# MAPPING THE CURRENT AND FUTURE CLIMATE EXTREMES AND HEALTH THREATS TO VULNERABLE POPULATIONS IN KOSOVO

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## Abstract

**Introduction**: Climate change affects human lives and health in different ways. High temperatures and heat waves are associated with excessive morbidity and mortality, especially among vulnerable categories of the population. In addition to deaths, high temperatures can increase pressure on the healthcare system by increasing emergency room visits, hospitalizations, premature births, causing mental health problems and other negative health outcomes. Infectious diseases that are transmitted through food and water have a high incidence rate and can be exacerbated by climate extremes such as heat waves, floods and droughts. As the climate continues to change, the risks to health systems and facilities including hospitals, clinics and community care centers are increasing, among others reducing the ability of health workers to protect people from a range of climate hazards.

**Objective**: The main objective of the study is to investigate and create an initial database of data and indicators for assessing the risk of climate change on the health of the population and the health system in Kosovo, as a tool to adapt to climate changes and reduce the risks for the population health and healthcare systems and facilities – including hospitals, clinics and community-based care centers.

**Materials** and **methods**: For conducting the assessment, data, information and publications
in the hydrometeorological, health and other relevant sectors, as well as relevant international publications were used. A vulnerability assessment is translated through the definition and analysis of the climate, public health and environmental health profile of Kosovo and the expected climate extremes in future scenarios, the organization and preparedness of the health sector, as well as the research of the current health profile of the population in Kosovo.

**Results and discussion**: the current and future climate profile of Kosovo is analyzed with a focus on the most important climate extremes such as heat waves and floods. Testing the RCP 4.5 and 8.5 future climate scenarios showed an increase in the average annual temperature and number of tropical days on almost the whole territory of the country with a maximum of $4^0$C and a decrease of the precipitation especially in the summer period for more than 30% (in the period 2071-2100) compared to the baseline scenarios.

We analyzed the demographic structure and some determinants of health of the population of Kosovo, vulnerable groups such as the elderly, the chronically ill, especially those with cardiorespiratory diseases, people with low incomes and low education, outdoor workers and the homeless, as well as the risk regions in the countries where the highest average temperatures or the highest atmospheric precipitation are registered. There is a particular risk in the northern part of the country, where the older population with low incomes and education is large. Fewer economic opportunities, higher poverty rates, greater distances to health centers and fewer services are available there. These structural factors thus further compromise the existing poor situation in which the aging population, including their long-term care, remains subject to lower quality care in rural and more northern areas. The highest mortality rate is expected to be registered among the most vulnerable population over 65 years of age.
Finally, a mapping of the risks of climatic extremes in Kosovo was prepared with indicators for further monitoring and assessment of vulnerability. In **conclusion**, high temperatures, rainfall and floods are presented as the biggest current and even more future climate and health risks in the area of Kosovo, which will also be a serious threat and burden for the health system.

***Key Words:*** *Climate profile; climate extremes; Kosovo; public health; risk map; vulnerable population groups.*

## Introduction

Climate change is affecting human lives and health in a variety of ways. It is also threatening the basic ingredients of good health – clean air, safe drinking water, a nutritious food supply and safe shelter – and has the potential to undermine decades of progress in global health.
Between 2030 and 2050, climate change is expected to cause estimated 250,000 additional deaths per year from malnutrition, malaria, diarrhea and heat stress alone. The cost of direct health damage is estimated to be between US$ 2-4 billion per year by 2030. Areas with weak health infrastructure – mainly in developing countries – will be the least able to cope without adequate preparedness and response assistance (1). High temperatures and heat waves are associated with excessed morbidity and mortality, particularly among vulnerable populations. In addition to deaths, high temperatures can increase the strain on the healthcare system by increasing emergency room visits, hospitalizations, preterm births, mental health problems and other negative health outcomes. According to one of the latest reports of the European Environment Agency (EEA), in the period 1980-2022, 5,582 deaths directly caused by floods and 702 lives lost from fires were registered in Europe. In addition, as many as 11% of hospitals in European countries were exposed to the devastating effects of floods. The lack of safe drinking water and the consequences of uncontrolled discharge of sanitary wastewater have been felt by approximately 30% of the affected population. To this the emergence of infectious diseases can be added due to the

appearance of fecal bacteria in bathing water, non-communicable diseases such as asthma and allergies due to damage to fences or episodes of drought and of course the serious impact of these extremes on the mental health of children or farmers in the affected regions (2). Mapping flood deaths or other effects of a given event can be useful for identifying risks to current and future populations. Mapping can be done at a local level, by linking to census indicators for small areas, or on a larger scale to show which geographic areas of a country are the most at risk from flooding.

The World Health Organization (WHO) has issued several documents as guidance for assessing risks in the health sector. Namely, as the climate continues to change, the risks to health systems and facilities – including hospitals, clinics and community-based care centers – are increasing, reducing the ability of health workers to protect people from a range of climate hazards. Health facilities are the first and last line of defense against the impacts of climate change as they can be responsible for large greenhouse gas emissions while also providing essential services and care to people affected by extreme weather events and other long-term climate hazards.

Many actions will need to be taken by sectors and decision-makers outside the health facility, and therefore health sector workers will need to influence, inform and demand interventions from local and national governments and policymakers (such as issuing improved Wash Sanitation and Hygiene (WASH) standards for health facilities) (3,4,5).

Some new international databases of climate change health indicators have also recently been published that can be used to assess climate change vulnerability at the national level. Namely, the Lancet Climate Change Countdown Report 2021 presents some useful indicators and calculations such as: exposure of vulnerable populations to heat waves, heat-related mortality, health and weather extremes, climate-sensitive infectious diseases, food security and malnutrition (6).

The basic steps for assessing vulnerability and adaptation of the health sector to climate change are thoroughly described and include vulnerability assessment (climate-sensitive health risks and outcomes), capacity assessment, assessment of future health risks, assessment of adaptation and integration of health policy into the global policy process for climate change adaptation (7).

Assessing health vulnerability to climate change in Kosovo is of great importance for adaptation and coping with climate change. The main concerns are urban air pollution, water scarcity, uncontrolled waste and wastewater disposal in Prishtina and other large cities, which can play a role in serious health outcomes resulting from the emission of atmospheric pollutants. PM2.5 particles can peak above 130µg/m3 monthly average in urban monitoring. The health information system in the country is under review and is not able to provide the data needed to adequately compare the burden of disease with that of higher-income countries. Food and water-borne infectious diseases, which have a high incidence rate in Kosovo, can be exacerbated by climate extremes such as heat waves, floods and droughts. On the other hand, vector-borne infectious diseases are currently of less concern in Kosovo or there is insufficient published data on them (8).

The study's main objective is to investigate and establish a baseline database and indicators

for assessing the current and future risk of climate change on the health of the population and the health system in Kosovo.

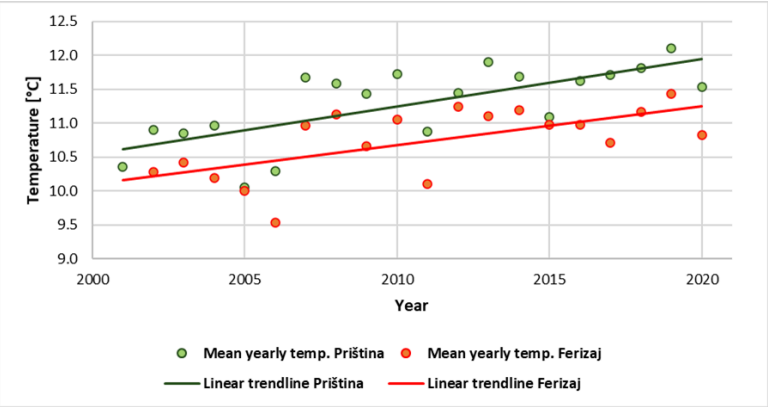
## Materials and Methods

The main methodological approach for assessing the vulnerability of the health sector in Kosovo to climate change was conducted by reviewing the basic demographic, economic, climatological, ecological and health profile of the country relevant for the assessment. In addition to current policies and national studies on the subject, which are scarce in Kosovo, the review also focuses on relevant international documents and studies. A survey was conducted on the current burden of disease in the population of Kosovo (basic health-epidemiological profile), in particular the conditions expected under available climate change scenarios for the region, as well as an overview and analysis of vulnerable population groups, and research into other risk factors/ health determinants of those diseases (besides climate change). One of the main products of the study was the mapping and prioritizing of current and future health risks from climate change in Kosovo. For our study, future climate scenarios Representative Concentration Pathways (RCP 4.5, 8.5) were analyzed in three time periods (2021-2030; 2036-2065; 2071-2100) for two climate extremes temperature and atmospheric precipitation. The basis for mapping the scenarios and assessing climate extremes for Kosovo was made based on mapping climate scenarios in the Western Balkans Climate Change Study (9).

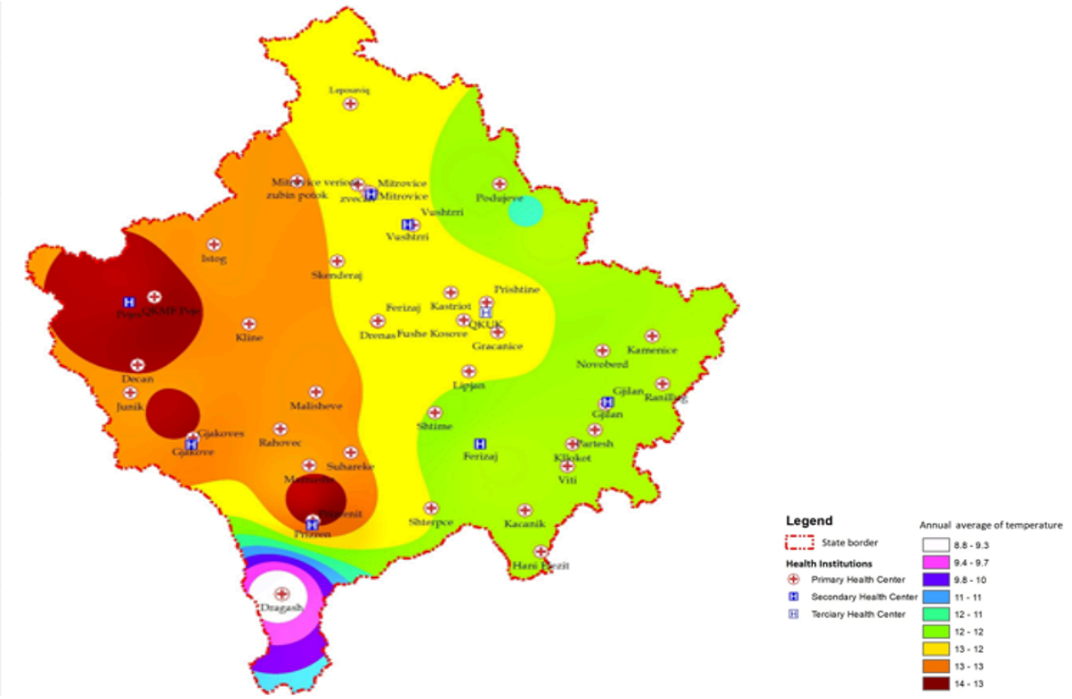
## Results

Kosovo has a predominantly continental climate, with warm summers and cold winters. Average temperatures range from -27°C in winter to 39°C in summer. The Kosovo Hydrometeorological Service has recorded temperature increases observed at the Prishtina and Ferizaj stations in the range of 1.3 and 1.0°C between 2001 and 2020 (Graphic 1).

**Graphic 1.** Mean yearly air temperature in Prishtina and Ferizaj meteorological stations 2001 - 2020 with linear trendlines.




**Source:** Meteorological data, monthly average, 2001 – 2020; Hydrometeorological Institute of Kosovo 2020.

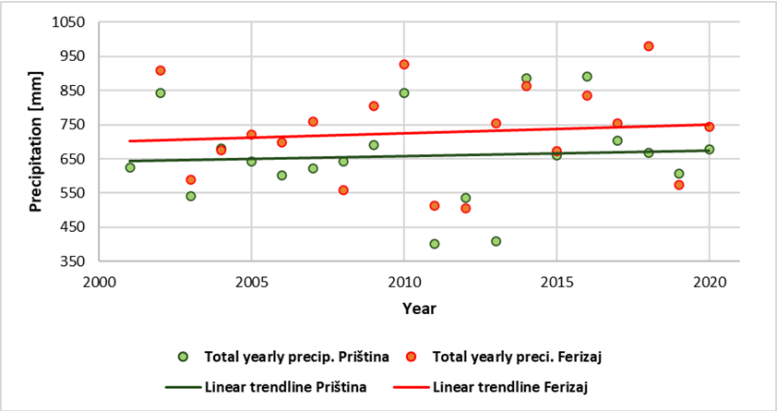



Map 1. Average annual temperature in Kosovo in 2022 in relation to the location of health facilities.

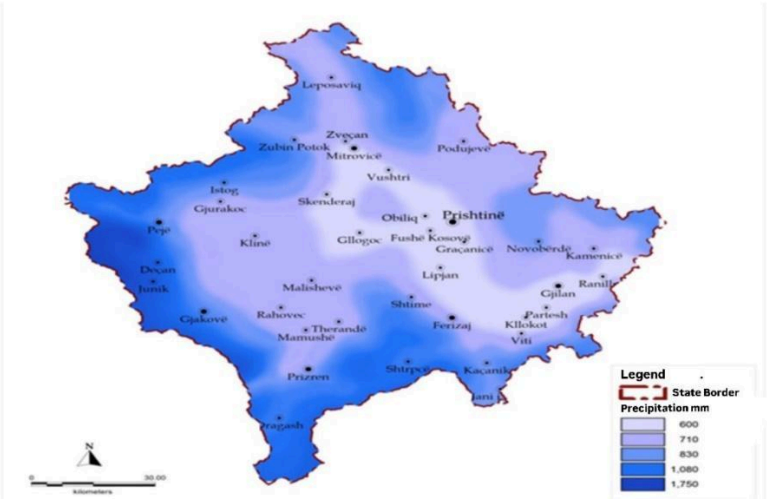
In terms of regional differences, data on average temperatures on the territory of Kosovo for 2022 show the highest temperatures in the southwestern part of the country (Peja, Gjakova, Prizren) (13-15 $^{0}$C) (Map 1).

Annual precipitation in Kosovo ranges from 600mm in the eastern Kosovo plain to 1.300mm in the western mountains (Map 2). Precipitation variations depend on topography, altitude, longitude and proximity to large bodies of water. A slight increase in annual precipitation was observed in Prishtina (31.5mm) and Ferizaj (45.4mm) stations (Graphic 2).

**Graphic 2.** Annual precipitation amounts at the Prishtina and Ferizaj meteorological stations in the period
2001-2020.




**Source:** Meteorological data, monthly average, 2001 – 2020; Hydrometeorological Institute of Kosovo 2020.




**Map 2.** Atmospheric precipitation zones in Kosovo.

Compared to other climate extremes since the 1980s, the frequency of extreme precipitation events in the form of heavy rains and droughts has increased, including the droughts in Kosovo in 1993, 2000, 2007, 2008 and 2013 (Map 2).

Kosovo is susceptible to floods and they occur frequently. Floods occur after storms in mountainous areas, continuous rains in lowland areas, and melting snow, accompanied or not by bad weather conditions. The main causes of floods in Kosovo are precipitation, uncontrolled construction in areas along rivers, dumping of solid waste in rivers, and failure to maintain riverbeds. The largest percentage of floods are in the river basins of the following rivers: Drim 50%, Iber 24%, Lepenec 20%, Morava 6%.

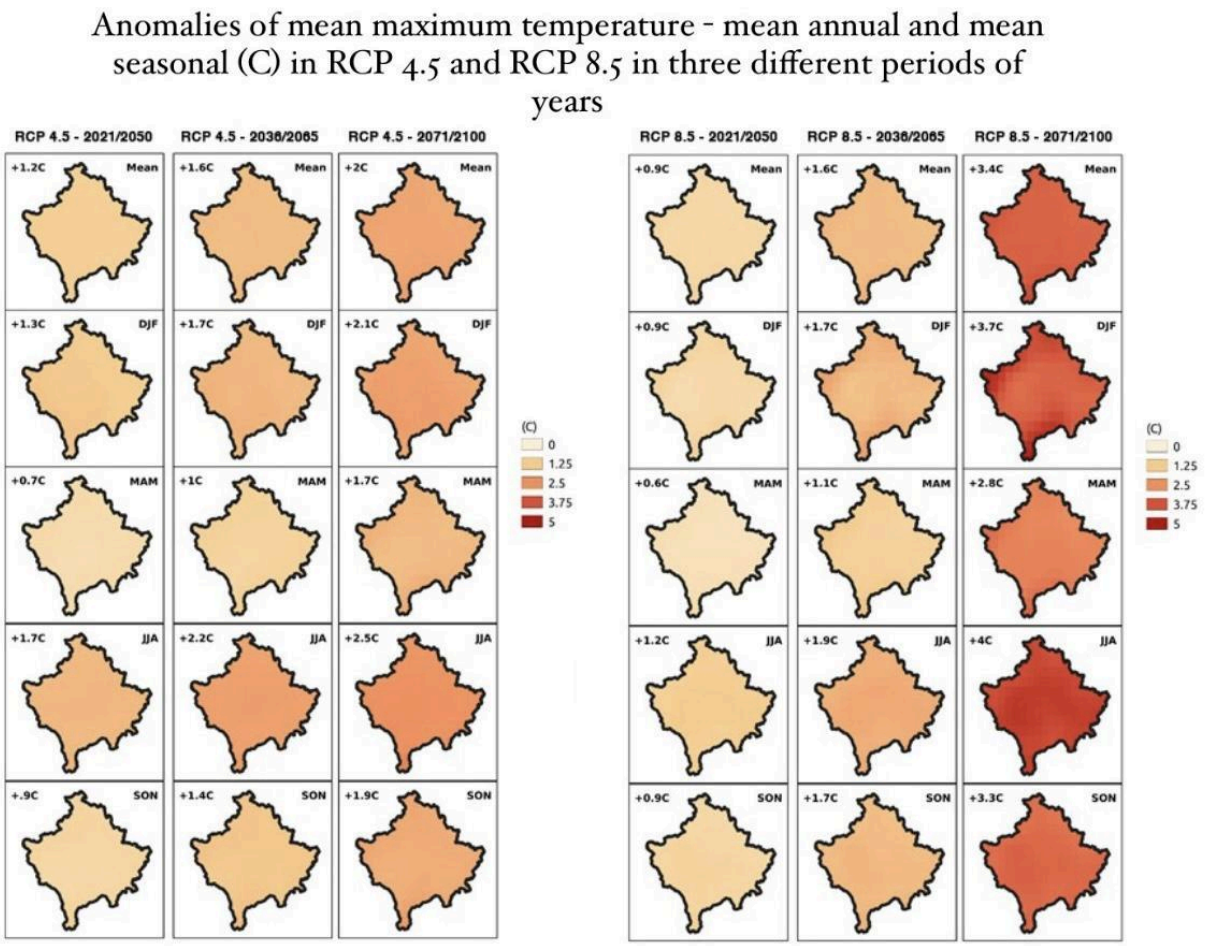
Periods of severe droughts have been recorded in Kosovo in 2008, 2014, 2018 and 2019. This has resulted in water shortages for crops and major concerns for farmers and the local economy. A prolonged deficit of below-normal precipitation was recorded between June 2012 and March 2014. December 2013 was the fifth driest month in Kosovo's recorded history. The drought continued throughout 2021–2022. Since 2015, the

Hydrometeorological Institute of Kosovo has established a drought monitoring program based on the Standardization Precipitation Index (SPI) calculated from precipitation amounts monitored at 31 monitoring sites. Since a technically severe drought only begins when SPI = -1.5, droughts in Kosovo up to date have been classified as moderate droughts. Water shortages mainly affect low-lying areas in the central and eastern parts of the country (10).

Future scenarios project the entire SEE region (including Kosovo) to experience warming higher than the global average, especially for mountainous areas, a decrease in total annual precipitation, with the largest decrease in summer, and an increase in winter precipitation, especially in the mountains, resulting in more frequent spring floods (11).

Climate change projections for Kosovo indicate a further increase in average air temperatures and a decrease in precipitation. The increase in temperature is expected to significantly affect Kosovo's climate, which will be classified as sub-temperate in most of the territory by the end of this century. The decrease in precipitation is expected to cause more droughts, with only the northeastern and northern parts of the country still experiencing a dry season (12).

According to the RCP 4.5 scenario: in the period 2021-2030 in the region of Kosovo there is an increase in temperature compared to the base period (1986-2005) by $1.20^0$C annually with the highest increase in the summer period (up to 1.70) but also in the period December-February (up to 1.30 $^0$C). For the mid-century period (2036-2065) according to this scenario, the temperature in Kosovo will increase on average by $1.6^0$C throughout the country, most of all in the summer period June July August (JJA) by $2.30^0$C, but again surprisingly in the second place is for the winter period December January February (DJF) with an average increase of $1.70^0$C about the base period. Finally, the RCP 4.5 scenario for the period 2071-2100 predicts an average increase in temperature throughout Kosovo by $2.00^0$C with the highest average in the summer JJA period ($2.5^0$C) and somewhat less in the winter DJF period ($2.30^0$C). The number of tropical days and days with heat waves will also increase significantly. Precipitation amounts are stabilizing, but especially in the summer period, a period of exceptionally low precipitation amounts will intensify, especially in the already mentioned risk zones in the southeast. Greater precipitation is expected in the western part (Map 3.RCP 4.5 and 8.5).



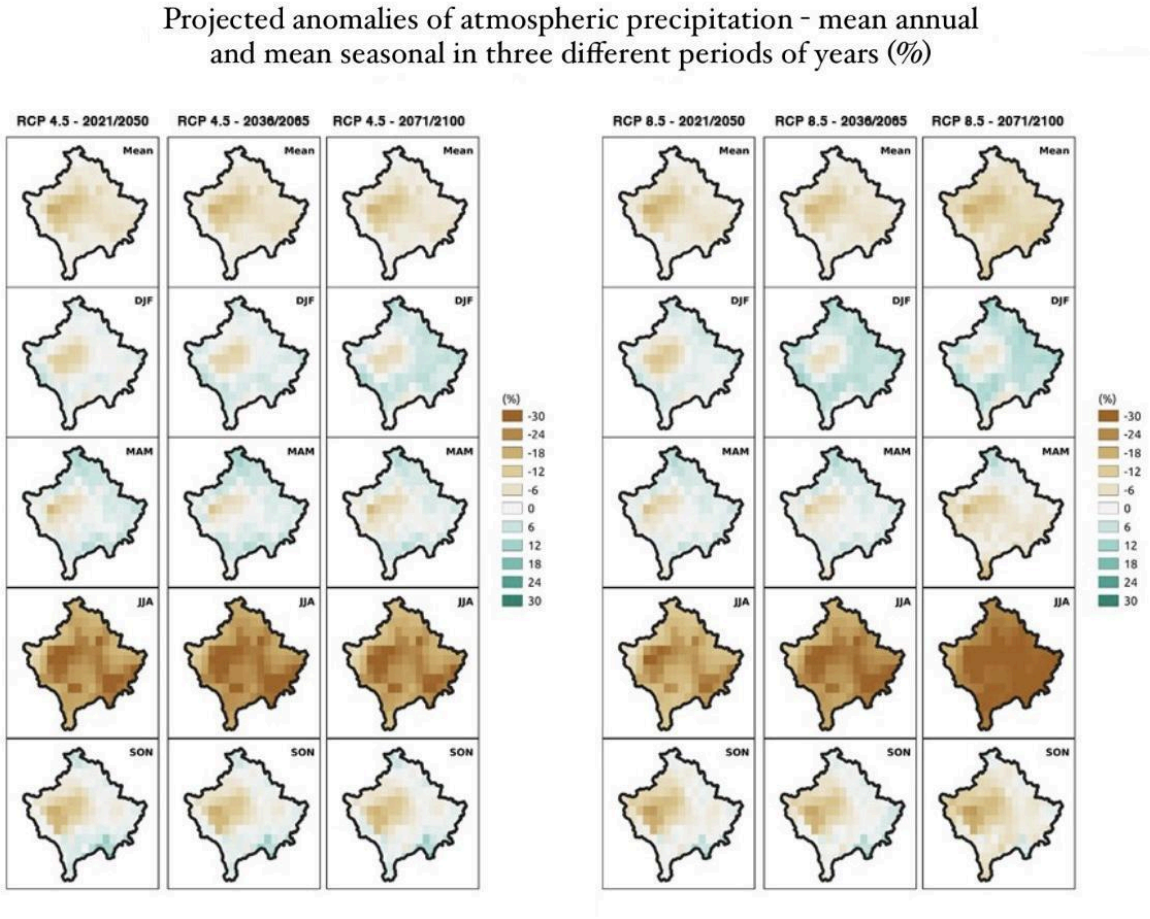

**Map 3.** Future Climate Scenario RCP 4.5 for temperature increase (variations) (left) and RCP 8.5 (right) at annual and seasonal levels in Kosovo in the period 2021-2100.

Seasons: Mean: annual average; DJF: December-January-February; MAM: March-April-May; JJA: June-July-August; SON: September-October-November.

**Source:** Simulated climate projections within the framework of the project: Climate proofing for sustainable development in the Western Balkans - https://www.entwicklung.at/en/projects/detail-en/climate-proofing-for-sustainable-development-in-the-western-balkans

The RCP 8.5 scenario predicts an average temperature increase on the entire territory of Kosovo by $0.9^0$C in the period 2021, an increase of $1.6^0$C in the period 2036-2065 and finally as much as $3.4^0$C at the end of the century (2071-2100) with a $4^0$C increase in the summer period but also a $3.7^0$C increased average temperature in the winter DJF period. Of course, the number of tropical days and nights, as well as periods with heat waves will be even more frequent. The areas in the western part of the country will be somewhat more affected. In terms of precipitation amounts, they will also show a slight downward trend in

the summer (JJA) period in this scenario, when in places precipitation will fall by as much as 30% compared to the base period (Map 4. RCP 4.5 and 8.5).




**Map 4.** Future Climate Scenario RCP 4.5 variations of atmospheric precipitation (left) and RCP 8.5 (right) at annual and seasonal levels in Kosovo in the period 2021-2100.

Seasons: Mean: annual average; DJF: December-January-February; MAM: March-April-May; JJA: June-July-August SON: September-October-November.

**Source:** simulation climate projections within the framework of the project: Climate proofing for sustainable development in the Western Balkans - https://www.entwicklung.at/en/projects/detail-en/climate-proofing-for-sustainable-development-in-the-western-balkans.

The elderly population is certainly the most vulnerable population group to all environmental hazards, including climate change. According to forecasts, the share of the population aged 65+ will increase to 13% by 2031 and reach 27% by 2061. In a 2013 survey, 42% of older people in Kosovo were unable to access medical care, 88% of whom

were unable to afford it due to high costs. About 83% of older people reported at least one chronic condition (63% cardiovascular disease), and 45% had at least two chronic conditions. The most common chronic conditions were cardiovascular disease, followed by stomach and liver diseases, diabetes and lung diseases, with 63%, 21%, 18% and 16%, respectively (13).

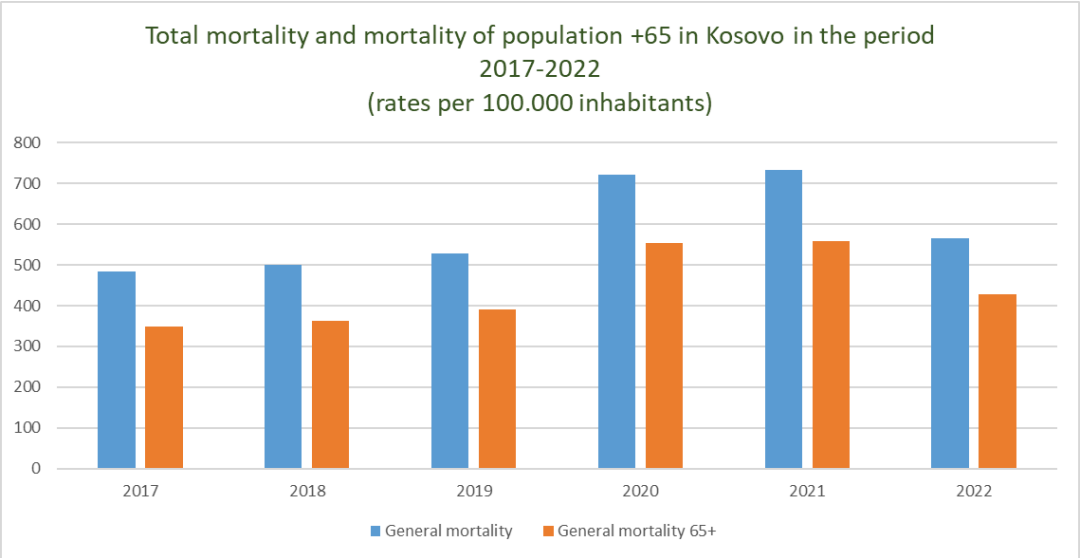
From a public health perspective, the country's geographical-regional inequalities mean that people in the north and rural areas face multiple aspects of exclusion and vulnerability. There are fewer economic opportunities, higher poverty rates, greater distances to health centers and fewer services available. These structural factors thus further compromise the existing poor situation in which the ageing population, including their long-term care, remains subject to lower quality care in rural and more northern areas.

Gross National Income per capita (GNI per capita, according to the Atlas method) in 2019 was $4,640 in Kosovo, which was the lowest in the region. Based on household income surveys in 2019, it is estimated that 18.0% (approximately 1 in 5 people) of the population of Kosovo lives below the poverty line (1.85 euros per day), with 5.1% of the population living below the extreme poverty line (approximately 1 in 20 people) (1.31 euros per day) in 2017 (14). The poverty rate in rural areas is higher than that in urban areas, and the gap between urban and rural areas continues to grow.

The latest data shows that the total number of deaths in Kosovo in 2021 is 14,900, while the mortality rate is 8.4 deaths per 1,000 inhabitants. This figure is the lowest compared to countries in the region - where Serbia has the highest mortality rate of 17‰ - and European Union countries with an average of 12‰. Circulatory diseases and tumors are among the most common causes of death in Kosovo for the period 2016-2020 (15).

The highest mortality rate is expected to be registered among the most vulnerable population over 65 years of age (over 70% of total mortality) (Graphic 3).

**Graphic 3.** Total mortality and mortality of population +65 in Kosovo in the period 2017-2022 (per 100,000 people).



**Source:** Kosovo Agency of Statistics, Statistical Yearbook 2022.

In Kosovo, 81.4% of the population can access the nearest primary health facility within 30 minutes on foot or by public transport, and 76.5% can access a pharmacy within 30 minutes. On the other hand, 54.8% of the population can reach a General Hospital within 30 minutes on foot or by public transport, and 87.3% within an hour (16).

However, there are some cities that take longer to access a health facility. Only 3.3% of the population at the central level needs an hour or more to travel to primary health facilities. Meanwhile, for Novo Brdo and Zubin Potok this percentage is 57.3% and 58.9%, respectively. Moreover, the percentage of residents who need an hour or more to access general hospitals is 81.2% for Novo Brdo, 60% for Zubin Potok and 55.1% for Strpce.

In terms of chronic non-communicable diseases in Kosovo in the period 2015-2021, among the ten non-communicable chronic diseases, the highest number of cases is dominated by: Primary arterial hypertension with 46.5%, followed by non-insulin-dependent diabetes with 36.9%, Insulin-dependent diabetes with 6.35% and Schizophrenia with 2.95% (17).

Cases of acute diarrhea and salmonellosis can be linked to poorly regulated infrastructure such as drinking water supply from uncontrolled sources, long water supply interruptions, lack of basic sanitation, irregular waste disposal, unsafe food, poor economic and hygienic conditions that are evident in Kosovo. Of the vector-borne diseases, Lyme disease, West Nile virus and malaria occasionally occurred in Kosovo during the observation period (2018-2022) (18).

Among the environmental factors that may, in synergy with climate change, affect the health of the population of Kosovo, the state of air quality and the safety of drinking water are worth highlighting.

Ambient air quality is particularly poor in Prishtina, the Obilic area, the Drenas area and the Mitrovica area. Besides the domestic heating, the two coal-fired power plants Kosovo A and B can be considered the main source of particulate matter in the Prishtina region. The Kosovo A power plant, which pollutes 3 times more than the newer Kosovo B in terms of particulate matter, will still be closed (19,20).

Rising temperatures, changes in precipitation patterns, floods and extreme droughts can have a serious impact on drinking water supply systems. Exposure to a large number of pathogens in water and food increases, is often accompanied by diarrheal diseases (intestinal infections) that can be a major risk to public health during climate extremes.

The analysis of the demographic, socio-economic, health and climate profile of Kosovo confirmed that there is a health risk to the population from climate change, especially from certain climate extremes and especially in future climate scenarios if mitigation and adaptation measures are not taken.

The risk matrix contains the main elements:

- A climate extreme that is occurring or is expected to occur in the future,
- Expected health risk,
- Vulnerable population groups,
- Vulnerable regions,

- Expert assessment (of the actuality of the risk) or proven risk,
- Effect/ consequences on the health sector,
- Indicators for monitoring risk/ consequences.

Although for the needs of this research, sufficient quality health data covering a longer historical period have not been obtained, nor specific studies have been conducted or developed to assess the direct connection between climate change and health, indirect indicators and existing models - forecasts confirm that the occurrence of high temperatures and heat waves, especially in the summer period, is the greatest risk from current and especially future climate change for the population in Kosovo. Of course, not all population groups are equally at risk, with the focus of risk being on the elderly, the chronically ill, workers who work outdoors (which primarily include agricultural and communal workers) and socially marginalized groups living in substandard conditions and most often in rural areas of Kosovo. In terms of geographical region, the risk is in urban settlements (due to the occurrence of heat wave islands but also due to summer air pollution), as well as settlements in the southwestern part of the country which seem to be most at risk from this climate extreme.

In conditions of such health risk, a special burden on the health system is expected with a focus on certain services (adult and elderly treatment services and emergency medical care) whose strengthening must be among the first priorities to enable appropriate climate adaptation and resilience. Cardio-respiratory diseases and mortality are the main health consequences as a result of exposure to extremely high temperatures and heat waves. Their monitoring will be among the main indicators for evaluating the risks and dealing with them.

In the absence of authentic studies investigating the direct impact of climate extremes on health, data from existing strategic documents and available manuscripts (including those for neighboring countries) indicate that increased atmospheric precipitation, floods, droughts and forest fires pose mainly moderate risks to health and the health system in Kosovo. The health risk is mainly indirect through health threats but also damage to basic infrastructure, the availability of safe water and food (floods and droughts), or air pollution (from fires).

Geographically, the greatest risk from these floods is in regions where these extremes have historically been reported with the highest frequency and those that are projected to be at higher risk in national climate scenarios. Particularly vulnerable population groups include the elderly, the chronically ill and socially marginalized groups, including the population living in remote rural settlements in the threatened areas. In these regions, access to health services will be more difficult, and a particular burden on the health system will be the overloading of primary healthcare facilities and emergency medical services. Injuries, drowning, impaired mental health or an increased number of vector-borne and infectious diseases transmitted through contaminated drinking water and food are also expected to be more common.

The simultaneous occurrence of high temperatures and floods or high rainfall can be assumed to be a moderate health risk for the population in the affected regions. Increased

incidence of some enteric infectious diseases from unsafe water and food (especially during floods) or vector-borne infectious diseases (during high temperatures and increased rainfall), with deterioration of drinking water quality, are among the main health risks and impacts. From a geographical perspective, a more serious effect is expected in regions with historically the highest risk of floods and high precipitation and those with predominantly rural unsafe water supply systems, as well as regions suitable for the emergence of the Asian tiger mosquito (Aedes albopictus) and West Nile virus.

The effects on the agricultural sector can also be considered as a threat to public health. Namely, as concluded from this task, increased temperature, more frequent and prolonged heat waves, reduced rainfall in some regions and the increased number of hot and tropical days will have a very negative impact on agricultural crops and livestock and increase heat stress. These conditions reduce productivity in agriculture and especially affect the health of livestock. All this, in regions that rely mainly on locally produced food, can also result in a risk of malnutrition, especially among vulnerable population groups.

**Discussion**

According to the 2018 Regional Cooperation Council (RCC) Study on Climate Change in the South-Eastern Europe (SEE) region, the priority recommendation for the SEE region is to ensure human health, safety and quality of life, including the development of warning systems, information dissemination and public preparedness, for disaster risk management. In the presented climate period, the temperature in the region increased by 1.2°C compared to the previous climate period (21). Precipitation decreased during the 1980s and 1990s, then started to increase and returned to the current climate, to the values of the period defined as the past climate. The intensity of extreme heat waves described by the Heat Wave Magnitude Index (HWMI) has increased across the Western Balkans region, particularly along the eastern Adriatic coast (22, 23). The largest increases have been observed in southern Bosnia and Herzegovina, Montenegro and northern Albania. Other significant increases have been observed in northern Serbia, Kosovo and the Republic of North Macedonia. On average, the magnitude of extreme heat waves over the Western Balkans has doubled in the last two decades compared to the period 1981–2000. According to the same RCC study, climate change shows that the Western Balkans is moving towards a subtropical climate further north, leaving coastal and southern areas very hot and dry during the summer season, which is expected to last longer from the near future to the end of the century. The most important climate-related risks to human health in the region are the following: an increase in the frequency and intensity of heat waves, a very likely decrease in the quality of drinking water, and a very likely wider spread and emergence of new vector-borne diseases (24). Since 2000, there has also been an increase in the number of forest fires in Kosovo (25). Although no direct health effects have been recorded, between 2001 and 2023, Kosovo lost 2.25kha of forest cover to fires and 15.1kha to all other causes of loss (13% of the total forest cover lost during that period). The year with the highest forest cover loss due to fires during this period was 2012, with 575 hectares lost to fires, which is 33% of the total forest cover loss for that year (26).

To predict future scenarios, the possible future impact of high temperatures on population mortality in European countries was measured in 2017. In this, the period 1971-2000 was considered as the basic climate baseline and meteorological projections refer to future periods 2036-2064 and 2071-2099, and in terms of model scenarios the focus was on Representative Concentration Pathways (RCP) 4.5 and 8.5 (27).

Increased flooding and stagnant water, increase the availability of habitat for mosquito larvae, thus supporting the spread of the Asian tiger mosquito. The Asian tiger mosquito (Aedes albopictus) is an invasive mosquito species that is considered a potential vector of about 22 arboviruses, including Dengue, Chikungunya and Zika. The first record of Aedes albopictus in Kosovo was made in July 2020, when a seven-weeks field survey confirmed the presence of adult mosquitoes in a village near Prizren. This discovery shows that the tiger mosquito is expanding its geographical range to the Balkans and southeastern Europe (28).

Judging by existing strategic documents, Kosovo's climate change-related vulnerability can be summarized in six key issues: air pollution, water scarcity, water quality, land degradation (soil contamination by heavy metals, soot drift, irregular waste disposal, hazardous material and chemical disposal), environmental degradation and basic services (e.g., food quality, forest maintenance, waste management, meteorological forecasts), and forest degradation (irregular logging, soil erosion) (29).

**Conclusions**

Floods and droughts are the most common climate extremes after heat waves that characterize the current and indicate the future climate profile of Kosovo.

Analyses of the future climate scenarios for two climate extremes (temperature and precipitation amounts), confirmed the forecasts that in the period until the end of this century in Kosovo there will be a further increase in average air temperature and a decrease in precipitation (especially in summer).

The occurrence of high temperatures and heat waves, especially in the summer period, is the greatest risk from current and especially future climate change to the health of the population in Kosovo. The risk from an increase (in winter) or decrease in precipitation (in summer) is more moderate.

Particularly vulnerable population groups are the elderly, the chronically ill, workers who work outdoors (primarily agricultural and communal workers), and socio-economically marginalized groups who live in substandard conditions, most often in the northern and rural areas of Kosovo.

**References:**


1. World Health Organization (WHO). Health topic Climate change. Available at: www.who.int/health-topics/climate-change#tab=tab_1 Last access 22.11.2024.
2. European Environment Agency (EEA) Report 3/2024: Responding to climate change impacts on human health in Europe, focus on floods, droughts and water quality. Available on

https://www.eea.europa.eu/en/analysis/publications/responding-to-climate-change-impacts. Last access 22.11.2024.

3. World Health Organization (WHO). Guidance for climate-resilient and environmentally sustainable health care facilities, Copenhagen: WHO Regional Office for Europe, 2020; pdf Available at: https://www.who.int/publications/i/item/9789240012226 .
4. World Health Organization (WHO). Operational framework for building climate resilient health systems, WHO Regional Office for Africa, 2015; pdf Available at: https://www.who.int/publications/i/item/operational-framework-for-building-climate-resilient-health-systems Last access 22.11.2024.
5. World Health Organization (WHO). Checklists to assess vulnerabilities in health care facilities in the context of climate change, Copenhagen: WHO Regional Office for Europe,2021; pdf Available at: https://www.who.int/publications/i/item/9789240022904 Last access 22.11.2024.
6. Romanello M. et al. 2021. The 2021 report of the Lancet Countdown on health and climate change: code red for a healthy future. Lancet. October 30 2021; Volume 398, Issue 10311, p1619-1662. Available on https://doi.org/10.1016/S0140-6736(21)01787-6, Last access 29 November, 2021.
7. World Health Organization (WHO). 2021. Climate change and health vulnerability and adaptation assessment Available on https://apps.who.int/iris/bitstream/handle/10665/345968/9789240036383-eng.pdf?sequence=1&isAllowed=y , last visit 09.11.2024.
8. National Institute of Public Health of Kosovo (NIPHK). Annual bulletin of infectious diseases 2018. Available on https://niph-rks.org/publikimet/ .
9. Vukovic Ana, Mandic Vujadinovic Mirjam. Study on climate change in Western Balkans region, Regional Cooperation Council 2018, Sarajevo 2018. Available on chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.rcc.int/download/docs/2018-05-Study-on-Climate-Change-in-WB-2a lowres.pdf/06af8f7432484a6ce384ebcb8c05e8d7.pdf .
10. Government of Kosovo, 2016 Natural and other disaster risk assessment. Available on https://ame.rks.gov.net/vleresimiIRrezikshmerise/enus/Natural%20and%20other%20Disasters%20Risk%20Assessment.pdf Last access 21.11.202427.
11. Western Balkan Investment Framework - Gas development plan and regulatory framework review and assistance – Strategic Environmental assessment report. Available on https://mmphi.rks.gov.net/MMPHIFolder/AnnouncementFiles/2023_b081cb56-2d66-4426-8047-3274fc548e6c.pdf (Last access 09.11.2024).
12. U.S. Agency for International Development (USAID). 2017. Climate change risk profile Kosovo; Available at: Climate Risk Profile: Kosovo | Global Climate Change. Available on

https://www.climatelinks.org/resources/climate-risk-profile-kosovo Last access 09.11.2024.
13. Jerliu, N., Toçi, E., Burazeri, G. et al. Prevalence and socioeconomic correlates of chronic morbidity among elderly people in Kosovo: a population-based survey. BMC Geriatr 13, 22 (2013). https://doi.org/10.1186/1471-2318-13-22) (Last access 09.11.2024).
14. World Bank Group. Consumption poverty in the Republic of Kosovo, 2019. Available on chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://documents1.worldbank.org/curated/ru/210201560762490515/pdf/Consumption-Poverty-in-the-Republic-of-Kosovo.pdf (Last access 09.11.2024 .
15. Kosovo Agency of Statistics (ASK). The Statistical Yearbook of the Republic of Kosovo, 2021, https://askapi.rks-gov.net/Custom/4bd04f76-1e2b-444c-8dc1-86d3edf20225.pdf (Last access 09.11.2024).
16. UNDP, Kosovo MOSAIC. Available on https://www.undp.org/kosovo/publications/kosovo-mosaic-2015 (Last access 09.11.2024).
17. National Institute of Public Health of Kosovo (NIPHK). Morbidity Reports for Kosovo, 2015-2021.
18. National Institute of Public Health of Kosovo (NIPHK). 2022. Annual Bulletin of infectious diseases 2018-2022. Available on https://niph-rks.org/publikimet/ (Last access 09.11.2024).
19. Ministry of Environment, Spatial Planning and Infrastructure. Annual report of the state of the air in Kosovo, 2022. Available on chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://ammk-rks.net/assets/cms/uploads/files/Raporti%20Vjetor%20per%20Gjendjen%20e%20Ajrit%202022%20final%20-Angl..pdf Last access 09.11.2024.
20. World Bank. Western Balkans – Regional AQM – Western Balkans – Reports AQM in Kosovo, October 2019. Available on chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://documents1.worldbank.org/curated/en/330811585586168639/pdf/Regional-Note-on-Air-Quality-Management-in-the-Western-Balkans-Bosnia-and-Herzegovina-Kosovo-and-North-Macedonia.pdf Last access 10.1.2025.
21. Regional Cooperation Council South East Europe (RCC –SEE) 2020 series. Study on Climate change in the Western Balkan Regions, Sarajevo 2018. Available on chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.rcc.int/download/docs/2018-05-Study-on-Climate-Change-in-WB-2a-lowres.pdf/06af8f7432484a6ce384ebcb8c05e8d7.pdf .
22. Simone Russo et al. Magnitude of extreme heat waves in the present climate and their projection in a warming world, Journal of Geophysical Research Atmospheres 19 (22):12500–12512 DOI: 10.1002/2014JD022098 (Last access 09.11.2024).

23. Simone Russo et al Top ten European heatwaves since 1950 and their occurrence in the coming decades Environ. Res. Lett.2015. 10 124003 DOI 10.1088/1748-9326/10/12/124003 Last access 09.11.2024.
24. European Environment Agency (EEA). Climate Change in the West Balkans. Available on https://climate-adapt.eea.europa.eu/en/metadata/publications/climate-change-in-the-west-balkans/11278310\ Last access 09.11.2024.
25. U.S. Agency for International Development (USAID). 2017. Climate change risk profile Kosovo. Available on chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Climate%20Change%20Risk%20Profile%20-%20Kosovo.pdf (Last access 09.11.2024).
26. GlobalForestWatch. Available on https://www.globalforestwatch.org/dashboards/country/XKO/?category=fires (Last access 09.11.2024).
27. Kendrovski V, et al. Michela Baccini, Quantifying Projected Heat Mortality Impacts under 21st-Century Warming Conditions for Selected European Countries. (Int. J. Environ. Res. Public Health 2017, 14, 729; doi:10.3390/ijerph14070729 Last access 09.11.2024.
28. Muja-Bajraktari N, Kadriaj P, Zhushi-Etemi F, Sherifi K, Alten B, Petrić D, Velo E, Schaffner F. The Asian tiger mosquito Aedes albopictus (Skuse) in Kosovo: First record. PLoS One. 2022 Mar 15;17(3):e0264300. doi: 10.1371/journal.pone.0264300. PMID: 35290988; PMCID: PMC8923454. Last access 09.11.2024).
29. Government of Kosovo. Climate change strategy 2019- 2028. Action Plan on climate change 2019-2021 https://www.lfmwb.net/publication/climate-change-strategy-2019-2028-and-climate-change-action-plan-2019-2021/ last visit 09.11.2024.