitats, which shows a shift of vegetation due to climate change, therefore making other species more dominant, which was not the situation originally (this may reduce the economic value of these forests).

In terms of biodiversity within forest ecosystems, the changes in precipitation and water availability may have an effect on bird and animal communities by leading to concentration of population in specific areas and increasing their vulnerability to pathogens. Another issue in terms of biodiversity and protected forest areas is the issue of protected areas. Bosnia and Herzegovina has only a very small area protected under IUCN categorization (less than 1% of the territory), which is an extremely small area in terms of regional averages and the natural potential of the country. Due to climate change effects, there is the possibility that in the future the already very small areas that are protected in Bosnia and Herzegovina might cease to protect the targeted species, features and processes. This calls for a reassessment of possible new areas and an extension of the size of the existing areas, including the consideration of forest ecosystem factors of high conservation value.

Sub-Mediterranean forests of Bosnia and Herzegovina are threatened by changes in soil chemistry and structure, with decreased pH levels and increased soil acidity, which will not be acceptable for the current species. The greatest threat will be to the oak species, which mostly grow at low altitudes (less than 860 m). The threats can undoubtedly cause species migration.

## Status of assessment and research on climate change

A. Selmanagic has recently defended a Master thesis in the Faculty of Forestry, University of Sarajevo, "Advocacy coalitions as agents of change in climate change policy making – a case study of Bosnia and Herzegovina" (Selmanagic, 2009). The author has identified problems and main issues of climate change as:

- Who advocates changes initiates processes in the climate change policy-making domain of Bosnia and Herzegovina?
- Has there been significant national progress noted in terms of mutual cooperation and establishment of advocacy coalition networks among different groups in order to campaign for change, and what are the strengths of these coalitions?

This study has shown that the climate change policy-making arena in Bosnia and Herzegovina is fairly weak. The research has shown that the low level of interest of the governmental structures in this domain probably lies in the fact that low social mobilization exist around the issue and therefore the ruling parties do not have an interest in the facilitation of further developments in order to attract the voting populace. Another possible factor which might have contributed to the weak position of government institutions is the low level of staff capacity in climate change-related spheres, where administration is complex, priorities are multiple and areas for significant improvement are ample (institutionally and legally).

Bosnia and Herzegovina is a non-Annex I Party to UNFCCC and has no obligations to reduce its GHG emissions; nevertheless it has already experienced climate change consequences due to its vulnerability. The research framework within the climate change domain is very limited at the national level and there is almost no science–policy interface. Researcher have limited capacities with insufficient information flow, which further down the line leads to limited public awareness and maintenance of the status quo in many sectors. The media, as a dominant actor with its potential to spread information, knowledge and stimulate public reaction through diverse tactics, must be recognized as such within the coalition's agenda.

The current state of politics in Bosnia and Herzegovina, where the public continues to be silent and scientific contributions on the issue are lacking, leads to very little climate change-oriented activity. Thus, it comes as no surprise that climate change policy issues are not visible at every level of the policy-making agenda in Bosnia and Herzegovina.

## Proposed areas for cooperation

### Outcomes

Bosnia and Herzegovina as a country in development and post-conflict recovery has sufficient scientific and political capacity to monitor all events related to climate change occurring in the region and globally. FAO as an intergovernmental organization can and should have an impact on the situation regarding climate change in the field of forestry. Therefore, Bosnia and Herzegovina needs the support and assistance of FAO. This assistance could be reflected in the following:

- Increasing the area of protected forest areas (which are now a little around 1%) and setting up of permanent sampling plots in them to monitor climate change.
- Assisting in taking appropriate measurements for monitoring changes in the economic forests and applying protective measures to minimize the impact of climate change on forests. Activities would include monitoring impacts on forest productivity, biodiversity and plant and animal communities, together with developing models of the various impacts of climate change.
- Increasing scientific capacity for monitoring and analysing the status of climate change.

- Analysing the impact of climate change on forests in terms of monitoring socio-economic changes in the forestry sector and generally in society, and their consequences.
- Increasing interest in and capacity of state institutions to address the problem of climate change, and to this end the development of the state agency that will deal with this problem. Better cooperation is needed on this issue between the Federation of Bosnia and Herzegovina and the Republic of Srpska.
- Generally improving the flow of information about climate change at the international level and especially local science–policy relationships.
- Developing societal consciousness through active participation of the media and educational institutions in monitoring the problem of climate change at regional and local levels.
- Drawing attention to the effects of drought at lower elevations and changing groundwater levels threatening forest ecosystems.
- Addressing carbon balance problems, with special regard to soil (humus) conditions with warming, and to forest area changes, harvesting, afforestation and fires.
- Highlighting changes in the climatic environment and its impact on natural (protected) ecosystems and biodiversity as a special theme that has prime importance for Bosnia.
- Sensitizing and raising awareness in the media, in civil society and in political circles should have high priority.
- Create a baseline network for monitoring changes.
- Developing a programme and strategy of adaptation and mitigation in forestry practice, and identifying the necessary associated research tasks

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