Annex 2d

Climate Rationale

to the GCF Funding Proposal (Simplified Approval Process)

ALBAdapt – Climate Services for a Resilient Albania

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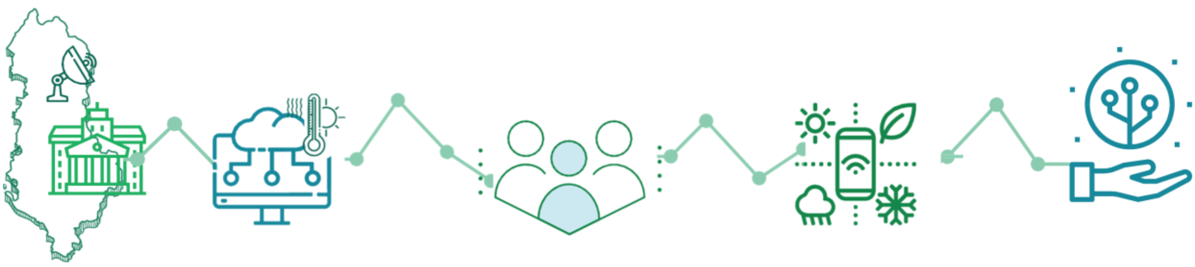
Version 1

Submitted by:

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH



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Abbreviations and Acronyms

AEZ	Albanian agro-ecological zones
AF	Adaptation Fund
DM	Data and Monitoring
EbA	Ecosystem-based adaptation
Eco-DRR	Eco-disaster risk reduction
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FbA	Forecast-based action
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoA	Government of Albania
IPCC	Intergovernmental Panel on Climate Change
MHEWS	Multi-hazard early warning system
MoI	Ministry of Interior
MoUD	Ministry of Urban Development
NCPA	National Civil Protection Agency
NDC	Nationally Determined Contribution
NFCS	National framework for climate services
NMHS	National meteorological and hydrological service
NTPA	National Territorial Planning Agency
RCP	Representative Concentration Pathway
TNC	Third National Communication
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
WB	World Bank
WBR	West Balkan Region
WMO	World Meteorological Organization

1. Introduction

1.1 The ALBAdapt Project

Albania is the most climate-vulnerable country in Europe. It is very exposed to extreme weather and climate-related events, a situation that is being further exacerbated by climate change. Future increases in the frequency and severity of floods and droughts, and secondary impacts such as landslides and wildfires, are forecast. Albania's economy is unusually dependent upon climate-sensitive sectors: agriculture accounts for 20% of gross domestic product (GDP) and employs ~60% of the workforce, 99% of electricity is generated from hydro-power, and tourism accounts for 8% of GDP and 38% of total exports. While everyone is at risk, climate impacts are particularly acute for people living in the coastal zone, where agriculture and tourism are highly vulnerable.

Albania's capacity to cope with climate impacts is hampered by an inability – of the government and of other stakeholders, notably the private sector – to produce high-quality, science-based information and to translate this information into warnings and decision support tools to reduce climate risks facing vulnerable communities and sectors. Albania is the only country in Europe that does not have a dedicated 24/7 national meteorological and hydrological service (NMHS). There is no national framework for climate services (NFCS) that engages stakeholders and provides the space for co-production and facilitation of better climate risk-informed decisions and solutions, including ecosystem-based adaptation. There is little innovation in service provision, with the result that impact-based forecasting and forecast-based action, for example, have not yet been adopted in Albania. Linkages with regional hydro-meteorological programmes and initiatives are weak, despite the enhanced forecasting and early warning capabilities they offer – and the reciprocal benefits they would receive from improved Albanian hydro-met observations and data-sharing.

Links between the NMHS and the early warning system are currently administratively and operationally weak. Effectively, there is no single multi-hazard early warning system (MHEWS) and the partial, fragmented system that currently operates is not sufficiently 'joined up' with the NMHS. Moreover, Albania's early warning system is not truly multi-platform, is inefficient and offers little certainty that all individuals, particularly vulnerable individuals, will be reached in a timely manner.

The ALBAdapt project will increase the adaptive capacity and climate resilience of Albania, through generation, coordination and effective use of climate information – in the form of a functional NMHS and NFCS – and a people-centred MHEWS that enables economic sectors and local communities (including vulnerable groups) to undertake actions in advance of, in anticipation of and in response to tailored warnings disseminated across multiple channels, including mobile telecommunications.

Component 1 of the project will implement foundational activities that support the development of a strengthened NMHS, accompanied by complementary platform services: a national climate information system (NCIS) and a user interface platform (UIP). Component 2 will put in place a robust, people-centred MHEWS that is strongly coupled to the NMHS and which supports the first steps in transitioning to impact-based forecasts and forecast-based action (FbA). Component 3 will support two critical aspects of climate investment: (i) private sector engagement with, and innovation in, climate services, and (ii) investment in nature-based adaptation solutions – ecosystem-based adaptation (EbA) / eco-disaster risk reduction (eco-DRR).

The ALBAdapt project will, inter alia: strengthen the capacities of the institutions involved in collecting and processing hydro-meteorological data in Albania and, equally crucially, fundamentally transform the institutional underpinnings of the NMHS and MHEWS to enhance clarity of roles and responsibilities, and to facilitate information exchange in a truly 'joined up' system; begin the process of mobilising private sector involvement in the provision of climate services, thereby partially detaching service provision from government budget constraints and introducing market discipline (user-oriented focus, dynamic adjustment, profit-seeking motivation) into the hydro-met sector; and improve the usability and usefulness of the hydro-met and early warning systems, thereby cementing their importance to policy-makers, local communities and end-users.

1.2 Brief Project Description

The ALBAdapt project aims to increase the adaptive capacity and climate resilience of Albania, through generation, coordination and effective use of climate information in conjunction with an early warning system (CIEWS).

As a result, vulnerable Albanian communities will be more resilient to climate change impacts, will be able to take early action, and will be able to make informed, climate-related investment decisions, particularly those related to water-related hazards in the coastal belt.

The project is structured across three components:

- Component 1: Weather, hydrological and climate information services
- Component 2: Multi-hazard early warning system and early action
- Component 3: Climate-informed investment decisions

Key project results will include:

- The government establishes fit-for-purpose institutional and regulatory frameworks for the effective implementation of NMHS and a national framework for climate services (NFCS), including the establishment of a national climate information system (NCIS): AlbaMet.
- The NMHS possesses the human, institutional, procedural, financial and infrastructure capabilities to effectively coordinate and cooperate in order to provide effective meteorological, hydrological and climate data and services.
- The NMHS, the National Civil Protection Agency (NCPA) and municipalities sensitise beneficiaries to climate risks, so they know why, where and how to react.
- Leveraging the improvements to the NMHS, NCPA, in fulfilment of its mandate, provides early warnings through a multi-hazard early warning system (MHEWS) that beneficiaries receive, understand and can take early action on.
- Trained municipal officials, Red Cross volunteers and communities at the local level (‘last mile’) are ready to respond to and handle climate hazard situations appropriately.
- All stakeholders, including government organisations, NGOs, civil society and the private sector (notably, micro, small and medium-size enterprises (MSMEs)) contribute to the design and widespread, effective use of climate services to enhance the implementation of adaptation options and to put measures in place that reduce the impacts of climate risks for society and for the economy.
- The benefits of hydro-met data are maximised by involving private sector actors in the provision of climate services.
- Investments in ecosystem-based adaptation (EbA) / eco-disaster risk reduction (eco-DRR) measures are identified, prioritised and demonstrated.

While the NMHS, NFCS and MHEWS will be enhanced – or established for the first time – for the entire population, early action and the development of a pipeline of EbA / eco-DRR measures will be focused on the Albanian coastal lowlands (coastal belt). This area, which represents a significant share of the Albanian population and economy, is especially important for the agricultural and tourism sectors and is at particular risk of the adverse impacts of climate change.

The ALBAdapt project is aligned with the Revised Nationally Determined Contribution (Republic of Albania, 2021a) and the National Adaptation Plan (Republic of Albania, 2021b), and with national policies and strategies – notably, the Law on Climate Change (2020), the Law on Civil Protection (2019), the National Climate Change Strategy (Resource Environmental Centre, 2022) and the National Disaster Risk Reduction Strategy (Republic of Albania, 2022). The ALBAdapt GCF project is specifically identified as Strategic Project 11 in the associated National Disaster Risk Reduction Action Plan.

2. Observed and Projected Climate Change

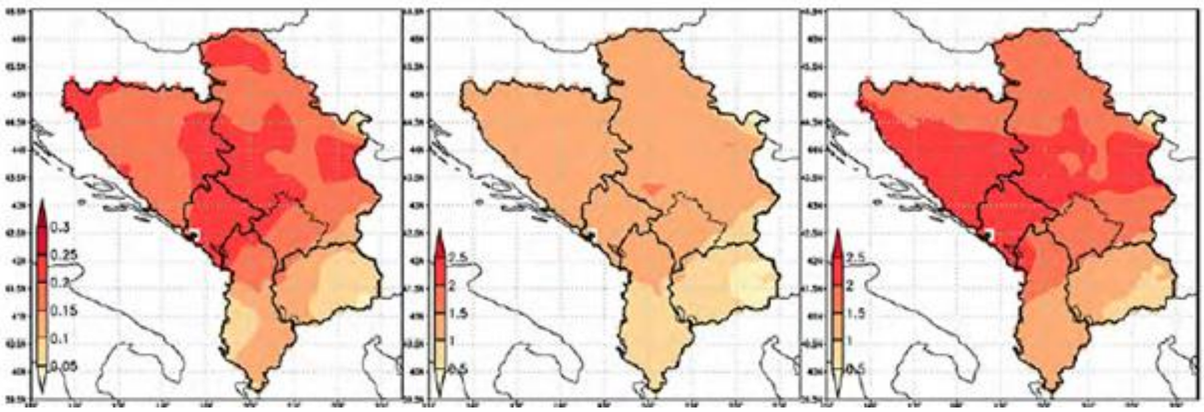
2.1 Temperature and Heat Waves

The Mediterranean climate of Albania is characterised by warm summers and mild winters, with warmest temperatures in the south-west due to warm air masses from the Adriatic and Ionian seas and coldest temperatures in the north-east due to continental air masses. The overall annual mean temperature is approximately 11ºC.

2.1.1 Observations

Together with Montenegro, Bosnia and Herzegovina, Serbia, Kosovo and North Macedonia, Albania forms the West Balkan region (WBR). Temperature observations for this region reveal a faster-than-global-average temperature increase, in particularly during the summer season and for maximum temperatures (Vukovic & Vujadinovic Mandic, 2018). A study conducted by Vukovic & Vujadinovic Mandic analysed daily values for the period 1961 to 2015 and defined the "past" climate baseline from 1961 to 1980 and the "present" climate period from 1996 to 2015. The average temperature for the WBR is 10.9°C (present climate period) and has increased by 1.2°C compared to the past climate period. The significant temperature increase began during the 1980s. Figure 1 shows the regional spatial variation of the difference between the present and past climate annual and summer temperature for the WBR, together with the average ten-year trend (1961 to 2015). The left panel shows the temperature (°C), the middle panel shows the mean temperature (°C) and the right panel shows the June-July-August season mean temperature (°C) for present climate period respect to the baseline period.

Figure 1: Average ten-year temperature trend (1961-2015)

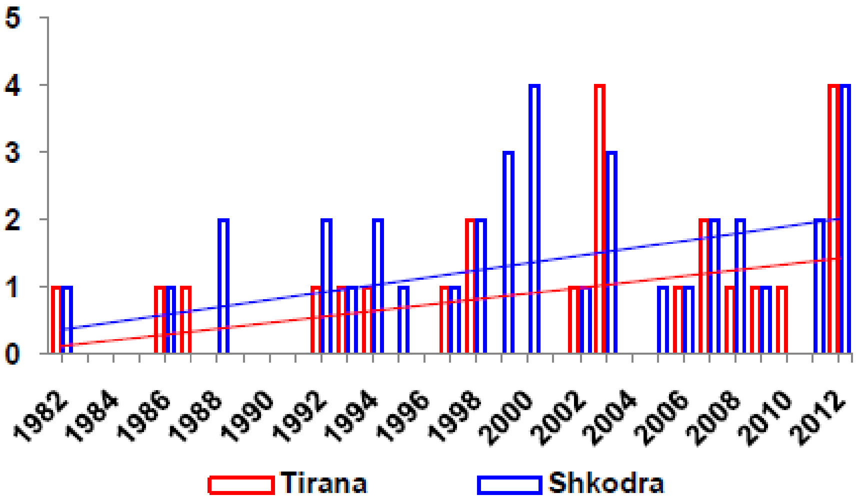


Source: Vukovic & Vujadinovic Mandic, 2018

The main temperature increase occurred during summer with stronger increases taking place in the northern region (+ 1.0 to 1.5°C), compared to central and south Albania (+ 0.5 to 1.0°C). The average 10-year trend (1961 to 2015) ranges from 0.1°C to 0.15°C/10year in the south, from 0.15°C to 0.2°C/10year in the east, from 0.05°C to 0.1°C/10year in the west and from 0.15°C to 0.25°C/10year in the north (Vukovic & Vujadinovic Mandic, 2018).

For this analysis, the World Meteorological Organisation (WMO) definition of a heat wave is used, namely, when the daily air temperature exceeds the long-term average temperature by 5°C for more than five consecutive days. Between 1961 to 2010, there has been an increase in the frequency of heat wave days. Similarly, the probability of days with a maximum temperature above the 90th percentile has increased by 20% (compared to the period 1951-1964) and 30% in the years between 1980s and 2015 (Ministry of Environment, 2016). Figure 2 shows the number of heat wave episodes recorded in Tiranë and Shkodër over a time span of 30 years between 1982 to 2012. Since 1996 there has been a notable increase in the frequency of heat waves, with 74% of heat waves having occurred since then. They occur mainly in June and August, and individual heat waves have lasted up to 16 days. In summary, an increase in frequency (inter- and intra-annual) and intensity (duration) of heat waves has been observed (Porja, 2013).

Figure 2: Recorded heat waves in Albania

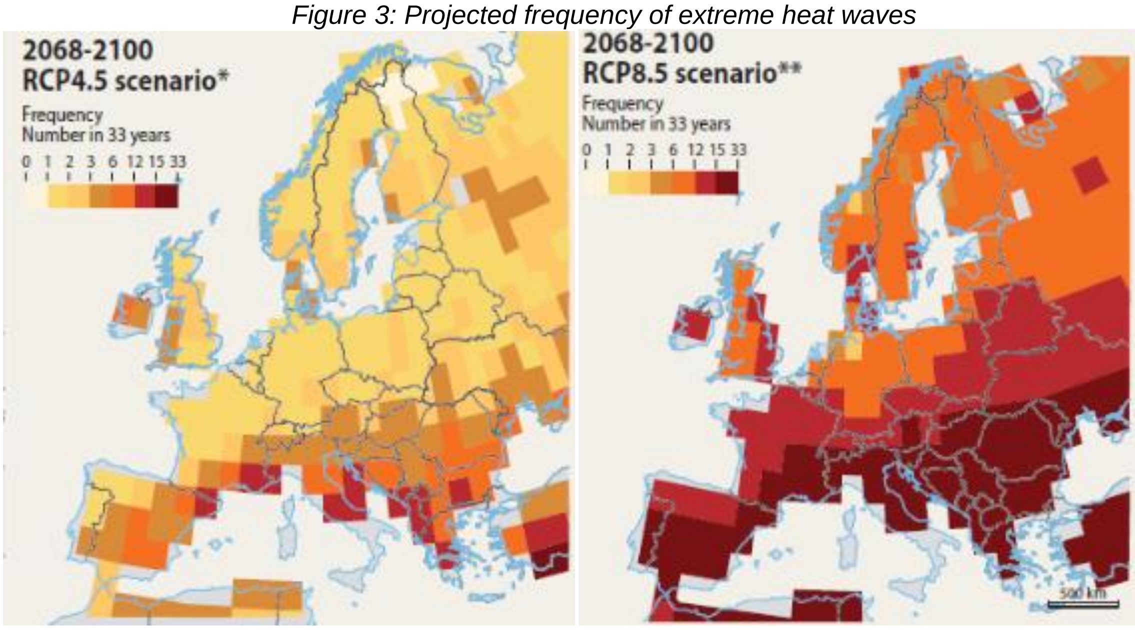


Source: Porja, 2013

2.1.2 Projections

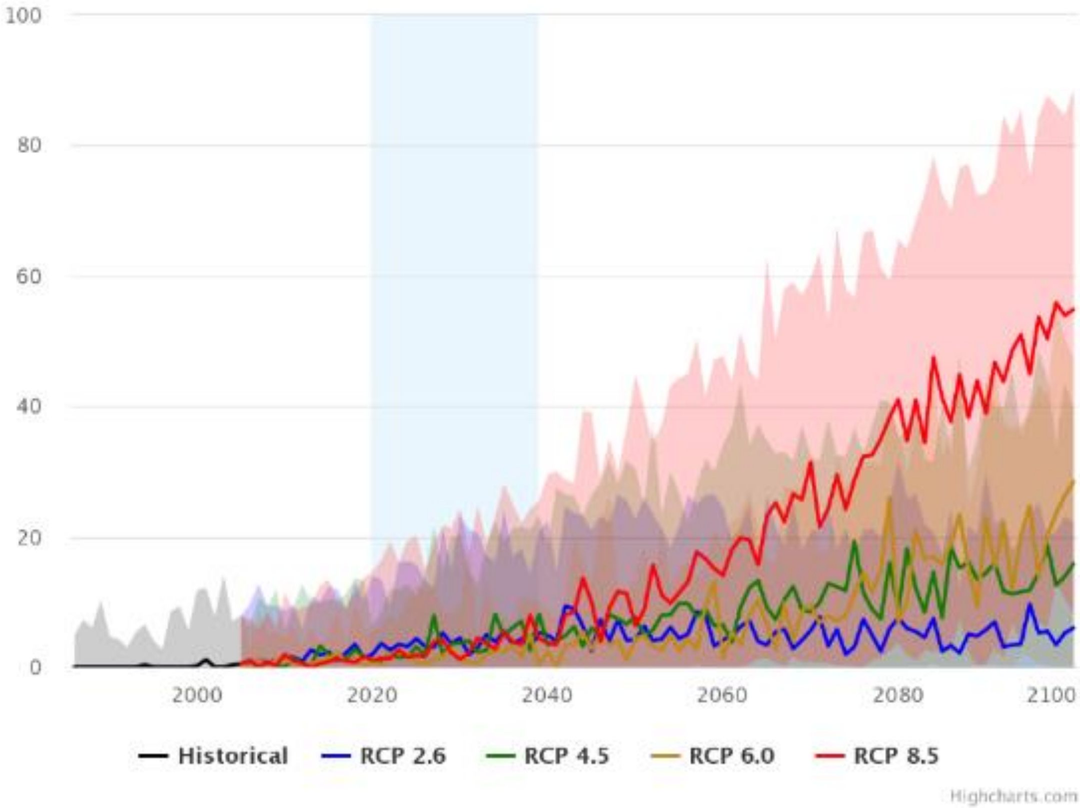
Figure 3 visualizes the difference in the frequency of heat waves projected to occur in the last third of the century for two different warming scenarios (Representative Concentration Pathway (RCP) 4.5 and RCP 8.5). While Albania will, on average, experience one, they are likely to occur on a yearly basis if emissions follow the RCP 8.5 pathway.

Figure 3: Projected frequency of extreme heat waves



Source: Alfthan, et al., 2015 For most of the 20th Century Albania's average annual temperature ranged between 11 and 12ºC. However, observed data clearly displays a steady increase of the average annual temperature over the most recent four decades. Climate projections from CMIP5 multiple-model ensembles under the high emissions scenario (RCP 8.5) show an increase of the average annual temperature of 1.0 to 1.3°C between 2020 and 2039 (within the project lifespan) and 1.2 to 4.4°C by 2100 relative to a 1986-2005 baseline, with the most significant increase projected to take place in summer (up to +5.8°C by 2100). Albanian coastal areas are projected to see an increase in minimum and maximum temperature in all seasons. The maximum coastal temperatures in summer are projected to increase by between 1.5 and 6.4°C; winter minimum temperatures are projected to rise by between 0.9 and 3.8°C. The average summer temperature in coastal areas could therefore be above 25°C by 2050 and around 30°C by 2100.

Figure 4: Projected number of hot days in Albania until 2100

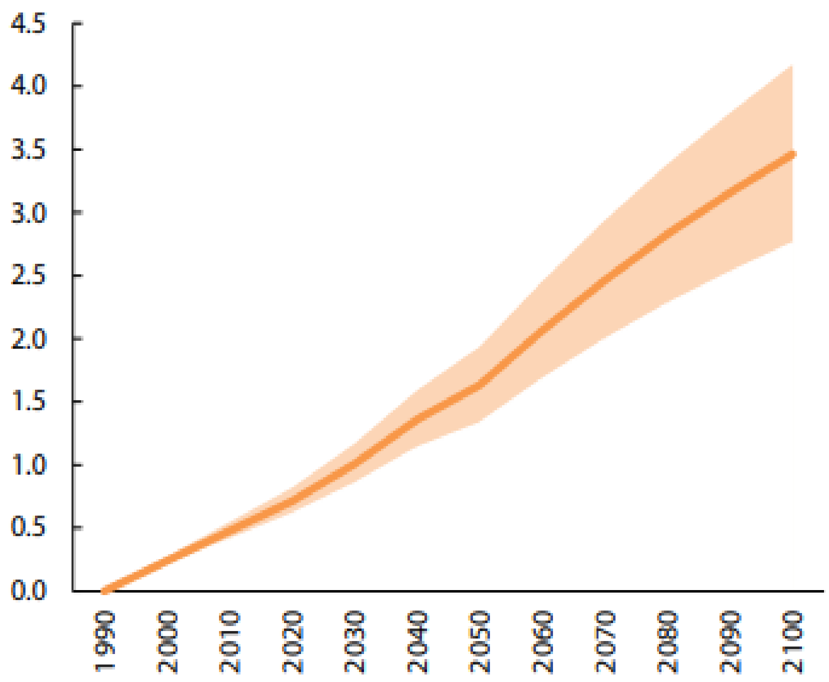


Source: World Bank Climate Change Knowledge Portal, 2021

In addition, heat waves are becoming more severe, and the number of hot days is projected to increase. Between 1961 and 2010, an increase in frequency (inter- and intra-annual) and intensity (duration) of heat waves (i.e., daily air temperature exceeded the long-term average temperature by 5°C for more than five consecutive days) has been observed (Porja, 2013). For the capital Tirana, climate models project a decrease in the return period for extremely high temperatures from 100 years to 9.2 (low-emission scenario RCP 2.6 and 3.6 years (high emission scenario RCP 8.5 by 2100. The number of tropical-temperature nights (minimum temperature > 20°C) in Albania is expected to increase from one to (RCP 2.6) and 70 nights (RCP 8.5) per year by 2100. The number of hot days (maximum temperature > 35°C) is projected to increase from two to seven days between 2020 and 2039 (within the project lifespan) and a significant increase is projected until the end of the century in Albania (World Bank Climate Knowledge Portal, 2021). Figure 5 illustrates the projected hot days for Albania from now to 2100 under different emission scenarios. The duration of heat waves in Albania is projected to increase to between 17.5 and 38.5 days per year (by 2050) (Ministry of Health of Albania, 2019). Unmitigated, an increase of frequency and intensity of heatwaves are expected to increase the number of heat-related cardiovascular and respiratory deaths, especially in summer.

For Albania specifically, one projection from a regional climate model suggests a strong temperature increase in the range of 2.9 to 4.9°C by 2100 (compared to the reference period from 1961 to 1990) and a strong increase in the duration of heat waves as well as a considerable reduction in cold spell length (Climate Service Center, 2012). It needs to be noted, however, that the third national communication (TNC) to the UNFCCC appears to be using older information and model scenarios, as both IPCC reports had already been published in 2006 and 2007.Figure 6 and Figure 7 provide a more detailed overview of the projected temperature increases for different time horizons and seasons.

Figure 5: Annual changes of temperature (average scenario °C)



Source: Ministry of Environment, 2016

Table 1: Projected temperature changes for different time horizons

Years	2030	2050	2080	2100
Annual	1.0 (0.7 to 1.2)	1.7 (1.3 to 2.2)	2.8 (2.0 to 3.5)	3.2 (2.4 to 4.1)
Winter	0.8 (0.7 to 0.9)	1.2 (1.1 to 1.4)	2.0 (1.7 to 2.3)	2.4 (1.9 to 2.7)
Spring	1.0 (0.8 to 1.2)	1.5 (1.3 to 1.8)	2.6 (2.2 to 3.0)	3.1 (2.6 to 3.6)
Summer	1.6 (0.5 to 1.8)	2.5 (2.1 to 2.8)	4.3 (3.8 to 4.9)	5.3 (4.6 to 6.0)
Autumn	1.0 (1.0 to 1.1)	1.6 (1.5 to 1.8)	2.8 (2.7 to 3.0)	3.5 (3.2 to 3.7)

Source: Ministry of Environment, 2016

Because of the predicted temperature changes, more hot days and heat waves are very likely over the coastal area. For Tiranë, extreme temperatures of 38°C, which used to be reached once every 50 years, are projected to occur every three years for a RCP8.5 scenario and 4°C world) or every seven years for a RCP2.6 scenario and 2°C world. With an increase in minimum temperatures, an increase in the intensity of heat waves during the summer is additionally to be expected (Ministry of Environment, 2016).

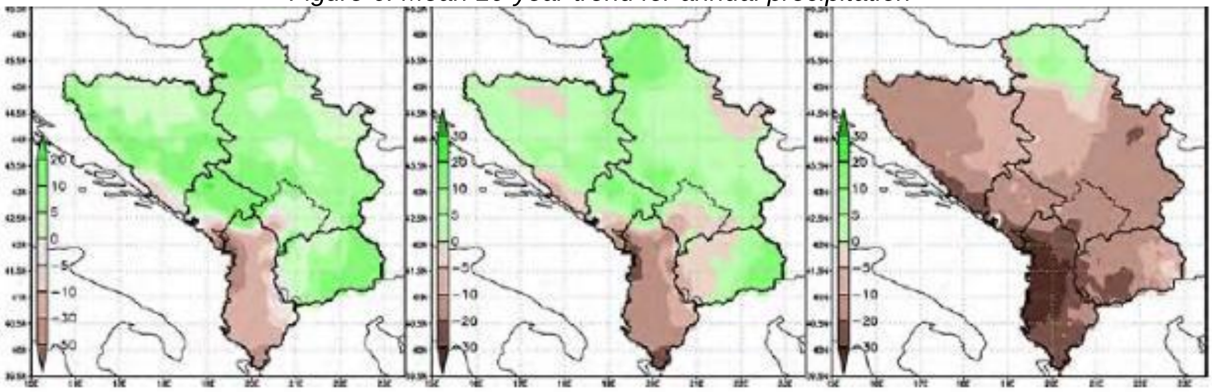
2.2 Precipitation

The Mediterranean climate of Albania is characterized by dry summers and wet winters, with almost half of the precipitation amount falling in winter. The south-eastern part of Albania receives, on average, 700mm rainfall per year and the mountainous regions in the north more than 2,000 mm (Climate Service Center, 2012).

2.2.1 Observation

The annual accumulated precipitation over the WBR did not change significantly (0.2%) when comparing the present climate period (1996 to 2015) (807mm) to the baseline period 1961 to 1980. Figure 6 shows the spatial distribution of the annual accumulated precipitation. Albania itself shows a marked decrease in precipitation compared to the baseline period, with the largest decreases in coastal areas (up to 20%). A similar spatial distribution is shown for the average 10-year trend, which was calculated for the entire 1961 to 2015 period with an increase of 10-20mm/10year in the region as a whole but a decrease over Albania specifically (10-30mm/10year) (Vukovic & Vujadinovic Mandic, 2018). This observation is confirmed by other sources that find a substantial decrease in yearly precipitation (approximately 10%) from 1940 to 2000 (Climate Service Center, 2012).

Figure 6: Mean 10-year trend for annual precipitation



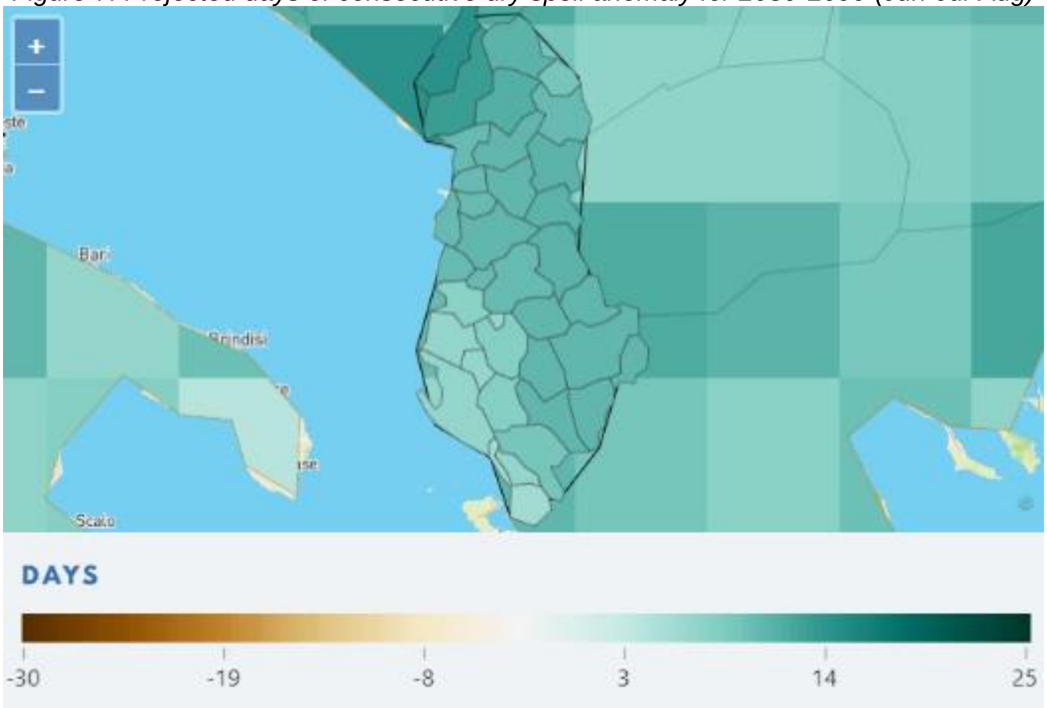
Source: Vukovic & Vujadinovic Mandic, 2018

2.2.2 Projections

Precipitation in summer will decrease, while winter months are projected to see an increase in precipitation, including increased frequency and intensity of torrential rain. Albania is already experiencing a reduction in annual total precipitation, with the largest decreases in coastal areas (up to 20%). All future scenarios considered in the TNC to the UNFCCC (2016) (Government of Albania, June 2016) and the revised Albanian Nationally Determined Contributions (NDC) (2021) (Government of Albania, 2021) indicate that further reductions in seasonal and annual precipitation are expected for all time horizons. The projected reduction in annual precipitation for the Albanian coastal area ranges from -1.6 to -7.1% by 2100 (Government of Albania, 2021).

However, the overall decrease in precipitation masks increased seasonality. Precipitation is primarily decreasing in the months with lower rainfall (February/March to August). Summer months are projected to see a reduction of up to 40%, as well as a substantial increase in the duration of dry spells. Winter months, in contrast, will see an increase in monthly average precipitation; average precipitation is expected to increase by between 1.8 and 7.8% (World Bank, 2019). In parallel, hazardous rainfall – i.e. intensive rain events with precipitation higher than the threshold that could cause social and economic damage is expected to increase for the northern (one to two days by 2030, two to three days by 2050, three to four days by 2080 and four to five days by 2100) and central and southern parts of the coastal areas (one day by 2030, two days by 2050, three days by 2080 and four days by 2100). Tirana, for instance, is projected to see a decrease in return period of heavy rainfall events from 100 years to 60-75 years (Ministry of Environment, 2016).

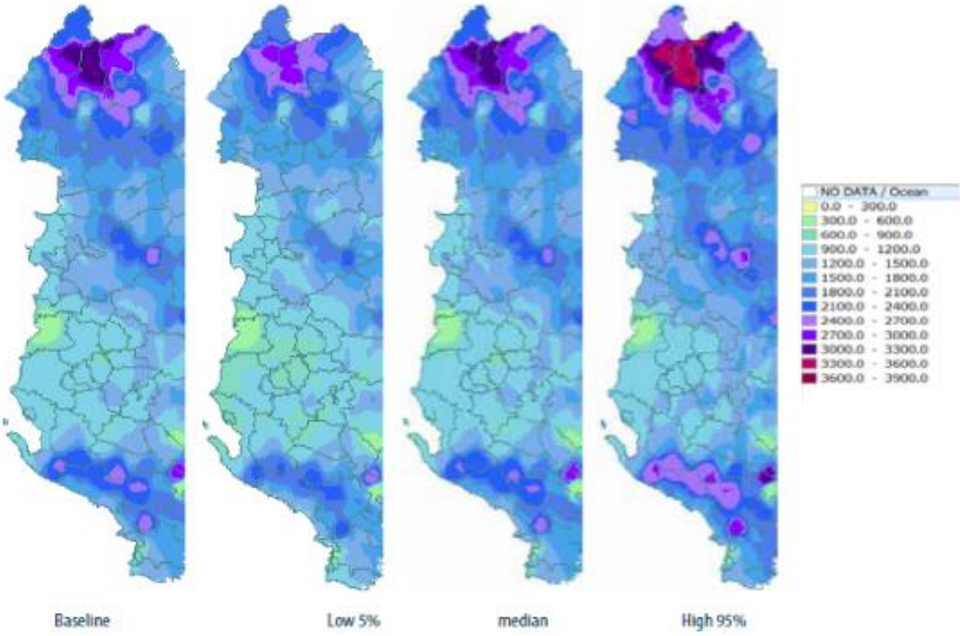
Figure 7: Projected days of consecutive dry spell anomaly for 2080-2099 (Jun-Jul-Aug)



Source: World Bank Climate Knowledge Portal, 2021

For Albania specifically, all RCP scenarios indicate a decrease in seasonal and annual precipitation relative to 1995 (1986 to 2005) for all time horizons (Ministry of Environment, 2016). The projected reduction in annual total precipitation ranges from -19% to -8% by 2100 compared to the reference period 1961 to 1990 (Climate Service Center, 2012), with a likely average decrease of 12.5% (Kay & Elrick, 2013). The faster increase in high-percentile precipitation (95%) compared to changes in the average precipitation indicates a tendency towards more intense rainfall events that cause flooding. This will particularly affect northern and southern Albania (see Figure 8). At the same time, the high reduction at the 5% level indicates a likely increase in drought frequency (Ministry of Environment, 2016).

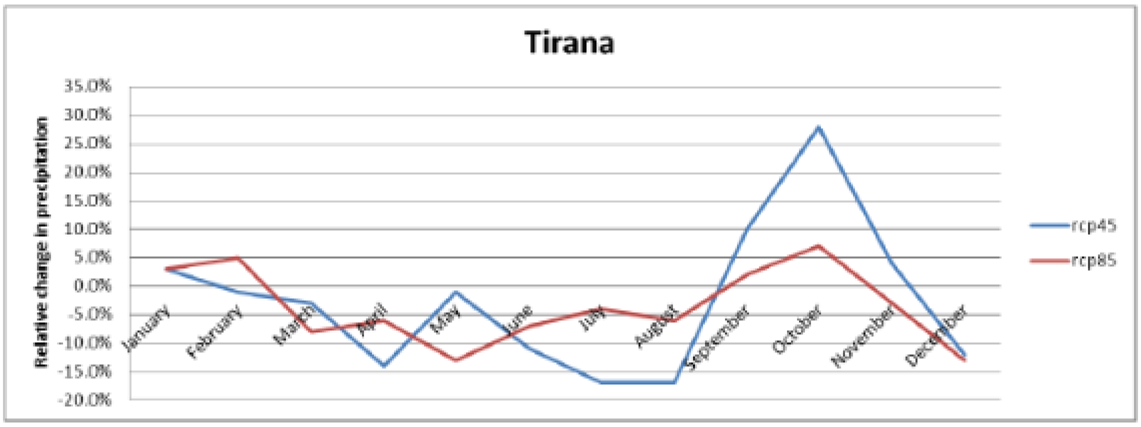
Figure 8: Precipitation distribution, baseline and expected changes by 2050 (average and 5% and 95% levels)



Source: Ministry of Environment, 2016

The overall decrease in precipitation masks increased seasonality. Precipitation is mainly decreasing in the months with lower rainfall (February/March to August). Summer months are projected to see a reduction of up to 40%, as well a substantial increase in the duration of dry spells (Climate Service Center, 2012). Winter months, on the other hand, will see an increase in monthly average precipitation, as shown in Figure 9 for Tirana and as generally applicable for most of the country (Xiong & Espinet Alegre, 2019).

Figure 9: Relative change in precipitation based on the CORDEX climate change projections for Tirana



Source: Xiong & Espinet Alegre, 2019

Table 2 shows the occurrence (return period) of the 24h maximum precipitation over the threshold that could cause economic damage. This is based on a time series (1957 to 2010) of representative stations measuring 24h maximum precipitation and expected levels of accumulated precipitation in a 24h period with calculated return periods. The number of extreme precipitation events can be expected to increase in terms of magnitude and frequency and for all three regions (North, Central and South), with dangerous events (those above 182mm/24hr) returning every 20 years in the north (Ministry of Environment, 2016).

Table 2: Expected 24h precipitation (mm) for the different return periods of three coastal regions

	Return period (years)					
Time	**2**	**5**	**10**	**20**	**50**	**100**
North	93±7	132±11	158±14	182±17	215±21	239±25
Central	79±8	105±11	125±14	145±17	170±22	189±25
South	74±6	97±8	116±11	134±13	157±16	179±19

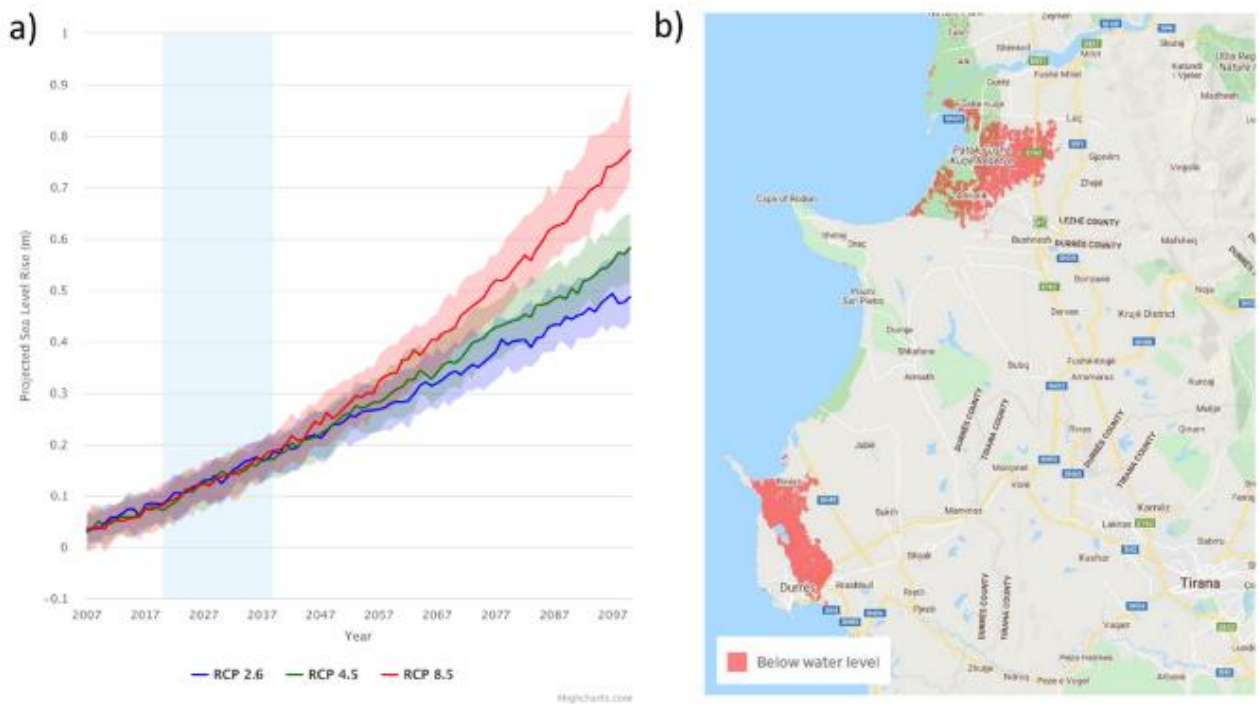
Source: Ministry of Environment, 2016

A projection (baseline to 2040s) of the average annual precipitation in the lowland agro-ecological zone shows the greater uncertainty inherent in predicting precipitation compared to temperature. While the low impact scenario for 2040 forecasts an increase, the medium and high scenarios predict a reduction of annual precipitation by 50mm and 90mm, respectively (see Figure 10).

2.3 Sea Level Rise

In the Adriatic and Ionian Seas, sea level rise in the range of 0.5-1.1 mm/year has been recorded over the past 50 years (Climate Service Center, 2012). Over the past century, total sea level rise of about 15 cm has been recorded in the Adriatic Sea and Albania is likely to confront sea level rise of approximately 40 cm (central estimate) by 2100 (Ministry of Environment, 2016). For the Vjosa Delta, in southern Albania, sea level rise of between 25 and 105 cm by 2100 is projected. Projections for the Drini-Mati River Delta suggest an increase of 45-60 cm by 2100 (Republic of Albania, 2021). A 10 cm sea level rise typically causes the frequency of flooding to a given height to increase by about a factor of three (European Environment Agency, 2017). Furthermore, sea level rise in Albania is likely to be compounded by local uplift or subsidence, as the area on the Adriatic coast is tectonically very active (Ministry of Environment, 2016).

Figure 10: Sea level rise and associated impacts in Coastal Albania due to climate change



Source: World Bank Climate Change Knowledge Portal, 2021

Albania already ranks highest in terms of overall disaster risk amongst all European countries, due to very high exposure to extreme natural events – a situation that is being further exacerbated by climate change (Behlert, B. et al, 2020). Between 1980 and 2010, 23 major disasters occurred (including nine floods, four earthquakes and three extreme temperature events), with approximately four million people affected. It is estimated that, on average, 50,000 Albanians are affected by floods every year and the annual negative impact on GDP is about US$ 200 million (World Bank, 2017). All climate scenarios project a future increase in frequency and severity of riverine floods, due to an intensification of heavy precipitation in winter months and ensuing snow melt in spring (Republic of Albania, 2021). The increase in flooding risk will, in parallel and seemingly paradoxically, be accompanied by an increase in drought risk. Albania already has the highest level of total drought severity per decade in Europe (European Environment Agency, 2017). The probability of droughts is projected to increase by 20%, potentially leading to 23 more drought days/year in the north and 14 more drought days/year in the south of Albania (Ministry of Environment, 2016). More severe heat waves and droughts will, in turn, provide more favourable conditions for wildfires during the hot and dry summer months, as observed in 2017 (FAO, 2018). Such a hot summer or heat wave would have been very rare a century ago. Nowadays, with about a 10% chance of it occurring every year, it is common. Model simulations of future scenarios lead to the conclusion that a summer seasons as experienced in 2017 will become the norm by the middle of the century (World Weather Attribution, 2017).

The coastal zone is particularly vulnerable to climate change. Temperature increases and precipitation reductions are projected to be of greater magnitude in the coastal zone than in the rest of the country. Moreover, the coastal zone also stands out due to its population share and its socio-economic importance, accounting for one-third of the national territory and half of the population (National Territorial Planning Agency (NTPA) and Ministry of Urban Development (MoUD), 2015). The coastal zone also plays a disproportionately important role regarding Albania's two key economic sectors of agriculture and tourism, both of which are highly exposed to climate change risk together with changes the hydrological cycle, which also plays an important role:

- Agriculture accounts for about 19.25% of GDP (O'Neill, 2021). One quarter of the coastal zone is agricultural land, representing two-thirds of all cultivated land in Albania. Most farmers (about 74%) are smallholders who cultivate cereals, fruits, vegetables, and fodder on farms averaging 1.2 ha in size (FAO, 2018).
- Tourism directly accounts for 8.5% of GDP and indirectly for 26.2% of GDP (Ministry of Tourism and Environment, 2019). Over 2.4 million tourists visit each year (Republic of Albania, Institute of Statistics, 2019). Two of the country's main tourist destinations, Vlora and Durres, are in the coastal zone.

For Albania, sea level rise projections estimate an average increase of 40 cm, ranging from around 14 to a maximum of 73 cm by 2100.

Figure 11 and Figure 12 show areas that are expected to be flooded by 2050 given an expected average sea level rise of 14.6cm and areas at risk because of sea level rise and river flooding. It is not clear from the source if this area will be permanently flooded or how frequently. A 10 cm sea level rise typically causes the frequency of flooding to a given height to increase by about a factor of three (European Environment Agency, 2017).

Local uplift or subsidence could have a supplementary influence on projected sea level rise, as the area on the Adriatic coast is tectonically very active (Ministry of Environment, 2016).

Figure 11: Areas at risk because of sea level rise and river flooding by 2050

Source: Ministry of Environment, 2016

Figure 12: Areas expected to be flooded by average sea level rise by 2050

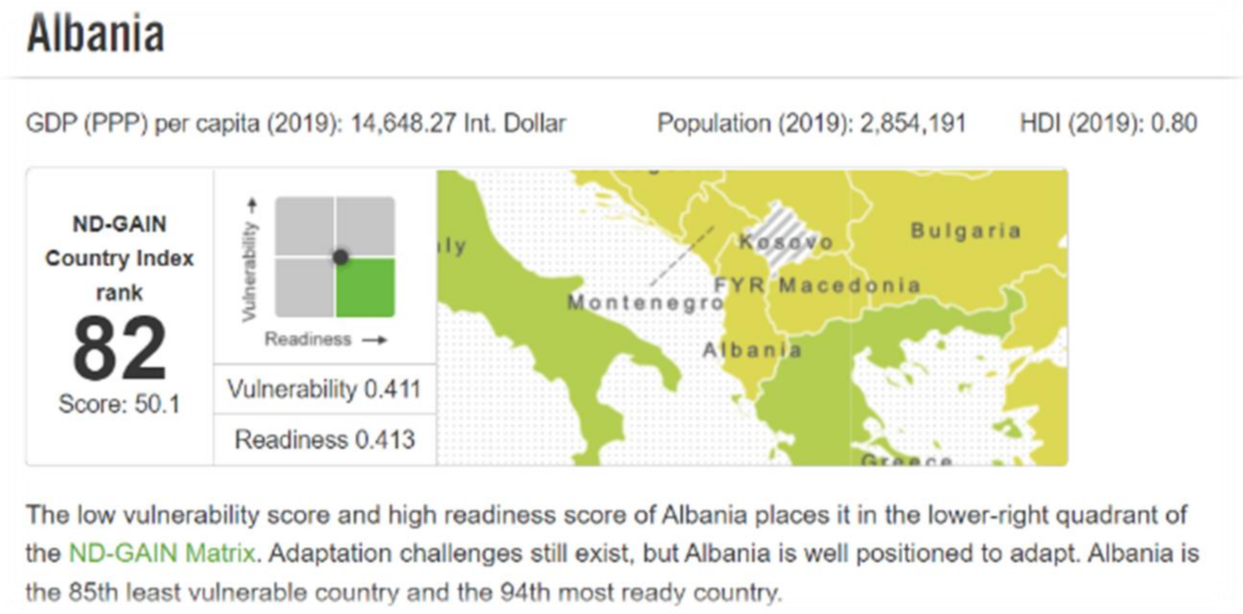
Source: Ministry of Environment, 2016

3. Observed and Projected Climate Hazards

3.1 Overview

The ND-GAIN index provides a ranked overview of the country's vulnerability to extreme climate events based on the challenges posed by its readiness to build up resilience against such events. Based on such assessment (see Figure 13Albania ranks globally 82nd out of 182 countries when it comes to the overall index of performance. The main focus of the government at this point remains recovery preparedness and resilience build-up through improvements of the infrastructure to fight against natural disasters (University of Notre Dame, 2019). The main causes of the vulnerability concerns of Albania, when it comes to extreme weather events, are the infrastructural needs and the economic circumstances of the rural areas. Albania is prone to various extreme weather events, which have substantially increased their frequency in the last 30 years. Besides being at high risk from geophysical hazards, Albania is systematically endangered by floods, droughts and heatwaves. The three main implications resulting from extreme climate events remain agriculture and food security, water management and public health which is directly linked to climate change (World Bank Group, 2021).

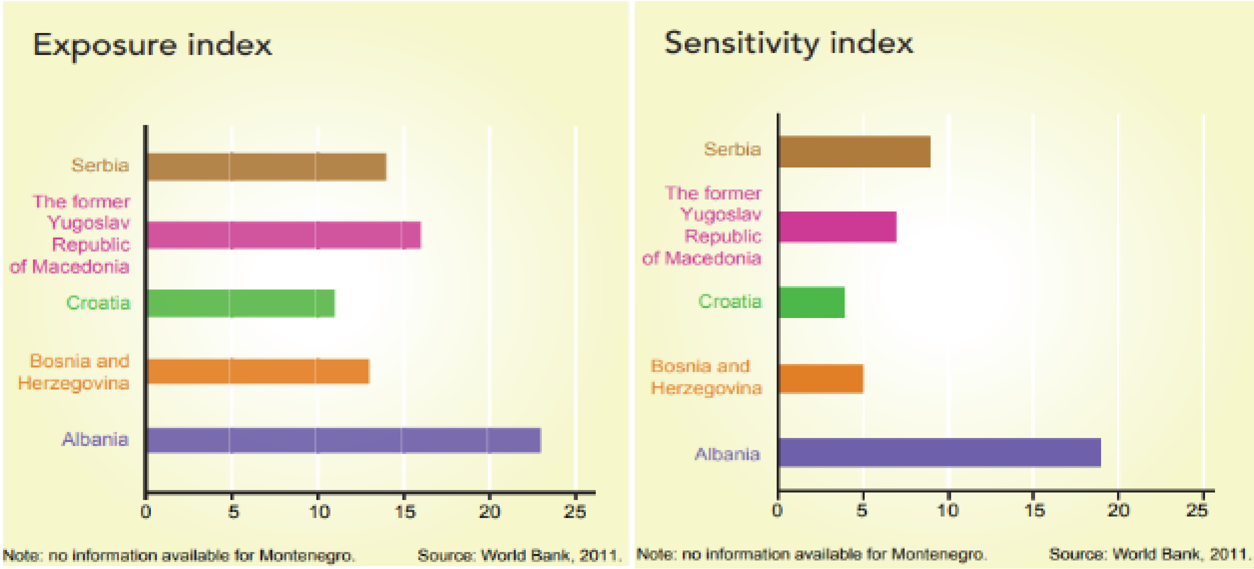
Figure 13: ND-Gain Index ranking Albania 82 out of 182 countries based on the Vulnerability/ Readiness assessment



Source: University of Notre Dame, 2019

For Albania, the high level of damage caused by natural disasters stems mainly from a high exposure to climate change (see Figure 14) and a lack of adaptive capacity (or sensitivity). According to the World Risk Report, Albania ranks highest with regard to the overall disaster risk amongst all European countries due to its very high exposure to extreme natural events (Behlert, et al., 2020).

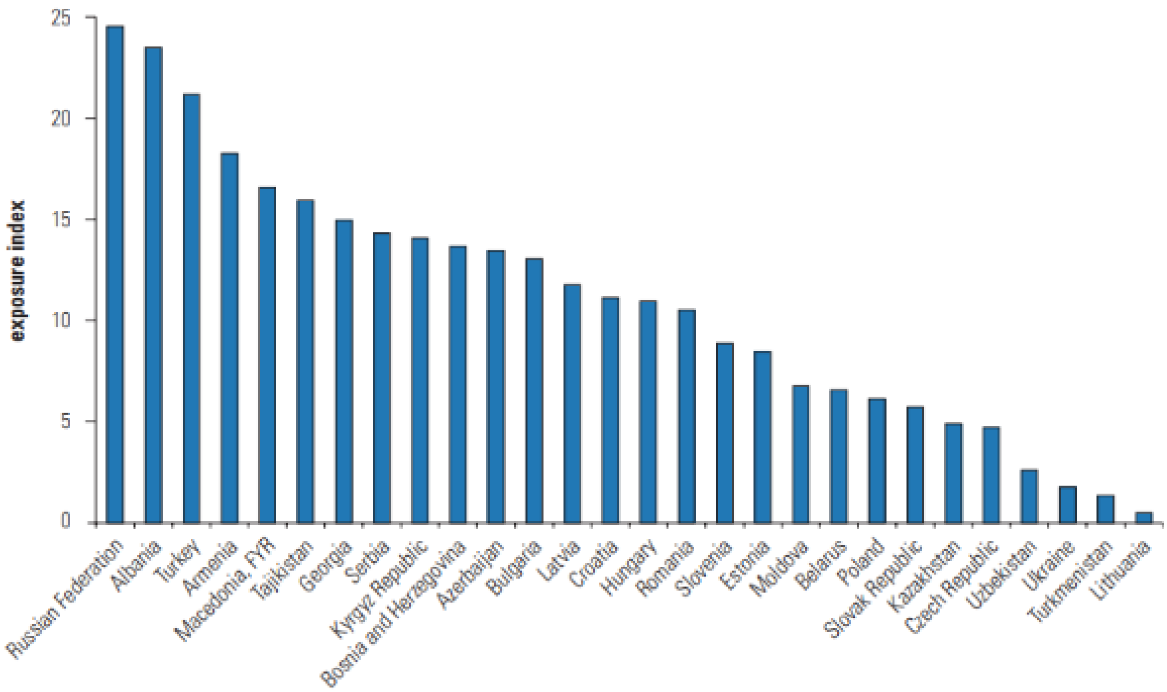
Figure 14: Index of exposure (left) and sensitivity to climate change (right) for Western Balkan countries (except Montenegro)



Source: ENVSEC & UNEP, 2012

The data on historic impacts and vulnerabilities emphasise that a need to strengthen adaptive capacity in Albania exists already under current climate conditions. However, this need is underlined by studies indicating that Albania will additionally be one of the countries experiencing the greatest increase in climate extremes by the end of the century. The index shown in Figure 15 combines the amount of additional hot, dry and wet years, summers and winters projected to occur over the period 2070 to 2100 compared to the baseline period of 1961 to 1990. The high index for Albania indicates that the country will experience an increase in the number of extremes, as well as in their variability, in the future (Fay, Block, & Ebinger, 2010). According to the TNC to the UNFCCC, there is evidence that the rate of disaster events has been increasing between 1993 and 2013 (Ministry of Environment, 2016).

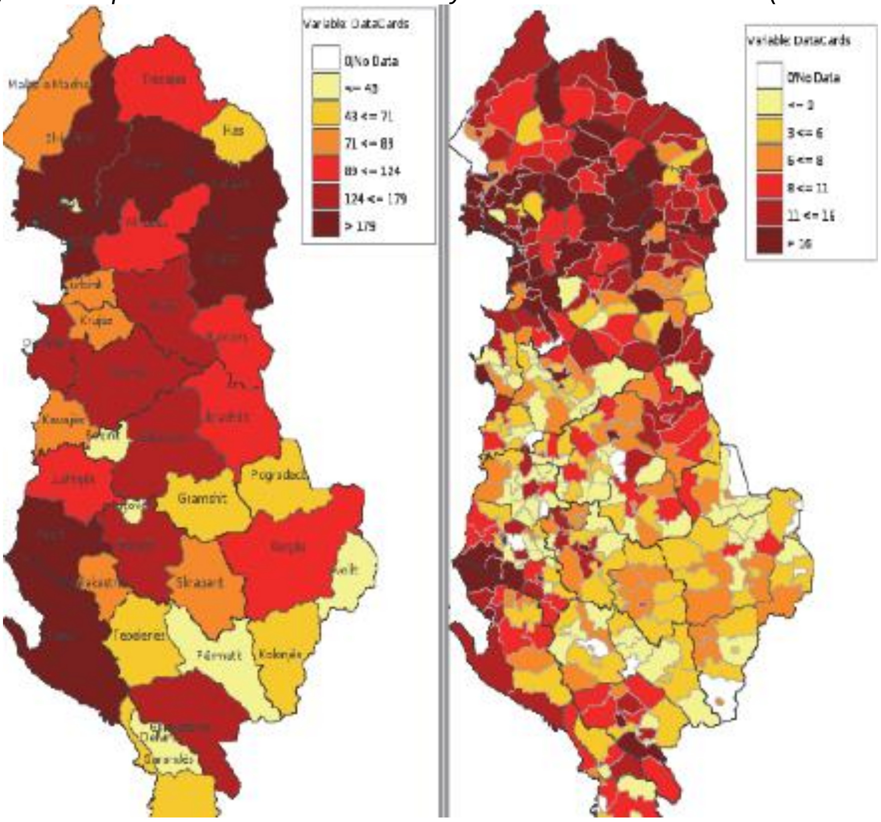
Figure 15: Europe and Central Asian countries likely to experience the greatest increases in climate extremes by 2100



Source: Fay, Block, & Ebinger, 2010

Hazard events occur throughout the country and almost all administrative units (95%) were affected by at least one hazard event between 1851 and 2013 (Toto & Massabò, 2014).

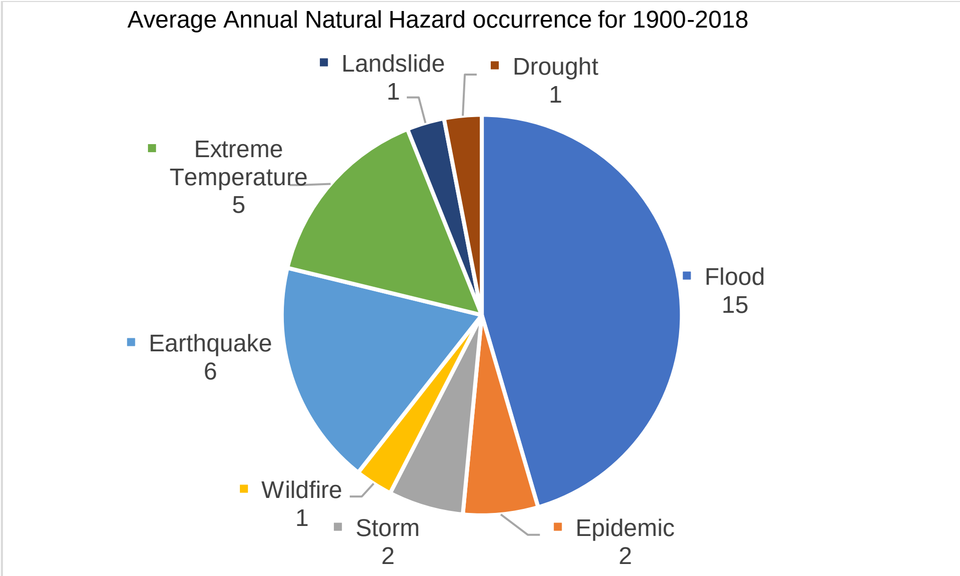
Figure 16: Spatial distribution of events by Districts and Communes (1851-2013)



Source: Toto & Massabò, 2014

Considered a multi-sectoral hotspot for various climate hazards, Albania is affected by various climate events (European Environment Agency, 2017). Historically, meteorological events (snowstorm, rain, storm, windstorm, hailstorm, thunderstorm, fog, cold wave, heat wave and frost, 33%), climatological events (forest fire and drought, 22%), hydrological events (flood, flash flood and surge, 21%) and landslides (dry and wet mass movement, 14%) accounted for more than 90% of the 4,305 disaster events that were recorded between 1851 and 2013 (Toto & Massabò, 2014). Figure 17 uses a different categorization to indicate that, between 1900 and 2018, on average 15 floods occurred per year, which accounts for 45% of all-natural hazards recorded in any specific year. Additionally, five heat wave episodes, two storms, and respectively one landslide and drought occurred per year.

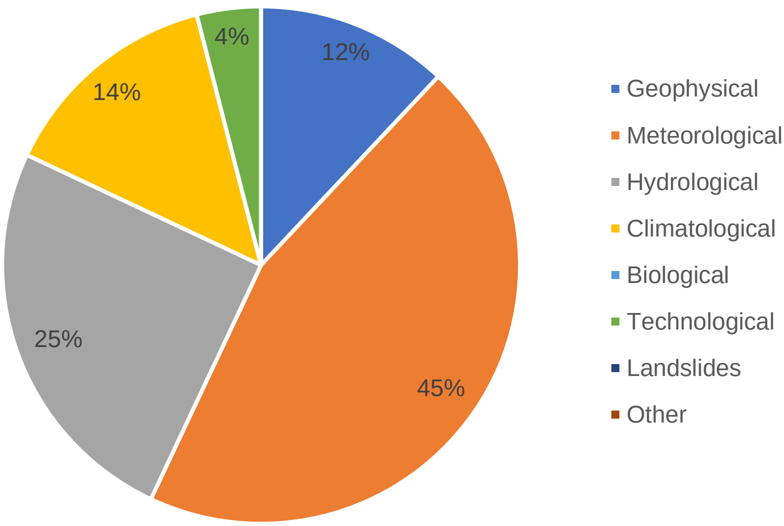
Figure 17: Average annual natural hazard occurrence for 1900-2018 with occurrence provided from the climate change knowledge portal



Source: World Bank, 2019

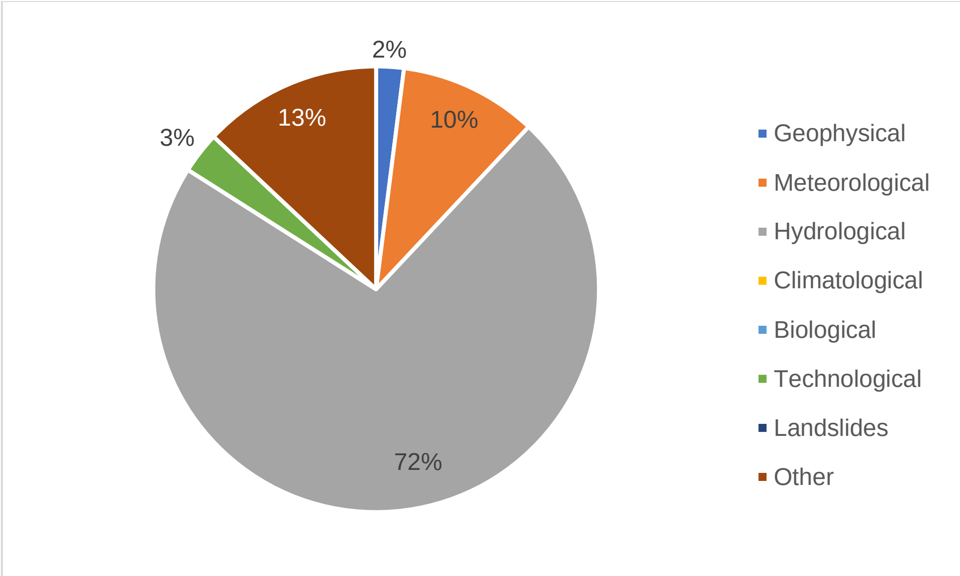
A total economic loss of ALL 10.5 billion (US$ 92 million) has been calculated for the period between 1993 and 2013 for all categories, causing severe consequences for the economy. Although hydrological events make up only about one fifth of historically recorded hazard events, they account for more than 70% of economic losses and for nearly 25% of the people affected by hazard events between 1851 and 2013. Meteorological events are responsible for the largest group of people affected, while geophysical and landslides (14% and 12% respectively) also show notable effects on the population (see **Error! Reference source not found.** and Figure 19) (Toto & Massabò, 2014).

Figure 18: Distribution of people affected by different disaster types



Source: Own illustration with data from Toto & Massabò, 2014

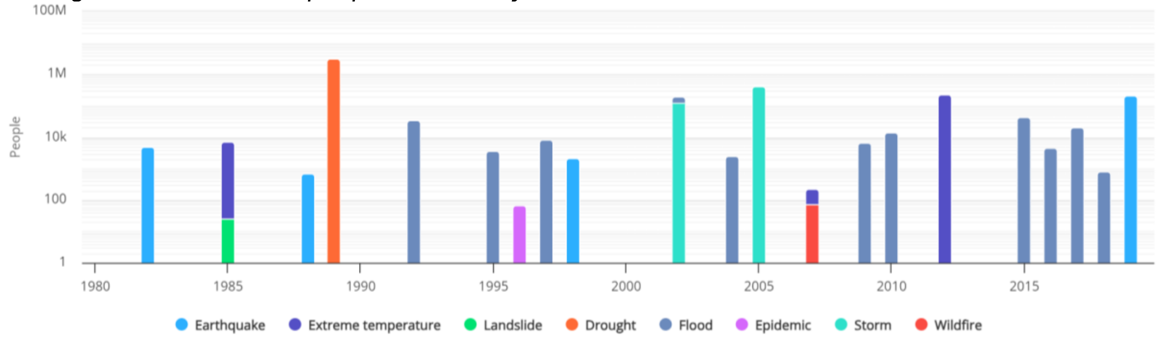
Figure 19: Composition of economic losses for different disaster types



Source: Own illustration with data from Toto & Massabò, 2014

Using a longer data set and different hazard categories, shows that floods are clearly the most frequent natural hazard impacting population, but temperature-related hazards (such as heatwaves and droughts) have an extensive impact when they occur.

Figure 20: Number of people affected by different Natural Hazards between 1985 and 2020

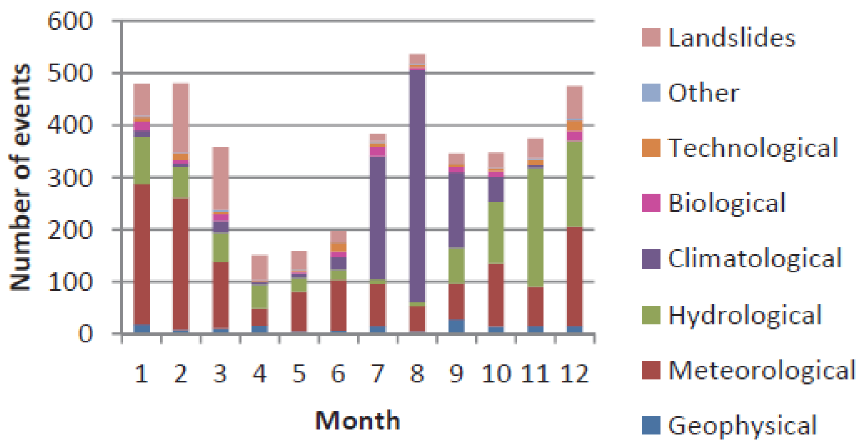


Source: World Bank, 2021

Based on information from the Ministry of Interior (MoI), the financial cost of preventing a disaster is ten times lower than the financial cost of disaster response and establishing initial conditions, with losses due to human life not considered. These costs depend on the level of vulnerability but also the capability of the economy to bounce back from damages caused by disasters (Pojani & Tola, 2010).

Finally, natural disasters in Albania show a distinct seasonal cycle, with climatological events causing a spike in August, meteorological disasters occurring mainly during the winter months and hydrological disasters occurring primarily in November and December (see Figure 21).

Figure 21: Seasonal distribution of disaster groups (1851-2013)



Source: Toto & Massabò, 2014

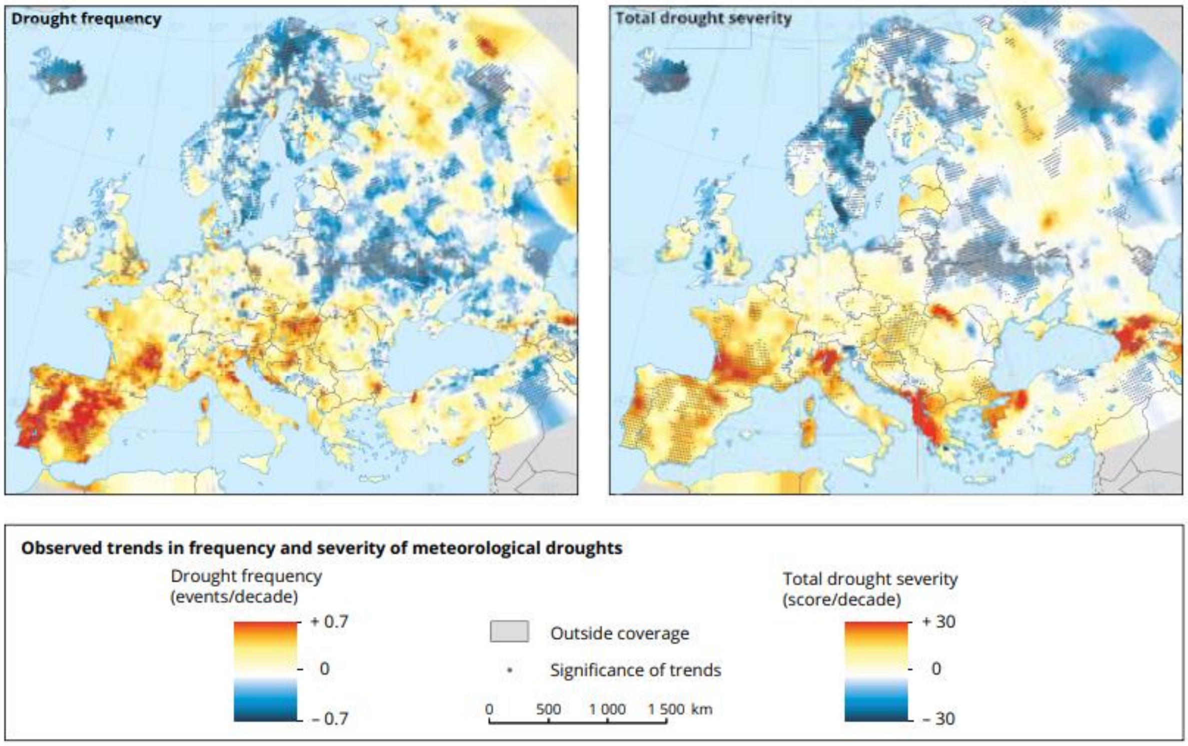
3.2 Droughts

A meteorological drought is an extended period of reduced precipitation compared to the multi-year average for a region. The result is water shortage for some environmental sectors, activities or groups (FAO, 2018b). If the water shortage results in insufficient soil moisture for certain agricultural production, an agricultural drought occurs. Additionally, hydrological droughts are defined that indicate deficiencies in surface and sub-surface water supplies.

In order for the multisectoral vulnerability of Albania to decrease, it is necessary to further invest in technologies that support the adaptability of the farmers while at the same time invest in the gathering and dissemination information through proper hydrometeorological information (World Bank Group, 2021). Significant negative impacts of droughts on the agricultural sector have been reported in the past. For example, the 1989-91 drought, one of the most notable disasters in Albanian history, affected three million people and caused an economic loss of US$ 24 million (FAO, 2018b). The main direct impacts of drought on natural resources, ecosystems and other sectors are reduced productivity and water levels, an increase in pests and plant diseases, as well as livestock and wildlife mortality rate and an increase in fire hazard and wind erosion. These can lead to indirect impacts, such as reduced income in the agriculture sector and correspondingly lower tax revenues, as well as rising prices for food and timber (ibid.) Between 1997 and 2012, droughts affected a total of 3.2 million people. In addition to agricultural droughts, Albania has also been affected by hydrological droughts that have put its energy security, which depends on hydropower generation, in peril (FAO, 2018b) (compare Water Supply / Water Sector and Associated Services).

According to observational data of the European Environment Agency (2017), Albania experienced one of the strongest increases in drought severity between 1950 and 2012 in all of Europe. Additionally, the south of Albania experienced an increase in drought events per decade (see Figure 22).

Figure 22: Observed trends in frequency and severity of meteorological droughts



Note: This map shows the trends in drought frequency (number of events per decade; left) and severity (score per decade; right) of meteorological droughts between 1950 and 2012. The severity score is the sum of absolute values of three different drought indices (SPI, SPEI and RDI) accumulated over 12-month periods. Dots show trends significant at the 5 % level.

Source: European Environment Agency, 2017

Future projections of rising temperatures (+3.2°C by 2100), a decline of annual precipitation (-18.1% by 2100) and an increased seasonality of precipitation with longer dry spells during summer (-50.4% by 2100) indicate an increase in the probability of droughts of up to 20% (Alfthan, et al., 2015; Ministry of Environment, 2016). Less precipitation overall will also lead to an increase in the number of consecutive days without precipitation (see Table 3). In the southern part of the country, which already experiences the longest dry spells, such periods might be prolonged by 14 days (to a total of 97) while the north will experience a prolongation of 23 days (to a total of 81) by the end of the century compared to the baseline period 1960-1990.

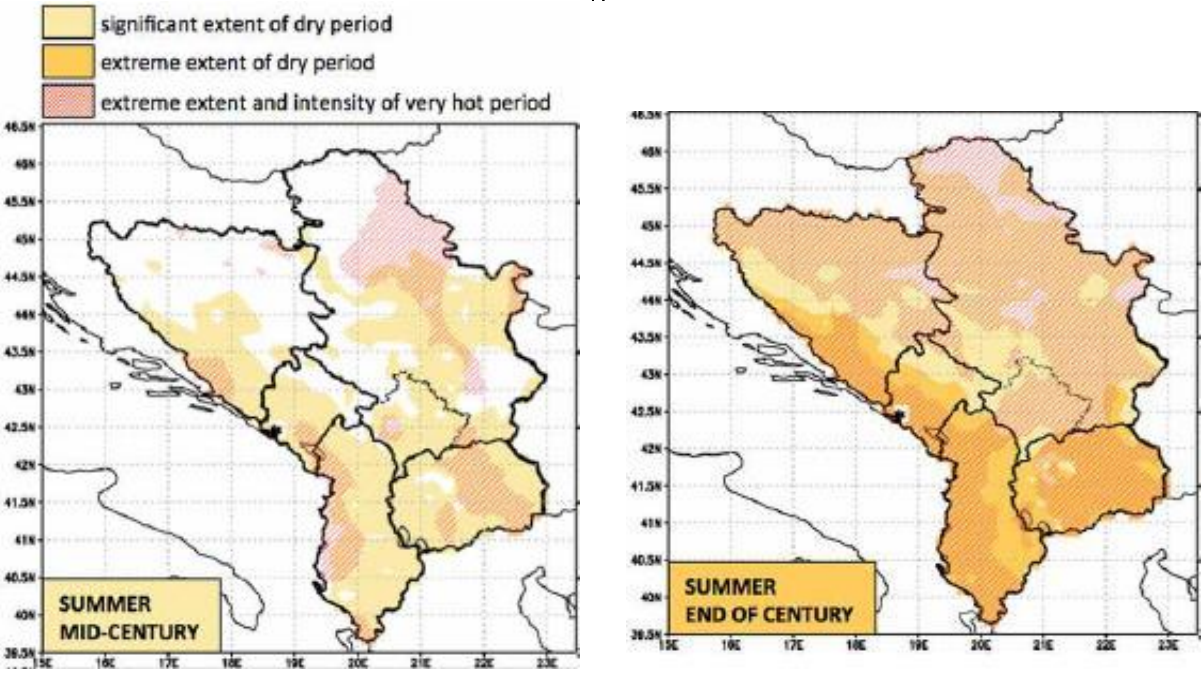
Table 3: Expected maximum number of consecutive days without precipitation

	Period	Time horizon			
	1990	2030	2050	2080	2100
North	58	63	69	74	81
Central	73	77	80	84	88
South	83	85	88	94	97

Source: Ministry of Environment, 2016

By the end of the century, dry periods during summer are projected to reach an extreme extent in all of Albania. In the coastal and central area of the country, this will be compounded by periods of extreme extent and intensity of heat (see Figure 23) (Vukovic & Vujadinovic Mandic, 2018).

Figure 23: Significant and extreme extent of dry and very hot periods in the Western Balkans region (I)



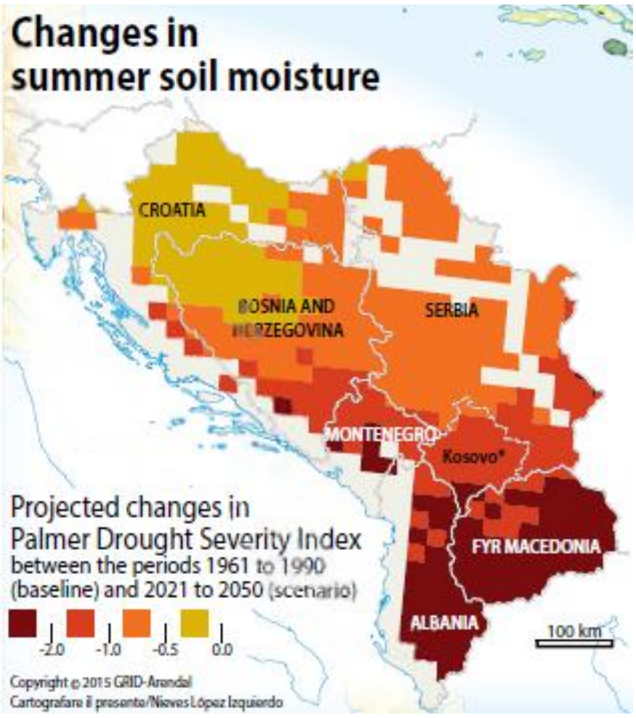
Source: Vukovic & Vujadinovic Mandic, 2018, p. 11

Values are derived from both the RCP 4.5 and RCP 8.5 scenario taking the higher values into consideration. Two periods are presented, mid-century (left panel) and end of the century (right panel). Maps show areas with most pronounced changes in comparison to present climate.

The maps indicate the risks of an increase of dry and very hot periods for the summer season related to climate change in the WBR. Values are derived from the RCP 4.5 and the RCP 8.5 scenarios, taking the respective higher values into consideration. Two periods are presented, summer mid-century (left panel) and summer end of century (right panel).

As a result of an increased period without precipitation, summer soil moisture is predicted to decrease in the entire country. However, the south will experience the largest changes, as shown in Figure 24.

Figure 24: Projected changes in Palmer Drought Severity Index between 1961-1990 period and 2021-2050 scenario



Source: Alfthan, et al.,2015

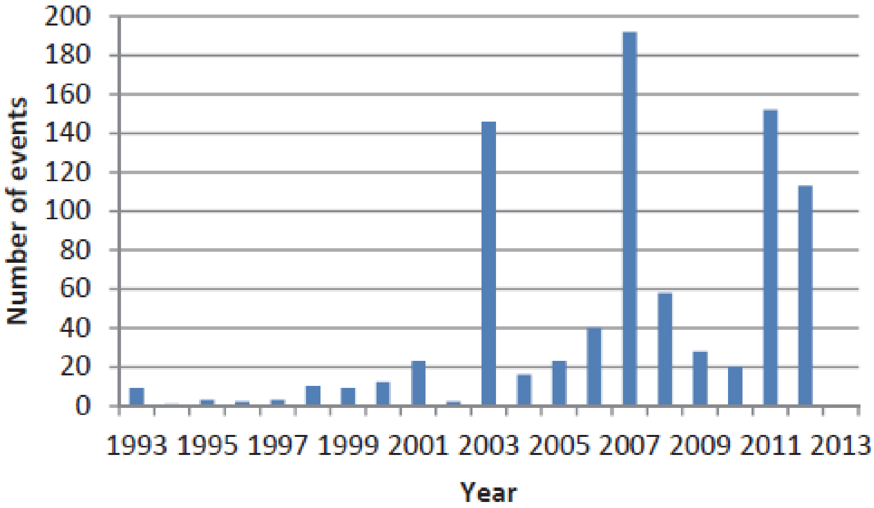
3.3 Wild/Forest Fire

Apart from the expected increase in drought severity and frequency, the projected increase in temperature, heat waves and dry spells will also increase the fire risk across the country (Ministry of Environment, 2016). More severe heat waves and droughts will provide more favourable conditions for wildfires during the hot and dry summer months, causing large-scale devastation and an additional threat to human health, infrastructure and productive sectors.

Although forest fires are partially seen as a natural phenomenon, the increasing frequency of the events corresponds to the higher annual temperatures, indicating that global warming is increasing the fire risk (see Figure 25). However, other anthropogenic interferences, such as poor ecosystem management, represent potential additional causes of the widespread occurrence of forest fires in the entire western Balkan region (FAO, 2018b).

The main damage of wildfires in Albania accrues to the agricultural sector where, between 1993 and 2012, 13,289 hectares of land were damaged by fires (Toto & Massabò, 2014). Furthermore, many cities – including the capital, Tirana – are at significant risk of heatwaves and wildfire impacts (Municipality of Tirana, 2015). In summer 2017, more than 600 fires broke out in multiple locations, especially in the south of Albania (GIZ, 2018).

Figure 25: Temporal behaviour of forest fires for the period 1993-2013



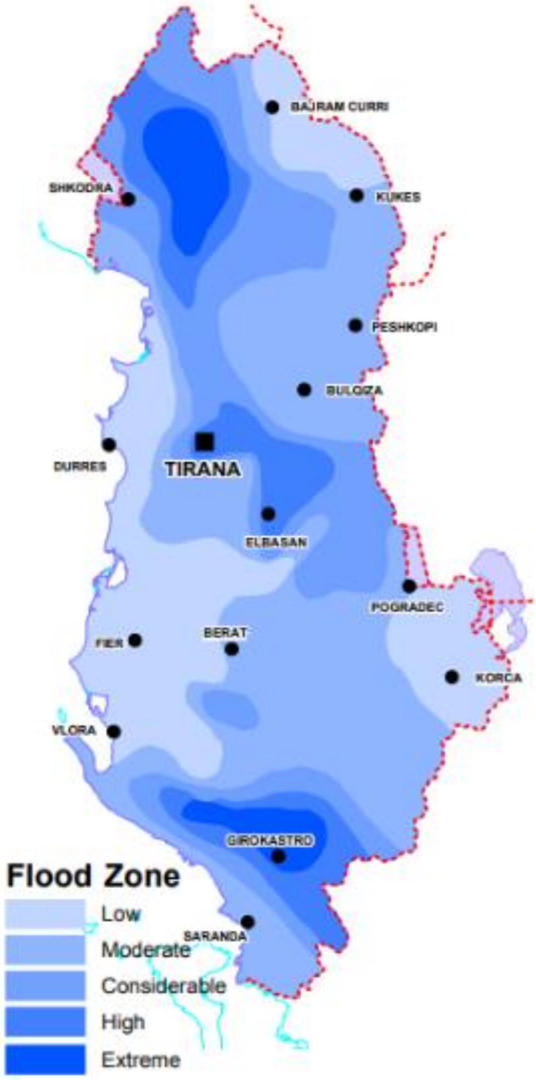
Source: Toto & Massabò, 2014

3.4 Floods

Albania is extremely exposed to flooding due to a strong seasonal cycle, with 80 to 85% of its annual precipitation occurring between November and March, which is also the period of major flood occurrence (FAO, 2018a). The greatest risk arises from the country's ample riverine system, but its long coastline is additionally affected by coastal flooding caused by storm surges. Riverine floods can either be caused by short-term extreme precipitation events in the case of flash floods or by snowmelt during spring season leading to week-long inundations (Ministry of Environment, 2016, p. 159).

The areas most affected are in north-west Albania between Shkoder and Tirana (the regions of Shkoder and Lezha) and, in the south, the area of Fier and Berat (Traverso, et al., 2017; Toto & Massabò, 2014; World Bank Group, 2017). confirms this point by indicating the regions with the highest peak specific discharges (i.e. risk of riverine flooding). Furthermore, the northern coastline, especially areas below sea level, such as the municipality of Lezha, experience continuous (coastal) flooding, heatwaves and seawater intrusion (Allkja, et al., 2020).

Figure 26: Flood potential of a 100-year flood based on historical data



Source: Selenica, Flood Potential in Albania, 2004

Floods (38%) and flash floods (33%) accounted for the major share of disasters in Albania between 1852 and 2013 (FAO, 2018a). As shown in Table 4, in the period 1993 to 2013 Albania experienced on average 22.4 floods and flash floods per year, concentrated on 39% of national communes (Toto & Massabò, 2014)that, on average, 50,000 people are affected by floods every year and that the annual average GDP affected amounts to about US$ 200 million (World Bank Group, 2017).

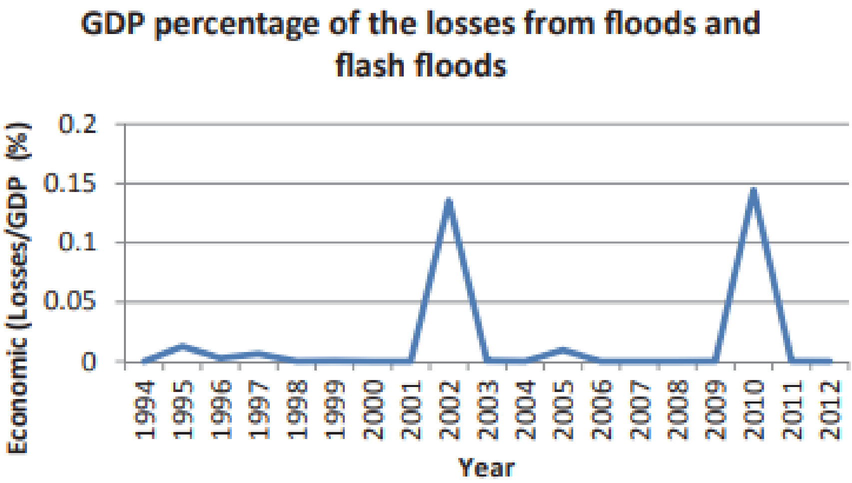
Table 4: Impact of floods and flash floods (1993-2013)

	Average for year	Maximum for year	Average for event	Maximum for event	% of communes	Most affected communes
Events	22,4	109 (in 2010)	n.a.	n.a.	39	Balldren i Ri (14) Ana e Malit (11), Zejmen (11)
Mortality	1,05	9 (in 1995)	0.05	5	1,6	Bushtrice (5), Kacinar (5), Gramsh (2)
Houses destroyed/damaged	40/1,136	539 (in 1995)/ 9,672 (in 2010)	1.8/50.7	300/ 7000	11/ 21.1	Gur I Zi (300), Shkoder (150), Dushk (46)/ Dajc (2,911), Shkoder (2,221), Berdice (1,352)
Agriculture (Hectares)	7,419	43,739 (in 2010)	331	20,000	16,3	Levan (7,000) Balldren I Ri (3,000) Gradishte (2,600)
Economic losses	ALL 370 mln	ALL 4,040 mln (in 2010)	ALL 16.5 mln	ALL 1,100 mln	17,6	Dajc (1,000 mln ALL) Berdice (540 mln ALL) Bushat (480 mln ALL)

Source: Toto & Massabò (2014)

Figure 27 depicts the economic losses from floods and flash floods. The two spikes highlight the floods of 2002 and 2010, which respectively caused damage of almost 0.15% of Albania’s GDP (Toto & Massabò, 2014).

Figure 27: Losses from floods and flash floods as percentage of national GDP



Source: Toto & Massabò, 2014

Noticeable flood events of the last decade include the floods in the Shkoder region, with an inundated area of 14,000 ha, and the 2015 floods that incurred estimated damage of over EUR 122 million (about US$ 173.66 million (2017 values)) and affected a total of 42,000 people in the southern part of Albania (FAO, 2016; Bijlsma, Teeuwen, Hartman, & Smaja, 2015; European Comission, 2015). In 2017, days of torrential rain, including on occasion a rain density of 130m erupted for two hours), caused river levels to rise rapidly. As debris streams blocked water channels, flooding occurred in densely populated urban areas. As a result, more than half of the country was inundated by this extremely heavy precipitation event, 3,500 houses and 10,000 hectares of farmland were impacted, more than 60 bridges destroyed, and main roads closed. Furthermore, in some areas the potable water was polluted, making it unsuitable for consumption. The overall result was widespread interruption to power and freshwater supply, suspended flights and ferry services, and even several fatalities (IFRC, 2018). The most recent major flooding occurred on 22 June 2018, when Tirana experienced in just 20 minutes the amount of rain that normally falls in a month. Due to flooded streets, public and private buildings, economic life came to a standstill, taking the city days to recover (GIZ, 2018).

As can be seen from these examples, flooding is a major socio-economic concern for the country. This is also visible in Table 5, which lists some of the major impacts floods have had on Albania up to 2021.

Table 5: Event, location and impacts of major floods in Albania

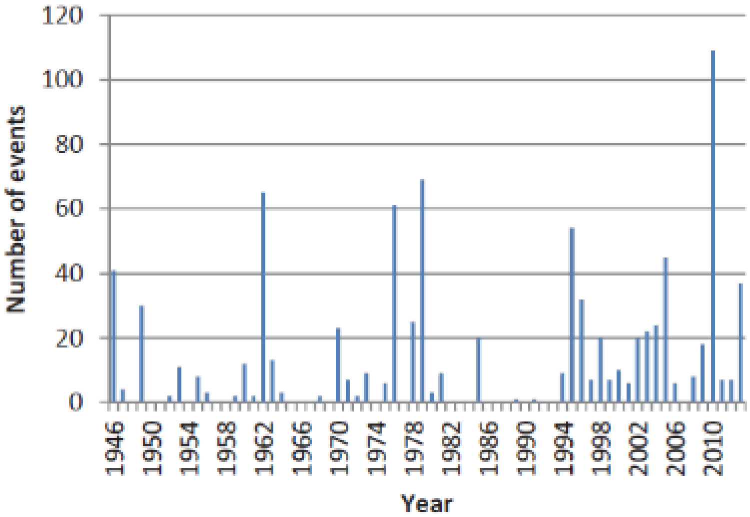
Event	Location	Impacts
Flood of November 1962-January 1963	Part of cities of Shkoder, Berat, Lezha and others	7,000 ha agricultural land flooded. Huge damages in flood infrastructure, road infrastructure, livestock loss, no victims.
Flood of December 1970 – January 1971	Vjosa river area	14,000 ha land flooded. Damages and desdges, pumping stations.
Flood of September – October 2002	Part of cities of Lezha, Shkoder, Gjirokastra, Berat and other (11 districts in total)	33,000 ha flooded. Considerable loss in agriculture, damages is, businesses. Roads, bridges, pumping stations, dams, electric stations, and other infrastructure, up to 9,727 people evacuated, $17.5 million evaluated as total loss cost.
Flood of December 2009 – January 2010	Buna River and Shkoder Lake	10,500 ha agricultural land flooded. Sustained damage in the nearby water supply, roads, bridges, and more than 2,500 House Buildings and 5,300

Flood of January - February 2015	Nine regions and 53 municipalities affected. Most affected municipalities were Vjosa, Devoll, Osum and Seman rivers.	12,225 ha of arable land flooded. 10,000 ha of agricultural land flooded Affected population was 397,316 people 15,000 farmers' settlements were affected 3,5000 head of livestock killed.
Flood of December 2017 Vlora	10,622 ha flooded and 5.800 ha in the presence of water. Damages of 4,700 houses Damages in public objects (23 schools).	10,622 ha flooded and 5.800 ha in the presence of water. Damages of 4,700 houses Damages in public objects (23 schools).
Flood of March 2018	Shkoder	4,704 ha flooded.
Flood of January-February 2021	Shkoder	5370 ha flooded.

Source: Own design with Data from Media and WMO, 2012

Studies suggest that between 1993 and 2013 a trend towards more frequent flooding and flash floods in Albania is discernible (Figure 28) (Toto & Massabò, 2014). It is assumed that this increase is directly linked to climate change-induced temperature es and that this trend will continue in the future (Ministry of Environment, 2016).

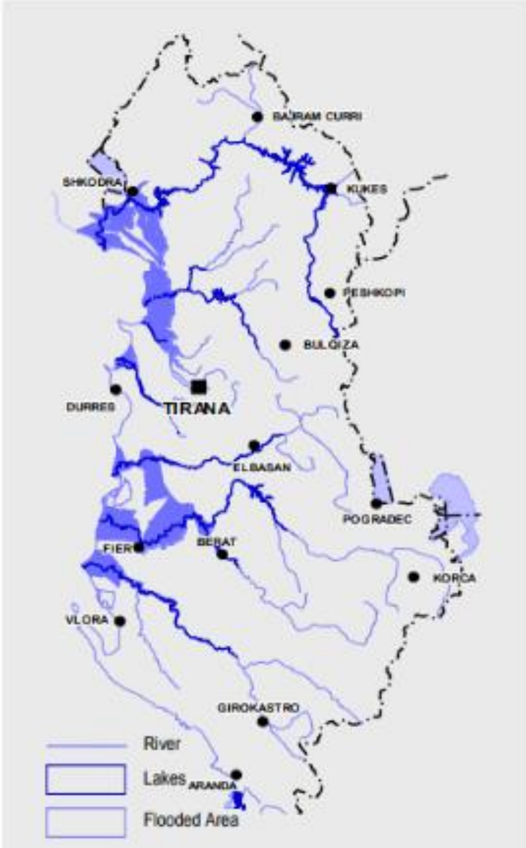
Figure 28: Temporal trend of floods and flash floods (1946-2013)



All climate scenarios project a further increase in the frequency and severity of devastating floods in the future, mostly due to an intensification of heavy precipitation in winter months and the ensuing snow melt in spring. Correspondingly, the flood risk in autumn, winter and spring is projected to increase (Ministry of Environment, 2016; Vukovic & Vujadinovic Mandic, 2018). Thus, the return period of the most severe floods will be shortened, and the level of damage will increase. A comparison between 2015 conditions and climate and socioeconomic scenarios for 2080 indicate that if a 100-year return flood event had occurred in 2015 it would have had an estimated US$ 700 million effect on GDP, while this amount increases to US$ 2.5 billion with a comparable flood in 2080 (World Bank Group, 2017).

Figure 29 shows the flood risk map of Albania for a 100-year return period to evaluate the flood potential computed using statistical methods (Selenica, Ardicioglu, & Kuriqi, 2011).

Figure 29: Flood Risk Map of Albania (100-year return period)



Source: Selenica, Ardicioglu, & Kuriqi, 2011

Beyond the impacts of changing precipitation patterns, model projections show that sea level rise will lead to an increase of river levels in the upper part of basins and a deceleration of river flows. This will lead to floods that will directly affect around 32% of the coastal area (3.76% of the country's surface). Additionally, the coastline is projected to regress inwards, increasing the pressure on settlement structures in the drained wetlands (Ministry of Environment, 2016). However, the exact impact will depend on the magnitude of sea level rise. Whereas the projected 48-60cm rise in 2100 would inundate coastal areas and create large-scale saltwater infiltration, the projected rise of 20-24cm by 2050 is not expected to cause major damage (Fay, Block, & Ebinger, 2010).

- The significant impacts that flooding events are having in Albania is not only caused by the geographical, meteorological and climatological conditions of the country but also by human activity. Infrastructure development in flood-prone areas such as the coast and wetlands that were drained in the 1950s and 1960s, much of it informal and for tourism purposes, has reduced the resilience to flooding (Ministry of Environment, 2016). Thus, the Third Communication of Albania to the UNFCCC (2016) concludes that a majority of flooding events of the 21st century was not just caused by heavy rain but also by mismanagement of cities and infrastructure in the northern coastal zone as well as of hydropower dams. For example, the flood risk management plan of the Shkoder region observes that the main risk factors for flooding are: Long-lasting intensive rainfall during winter;
- Snowmelt causing rivers to overflow;
- Sudden releases of large quantities of water from hydropower reservoirs and an inadequately working drainage system (Shkoder Region, 2015).

Additional drivers identified in the disaster risk reduction plan of the municipality of Lezha include:

- The erosion of coastal dunes (a problem mainly along the northern coast);
- Failing and damaged mountain stream embankments;

- Lack of maintenance of dams and drainage systems, as well as the absence of an efficient flood management system (Allkja, et al., 2020).

In addition, droughts are a concern, especially in poorer regions of Albania, where firewood is in high demand given the high electricity price. Thus, afforestation with fast-growing species is necessary to supply communities with firewood in a sustainable manner while addressing soil degradation and building resilience against floods (Ministry of Environment, 2016, p. 119)

Finally, a significant exposure to coastal flooding arises from the unregulated urban development along the coast and large number of dwellings situated at a maximum of 0.5m above sea level (Ministry of Environment, 2016).

While the general trends causing vulnerability to (coastal) flooding are well known, the exact magnitude of future vulnerability remains highly uncertain. A major factor in this uncertainty, apart from changes in socio-economic trends, is the high tectonic activity of the region, which means that the influence of sea level rise might be conditioned by local uplift or subsidence (Ministry of Environment, 2016).

3.5 Landslides

Soil water content in the WBR is projected to decline. As a result, saturation conditions and drainage will be restricted to winter and spring. Intense precipitation and flooding will, in turn, lead to an increase in soil erosion over the next century, causing widespread landslides. This might lead to pollution of waterways as well as a reduction in the functioning of irrigation infrastructure and reservoirs (Globevnik, Snoj, Šubelj, & Kurnik, 2018).

For Albania, the main causes of land instability are intense and frequent rainfall and snowfall. Landslides occur on average 25 times per year, but most frequently in February and March, coinciding with the highest number of (heavy) precipitation events. The country experiences several types of landslides, including torrent deposits, rock falls and topples. In the lowlands, an increased occurrence of landslides has been attributed to inappropriate land use and land management practices, as well as deforestation (FAO, 2018). Over the last 20 years, there has been an increasing trend in the number of landslide events (Toto & Massabò, 2014). Projections show for the higher altitudes of northern Albania a potential increase in 1-day precipitation amounts that could trigger landslides and flash floods (Xiong & Espinet Alegre, Climate Resilient Road Assets in Albania, 2019).

3.6 Coast/Sea Level Impacts and Exposure

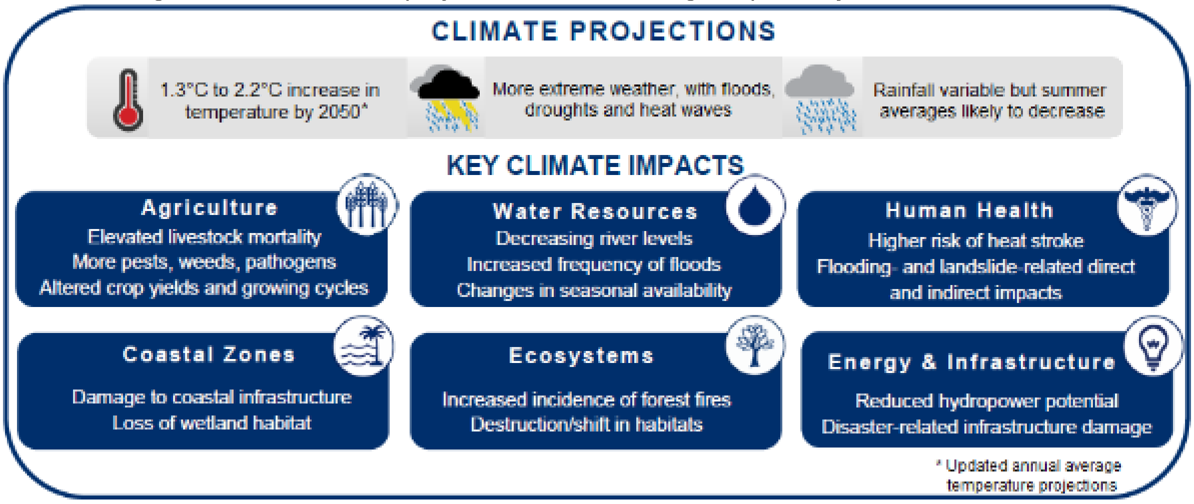
Although the narrow coastal belt on the Adriatic Sea makes up only around 11.8% of the entire country, it hosts around 36.3% of the Albanian population (Ministry of Environment, 2016). Albania, Croatia and Turkey are some of the most exposed countries with regard to saltwater intrusion (Fay, Block, & Ebinger, 2010). The coastal regions are vulnerable to the impacts of sea level rise, but also cliff erosion, degradation of the coastal ecosystem and intrusion of saltwater in freshwater systems (Ministry of Environment, 2016). While all estuaries of the Albanian coast are expected to be affected by climate change, the southern bedrock coastline will be affected differently from the sandy shoreline further north, where sea level rise is already eroding beaches, inundating low-lying areas and permanently converting wetlands into open water (Ministry of Environment, 2016). Combined with the lack of infrastructure and experience to cope with the challenges, regions such as the Drin Mati River Delta have already seen substantial erosion and seawater intrusion, consequently causing losses in marine and coastal habitats. The area occupies around 5,800 ha, of which 4,600 ha are considered endangered. The loss of nature and biodiversity in the area directly impacts sustainability and the propensity for development of the region (Kay & Elrick, 2013, p. 32). In north-western Albania, erosion is advancing at a very fast pace given the lack of solid sediments stemming from the River Drin, which would otherwise provide a barrier to the seawater intrusion (Allkja, et al., 2020).

The coastal squeeze, where the natural systems within the coastal zone are being compromised by anthropogenic alterations and sea level rise, increases the risk of flooding and places at risk existing infrastructure, agriculture and tourism activities that are located closest to the beaches (Ministry of Environment, 2016).

Up to 97% of the population that lives within 100km of the coast, as well as the corresponding infrastructure, might be at risk from climate impacts, mainly storms, flooding and sea level rise. Sea level rise is particularly problematic for the most exposed population that has settled along the shoreline and in drained floodplains and marshlands due to unregulated urban sprawl. This vulnerability is further increased by coastal erosion caused by the use of sand and gravel for construction, agricultural development and deforestation of the coastal area (USAID, 2016). Due to sea level rise, approximately 32% of the coastal area (or 3.8% of the country's surface) will be impacted by flooding by 2050 and most of existing agriculture and industrial areas will be lost due to sea level rise (Ministry of Environment, 2016).Sector-specific Climate Change Risk Assessment

According to Albania's TNC to the UNFCCC, the socio-economic vulnerability to climate change is centred upon the sectors of agriculture, water, tourism and population (Ministry of Environment, 2016). Figure 30 provides an overview of climate change projections and the resulting sectoral impacts for Albania by 2050.

Figure 30: Overview of projected Climate Change Impacts by 2050 for Albania



Source: USAID, 2016

3.7 Water Supply / Water Sector and Associated Services

Albania supplies its drinking water from precipitation-fed groundwater storage and depends on its abundant rivers for electricity generation and irrigation (Ministry of Environment, 2016). While the country possesses rich water resources, its water sector (supply and sewerage) faces multiple interrelated challenges that reduce its resilience to climatic stressors. The fragmented administration of the water sector, with multiple institutions holding overlapping responsibilities, results in unclear accountability and inefficiency. This has led to a lack of adequate infrastructure and human resources, which in turn creates an average rural and urban water coverage of only 80% and an average service continuity of 12 hours per day (European Commission, 2016). Additionally, a non-existing or weak monitoring system results in little knowledge regarding the quantity and quality of surface and groundwater in Albania (Ministry of Environment, 2016).

A decreasing trend in precipitation will alter water demand, the hydrology of watersheds and the thickness and expansion of snowpack (Ministry of Environment, 2016). As a result of reduced mean precipitation, mean annual surface runoff will decrease (Pojani & Tola, 2010). Compounded by increased evaporation due to higher temperatures, this may reduce reservoir storage. Additionally, a projected 41% reduction of summer precipitation and an expected increase in days with heavy precipitation in winter will result in an increasingly variable water supply, with more frequent droughts in summer and a higher flood frequency during the rest of the year (Ministry of Environment, 2016).

3.8 Drinking Water

While analyses suggest that Albania possesses sufficient water resources to cover its future demand, the poor condition or non-existence of its water infrastructure, particularly in terms of water supply and wastewater management, a weak data basis as well as a poor and highly fragmented regulatory and financial framework, render the sector highly vulnerable (Ministry of Environment, 2016; IDRA Research & Consulting and Magnum Opus Group, 2020).

In terms of the drinking water supply, studies suggest a future shortage in adequate quality and quantity due to climatic and non-climatic factors such as reduced groundwater recharge, increased salinity, growing population pressure and demand. Not only is climate change projected to reduce groundwater recharge but also to increase the salinity of aquifers along the coast due to more frequent flooding. However, without a long-term data basis, the extent of saltwater intrusion into aquifers along the Adriatic coast, as well as the deterioration of water quality due to frequent flooding, is difficult to quantify. Still, some evidence exists for saltwater intrusion into groundwater reservoirs along the Adriatic coast caused by more intense coastal flooding and over-exploitation. This is particularly problematic in the north of the country, where the drinking water supply of coastal towns is at risk of lasting damage. Here, the sandy coastline is increasingly being submerged due to sea level rise and freshwater aquifers are becoming more saline due to more intense coastal flooding. Reduced surface runoff and increasing evaporation may additionally reduce reservoir storage, thus affecting drinking water and hydropower production. This could threaten water quality by changing the erosion of riverbeds and modifying the turbidity and sediment load (Ministry of Environment, 2016).

Furthermore, while the average water availability exceeds total demand in all parts of the country, significant differences exist between the different municipalities, most of which experience (very) high water losses (World Bank, 2019). In terms of how far this will challenge the supply of high-quality drinking water, as well as water for irrigation, it is difficult to estimate due to a lack of data (IDRA Research & Consulting and Magnum Opus Group, 2020). Even if water resources remain abundant in all parts of the country, there remains the question of the necessary infrastructure to supply water where it is needed (Ministry of Environment, 2016; European Environment Agency, 2017).

3.9 Hydropower and Energy System

Apart from its groundwater reservoirs, Albania depends on its surface reservoirs and rivers for its national electricity production. Around 97% of electricity is produced at hydroelectric plants, mainly (90%) on the river Drin (Fay, Block, & Ebinger, 2010). However, already under current climatic conditions hydropower production is highly variable and unable to reliably meet domestic electricity demand. More frequent and prolonged droughts and climatic variability will exacerbate the pressure on the electricity supply in the future (USAID, 2016). The sensitivity of the country’s energy security to water scarcity was clearly exposed in 2003 and 2007, when the average production of one hydroelectric plant, the Fierza power plant, decreased by a third (FAO, 2018b). This problem is further exacerbated by the seasonality of electricity demand, which is highest in summer when supply is lowest (Ebinger, 2010).

The vulnerability of the water sector stems from the variability of extreme weather events that are projected throughout this report. The projected future hazards related to the reduction of precipitations are combined with the expected changes from snow to rain, given the marginally increasing temperature, resulting in substantial decreases in river flows. On the other hand, such increasing temperatures and the dry spells, will eventually affect soil moisture, consequently affecting groundwaters. Various reports consider the lack of training personnel and proper modelling tools as the main causes that adaptability to the new climate implications are difficult to implement. Since adaptability raises concerns, it is important to emphasize the needs for climate information services to provide the technical data in order for efficient planning to take place. Such considerations would positively affect not only the supply of water for general use but also support the reliance that 90% of the Albanian energy supply has on the Drini River Basin. To improve the efficiency of supply and diversify the energy sources, the country would benefit from the capacity building in data monitoring and forecasting stemming from the meteorological and hydrometeorological information systems (World Bank Group, 2021).A study by Traverso et al. (2017) found that, by 2050, hydroelectricity generation could be reduced by between 15% for large dams and 20% for small dams.

3.10 Agriculture

The government of Albania (GoA) identifies agriculture as the second key sector (besides tourism) to hold untapped growth potential (Republic of Albania, 2013). While the population share employed in the agricultural sector is falling, it still provides income to more than a third of the Albanian population (World Bank Data, 2020). At the same time, a large part of agricultural produce is used for subsistence consumption rather than for sale on the market, which increases the relevance of this sector beyond its nominal contribution of one-fifth of national GDP (Ministry of Environment, 2016).

The agriculture sector is of crucial importance with regard to socio-economic development in Albania as it contributes about 23% to the country’s GDP and accounts 42% of the overall employment. In Albania, there are about 350,000 farms (or agriculture businesses), of which the majority of the approximately are subsistence farmers. Roughly 50,000 companies are market-oriented, but only two thirds of those are formalised, i.e. registered for taxation. The farm structures are small and complex with an average farm size of 1.2 ha and fragmented into three to five plots of different size and land quality. There is no official definition of what constitutes large farmers, but the consensus exist that large farms are those of 2 hectares and above (Imami, 2018).

In Albania, agricultural activities are limited to about one quarter of the national territory due to the topography of the country. This area is shared by more than 350,000 farms, resulting in a high fragmentation of the land and small average farm size (Imami, 2018).

It is estimated that the average farm operates at a low efficiency of only one third of its potential (FAO, 2018a). As it is especially the economically marginalized who tend to be more dependent on the agricultural sector, these groups will be disproportionately affected by the negative effects of climate change (Sutton, Srivastava, Neumann, Strzępek, & Droogers, 2013, p. 21). Additionally, these smallholder farmers, with limited access to financing, display a particularly low adaptive capacity (Sutton, Srivastava, Neumann, Strzępek, & Droogers, 2013).

The coastal lowlands are the most important areas of agricultural production, hosting 65% of cultivated land, 60% of fruit trees, 90% of greenhouses, 75% of vegetables and 64% of field crops (FAO, 2018a), but the coastal lowlands are also the area most vulnerable to floods and heatwaves/droughts. The main causes of vulnerability are topography, i.e. low land and large river delta, and altitude, meaning a significant portion of the agricultural land is less than 5m above sea level, with many fields having only been drained in the late 1950s and 1960s or at an elevation of around 50cm above sea level, while climate projections show a much larger reduction in precipitation in coastal compared with inland areas, coupled with a temperature increase (Ministry of Environment, 2016). Mechanization potential in the agricultural sector is limited due to its topography, thus farmers have reverted to opportunistic land reclamation and pasture conversion to enhance production. This inappropriate land use and management has accelerated deforestation and erosion as well as a rise in groundwater levels in the lowlands, exacerbating risks from land instability, landslides and floods (USAID, 2016; FAO, 2018a).

Information on damage caused by extreme events in the agricultural sector is supposed to be available at the relevant municipalities. However, there are no common methodologies or standards to assess such damage (in general, beyond agriculture), and no central monitoring. For the same reason, the datasets available in the public DesInventar database (losses and damages dating back until 1851) are fragmented and not always comparable, and sometimes contradict information from other sources. However, this could provide an entry point for a move towards climate-smart agriculture in providing climate information and services, and especially climate information product development (e.g. insurance). The combination of forecasts and loss assessments (e.g. through remote sensing technology via satellites or drones) could be linked to start ups or incubators.

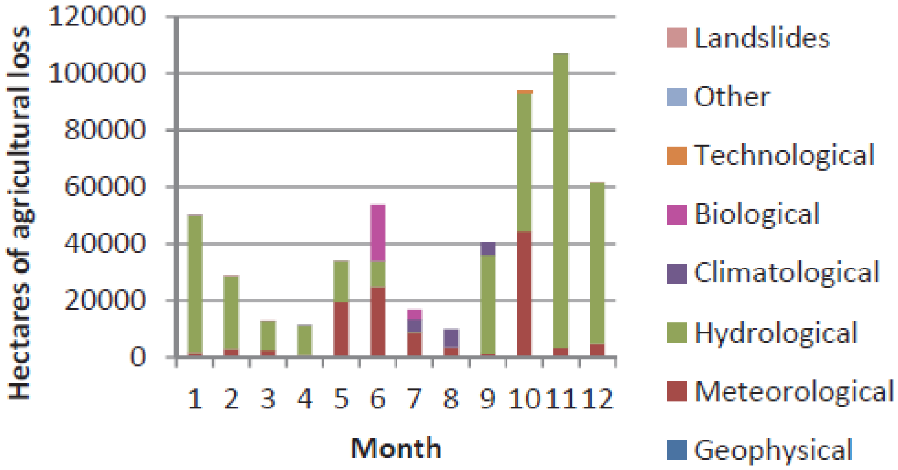
Table 6 highlights some of the impacts recorded and published. Investments in improving damage assessments are part of the proposed project (GIZ, 2018).

Table 6: Overview of the impact of major floods in Albania on agriculture

Event	Location	Impacts
Nov.1962 – Jan. 1963	Part of cities of Shkoder, Berat, Lezha and others	70,000 ha of agricultural land flooded. Huge damage in flood infrastructure, road infrastructure, livestock loss, no victims.
Dec. 1970 – Jan. 1971	Vjosa river area	14,000 ha land flooded. Damage and destruction of embankments, irrigation channels, bridges, pumping stations.
Sep. – Oct. 2002	Part of cities of Lezha, Shkoder, Gjirokastra, Berat and others	33,000 ha flooded. Considerable loss in agriculture, damage in houses, businesses, roads, bridges, pumping stations, dams, electric stations, and other infrastructure, up to 9,727 people evacuated, $17.5 mio total losses.
Dec. 2009 – Jan. 2010	Buna River and Shkoder Lake	10,500 ha agricultural land flooded. Sustained damage in the nearby water supply, roads, bridges, and more than 2,500 buildings and 5,300 residents evacuated.
2015	Vjosa, Devoll, Osum and Seman rivers	6,879 ha flooded. 35,000 head of livestock killed.

*Source: Own design, compiled with data from FAO, 2018b and WMO, 2012*Figure 30. highlights that hydrological event (flooding) are the main reason for agricultural losses (accounting for about 70% of historic losses), with large impacts during winter months, in which precipitation is projected to increase (Toto & Massabò, 2014).

Figure 31: Profile of agricultural losses in ha due to disasters (1851-2013)



Source: Toto & Massabò (2014)

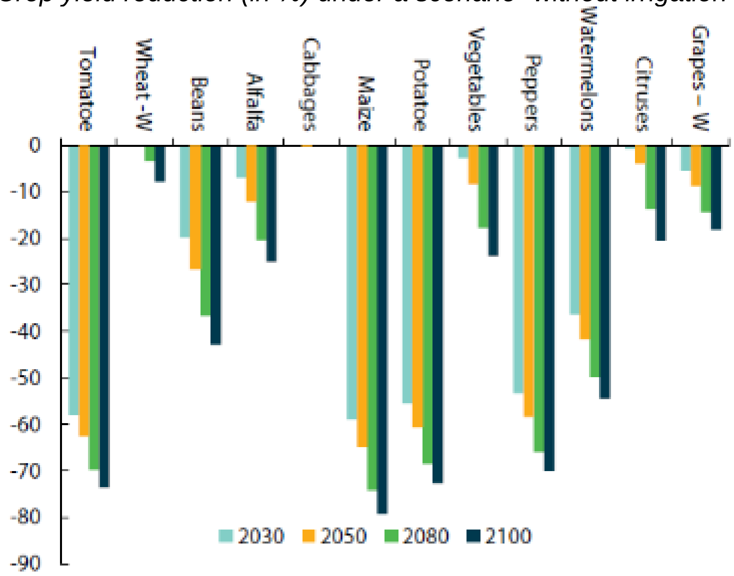
Additionally, most of the existing agriculture and industrial areas will be lost due to sea level rise. About 32% of the coastal area (or 3.76% of the country's surface) will suffer direct consequences from flooding and will, by 2050, be lost or become un-usable due to inundation and increased salinity, as a consequence of sea level rise (Ministry of Environment, 2016). According to a risk analysis of the agricultural sector by the FAO, approximately 130,000 hectares of agricultural land are at risk of riverine flooding. Floods are particularly problematic in spring, when planting of summer crops can be delayed or prevented, and during late summer, when flooding can destroy the entire year's crop (Sutton, Srivastava, Neumann, Strzępek, & Droogers, 2013). A study conducted in the aftermath of the 2015 floods found that over 90% of households in the most affected areas reported lower incomes as a direct result of the floods. With agriculture and livestock being the primary source of income in the affected areas, lower incomes could be largely attributed to loss of crop and livestock (UNDP - Albania, 2016). Generally, farmers are not equipped to respond to either floods or droughts effectively.

Historically droughts have not accounted for a major share of losses, but this is predicted to increase (FAO, 2018a). However, droughts are already a primary concern for farmers in the northern and western part (at higher elevation) of the country. About one third (10,000 ha) of the irrigated farmland is already unable to access the irrigation network and alternative irrigation sources such as groundwater are costly and more difficult to use. In the centre of the country, farmers are additionally suffering from drainage problems and falling water levels in wells. In the lowlands, farmers also see drought as the primary climate concern, as irrigation and drainage infrastructure are mostly dysfunctional impeding adaptation. In this region, farmers also suffer from heat waves, soil drainage and water quality issues (World Bank, 2013). Although FAO concludes that in the near-future droughts will have a more severe impact on agriculture than floods and landslides, the GoA has not given much importance to the governance of drought risk. Thus, drought risk analyses are only carried out for research and development projects but not on an institutionalized national scale (FAO, 2018a).

Information on damage caused by extreme events in the agricultural sector are supposed to be available at DesInventar. Apart from flooding and extreme precipitation events, changes in temperature patterns will also affect crop productivity. Farmers focusing on crops like wheat, grapes and olives, but even more so livestock (which accounts for 59% of agricultural production), will particularly suffer from heat and drought stress (FAO, 2018a). Although the effects of climate change on livestock production continue to be difficult to quantify, projections show a high vulnerability to higher temperatures. One study estimates that a 2.5°C temperature increase leads to a decrease in income per animal of 19% for beef cattle, 21% for goats and 29% for chickens. The main reasons for this decrease are increased mortality and reduced reproduction and feed (Sutton, Srivastava, Neumann, Strzępek, & Droogers, 2013, p. 45). Changes in precipitation patterns (increasingly concentrated in the winter months), in conjunction with higher temperatures, will increase the drought risk and will have a more significant impact on crop yields than a predicted slight decrease in the total annual amount of precipitation (Ministry of Environment, 2016).

On the other hand, climate change might bring some opportunity for enhanced crop production in the coastal area due to an extension of the cropping season (+2237 days) (FAO, 2018b). Vukovic & Vujadinovic (2018) project for southern Albania an extension of the growing season of over 50 days, mainly due to an earlier start, by the end of the century (+1020 in the near future; +2040 at mid-century). Furthermore, while almost all crops are projected to suffer from drastic yield reductions without irrigation, some crops are less vulnerable to the effects of increasing temperatures and altered water availability (see Figure 32). Additionally, provided with a functioning irrigation system and adequate information, farmers might even be able to benefit from an extended growing season (Ministry of Environment, 2016).

Figure 32: Crop yield reduction (in %) under a scenario "without irrigation" (2030-2100)



Source: Ministry of Environment, 2016

3.11 Irrigation

Half of the agricultural land in Albania is rain-fed and the other half is irrigated (mostly in the coastal plains), making Albania the largest consumer of water for irrigation in the WBR (Ministry of Environment, 2016). Fields are mainly irrigated by diverted rivers, supplemented by over 600 irrigation dams. Irrigation projects have been endangering wetlands along the coastline (World Bank, 2003; EEA, 2018).

Nevertheless, irrigation is already indispensable in the summer months, as 75% of the development stage of many crops coincides with the annual period without precipitation (FAO, 2018a). Climate change is projected to reduce the annual amount of effective rainfall to a level where it will not suffice for most crops and thus to substantially increase the water demand for irrigation at the same time as altering the runoff of rivers. Furthermore, a lengthening of the period without precipitation and warmer average temperatures is projected. Thus, soils with a small water-holding capacity will face an increasing risk of summer water shortage (FAO, 2018a). As a consequence, Albania will need to expand its agricultural land under irrigation to avoid yield losses (Ministry of Environment, 2016).

With various climate scenarios projecting a net surplus of water until at least 2050, Albania should be able to maintain and even expand its area of irrigated agricultural production. But irrigation needs are already inadequately met and will become increasingly challenging as water resources are subject to increased variability and unpredictability. The forty-year-old irrigation system mainly consists of diverted rivers and more than 600 irrigation dams and remains in poor repair (Globevnik, Snoj, Šubelj, & Kurnik, 2018). Additionally, information is scarce, and water is not managed appropriately. The arising distributional problems will necessitate efficient use of Albania's abundant water resources and ultimately the implementation of adaptation measures (Sutton, Srivastava, Neumann, Strzępek, & Droogers, 2013; FAO, 2018a; Ministry of Environment, 2016). The Albanian agricultural ministry has set itself the goal to provide a fully functioning irrigation system to 360,000 ha of agricultural lands and is working towards the realization of this goal with support from the WB (FAO, 2018a).

3.12 Tourism

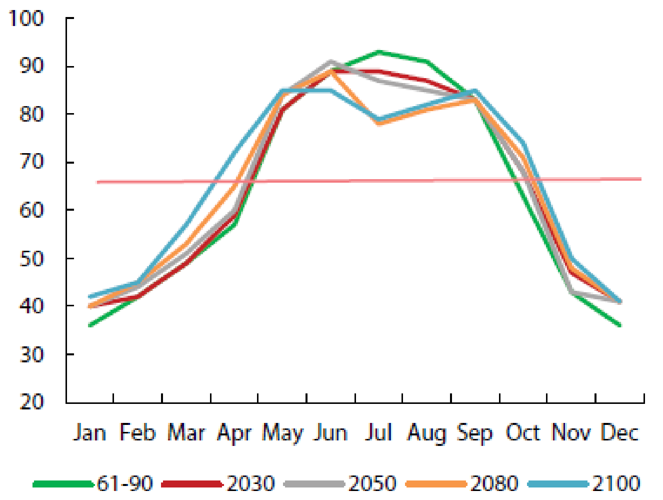
Tourism has been an important driver of economic growth for Albania since the beginning of the 21st century and expectations prior to the COVID-19 global pandemic were that this sector would continue to grow significantly in the future (Republic of Albania, 2013). However, at present, Albania continues to be severely affected by the aftermath of the November 2019 earthquake and the outbreak of the COVID-19 pandemic. The economy is expected to contract in 2020 and to rebound gradually in 2021-22. Nevertheless, major uncertainty and downside risks are prominent, including an increase in new infections and a more severe pandemic resulting in weaker tourism, which would further dampen the economy (IMF, 2020). Tourism accounts for more than 20% of Albania's GDP and was one of the most affected sectors by the pandemic, with 61.5% fewer foreign tourists in July 2020 compared to the previous year (OECD, 2021).

Tourism contributed 2.8% of GDP growth in 2019 directly, amounting to 27% of total GDP according to government statistics. Considering its indirect contribution, this would be even higher (KNOEMA, 2020; INSTAT, 2020). Approximately 80% of tourism is focused on the capital Tiranë and the coastal area (Ministry of Environment, 2016). The main tourist destinations are the capital district of Tiranë, Vlorë and Durrës at the coast and the Korce district in the south-east. To accommodate rising number of tourists (pre-pandemic), the necessary infrastructure, mainly hotels and restaurants in the coastal region, has been significantly expanded over recent years. Given the uncertainties and risks associated with the economic outlook, it is difficult to estimate how long it will take until things will go back to "normal" or the new post-pandemic conditions. Still, tourism – and thus tourist infrastructure – is expected to grow in the future.

Albania's TNC to the UNFCCC (Ministry of Environment, 2016) identifies the tourism sector as being susceptible to various challenges, including waste management, beach quality, coastal erosion and flooding. In recent years, many tourism structures have been constructed along the beaches of the Adriatic coast, which are prone to flooding and subsidence. Inadequate already for current climatic conditions and extreme events, this infrastructure (water, roads, electricity supply) suffers annual damage from sea surges and river flooding; events that will become more frequent and intense under all climate change scenarios (Ministry of Environment, 2016). Furthermore, given the projected inward migration of the Adriatic coast, much infrastructure will have to permanently resettle, which would require huge infrastructure investment. Additionally, several beaches are projected to disappear as early as 2030, while new ones will form.

Overall, it is projected that climate change will lead to a further increase in the number of tourists visiting Albania, as the season with good levels of comfort is extended. However, this will aggravate other pre-existing problems such as removal of urban waste, wastewater treatment and the pollution of water, air and sand. Additionally, increasing tourist numbers will increase the demand for water and energy and thus the pressure on the water sector (see Water Supply / Water Sector and Associated Services, above) (Ministry of Environment, 2016).

Figure 33: Current and projected tourism comfort index up to the year 2100



Source: Ministry of Environment, 2016

3.13 Urban Areas

1.6 million people, 62% of the Albanian population, are estimated to be living in cities (CIA, 2020). Many of these cities are located in the low-lying coastal zone or the enclosed lowlands. Thus, more than one-third of the Albanian population (36.3%) live in the low-lying zones highly sensitive to flooding (Ministry of Environment, 2016). This number is expected to grow as the main migration trends (rural to urban and mountainous inland to coast) continue.

Urban areas, such as around Durrës, Kamza, Kurbin, Lezha, Shijak and Tiranë, are regularly hampered by extreme events, mainly floods (World Bank, 2020). The larger area around the capital of Tiranë and the main port of Durrës, which is the economic heart of the country and home or place of work to more than a third of the country's population, has been affected by at least three major flood events in the past four years, the most recent occurring on 22 June 2018 (UNDRR, 2020). Caused by extreme precipitation, public and private buildings were flooded, and roads were blocked, bringing traffic and economic life to a standstill for several days. Similar events have hit most of the other larger cities, among them Vlorë, Fier and Berat. Additionally, many cities – including the capital of Tiranë – are already experiencing an increase in the frequency of heatwaves. These will not only increase pressure on the water supply but also affect the health of the urban population.

In a vulnerability assessment of the capital city, Tiranë a high vulnerability of water supply and sanitation services to heat waves, droughts and heavy precipitation was identified. Similarly, it was assessed that electricity services are highly vulnerable to heavy precipitation and floods, as well as storms. The building stock and materials were found to be vulnerable to heat waves. Small-scale industry, which encompasses almost all industry in Albania, as well as the transport sector, are highly vulnerable to heavy precipitation and floods. Further details, including assessment of sensitivity/exposure and capacity to adapt, are listed in the annex of the vulnerability assessment and adaptation action plan for Tiranë (Municipality of Tirana, 2015).

Table 7: Evaluated classes of vulnerability for different receptors in Tirana

Receptors	Heat wave	Extreme cold	Drought	Heavy precipi-tation/ Floods	Storm
Public health / vulnerable groups	high	medium	medium	low	medium
Transport	medium	medium	medium	high	medium
Electricity services	medium	medium	medium	high	high
Water supply and sanitation services	high	medium	high	high	medium
Social infrastructure	high	medium	high	low	low
Building stock and materials	high	medium	medium	medium	medium
Tourism	low	medium	medium	medium	low
Small scale industry	medium	medium	medium	high	low
Retail	medium	low	medium	medium	low
Green spaces	high	medium	high	medium	medium
Water resources and quality	high	n/a[8]	high	medium	medium
Air quality	high	n/a	high	n/a	n/a
Agriculture	n/a	n/a	n/a	n/a	n/a
Forestry	medium	medium	high	medium	medium
Biodiversity / eco-systems	medium	medium	medium	low	low

Source: Municipality of Tirana, 2015

Vulnerability of other cities and towns can only be estimated. A government assessment estimated that, by 2030, more than 41,000 dwellings situated at a maximum of 0.5 metres above sea level will be at high risk of flooding caused by storm surges. Additionally, many economic and social-cultural facilities, such as factories, ports, schools and medical centres that were constructed since the 1950s, are at risk from flooding due to damaged protection structures (Ministry of Environment, 2016).

3.14 Health

The main health risks exacerbated by climate change relate to extreme weather events, communicable diseases and air quality (USAID, 2016). Albania will face an increase in the number of annual heat-related deaths among the population aged 65 and over due to warming trends and population growth. Vector-borne, water-borne and food-borne diseases are expected to spread more widely due to changing temperatures and more frequent flooding (Ministry of Environment, 2016). Especially marginalized communities will be increasingly exposed to various epidemics, such as the increase of Leptospirosis, a dangerous infection, that spread widely in the Shkodër district in the aftermath of the 2010 floods (Ministry of Environment, 2016). Higher temperatures coupled with longer dry periods may exacerbate the problem of urban air pollution caused by dust from gravel roads, aging vehicles and congestion (USAID, 2016). As a result, respiratory diseases are expected to increase, as well as preventable early deaths from cardiovascular diseases (Ministry of Environment, 2016). In remote areas, the population's health will also be affected by heat waves as well as drought, forest degradation and wildfires – all of which are also expected to increase due to climate change (World Bank, 2019).

3.15 Transportation

The Albanian transportation and trade networks are sensitive to river and coastal flooding, as well as landslides. A WB study (2019) found that fluvial flooding would account for 84% of annual expected damage to the primary road network in Albania. For example, flood-related losses along the Tiranë-Durrës and Durrës-Vlorë roads, the two most critical road corridors in the country, would amount to around EUR 13 million (about US$ 18.8 million (2017 values)) per year. The damage that could occur at bridges and culverts alone is estimated to reach up to almost EUR 19 million (about US$ 27.5 million (2017 values)) per year, as these are the most exposed and vulnerable elements of the road infrastructure. While coastal flooding does not pose a major risk to the primary road network, it may have a significant effect on secondary and local roads. The overall economic impact of landslides is noticeably lower. However, as they are a major danger on some mountainous roads that generally experience low traffic volume but, in turn, show little redundancy, the social impacts for e.g. villages becoming isolated should not be neglected (Xiong & Espinet Alegre, Climate Resilient Road Assets in Albania, 2019).

In summary, a need exists to make bridges and culverts more resilient to floods and heavy precipitation, which is in all cases an economically viable investment. Mitigation measures for landslides will only yield positive investment returns for highly trafficked and critical corridors (Xiong & Espinet Alegre, 2019).

3.16 Climate Risk Insurance and Finance

The insurance industry in Albania is relatively new and, prior to 1991, non-existent. Today, it is professionally regulated with a comprehensive insurance law in place. Insurance penetration (defined as premiums as a percentage of GDP) has grown from 0.65% to 1.04% in 2017, and twice as fast between 2008 and 2016; there are favourable macroeconomic factors to suggest further insurance demand growth. The insurance sector in Albania as a whole remains underdeveloped and small, with only US$ 135 million written premiums in 2017, in comparison to peer countries in the region such as Croatia (US$ 1,368 million), Serbia (US$ 864 million) and Bosnia and Herzegovina (US$ 394 million) (WBG, 2019).

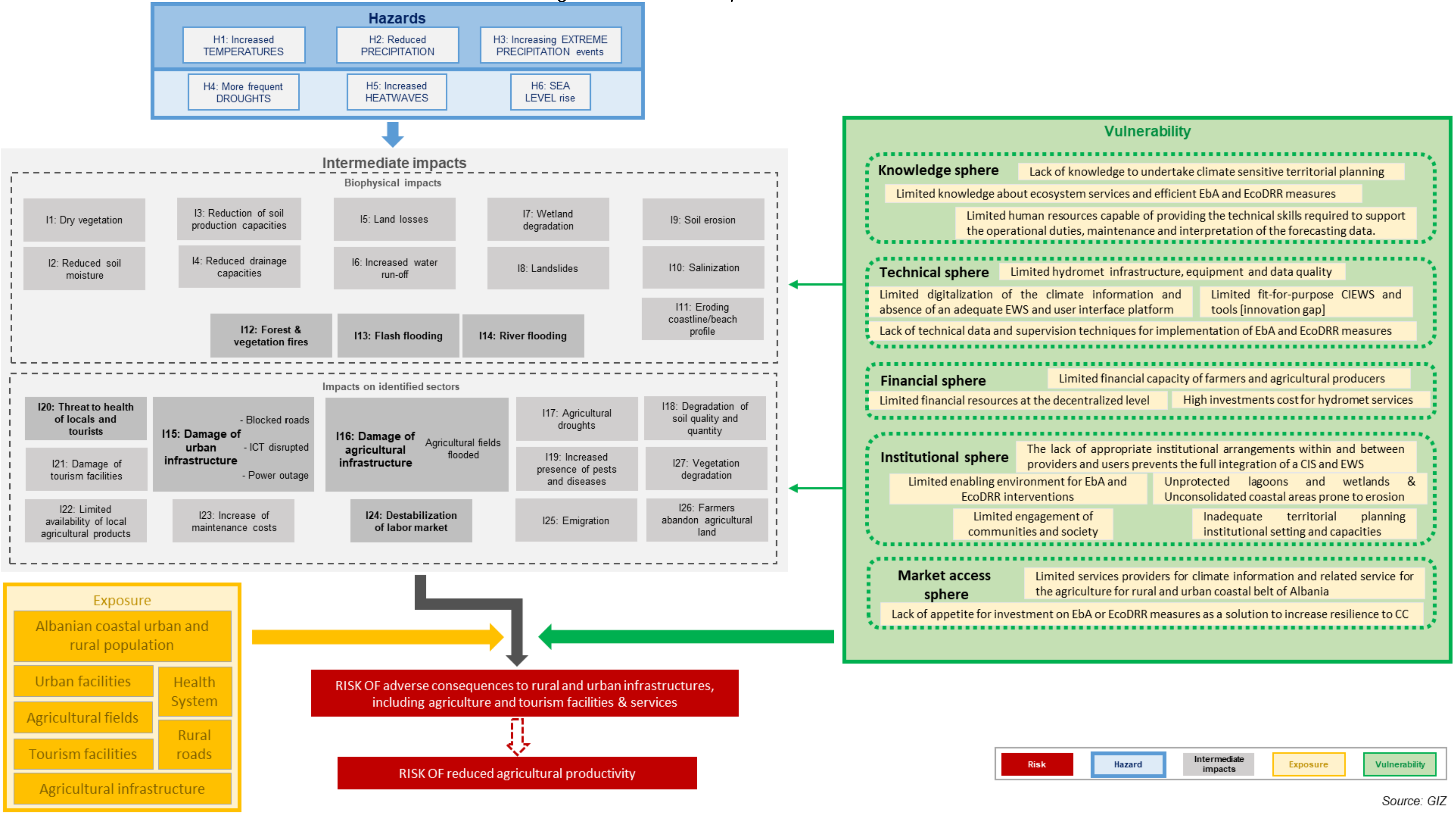
The insurance industry is almost non-existent in the agricultural sector. This also reflects the absence of public-private insurance schemes. The main reasons for this low penetration are the lack of information available to farmers, the perception of agriculture being too risky a sector, as well as the absence of an adequate legal framework (FAO, 2018a). Currently, there is no insurance to either address the risks of this economic activity or the other risks covering people engaged in this sector, despite its growing importance. The lack of demand can be partly explained by the absence of insurance in the communist era and the post-communist insurance monopoly. It could also indicate a rational choice if available insurance schemes provide poor value for money. On product development as well as claims assessment and fraud policing, the lack of digital infrastructure and reliable statistics is a major constraint in building a relationship between consumers and insurers (WBG, 2019).

An Adaptation Fund (AF) project proposal from 2016, to be implemented by the Western Balkans, aims to improve risk management through the development of flood-risk maps and insurance schemes (Adaptation Fund Board, 2016).

4. Climate Impact Chains

Climate impact chains, as a conceptual model for analysing climate risks, presents the cause-effect relationship of the processes, in the coastal zone, leading to two climate risks on two relevant sectors – Agriculture and Tourism (See Figure 34). As shown in the figure below, the processes are assigned to the risk components hazard (in blue), vulnerability (in green) and exposure (in yellow), while cascading effects are considered as intermediate impacts of hazards (in grey boxes); impacts that affect Albania's economy and infrastructure. In combination with different aspects of Albania's vulnerability as well as the exposed assets, it can be concluded that Albania's rural and urban infrastructure, but also agricultural productivity is at risk due to climatic change.

Figure 34: Climate Impact Chains visualization of Albania



Source: GIZ

Table 8: Climate Impact Chains detailed interlinkages between Hazards and Impacts

Hazard/Impact	Further references
H1: Increased temperatures	For all of Albania, an increase in temperature is expected for the projections with four RCP scenarios in time horizons up to 2050 and 2100 respectively (MoTe 2022, p. 114). Prominently, the RCP 8.5 scenario, projects a temperature increase of 4.7°C until 2100 (MoTe 2022, p.114). This hazard is projected to be more prominent in the coastal zone than in the rest of the country.This geographical distribution of temperature increase is also reported by ThinkHazard! (see Think Hazard (2023)) which assesses a medium risk of a extreme heat hazard in the western part of the country. In the coastal belt of Albania, the maximum temperatures in summer, are projected to increase by 1.5 to 6.4°C, by 2050 and 2100 respectively; winter minimum temperatures are projected to rise by 0.9 to 3.8°C by 2050 and 2100, respectively. Through this increase of temperature, the frequency of droughts will also increase (World Bank Group 2021, p. 10), which is described in more detail in H4. Further, projections of the temperature increase indicate a faster increase of high-percentile temperatures (90%) than mean temperatures, especially in summer (MoTe 2022, p. 115). Additionally, minimum temperatures will also increase, consequently concluding that, heat waves' intensity will increase in the future (MoTe 2022, p. 115), as described in H5. Lastly, increasing temperatures will also impact sea level rise (see PIK (2023)), which can be found in H6.
H2: Reduced precipitation	For the time period between the project implementation, leading to the 2039 and 2099 timeframe projections, Albania expects a further reduction in seasonal and annual precipitation. This hazard is projected to be more prominent in the coastal zone than in the rest of the country. Particularly in summer, up to 40% of precipitation reduction is expected by the end of the century, contributing to the increasing drought events' frequency (see PIK (2023)). This increase in frequency is also represented in quantification of dry spell days between 2020 and 2039, where the RCP4.5 and 8.5 scenarios expected an increase of respectively 13 and 26 days. Thereby, as described further in H4 (below), soil moisture and consequently agricultural productivity, will be negatively impacted (see PIK (2023)). Albania does not only expect a reduction in precipitation, but a change in rainfall intensity (World Bank Group 2021, p.8), which is further described in H3.
H3: Increasing extreme precipitation events	In all of Albania, specifically in the coastal zone, an increase in hazardous rainfall and extreme precipitation is expected. Through extreme rainfalls, land losses (I5) and wetland degradation (I7) may increase (World Bank Group 2021, p.13). Also, increased water run-off (see I6) but also soil erosion (I9) may become more frequent (World Bank Group 2021, p.13). Most importantly, extreme precipitation events may lead to flooding (I13, I14) (MoTe 2022, p.119).
H4: More frequent droughts	Based on increased temperatures (H1) and reduced precipitation (H2), Albania will experience more frequent droughts. Currently, Albania already has the highest level of total drought severity per decade in Europe. Furthermore, the projections suggest that the probability of droughts is expected to increase by 20%. Droughts will extensively impact water resource availability, by which especially soil moisture (see I2) will decrease, leading to dry vegetation (I1), but also a change in soil production capacities (I3), also represented in agricultural droughts (I17) (see PIK (2023)). Through these impacts, Albania may also experience further land loss (I5).

Hazard/Impact	Further references
H5: Increased heatwaves	Heatwaves in Albania may increase in intensity, duration and frequency, possibly by as much as six-to-eight times per year (World Bank Group 2021, p.7). Within the Western Balkans, especially Albania and the Republic of North Macedonia are considered as regions which are the most impacted by heatwaves. Apart from consequences similar to the ones described in H4, such as dry vegetation and reduced soil production, heatwaves may immensely impact the health of locals and tourists, as described in I20. Through the projected increase of the duration of heatwaves in Albania (between 17.5 and 38.5 days per year by 2050), a consequent increase in heat-related cardiovascular and respiratory deaths is expected, especially in summer.
H6: Sea level rise	Although sea level rise has an impact on many countries, for Albania specifically, a sea level rise of around 40cm is expected until 2100, which is likely to be compounded by local uplift or subsidence, as the area on the Adriatic coast is tectonically very active. Sea level rise may lead to damage of tourism facilities and agriculture land in the coastal belt, which makes up only a tenth of Albania's land area but is inhabited by a third of Albania's population with an increasing tendency (World Bank Group 2021, p. 26f). Further, salinization of groundwater may also increase (I10) (MoTe 2022, p.138). Generally, sea-level rise leads to an increase of land (I5) and wetland loss (I7) but also rural and urban damages (I15) (see PIK (2023)). Through the former and latter, agricultural production could be influenced, leading to food scarcity (see PIK (2023)). Lastly, sea level rise may also increase flooding probability, as described in I14.
I1: Dry vegetation	Similar to the effects described in I2, based on the two hazards - temperature increases and decreasing precipitation Albania expects a decrease in vegetation moisture (World Bank Group 2021, p.19). Thereby, soil production capacities decrease (I3) (see PIK (2023)). Consequently, the frequency of forest fires, as described in I12, may increase (see PIK (2023)).
I2: Reduced soil moisture	As described above, based on the two hazards of temperature increase and decreasing precipitation, Albania expects an increase in soil moisture deficits (World Bank Group 2021, p.19). Based on this change in soil moisture, agricultural productivity would decrease due to reduced capacities of the soil (see PIK (2023)) (I3). One specific aspect of reduced agricultural productivity is reduced drainage capacity of the soil (see PIK (2023)) (I4). As seen in the impact chains provided by PIK (2023), such change in soil moisture also increases the frequency of forest fires, as described in I12.
I3: Reduction of soil production capacities	Based on the expected increase in temperatures and simultaneous increase in the frequency and intensity of extreme droughts and floods in Albania, soil productivity will deteriorate (World Bank Group 2021, p.10). This could lead to a reduction of production capacities that may reduce crop yields (Alfthan et al. 2015, p.70). Thereby, it would have an impact on domestic consumption but also export cash crops (World Bank Group 2021, p.10).
I4: Reduced drainage capacities	As moisture within the soil is expected to decrease, drainage capacities will decrease simultaneously. This will further worsen water run-off, thereby increasing the risk of floodings in Albania (I6, I13). Generally, this will also impact the production capacities of Albania's soil (I3).

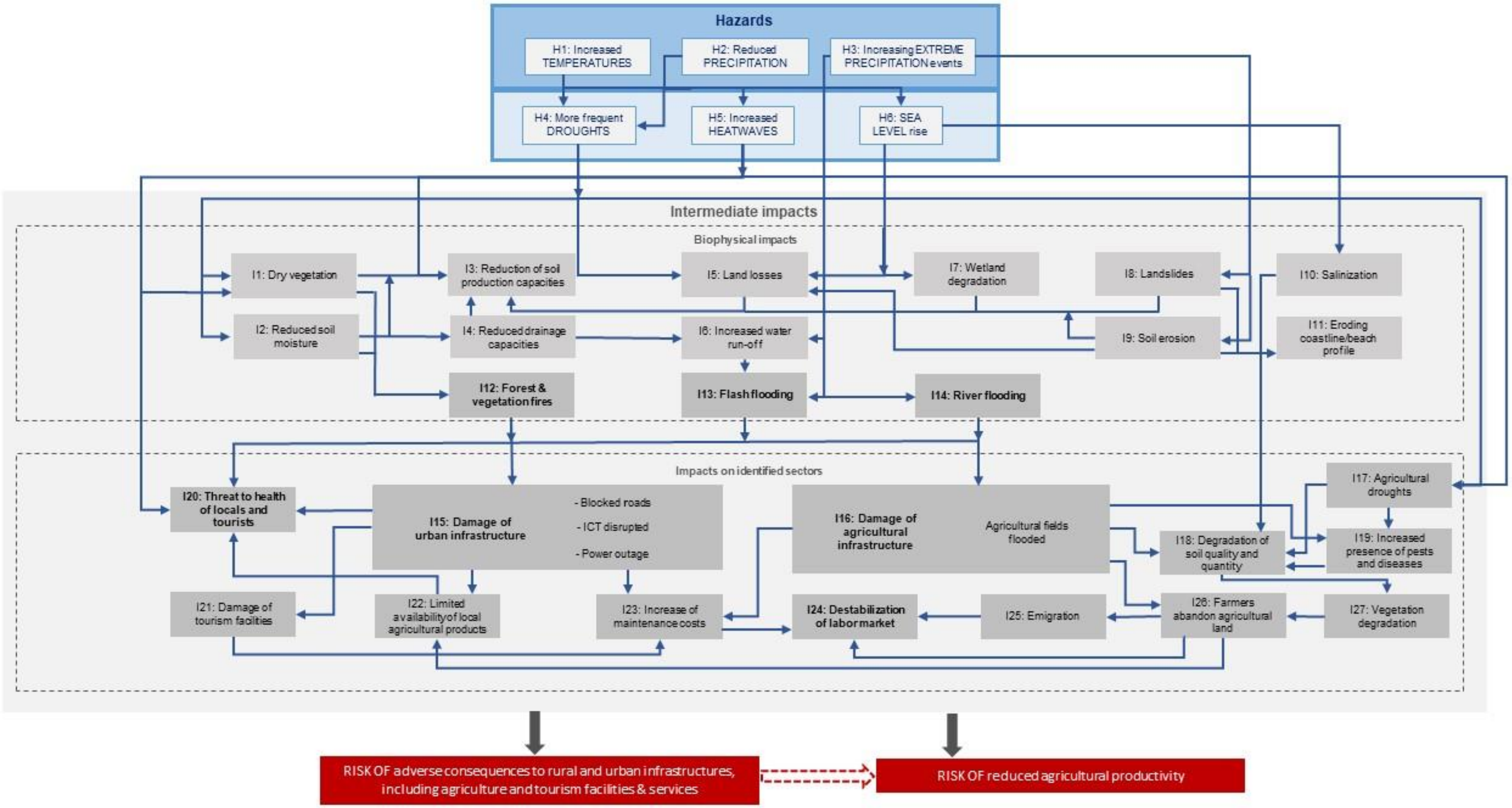
Hazard/Impact	Further references
I5: Land losses	The expected land loss based on various described hazards, most importantly sea level rise, will prohibit the utilization of large areas within the coastal belt of Albania (MoTe 2022, p.140; PIK (2023)). Thereby, reduced soil moisture will result in lower production and productivity (see I3), which may further impact agricultural yield (see PIK (2023)).
I6: Increased water run-off	Based on the influences by the described hazards, increased drought risk in combination with intense rainfalls, water run-off in Albania may increase (Alfthan et al. 2015, p.21). As water run-off patterns may change, with a potential decrease in spring and increase in winter (World Bank Group 2021, p.19). This will further impact agriculture and water management, but also, may add to the risk of flash floods (World Bank Group 2021, p.19), as described in I13.
I7: Wetland degradation	Albania is known for its rich and complex hydrographic network – especially wetland ecosystems play the role as important migration routes for migratory species of the wild fauna (MoTe 2022, p.2). Due to the environmental changes such as sea level rise and the increased temperature of the aquatic environment, wetlands – which are of national importance in Albania – may experience losses (MoTe 2022, p.140). Thereby, especially in the coastal zone, relevant marine and coastal ecosystem services may be lost (MoTe 2022, p.140).
I8: Landslides	Typically, Albania is categorized as a disaster-prone country, being exposed to geological hazards such as landslides, but also hydro-meteorological ones (MoTe 2022, p.143). Such hazardous exposures are expected to increase through climate change, as it directly affects the rainfall intensity and other climatic events (World Bank Group 2021, p.13). Apart from the changes in precipitation levels, climate-inducedsea level rise may further increase the risk of landslides (MoTe 2022, p.153). More specifically, the coastal zones of Albania will have a higher risk of landslides, with exception of the Lushnje region (see ThinkHazard! (2023)). This may reduce the capacity of Albania's soil but may also destroy the natural environment in the coastal area (I11) (MoTe 2022, p.153).
I9: Soil erosion	Albania is exposed to geological hazards such as soil erosion, but also hydro-meteorological hazards (MoTe 2022, p.143). As intense rainfall frequency will increase, due to climate change, the risk of further soil erosion in Albania, may also increase (World Bank Group, p.13). Apart from changes in precipitation, climate-inducedsea level rise may further increase the risk of soil erosion (MoTe 2022, p.153). In total, around 25% of Albania is affected by soil erosion (Alfthan et al. 2015, p.21). Soil erosion may reduce the capacities of Albania's agricultural land but may also destroy the natural environment in coastal zones (I11) (MoTe 2022, p.153).
I10: Salinization	Through the expected sea level rise, Albania will experience an increased salinization of groundwater, which will directly impact ecosystems and biodiversity (MoTe 2022, p.140). Another aspect of salinization is the implication it has on the increased sea surface temperature, which may increase the salinity of coastal freshwater aquifers (World Bank Group 2021, p.26). This may negatively impact freshwater resources and water quality (World Bank Group 2021, p.26). Both aspects of salinization worsen the quality and productivity of Albania's soil (I18).

Hazard/Impact	Further references
I11: Eroding coastline/beach profile	Based on the impacts in I8 and I9, it can be concluded that Albania's coastline is vulnerable to climate change impacts. The eroding coastline and beach profile is further intensified by sea level rise (MoTe 2022, p.158). Not only the natural environment, but also the settlements and infrastructure of these areas are in danger (MoTe 2022, p.128).
I12: Forest & vegetation fires	Due to the combination of increased temperatures and reduced precipitation, the frequency of forest fire in Albania is expected to increase (see PIK (2023)). Albania is categorized as a high risk of wildfires country, (see ThinkHazard! (2023)), which is also worsened by the country's high forest coverage percentage (World Bank Group 2021, p.14). Similar to the implications of floods and flash floods, such extreme events will increase the risk for injuries and preventable deaths among the most vulnerable population groups (I20) (MoTe 2022, p.152). Further, forest & vegetation fires will affect infrastructure (I15, I16).
I13: Flash flooding	The expected changes in precipitation patterns and intensity, may lead to more frequent flash flooding, damaging rural and urban infrastructure, for example in key agricultural zones (World Bank Group 2021, p.15f) (I15, I16). More importantly, Albania's population will be more frequently endangered by extreme weather events (I20). During two major flash floods since 1900, in total 56,002 Albanian inhabitants were affected with total damage amounting to nearly 16 million US$ (World Bank Group 2021, p.13).
I14: River flooding	The Albanian infrastructure is expected, by the end of the century, to be further impacted by riverine flooding stemming from precipitation changes and sea level rise of around 48 to 60 cm (World Bank Group 2021, p.11). Due to Albania's hydrographic profile, river floods are highly dangerous and detrimental to the country's economic and social circumstances (World Bank Group 2021, p.12). According to ThinkHazard! (see ThinkHazard (2023)) the coastal area portrays a high risk of encountering riverine floods. Since 1900, eight riverine floods led to 134,484 affected Albanian inhabitants and total damage of around 17 million US$ (World Bank Group 2021, p.13).
I15: Damage of urban infrastructure	All of the mentioned natural hazards and their increasing presence are a threat to Albania's urban infrastructure (World Bank Group 2021, p.15). Damage based on sea level rise and flooding will affect not only roads, but also water management, energy generation and transmission infrastructure (World Bank Group 2021, p.27). Especially in the coastal belt, unregulated urban development up to the shoreline, increases the risk of damages to such infrastructure and to the population (World Bank Group 2021, p.26). This will not only limit the accessibility of large shares of population (I22), but also lead to damage of various facilities (I21).
I16: Damage of agricultural infrastructure	Due to extreme weather events, essential infrastructure for crop and livestock production will be endangered, namely irrigation systems, livestock shelters, and storage facilities (World Bank Group 2021, p.12). Within the coastal zone, around one quarter is categorized as agricultural land. Thereby, damages to agricultural infrastructure will have far-reaching consequences into the ecosystems and biodiversity, but also food production (World Bank Group 2021, p.16). Although for some crops, the changes in climate may be positive, the majority of agricultural crops will require additional irrigation (World Bank Group 2021, p.17). Furthermore, increased temperatures and intense waterfall or flooding, increase the presence of pests and diseases (I19) (World Bank Group 2021, p. 17). The aforementioned aspects would make agriculture more cost intensive (I23) while also reducing the soil quality (I18) and productivity.

Hazard/Impact	Further references
I17: Agricultural droughts	The increased temperatures and therefore, higher probability of droughts, will increase competition for water resources, especially in agriculture (World Bank Group 2021, p.22). Thereby, soil quality, consequently the agricultural productivity of Albania, will be endangered (see PIK 2023). As seen in I19, the constantly increasing temperature in Albania will also have a negative impact on the vegetation conditions due to pests and diseases.
I18: Degradation of soil quality and quantity	Albania's agriculture and its productivity is particularly vulnerable to climate change impacts, as it is not only endangered through extreme weather events and their damage to infrastructure, but also through increased temperatures and heightened precipitation variability (World Bank Group 2021, p.16). Climate change will reshape not only aspects such as soil moisture, but also crop growth cycle, which may further degrade Albania's vegetation (I27) (World Bank Group 2021, p.17).
I19: Increased presence of pests and diseases	Albania's yield production and quality are affected by the increasing temperatures and by the threat fields' waterlogging due to intense rainfall and flooding (World Bank Group 2021, p. 17). Hence, pests and diseases will be more prominent, contributing to Albania's soil degradation (I18) (World Bank Group 2021, p.17).
I20: Threat to health of locals and tourists	The increasing frequency of heatwaves, is expected to result in increased mortality in Albania, resulting from heat strokes and other cardiovascular diseases (Alfthan et al. 2015, p.42). Furthermore, due to longer-lasting, more frequent, and more intensive heatwaves, air pollutants may increase in concentration and dispersion, affecting the health of locals and tourists (World Bank Group 2021, p.24). Additionally, floods also are seen as a threat to the health and wellbeing of locals and tourists – not only due to their direct impact, but also through damaged infrastructure, which may implicitly limit the access to safe and clean drinking water, especially in rural areas (World Bank Group 2021, p.24). Similar to the direct implications of flooding, wildfires may also lead to deaths and injury (Alfthan et al. 2015, p.72).
I21: Damage of tourism facilities	Apart from the general vulnerabilities of urban development in in the coastal area, as described in I15, especially tourism facilities are in danger as these have been built without consideration of the risk of extreme weather events (World Bank Group p. 27). This could impact tourism numbers and lead to increased costs for the tourism sector (I23).
I22: Limited availability of local agricultural products	The food security of Albania's inhabitants and visiting tourists and especially the availability of local products is worsened by climate change impacts, such as a general lower agricultural productivity but also, a simultaneously increased risk of floods and fires and thereby damaged infrastructure (World Bank Group 2021, p.15f).

Hazard/Impact	Further references
I23: Increase of maintenance costs	Damaged urban and rural infrastructure may increase costs for Albanian locals, especially if infrastructure is rebuilt in a more resilient way. Thereby, the labor market may be also impacted by climate change (I24).
I24: Destabilization of labor market	Both targeted sectors – agriculture and tourism – play an important role in Albania's economy. Agriculture is the main source of employment for Albania's rural population (World Bank Group 2021, p. 16). The sector provides the income basis for most of the population and serves as an employment safety net (MoTe 2022, p.45). Tourism also plays an important role in Albania's economy, as it is one of the main engines of the country's economic development (MoTe 2022, p.16). Climate change implications, including increasing financial cost and lowered productivity, may lead to a destabilization of the labor market in both sectors, deeply impacting Albania's economic development.
I25: Emigration	Due to the economic losses in the agricultural sector (Alfthan et al. 2015, p.41), farmers may have incentives to emigrate from Albania. The historic emigration in the last decades has already led to a structural shift away from agriculture (MoTe 2022, p.13). As it is still an important sector in Albania (MoTe 2022, p.13), changes in agricultural productivity may destabilize the labor market (I24).
I26: Farmers abandon agricultural land	As the productivity of agricultural land may further decrease in the future, farmers may be incentivized to abandon their agricultural land. This is further impacted by the destruction of agricultural infrastructure through flooding. Thereby, local product availability will decrease (I22), but also, the agricultural labor market may be affected (I24, I25).
I27: Vegetation degradation	The ever-changing climate conditions, especially the continuous variability in temperature and precipitation levels, will pose a threat to Albania's agricultural production and vegetation (World Bank Group 2021, p.16). Thereby, economic losses, due to lower productivity, could be expected (Alfthan et al. 2015, p.41). Based on the lower productivity, the increasing damages of infrastructure (I16), or the land being either unusable or not economically feasible, it can be expected that farmers will leave the agricultural land (I26).

Figure 35: Detailed assessment of influences within Climate Impact Chains

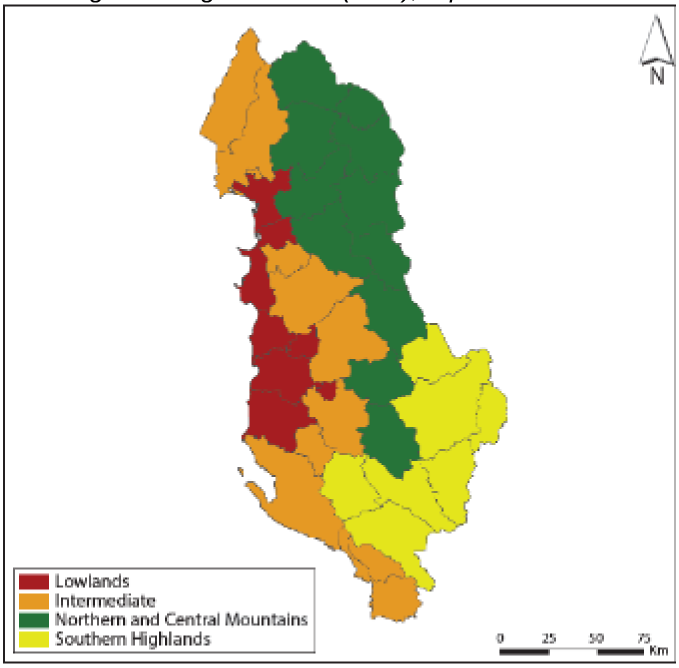


Source: Own elaboration

5. Conclusions from the Climate Risk Assessment

In line with Albania's "Self-Assessment on Climate Change Activities", the coastal area and the ensuing lowlands coast are identified as priority area for adaptation action. This corresponds to the red and orange areas (the latter only on the coastal fringe) in Figure 36.

Figure 36: Albanian agro-ecological zones (AEZ), reprinted from Industrial Economics



Source: World Bank, 2013

In the low-lying coastal area, all three factors – hazard, exposure and vulnerability – combine to form a significant risk from climate change. In terms of hazard, increases in the duration and frequency of heatwaves and a simultaneous decrease of annual precipitation by up to 150 mm/year are projected. These trends will enhance the drought risk (both frequency and intensity). Additionally, sea level rise is increasing the likelihood of coastal flooding in the area.

While temperature increases and precipitation reductions are projected to be larger in coastal areas than in the rest of the country, the area also stands out due to its socio-economic importance and the corresponding exposure of economic enterprises and a notable population share. More than one third of the Albanian population live in cities in the low-lying coastal zone and the region attracts around 80% of tourism. Together with the larger area around Tiranë and the main port of Durrës, it is also the economic heart of the country. Moreover, two thirds of cultivated land and agricultural production are concentrated in this area.

The growth in population, tourism, economic significance and agricultural production this area has seen over the last decades has come at the expense of resilience. Thus, infrastructure development in flood-prone areas, such as the coast and wetlands that were drained in the 1950s and 60s, much of it informal and for tourism purposes, has reduced the resilience to flooding. Furthermore, the coastal squeeze, in which the natural systems within the coastal zone are being compromised by anthropogenic alterations and sea level rise, increases the risk of flooding and places existing infrastructure, agriculture and tourism activities that are located closest to the beaches at risk (Ministry of Environment, 2016). On the other hand, the poor state of the irrigation system is causing great vulnerability among farmers regarding droughts, heat waves, soil drainage and water quality issues. Inappropriate land use and land management practices have also heightened the vulnerability to landslides in the area.

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