

Revision of the Nationally Determined Contribution
of the Republic of Serbia under the Paris Agreement

Climate Change Adaptation

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ABBREVIATION LIST

NDC	National Determined Contribution
INDC	Intended National Determined Contribution
UNFCCC	United Nation Framework Convention on Climate Change
GHG	Greenhouse gasses
GDP	Gross Domestic Product
USD	United States Dollar
EUR	Euro
UNDP	United Nations Development Program
GEF	Global Environment Facility
MRV	Monitoring, Reporting and Verification
EU	European Union
IPA	Instrument for Pre-Accession Assistance
IPCC	Intergovernmental Panel on Climate Change
GCF	Green Climate Fund
RCP	Relative Concentration Pathways
UNCCD	United Nations Convention to Combat Desertification
LDN	Land Degradation Neutrality

1. INTRODUCTION

The Republic of Serbia on 30th of June 2015 submitted its Intended National Determined Contribution (INDC) to the United Nation Framework Convention on Climate Change (UNFCCC). By this document Serbia committed itself to reduce, by 2030, its greenhouse gasses emissions (GHG) by 9.8% compared to 1990 as the baseline year. In addition, the INDC document includes, although as not mandatory, the basic information on observed and projected climate change in Serbia, it defines the most vulnerable sectors of the economy and the environment and presents assessment of material losses that the country suffered in the period 2000-2014 due to extreme weather events.

In accordance with the UNFCCC guidance for updating the NDCs, this report will present the proposed adaptation measures for the most vulnerable sectors of the Republic of Serbia, the national strategic goals, legal framework related to climate change and adaptation, as well as overview of national documents relevant to reducing risks and consequences of extreme weather events and slow-onset events caused by climate change.

2. NATIONAL CIRCUMSTANCES

The Republic of Serbia is located in the Balkan Peninsula. The larger part of its territory belongs to Southeastern Europe, while smaller, northern part belongs to Central Europe. Its total area is 88,449 km². The relief of the country consists of three parts: Pannonian valley flatlands at the north, the hilly areas in the middle part that transform to mountains towards the south. Rivers of Serbia belong to basins of the Black Sea, the Adriatic Sea and the Aegean Sea.

The Serbian climate is predominately under the influence of its relief and the vicinity of the Mediterranean Sea. The largest part of the country has moderately continental climate, with four distinct seasons. The mountains above 1,000 m above the sea level are characterized by mountainous climate, with shorter summers and more snowfall relative to the lower regions. July is the hottest month and January is the coldest. Autumn is warmer than spring due to the proximity of the Adriatic Sea. The precipitation regime is continental, with most precipitation occurring in June and with February being the driest month. The average annual precipitation in the lower

parts of the country ranges between 500 and 700 mm, and it exceeds 700 mm at the mountains higher than 1,000 m above the sea level.¹

According to the Statistical Office of the Republic of Serbia, the population of Serbia is 6,963,764². Since 1998 the population of Serbia declines. The average annual population growth rate in the period 2011-2018 was -4.5 per 1,000 inhabitants. The average age of the population for the year 2018 was 43 years, with 14.3% of citizens younger than the age of 15 and 20.2% older than the age of 65. During the period 2011-2018 the share of citizens younger than the age of 15 dropped by 0.1%, while at the same time the share of older than the age of 65 increased for 2.9%.

The gross domestic product (GDP) in 2018 was 50,540 billion USD, or 7,239 USD per capita, which represent an increase of 4.4% relative to the previous year. The industry sector (mining, manufacturing, and electricity and gas supply) is the largest contributor to the country's GDP, with 19.9%. Agriculture, forestry and fishery sector makes 6.3% of GDP, with a real growth rate of 15.2% in 2018.

Agricultural land covers 3,486,908 ha, or 39.4% of the total area of the Republic of Serbia. It is mostly arable land and gardens (74.5%), permanent grasslands (19.5%), orchards (5.3%) and vineyards (0.6%). The total number of agricultural households is 564,541 and they mostly (39%) own vineyards up to 2 ha of land. Organic food production is represented on 14,358 ha of land.

The total area under forests is 2,237,511 ha, or 25.3% of the total area of the Republic of Serbia. State-owned forests make 43%, while 57% are privately owned. The total area of protected natural assets is 668,795 ha, or 7.5% of the total area of the country. There are 459 areas, 5 habitats and 2633 species that are protected by the law.

3. STRATEGIC AND LEGISLATIVE FRAMEWORK

The Ministry of Environmental Protection is in charge of coordinating climate change policy in the Republic of Serbia. Department for Climate Change has been established within this ministry, and it consists of the Mitigation Group and the Adaptation Group.

The Republic of Serbia, as a developing non-Annex I country, has signed the United Nations Framework Convention on Climate Change on 10 June 2001, the Kyoto Protocol (ratified on 17 January 2008) and the Paris Agreement (ratified on 25 July 2017). In line with its commitments, the Republic of Serbia has so far submitted two

¹ http://www.hidmet.gov.rs/podaci/meteorologija/ciril/Klima_Srbije.pdf

² <https://www.stat.gov.rs> - data for 1.1.2019, without Kosovo i Metohija

National Communications under the UNFCCC (in 2010 and 2017), as well as the First Biennial Update Report (2016). The Second Biennial Update Report and the Third National Communication are currently being prepared. The development of these documents is continuously supported by the Global Environment Facility (GEF) and with the technical assistance of United Nations Development Programme (UNDP).

The National Council for Climate Change was established in 2014, as an advisory body of the Government of the Republic of Serbia. Its members are representatives of relevant ministries and other bodies and organizations, representatives of the scientific and research institutions, as well as representatives of civil society. The role of the National Council is to provide expert opinions and recommendations on drafts of relevant strategies, laws and other planning documents related to climate change, to monitor their implementation and to propose measures for their improvement.

The establishment of the national strategic and legislative framework in the field of climate change in the Republic of Serbia is underway. The draft Law on Climate Change³ has been developed and is expected to be adopted during 2020. The Law provides legal framework for the GHG emissions reduction and climate change adaptation by promoting the alignment, adoption and implementation of sectorial policies. This Law foresees the development of the Low-Carbon Development Strategy and the Climate Change Adaptation Programme, as well as the establishment of a GHG emissions monitoring, reporting and verification (MRV) system. Although the significance of climate change and adaptation has been recognized in a number of national strategies, the adoption of the Law on Climate Change will contribute to harmonizing the Serbian legislation with that of the European Union (EU) putting in place a policy framework and setting national priorities in the field of climate change, including the adaptation to changing climate conditions.

The draft Low-Carbon Development Strategy with the action plan⁴, as foreseen by the draft Law on Climate Change, is already developed and its adoption is expected during 2020. The draft Strategy was developed with the financial and technical support of the EU Instrument for Pre-Accession Assistance (IPA) funds, as well as with the active engagement of stakeholders from the public and private sector, research community and civil society organization. The draft Strategy focused on the development of climate-resilient society in Serbia and it sets the roadmap for reaching the climate neutrality by 2030, with perspectives until 2050.

³ <https://www.ekologija.gov.rs/dokumenti/>

⁴ https://www.ekologija.gov.rs/wp-content/uploads/javne_rasprave/Strategija%20niskougljeni%C4%8Dnog%20razvoja%20sa%20akcionim%20planom_za%20javnu%20raspravu.pdf

As the draft Strategy aims to create climate-resilient society in Serbia, some of its specific objectives are related to climate change adaptation, particularly in the sectors of agriculture, forestry and water management, which are highly vulnerable to climate change while, at the same time, represent sources and/or sinks of the GHGs. Raising the adaptive capacity in these sectors is, among others, key to achieving the set GHG emission reduction targets. Thus, the specific objectives of the draft Strategy define climate change adaptation related measures in agriculture (specific objective 2: reducing GHG emissions in agriculture by 15% by 2030 and maintaining the levels of emissions from 2 to -24% by 2050 compared to 2010), forestry (specific objective 3: increasing carbon sinks in forests by 17% by 2030 and maintaining them between 22 and 132% by 2050 compared to 2010) and water management (specific objective 4: preserving the mitigation potentials of priority sectors by increasing their climate resilience). In addition to the proposed adaptation measures, specific objective 5 focuses on promoting transition to climate change neutral economy and society resilient to climate change through education, capacity building and awareness raising.

The draft Strategy has developed the Adaptation Planning Framework⁵, which provides a methodology for assessment and planning of adaptation measures for future policies and projects in sectors with the highest priorities in adaptation. The proposed framework is based on climate risk assessments and extreme weather events risk assessments, identifying adaptation measures and prioritizing them, while at the same time following the approach and guidance of the Intergovernmental Panel on Climate Change (IPCC). The framework provides a methodology for monitoring and evaluation of measures within the climate change adaptation plans.

The Climate Change Adaptation Programme, which is to be developed in accordance with the draft Law on Climate Change, is aimed at assessing the impacts of climate change on the society and sectors of the economy, identifying the most vulnerable sectors, propose adaptation measures, and assess their costs and benefits. The overall goal of the Programme is to develop a list of priority adaptation measures and to identify the implementation needs, as well as institutions responsible for the implementation. Once the Programme is developed and adopted, planning and policy-making in vulnerable sectors will be aligned with the climate change adaptation policy.

The Climate Change Adaptation Programme will be developed through the project “Advancing medium and long-term climate change adaptation planning in the Republic of Serbia” that has been initiated in the end of 2019 with the support of the

⁵ <http://www.serbiacclimatestrategy.eu/adaptation-planning-framework/>

Green Climate Fund (GCF) and implemented with the assistance of UNDP. The objectives of this project are to strengthen the adaptive capacity to changing climatic conditions, to assess climate risks and vulnerabilities, and to develop methods, tools and information systems to support decision-making and planning of adaptation measures in different sectors (agriculture, water management, forestry, energy, transport and infrastructure). The previously drafted National Plan for Adaptation to Climate Change⁶ (2015), which was not formally adopted, identified agriculture, forestry, water management and biodiversity as the sectors most vulnerable to climate change. The new Climate Change Adaptation Programme, in addition to these four priority sectors, will propose adaptation plans for the infrastructure, construction, transport and energy sectors, in which the impact of climate change and the possibilities of adaptation have not been systematically assessed in Serbia so far. The project is planned to be completed in 2022, with the possibility of financing the second phase.

In addition to the drafts of Law on Climate Change and Low-Carbon Development Strategy, climate change was recognized as an issue in a number of other sectorial strategic documents, which set the direction of action of the Republic of Serbia in combating climate change.

The National Sustainable Development Strategy⁷, the National Environmental Protection Programme⁸ and the National Strategy for Sustainable Use of Natural Resources and Good⁹ recognize the significance of climate change adaptation for the preservation and sustainable use of natural resources, primarily in forestry, maintaining the quality of land, water, and air, as well as preserving biodiversity.

The Biodiversity Strategy for the period 2011-2018 with the Action Plan¹⁰ identified adaptation to climate change as one of its objectives and defined priority measures for increasing institutional capacities, awareness raising, and development of national strategy in order to achieve better understanding, planning and minimizing the risks of climate change impacts. However, the draft Nature Protection Programme of the Republic of Serbia for the period 2020-2022¹¹ concluded that this objective was not sufficiently fulfilled.

⁶ <http://www.klimatskepromene.rs/wp-content/uploads/2017/09/NAP-UNDP-2015-srpski.pdf>

⁷ Official Gazette RS, No. 57/2008

⁸ Official Gazette RS, No. 12/2010

⁹ Official Gazette RS, No. 33/2012

¹⁰ Official Gazette RS, No. 13/2011

¹¹ <https://www.ekologija.gov.rs/wp-content/uploads/razno/PredlogProgramaZastitePrirodeRS2020-2022.pdf>

The Strategy of Agriculture and Rural Development for the period 2014-2024¹² identified climate change adaptation and mitigation as one of the priority areas of strategic planning. Although explicit adaptation measures are not recommended by this strategy, there is a number of defined measures for sustainable management of natural resources, the improvement of technologies, techniques and resources, the improvement of the knowledge and technology transfer systems and the improvement of the natural disaster insurance system, which all contribute to the climate change adaptation.

The Water Management Strategy for the territory of the Republic of Serbia until 2034¹³ identifies climate change as an important factor in long-term planning in the area of water use and flood and drought protection. Among other goals, this Strategy promotes adaptive water management based on sustainable development principles. Many measures stated in the Strategy can be considered as climate change adaptation measures, although they are not explicitly marked as such.

The Sustainable Urban Development Strategy of the Republic of Serbia until 2030¹⁴ sets, as one of its special goals, the improvement of the quality of the environment, health and safety of inhabitants in urban settlements and a high level of adaptation urban areas to climate change. Its achievement is planned through measures to improve the quality of the environment, waste management and energy efficiency, as well as reducing the risk of natural disasters and establishing an efficient system of protection and response.

The Ministry of Environmental Protection in 2020 initiated the development of National Action Programme for Combat Desertification and Land Degradation and Mitigation of Drought Impacts with a purpose of adopting measures to prevent further land degradation and achieve land degradation neutrality.

4. OBSERVED AND PROJECTED CLIMATE CHANGE AND EXTREME WEATHER EVENTS

The top ten hottest years since meteorological measurements began in Serbia are recorded after 2000. The increasing trend of the mean annual temperature has been

¹² Official Gazette RS, No. 85/2014

¹³ Official Gazette RS, No. 3/2017

¹⁴ Official Gazette RS, No. 47/2019

observed over the last 7 decades (0.36 °C per decade). Since the 1980's the warming has accelerated to 0.6°C per decade.¹⁵

The observed mean annual temperature increase in the period 2008-2017 relative to the reference period 1961-1990 in the largest part of territory of Serbia exceeded 1.5°C, and in the western and eastern parts of the country it even exceeded 2°C. During the same time period, the annual precipitation increased up to 10%, and in the southern part of the country up to 20% relative to the reference period. Observed changes are more pronounced during the summer season which has become warmer by about 2.5°C, while summer precipitation decreased by 10 to 20% in most of the country, and up to 30% in the southern part.¹⁵ Increasing frequency of extreme events has been observed, including among others heat waves, droughts, flooding, intense rainfall, etc.

Projections of regional climate models according to two IPCC scenarios of GHG emissions, the RCP8.5 and RCP4.5¹⁶, foresee further increase of temperature, changes in the precipitation regime, and increase of intensity and frequency of extreme weather events.¹⁵

According to the scenario RCP4.5, which implies the stabilization of the GHG emissions by 2040, the mean annual temperature in the territory of Serbia will increase relative to the reference period (1986-2005) by about 0.5°C in the near future (2016-2035), by 1.5°C by the middle of the century (2046-2065) and up to 2°C by the end of the century (2081-2100). The change in the mean annual precipitation will not be as pronounced as in the case of temperature change, but will be characterized by interannual precipitation redistribution. It is estimated that by the middle of the century there will be a reduction of mean annual precipitation of up to 5% in most of the country, along with an increase of up to 5% in the north. By the end of the century, a larger part of the territory of Serbia could experience up to 10% more precipitation at the annual level, but at the same time up to 20% less precipitation during summer.

The changes of the mean annual temperatures according to the scenario RCP8.5, which implies continued increase of emissions until the end of the century, would be greater by about 0.5°C relative to RCP4.5 in the first two time periods, while by the end of the century under this scenario they are expected to increase by about 4.3°C

¹⁵ Djurdjević V., Vuković A., Vujadinović Mandić M., Observed climate change in Serbia and projections of future climate based on different emission scenarios, 2018 (http://www.klimatskepromene.rs/wp-content/uploads/2019/04/Osmotrene-promene-klime-Final_compressed.pdf)

¹⁶ IPCC, Climate Change: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, pp.151, 2014

relative to the reference period. By the middle of the century mean annual precipitation is expected to increase practically in the whole territory of Serbia up to 10%. By the end of the century, this trend will change, and only the northern part of the country will have an increase of mean annual participation up to 10%, while the rest of the country in most parts will experience a reduction of up to 10% and up to 20% in the southern parts. During the summer season, the deficit of rainfall will be stronger and will range from 10 to 30% across Serbia.

5. SECTORIAL ASSESSMENT OF CLIMATE CHANGE IMPACTS AND PROPOSED ADAPTATION MEASURES

As presented in the NDC, the sectors that are most vulnerable to climate change in Serbia include: agriculture, water management, forestry, biodiversity and public health.

The Initial and the Second National Communication of the Republic of Serbia to the UNFCCC, the draft National Climate Change Adaptation Plan, the draft Low-Carbon Development Strategy of the Republic of Serbia and a number of other sectorial strategies provides an assessment of climate change and define priority adaptation measures aimed at increasing resilience to climate change of the most vulnerable sectors.

5.1. AGRICULTURE

Increasing temperature, redistribution of precipitation, increased climate variability, and increasing frequency and intensity of extreme weather events during recent decades have all affected the Serbian agriculture, particularly the quality and quantity of plant and animal production. Due to the increased temperature there has been a shift and shortening in phenophase of plants and accelerated ripening, which often had negative impact on yield quality. Due to earlier vegetation onset, agricultural plants, particularly fruits, are under the greater risk of late spring frosts. Drought, high temperatures, storms, hail, intensive rainfall and flooding all have negative impacts on the yield of agricultural plants and can also cause physical damage to different plant organs. Climate change affects the habitat change of different vectors (mosquitoes, ticks, expansion of areas of allochthonous animal species) and infectious diseases of domestic and wild animals. Moreover, it increases the likelihood of spreading of new diseases (such as Lumpy skin disease and Bluetongue). Changes in temperature and precipitation regime can reduce the quality of grazing of animals and animal reproduction. It is estimated that drought causes the greatest losses and damages in the Serbian agriculture. During the past 20 years Serbia has

recorded 7 dry years (on average, one dry year per 2.8 years), while in the period 1950-2000 there were only 3 dry years (one dry year per 16.7 years). Only one drought, in 2012, resulted in estimated damages and losses in the Serbian agriculture of USD 2,000,000. The draft National Adaptation Plan estimated the losses and damages resulting from drought in the Serbian agriculture in the period 1994-2014 at minimum USD 4.6 billion.¹⁷

The Strategy of Agriculture and Rural Development for the period 2014-2024¹⁸ recognizes that the response to climate change impacts in this sector so far has been inadequate and that system-wide solutions are needed, particularly related to use of new technologies. That is why the adaptation and mitigating climate change impacts is defined as one of the strategic objectives of the Serbian agricultural policy.

Priority adaptation measures in the sector of agriculture proposed through the relevant sectorial strategies and planning documents are:

- 1) Constructing new irrigation systems and more efficient use of the existing ones.
- 2) Use of small, multi-purpose water accumulations.
- 3) Adjustment of the technologies of agricultural plant and animal production.
- 4) Improvement of the use of meteorological and climatological information for planning in agriculture.

Constructing new irrigation systems and more efficient use of the existing ones is one of the adaptation measures that would mitigate an impact of the increased frequency and intensity of droughts that bring the greatest yield losses. According to the Strategy of Agriculture and Rural Development, in Serbia there is 250,000 ha of land with irrigation systems. However, currently is being irrigated only from 40 to 70,000 ha. About 70,000 m³ of water is being used annually for irrigation and the water is being captured mostly from rivers (90%)¹⁹. The most common is irrigation by sprinkling (93.3%), drip irrigation (6%), while surface irrigation is found at only 0.1% of the agricultural land. Irrigation is mostly used for vegetables, watermelons and strawberries. Despite this, it has been noted that in the dry years, the yields of sugar beet and corn have the largest losses (up to 70%), while other field crops suffer slightly less. The impact of drought in fruit growing, in addition to the reduction of yield during the dry year, can be transferred to the next year. Therefore, it is necessary to increase the share of irrigated land, as well as to introduce new technologies that increase water use efficiency (drip irrigation, precision irrigation, etc.), especially for crops grown on shallow soils. This is a mid-term and long-term

¹⁷ INDC, 2015

¹⁸ Official Gazette RS, No. 85/2014

¹⁹ <https://www.stat.gov.rs/sr-cyrl/vesti/20190109-navodnjavanje-2018/>

adaptation measure, and the draft Low-Carbon Development Strategy envisages that the percentage of irrigated land be increased to 7% by 2030 (about 220.000 ha), and between 10 and 15% by 2050. The similar goal of creating the new from 150.000 to 250.000 ha of the irrigated land by 2034 that was set by the Water Management Strategy.

Use of small, multi-purpose water accumulations is an adaptation measure, which accompanies the previous one, the construction of irrigation systems. Irrigation in some parts of Serbia exerts additional pressure on the water supply systems, particularly during summer months and drought. Therefore, it is necessary to construct accumulations such as small lakes, ponds, multi-functional reservoirs that can be used for water supply, irrigation, erosion control, flood protection, and sustainable agro-ecosystem management.

Adjustment of the technologies of agricultural plant and animal production is an adaptation measure implying a whole set of different activities, starting from the selection of species and varieties to the implementation of adequate agro-technical measures, including those for sustainable use and improving of land quality. Key prerequisite for preserving and enhancing the quality of plant and animal production is an adequate selection of plant species and varieties, as well as species, breeds and strains of domestic animals, in relation to the existing and projected future climate conditions of the area where they are grown. Additionally, there is a need to promote work on selection, breeding, and development of genotypes tolerant to extreme weather conditions, primarily drought. Adjusting the crop growing systems, land management and crop rotation to the changing climate conditions, growing winter cover crops and winter crops and adjusting zootechnical conditions in animal husbandry facilities and process of animal production are activities that promote the sustainable agriculture and rational use of natural resources. Particularly important are the activities related to increasing the quality of soil and rational use of fertilizer because such measures, in addition to climate change adaptation, also contribute to the reduction of GHG emissions from the agriculture sector.

Improvement of the use of meteorological and climatological information for planning in agriculture is an adaptation measure that implies monitoring of climate change and extreme weather events impacts in the sector of agriculture, and also promotes the use of publicly available data for planning activities in agricultural production. Meteorological and climatological data which can be used in agricultural practice include a whole set of information, from measurement and observation (on the ground, drones, satellites), through short-term and long-term (seasonal) forecast, to climate projections. In order to make such information available, understandable

and useful for the farmers, it is necessary to improve the operational agrometeorological monitoring and forecasting products of the Republic Hydrometeorological Service of Serbia and to systemically and continuously train the Agricultural Advisory Service and farmers.

5.2. WATER MANAGEMENT

The greatest share of the available surface water is that of transit waters (92%) flowing into Serbia as big rivers, while only 8% originates on the territory of the country. In the north, the greatest part of water resources belong to transit waters, while in the south surface waters are mostly domicile waters that depend on local the climate conditions, more specifically on the difference between total precipitation and evapotranspiration. Due to the temperature increase in recent decades, Serbia has experienced increased evapotranspiration which ranges from a couple of percentages to as much as 10% for the period 2008-2017 relative to the reference period 1961-1990. The positive trend of evapotranspiration, along with interannual redistribution of precipitation has resulted in reduced the water content in soil (up to 2m depth) in practically the whole territory of Serbia. The biggest reduction of the soil water content, exceeding 10%, has been recorded during summer and autumn months, which in turn can affect water supply, agricultural and energy production. Measurements have indicated a trend of reducing river flows in central and southern Serbia, amounting to -2 to -3% per decade. Negative trends of river flows have been observed on the Sava and the Danube (about -1% per decade) rivers. At the same time, due to more frequent and intensive rainfall there are increasing risks from floods and flash floods.²⁰

The anticipated changes in the precipitation regime, the redistribution of precipitation within a year, longer dry periods, increased intensity of precipitation and less snowfall will impact the future availability of surface and ground water in the country. Projections indicate¹⁹ further reduction of flows on all rivers in Serbia, amounting to -8% by the mid-century and up to -17% by the end of the century, compared to the reference period 1971-2000. The biggest reduction in river flows is expected in central and eastern Serbia, and the least on the Sava and the Danube rivers.

Alongside, the groundwater recharge is expected to reduce across the whole territory of Serbia on the average by -10% by the mid-century and by up to -50% by the end of

²⁰ Draft of the Third National Communication of the Republic of Serbia under the UNFCCC – climate change adaptation, 2020

the century, compared to the reference period 1951-2010. This reduction will more strongly affect groundwater in the east and southeast of the country.

The increase of air temperature will also affect the increase of water temperatures, which could have negative effects on the quality of water, the ecosystems and energy production.

Water management in Serbia is organised in three strategic areas: water use, protection against harmful effects of water, and protection of water quality. The Water Management Strategy for the territory of the Republic of Serbia until 2034 recommends many measures for improvement of the strategic areas, many of which may be considered as adaptation measures since the water resources strongly depend on climate conditions. Priority adaptation measures adopted from the Strategy are:

- 1) Increasing efficiency of water supply systems
- 2) Improving protection of water springs and preservation of water quality
- 3) Development of flood risk management plans
- 4) Improving protection against floods and flash floods
- 5) Improving protection against inland flooding
- 6) Improving the water management in drought conditions and water shortage

Increasing efficiency of water supply systems is a mid-term measure in the strategic field of water use, encompassing reduction of losses in water supply systems to an optimum level, introducing cost-recovery drinking water tariffs, and organisational optimisation of water supply utilities. Losses in water supply systems are high, at about one third. Lack of water is recorded in 8 municipalities, and additional 6 municipalities face issues of water shortage and insufficient water quality. These problems are aggravated during summer months, as the water demand increases. As climate change projections suggest reduced water availability of both, surface and ground water, particularly during the summer months, the increased efficiency of the water supply systems would ensure stability and security of water supply in the country. In Serbia, 81% of households are connected to public water supply. In Northern Serbia, almost 90% while in Central and Southern Serbia approx. 70% of households are connected to public water supply. About 650 million m³ of water is used annually for public water supply, including 65% from groundwater, and from watercourses (26%) and reservoirs (8%).²¹ The Water Management Strategy foresees an increase in the level of public water supply systems coverage from today's 80% to 88% by 2024 and to 93% by 2034. This will increase the amount of water

²¹ <https://publikacije.stat.gov.rs/G2019/Pdf/G20191100.pdf>

used from present 680 million m³ to 827 million m³ in 2034. It is planned to reduce losses in public water supply systems from present 33% to 25% by 2034, through regular maintenance and rehabilitation of existing systems, control of water consumption and detection of leaks and losses.

Improving protection of water springs and preservation of water quality is an adaptation measure in the strategic field of improving water quality. In order to maintain and improve the quality and quantity of water used for public supply, it is necessary to establish a system for monitoring relevant parameters of surface and ground water quality, determine sanitary protection zones at existing water springs, implement appropriate protective measures, control the input of pollution through the construction of sewage systems and controlled use of fertilizers and pesticides. In addition, it is necessary to define and protect habitats and species that depend on water quality, as well as areas sensitive to nutrients. The development of the Water Management Plan on the territory of the Republic of Serbia from 2021-2027 is currently underway within the European Union Twinning Project "Support to Policy Planning in the Water Management Sector". The project aims at improving surface and ground water quality standards in Serbia, as well as strengthening capacities in water management. This project will enable the process of implementation of the European Union Water Framework Directive, as a key regulation in the field of integrated and environmental water management.

Development of flood risk management plans, improving protection against floods and flash floods and improving protection against inland flooding are adaptation measures in the strategic field of protection against harmful water effects. It is estimated that about 18% of the territory of Serbia is vulnerable to floods, including more than 500 major settlements, companies, and road infrastructure. Flood protection measures mostly rely on building embankments. In order to improve flood protection it is necessary to rehabilitate and regularly maintain the system of water facilities for flood protection, to use existing or build new retentions, reservoirs, canals, to improve monitoring and protection against land erosion, and to implement other active protection measures.

The Law on Waters²² specifies that water risk management requires the preparation of a preliminary flood risk assessment, flood risk management plans and general and operational flood protection plans. The first Preliminary Flood Risk Assessment for Serbia was developed in 2011, based on available data (hydrological, land use, topography, etc.) and data on damages caused by floods in the past. According to the Law on Waters, the renewal of the Preliminary Flood Risk Assessment is performed

²² Official Gazette RS, No. 30/2010, 93/2012, 101/2016, 95/2018, 95/2018

every six years, and this document was revised in 2019, when 101 significant flood areas were determined. Flood Risk Management Plans are prepared on the national level and for the watercourses, on the basis of hazard maps and flood risk maps. These plans prescribe measures and activities for flood risk management. Although the Law on Waters foresees that risk management plans are adopted by 2017, their preparation is delayed, mainly due to the lack of financial resources and capacities. The hazard maps and flood risk maps, which are the basis for the development of these plans, are currently under the development within the project "Study of mapping of flood zones in Serbia", funded by the European Union.

Improving the water management in drought conditions and water shortage is the only specific adaptation measure defined by the Water Management Strategy. It involves the development of drought management plans with proposed measures to prevent and mitigate the effects of drought, as well as the development of monitoring and forecasting systems. These plans will be made based on the assessment of meteorological and hydrological observations in the past, as well as climate projections for the future.

5.3. FORESTRY

The forests in Serbia cover about 2,360,000 ha, most of which are state owned (51.4%). The major types of forests are beech (27.6%), oak (24.6%), with only about 6% of coniferous trees. The Forestry Development Strategy of the Republic of Serbia²³ estimated that the state of forests is unsatisfactory in terms of their health, age structure, production funds and forest cover.

The most significant climate change impacts on forests in Serbia include the more frequent occurrence of droughts, forest fires, pests and diseases. The English oak has been identified as the most vulnerable tree species as it is dependant on the groundwater level, which is being reduced in recent decades. On the other hand, black and white pine and downy oak are coping well with the arid conditions and will be least affected by the more frequent droughts in the future. Extreme droughts, fires, strong winds, frost, and pests (gypsy moth, *Lymantria dispar* L.) and diseases have caused the largest damages in Serbian forests in the past two decades.

Due to the poor status of forests and their huge significance for both climate change mitigation and adaptation, it is necessary to systemically improve the forestry sector. Priority adaptation measures proposed through the relevant strategic and planning documents include:

²³ Official Gazette RS, No. 59/06

- 1) Reforestation using climate adaptable tree species
- 2) Adopting the close-to-nature forest management and the climate-smart forestry principles and approaches
- 3) Conversion of coppice into high forests
- 4) Reducing the negative risk factors of biotic and abiotic origin

Reforestation using climate adaptable tree species is a measure that at the same time contributes to both climate change adaptation and mitigation. The Programme of Forestry Development in the Territory of the Republic of Serbia for the period 2011-2020 foresees the increase of areas under forests by 6,000 ha annually. The draft Low-Carbon Development Strategy also envisaged afforestation of 5,000 ha annually by 2030, but with habitats mapping, as a first step in order to identify adequate tree species for each location. While planning the afforestation it is recommended to favour multi-purpose protective forests, such as wind-protective belts and forests preventing soil erosion and flash floods.

Adopting the close-to-nature forest management and the climate-smart forestry principles and approaches is an adaptation measure that implies a set of activities in order to achieve sustainable forest management. Among other activities, there is the promotion of trees species adequate to the habitat, promotion of mixed forests, preservation and increasing of the genetic variations within tree species, and promotion of natural forests renewal.

Conversion of coppice into high forests is an adaptation measure that aims to strengthen the ecosystems, which will increase the adaptive capacity of forests. The draft Low-Carbon Development Strategy foresees direct annual conversion of 7,000 ha of coppice into high forests. This process implies the selection of natural seeds of best trees of coppice origin, and their planting in appropriate locations.

Reducing the negative risk factors of biotic and abiotic origin is an adaptation measure that supports the forest management and strengthens the capacities for climate change adaptation. It includes improvement of forest fires monitoring and early warning systems, development of guidelines for assessing vulnerability to forest fires, and development of guidelines for prevention against forest fires, extreme weather conditions (strong wind, ice), pests and diseases.

5.4. BIODIVERSITY

Climate change in Serbia could result in phenological, morphological, physiological changes and changes in the behaviour of species, changes in conditions or loss of existing natural habitats, changes in number and distribution of species, increasing

the number of pests and diseases, or genetic changes. The most vulnerable habitats are high mountains, pastures, forests, riverbanks, wetlands and steppe habitats.

Although biodiversity in Serbia is threatened by climate change, significant researches have not been conducted in this field. The Biodiversity Strategy of the Republic of Serbia with the accompanying Action Plan for the period 2011-2018²⁴ envisaged several measures related to the climate change adaptation, which have hardly been achieved at all. The draft Nature Protection Programme of the Republic of Serbia for the period 2020-2022²⁵ stipulates that the main problems in the field of biodiversity adaptation to climate change are insufficient interaction among researchers, decision-makers and other stakeholders, lack of systematic monitoring of climate change impacts on biodiversity, insufficient number of models for projections and assessment of climate change impacts on biodiversity, as well as low public awareness on this issue. Within the specific strategic objective of biodiversity protection, there is a measure on ***monitoring the impacts of climate change on biodiversity and impacts of biodiversity on mitigating the effects of climate change***. It implies the development of the vulnerability assessment methodology and indicators, determining the number of species, habitats and ecosystems that are subject to monitoring climate change impacts, developing specific measures to protect the species and habitats sensitive to climate change, monitoring the level of endangerment of biodiversity from natural disasters, and raising public awareness about the climate change impacts on biodiversity through campaigns, media, and scientific publications. In addition, in order to strengthen research capacities, it is necessary to work on ***improving the cooperation among scientists and researches and capacities of researchers***. One of the first comprehensive steps would be to ***develop a national assessment of biodiversity vulnerability to climate change*** in Serbia. All strategic measures relevant to reducing vulnerability and biodiversity losses and maintaining biological diversity at genetic, species, and ecosystem levels can be understood as adaptation measures, as they increase the adaptive capacity.

5.5. PUBLIC HEALTH

Climate change can have a direct or indirect impact on public health. Direct impact implies injuries, diseases, and fatalities resulting from climate change and extreme weather events (floods, heat waves, storms, etc.). The indirect impact includes the consequences for public health that are associated with the more frequent occurrence of vector-borne diseases, reduced air and water quality, as well as reduced availability of food and water. The categories of population that are particularly

²⁴ Official Gazette RS, No. 13/2011

²⁵ <https://www.ekologija.gov.rs/predlog-programa-zastite-prirode-za-period-od-2020-do-2022-godine/#more-3029>

vulnerable to the health impacts of climate change are the elderly, particularly those in single member households, the chronically ill, the poor, children, farmers and outdoors workers. It is estimated that in Serbia about 35% of the total population is vulnerable.²⁶

Climate change is included in the Public Health Strategy of the Republic of Serbia 2018-2026²⁷ through the specific objective to improve the environment, adaptation measures and response to climate change – ***development of action plans for response to climate change in urban areas***. Although not specifically stated, all strategic measures related to improving the quality of air, water and soil, to improving monitoring of infectious diseases, those aimed at improving the position of vulnerable population groups (prevention of chronic diseases, poverty reduction, improving access to health care services), and measures aimed at strengthening the capacities of health care institutions and services, could be indirectly understood as climate change adaptation measures. Nevertheless, it is necessary to conduct a detailed vulnerability assessment on the territory of Serbia, to plan adaptation measures, to set priorities and to mainstream them in the strategic documents of the public health sector. Problems that might arise in this process are primarily the lack of relevant systematised data needed for assessment of climate change effects on health, and insufficient funding and capacities. Therefore, as a first step it is necessary to ***improve scientific research, cooperation and capacities in the field*** and to ***establish a monitoring system of infectious diseases and vectors (i.e. mosquitos) introduced as a consequence of climate change***.

6. DISASTER RISK REDUCTION

Serbia's NDC quotes that the damages caused by climate change and extreme weather events for the period 2000-2015 are estimated at minimum EUR 5 billion. Of this amount, more than 70% are damages caused by droughts and high temperatures. Individual events with highest damages are the drought of 2012 (EUR 2 billion) and the floods of 2014 (EUR 1.7 billion).

After the disastrous flooding in 2014, in order to develop a long-term system for disaster risks management, the Government of the Republic of Serbia adopted its National Disaster Risk Management Programme. The programme is a framework for the development of programmes for protection against natural disasters, coordination and implementation of activities for risk reduction and more efficient

²⁶ Draft of the Third National Communication of the Republic of Serbia under the UNFCCC – climate change adaptation, 2020

²⁷ Official Gazette RS, No. 61/18

response. The National Programme is funded through an earmarked multi-donor fund. The National Programme and the National Strategy for Protection and Rescue in Emergency Situation²⁸ were the basis for the adoption of the Action Plan for implementation of the National Disaster Risk Management Programme for the period 2017-2020. Its general goal is for the Republic of Serbia to build a disasters risk management system, to establish a system of inter-institutional cooperation, and to become more resilient to natural disasters and other hazards and to be capable to recover in a timely manner. In order to achieve the general goal, six specific objectives have been identified, which are fully aligned with the four priorities of the Sendai Framework for Disaster Risk Reduction 2015-2030, specifically:

- 1) Establish and develop institutions (linked to Priority 2 of the Sendai Framework – Strengthening disaster risk governance)
- 2) Identification and monitoring of natural disaster risks (linked to Priority 1 of the Sendai Framework – Understanding disaster risk)
- 3) Structural and non-structural risk reduction (linked to Priority 3 of the Sendai Framework – Investing in disaster reduction for resilience)
- 4) Early warning and preparedness systems (linked to Priority 4 of the Sendai Framework – Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction)
- 5) Strategy of funding in case of risks of disasters (linked to Priority 3 of the Sendai Framework – Investing in disaster reduction for resilience)
- 6) Efficient recovery (linked to Priority 4 of the Sendai Framework – Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction)

On the basis of the National Strategy for Protection and Rescue in Emergency Situation²⁹ the Law on Disaster Risk Reduction and Emergency Management³⁰ was adopted. This Law introduced the obligation to develop Disaster Risk Assessments and Plans for Protection and Rescue at national level, at the level of units of local self-governments, companies, public health, social and educational institutions, and legal entities. The methodology is also prescribed to conduct vulnerability assessments in case of natural disasters and other accidents and protection and rescue plans in emergencies.

²⁸ Official Gazette RS, No. 86/11

²⁹ Official Gazette RS, No. 86/2011

³⁰ Official Gazette RS, No. 87/2018

The Emergency Management Sector of the Ministry of Internal Affairs conducted the Disaster Risks Assessment for the Republic of Serbia³¹, which was adopted in March 2019. This document defined natural and other disasters, which pose significant risks for lives and health of people, the economy, the environment and social stability. The analysed phenomena also include extreme weather events (heavy precipitation; droughts and heat waves; hailstorms, storms and heavy rainfall; snow storms, snowdrifts, cold waves), and disasters caused by them (flooding, landslides, land erosion, forest fires). The risk assessment in this document was conducted on the basis of the scenario for the most likely adverse event and the scenario for the adverse event with the most severe consequences defined on the basis of historical data.

Consequences on human lives and public health, the economy and environment, and social stability were assessed for each hazard. The Table 1 provides an overview of the consequences and the level of risks for the scenarios for the adverse event with the most severe consequences. All the selected hazards have unacceptable, high-risk level, except the one involving hail, storms and heavy rainfall where risk was assessed as moderate and acceptable. The conclusion of this document states that the Republic of Serbia is exposed to the impacts of the considered hazards, that the protected values are vulnerable, and that preventive action is needed to reduce the risks of individual hazards to acceptable levels by implementing the proposed prevention and response measures.

Table 1: Assessed levels of consequences and risks for the scenarios of the adverse event with the most severe consequences from the Disaster Risks Assessment for the Republic of Serbia

Adverse event	Scope of consequences ¹				Likelihood of occurrence ²	Risk level	Impacts of climate change
	Human lives and public health	Economy and environment	Social stability	Total			
Heavy precipitation	5	5	3	4	2	High	Increased frequency
Drought and heat wave	4	5	1	3	2	High	Increased frequency, duration and intensity
Snow storm, snowdrift, ice, and cold wave	4	3	1	3	3	High	Reduced frequency
Hail, wind storm, and heavy precipitation	2	3	1	2	3	Moderate	Increased frequency and intensity

³¹[http:// prezentacije.mup.gov.rs/sektorazazastituispasavanje/HTML/licence/Procena% 20rizika% 20od%20katastrofa%20u%20RS.pdf](http:// prezentacije.mup.gov.rs/sektorazazastituispasavanje/HTML/licence/Procena%20rizika%20od%20katastrofa%20u%20RS.pdf)

Flooding	3-5*	3-5*	3-5*	3-5*	2	High	Not considered
Land slide	2	5	5	4	2	High	Not considered
Forest fire	4	5	3	4	2	High	Not considered

¹Scope of consequences: (1) minimum, (2) low, (3) moderate, (4) serious, (5) disastrous

²Likelihood of occurrence: (1) neglectable, (2) low, (3), medium, (4) high, (5) extremely high

* The scale of the size of consequences depends on the selected scenario

6.1. FINANCIAL ASSESSMENT OF LOSSES AND DAMAGES

The assessment of losses and damages caused by natural disasters in the Republic of Serbia is done using the Guidance on a unique methodology for assessing the damage from natural disasters³² adopted in 1987. Since the methodology is outdated and not very detailed, in practice the financial assessment is done only for adverse events with large consequences on infrastructure and housing, such as floods and earthquakes.

In 2013 through the project “Disaster Loss Database in Serbia”, which was supported by UNDP, the DesInventar was introduced as a methodological and technological tool for creating a database on loss, damages and impacts of disaster events. Within the project data on disaster events since 1986 were collected and analyzed. After the project ended, local self-government became responsible for collecting and entering the data into the DesInventar database. However, since there is no adequate assessment methodology, some of recorded natural disasters (such as forest fires and droughts) lack financial assessment of loss and damage. In addition, some of local self-government often enter the data irregularly, with errors, or do not enter at all. Therefore, there is a strong need to update the methodology for loss and damage assessment for all types of natural disasters and to improve usage of the DesInventar database in order to achieve its full potential.

For the purpose of this report, financial assessment of loss and damage of natural disasters in the period 2015-2020 in Serbia was completed using publicly available data from different sources. Loss and damage caused by floods were estimated from data in the DesInventar and the records of the Public Investment Management Office on state aid paid through the Flood Relief and Reconstruction Programme³³. Loss and damage in forests, caused by forest fires and extreme weather events (strong wind,

³² Official Gazette SFRJ, No. 27/87

³³ <http://www.obnova.gov.rs>

rain, hail, snow and ice) were estimated based on volume of damaged woods data from the Statistical Office of the Republic of Serbia³⁴ and the average price for firewood³⁵. Drought loss and damage was estimated based on the available literature, while for the windstorms, hailstorms and snowstorms the estimation was based on data from the DesInventar. In the Table 2 presented are minimum estimated loss and damage for the natural disasters and extreme weather events recorded in Serbia in 2015-2020 period. This analysis finds that Serbia suffered damage of minimum 1.8 billion EUR in this five year long period.

Table 2. Minimum estimated loss and damage for the natural disasters and extreme weather events recorded in Serbia in 2015-2020

Event	Period	Details	Minimum estimate od loss and damage (EUR)	Data source
Flooding	January-March 2015	Several municipalities of central, southern and western Serbia were affected	7,730	Public Investment Management Office and DesInventar
Flooding	March 2016	16 municipalities of central and western Serbia were affected	1,648,665	Public Investment Management Office and DesInventar
Flooding	May-June 2017	12 municipalities of central and western Serbia were affected	280,538	Public Investment Management Office and DesInventar
Flooding	March-April 2018	19 municipalities of central, eastern and western Serbia were affected	2,511,880	Public Investment Management Office and DesInventar
Flooding	May-August 2018	23 municipalities of central, eastern and western Serbia were affected	313,288,986	Public Investment Management Office and DesInventar
Flooding	June 2019	22 municipalities of central, eastern and western Serbia were affected	3,661,793	Public Investment Management Office and DesInventar
Flooding	June-July 2020		4,383,303	Public Investment Management Office and DesInventar

³⁴ <https://www.stat.gov.rs>

³⁵ <https://srbijasume.rs/ssume/wp-content/uploads/2019/05/Cenovnikogr.pdf>

Forest fire	2015	1,033 ha of forest were affected and 5,059 m ³ of trees were damaged	128,619	Statistical Office of the Republic of Serbia, Forestry in the Republic of Serbia 2015
Forest fire	2016	317 ha of forest were affected and 37,114 m ³ of trees were damaged	943,576	Statistical Office of the Republic of Serbia, Forestry 2016
Forest fire	2017	1,258 ha of forest were affected and 11,415 m ³ of trees were damaged	290,212	Statistical Office of the Republic of Serbia, Forestry 2017
Forest fire	2018	690 ha of forest were affected and 707 m ³ of trees were damaged	17,975	Statistical Office of the Republic of Serbia, Forestry 2018
Forest fire	2019	4,068 ha of forest were affected and 2,397 m ³ of trees were damaged	60,941	Statistical Office of the Republic of Serbia, Forestry 2019
Extreme weather events in forests (wind, rain, hail, snow, ice)	2015	14,154 ha of forest were affected and 116,431 m ³ of trees were damaged	2,960,110	Statistical Office of the Republic of Serbia, Forestry in the Republic of Serbia 2015
Extreme weather events in forests (wind, rain, hail, snow, ice)	2016	2,637 ha of forest were affected and 86,826 m ³ drveća	2,207,441	Statistical Office of the Republic of Serbia, Forestry 2016
Extreme weather events in forests (wind, rain, hail, snow, ice)	2017	10,084 ha of forest were affected and 44,074 m ³ of trees were damaged	1,120,525	Statistical Office of the Republic of Serbia, Forestry 2017
Extreme weather events in forests (wind, rain, hail, snow, ice)	2018	2,022 ha of forest were affected and 74,495 m ³ of trees were damaged	1,893,941	Statistical Office of the Republic of Serbia, Forestry 2018
Extreme weather events in forests (wind, rain, hail, snow, ice)	2019	1,999 ha of forest were affected and 58,028 m ³ of trees were damaged	1,475,288	Statistical Office of the Republic of Serbia, Forestry 2019
Drought	2015	Estimated yield losses of wheat, alfalfa and clover	120,000,000	Third National Communication of the Republic of Serbia under the UNFCCC - Report on agriculture vulnerability assessment (in Serbian), Stricevic et al., 2020
Drought	2017		1,300,000,000	Maslac, 2018 ³⁶

Hailstorm	2015-2020	67 recorded events over 5 years, from May to August	35,200,000	DesInventar
Windstorm	2015-2020	23 recorded events over 5 years	7,814,200	DesInventar
Snowstorm	2015-2020	13 recorded events over 5 years, from January to May	881,245	DesInventar
TOTAL			1,800,776,968	

The Study on the Socio-economic Aspects of Climate Change in the Republic of Serbia (2020)³⁷ estimated is potential change of the country's GDP if the global mean annual temperature increases by 1°C, 2°C, 3°C, or 4°C by the end of the century. Depending on the chosen scenario, the GDP in the period 2020-2040 could decrease from 1.20 to 6.87%, or from 15,465 to 97,534 billion USD (Table 3). By the end of the century the losses could be significantly larger and in the period 2020-2100 GDP could decrease 4.19 to 17.06%, or from 344,364 to 2,002,410 billion USD. Since even small warming may lead to large losses, it is important to develop a methodology that systematically includes quantified projected climate change impacts to all relevant natural disasters considered within the National Disaster Risks Assessment.

Table 3: Serbia's GDP potential decrease in case of the global mean temperature increase, relative to the projected GDP without warming (source: Bozanic and Mitrovic, 2020).

Temperature increase	GDP decrease (billion USD and %)	
	2020 - 2040	2020 - 2100
1 °C	15,465 (1.20%)	344,364 (4.19%)
2 °C	58,124 (4.53%)	766,317 (9.32%)
3 °C	59,107 (4.97%)	890,403 (11.65%)
4 °C	97,536 (6.87%)	2,002,410 (17.06%)

6.2. LAND DEGRADATION

Preserving and improving the quality of land is an important component of sustainable development, while at the same time it contributes to adaptation and mitigating the climate change impacts. The United Nations Convention to Combat Desertification (UNCCD) has adopted, as one of its goals for sustainable development,

³⁷ Bozanic D. and Mitrovic Dj, The Study on the Socio-economic Aspects of Climate Change in the Republic of Serbia, 2020

to combat against desertification, to restore degraded land and to achieve a land degradation neutrality (LDN) in the world by 2030 (Goal 15.3).

In order to determine the initial degree of degraded land, assess land degradation trends, define measures that need to be taken to achieve LDN, as well as to monitor the effect of these measures, three indicators were set by the UNCCD: land cover, land productivity and carbon stocks.

According to the Report on the applied methodology and identification of objectives for establishing neutrality of land degradation in the Republic of Serbia³⁸ (2019) in the Republic of Serbia degraded land accounts for 6.47% of the total territory of the country (5,725.2 km²), 20.54% of the total territory (18,755.5 km²) is in the category of stable condition, while 72.86% is in the category of improved condition (64,472.7 km²). Based on the analysis of the recommended indicators, a number of measures have been defined, in order to achieve land degradation neutrality in the Republic of Serbia by 2030. The following measures are defined as priorities in this process:

- 1) Introducing measures addressed to achieve LDN in strategic, legal and planning document.
- 2) Improvement, restoration and remediation of degraded areas by applying the principles of sustainable land management.
- 3) Establishment and development of land monitoring in accordance with national environmental protection indicators (land use change, land productivity, land erosion).
- 4) Establishment of detailed databases for the territory of the Republic of Serbia for the application of LDN methodology.
- 5) Raising public awareness and the role of education in combating land degradation and drought.

7. IMPLEMENTATION OF ADAPTATION MEASURES

The establishment of the national strategic and legislative framework in the field of climate change in the Republic of Serbia is underway. While the draft Law on Climate Change and the draft Low-Carbon Development Strategy pending for the adoption, the next important step concerning the climate change adaptation is the development and adoption of the Climate Change Adaptation Programme.

³⁸ Ministry of the Environmental Protection of the Republic of Serbia, Report on the applied methodology and identification of objectives for establishing neutrality of land degradation in the Republic of Serbia, 2019

The needs for the assessment across the sectors are not uniform. In sectors that directly depend on weather conditions, such as agriculture, forestry and water management, the impacts of climate change in Serbia are known, clearly visible and sufficiently scientifically researched. In the adopted strategies of these sectors, some of the proposed measures also refer to climate change adaptation, although it is often not explicitly indicated.

On the other hand, in sectors such as biodiversity, public health, infrastructure and transport, the impact of climate change has been noticed, but not significantly and systematically researched, and in indicators and systems for monitoring the impact and consequences of climate change are generally not developed.

Due to the above, it is important to consider all the needs and shortcomings related to climate change adaptation in relevant sectors through the Climate Change Adaptation Programme that is going to be developed within the project “Advancing medium and long-term climate change adaptation planning in the Republic of Serbia” (2019-2022). The Programme will define sector-specific adaptation measures, prioritize them on the basis of the Framework for Planning Adaptation to Climate Change, set quantitative targets, determine indicators of implementation of measures, institutions responsible for their implementation and methods of financing. Within the project, all relevant data on climate change will be collected across the sectors and institutions in order to establish a national database. This will improve, both quality of the data and process of implementation monitoring.

The implementation of the adaptation measures presented in this document should be followed within sectors by monitoring the fulfillment of the objectives of the relevant strategic and planning documents.

An example of good practice of the implementation of adaptation measures is “the adapting of cultivation technologies in agriculture”, which actually involves a large number of activities. Important regulatory activities within this measure are the development of the Zoning of wine-growing regions of the Republic of Serbia (2012) and the Zoning of fruit production in the Republic of Serbia (in progress). During their development, in addition to the analysis of past climatological across the country, the climate change projections were considered as well in order to recommend suitable species and/or varieties, appropriate cultivation systems and agrotechnical measures.

On the other hand, the key to the success of the implementation of this measure is in the transfer of knowledge and continuous education of agricultural producers, in which the network of Agricultural Advisory Services under the Ministry of Agriculture, Forestry and Water Management plays an important role. The Ministry

is also producing publications that can help farmers to adapt their farming technology and thus reduce the impact of various natural disasters caused by climate change. Examples of such publications are the brochures "Good Agricultural Practices and Technologies for Mitigating the Effects of Natural Disasters in Maize Production in Serbia" and "Good Agricultural Practices and Technologies for Mitigating the Effects of Natural Disasters in Soybean Production in Serbia".

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ANNEX

Table: Overview of priority climate change adaptation measures by sectors

SECTOR	Priority adaptation measure	Description	Sector(s) involved or affected	Responsible institution	Indicator	Financial needs up to 2030	Potential sources of funding
AGRICULTURE	Constructing new irrigation systems and more efficient use of the existing ones	Constructing new irrigation systems and increasing the irrigated area from currently 40.000-70.000 ha to 220.000 ha until 2030 (new 150.000-180.000 ha under the irrigation systems).	Agriculture Water Management	Ministry of Agriculture, Forestry and Water Management	Volume of water used for irrigation per year (m ³ /year) (Statistical Office of the Republic of Serbia)	More than 100.000.000 EUR (440.000.000 EUR proportionally from the Water Management Strategy)	Budget (IPARD) International funds (Adaptation Fund, GCF, GEF, Abu Dhabi Fund for Development)
	Use of small, multi-purpose water accumulations	Constructing and use of small water accumulations (small lakes, ponds, reservoirs) for irrigation and water supply during drought, erosion management, flood protection and agro-ecosystems management.	Agriculture Water Management Biodiversity	Ministry of Agriculture, Forestry and Water Management, Republic Water Directorate Public Water Management Companies	Number of issued permissions for constructing lakes or accumulations (Local self-government, Republic Water Directorate)	From 10.000.000 EUR to 100.000.000 EUR	Budget (IPARD) International funds (Adaptation Fund, GCF, GEF)
	Adjustment of the technologies of agricultural plant and animal production	Development of recommendations for species and varieties selection, agro-technical measures (including sustainable land use and rational fertilizer management) and zoo-technical conditions. Provide financial support for farmers to implement the recommended measures.	Agriculture Environmental Protection Mitigation Co-benefits	Ministry of Agriculture, Forestry and Water Management	Number of agricultural households with granted state subventions for implementation of the recommended measures (Agricultural Advisory Service)	From 1.000.000 EUR to 10.000.000 EUR	Budget (IPARD) International funds (Adaptation Fund, GCF, GEF) Private funding
	Improvement of the use of meteorological and climatological information for planning in agriculture	Improvement of the agrometeorological monitoring systems. Improvement and promotion of agrometeorological short-term and long-term forecasts products.	Agriculture	Ministry of Agriculture, Forestry and Water Management Republic Hydrometeorological Service of Serbia	Number of agrometeorological forecasts users (Agricultural Advisory Service, Republic Hydrometeorological Service of Serbia)	From 1.000.000 EUR to 10.000.000 EUR	Budget (IPARD) International funds (Adaptation Fund, GCF, GEF) International projects

WATER MANAGEMENT	Increasing efficiency of water supply systems	Decrease of water losses in water supply systems to 25% until year 2034 through regular maintenance, rehabilitation of existing systems, detection of water leaks and losses.	Water Management	Ministry of Agriculture, Forestry and Water Management, Republic Water Directorate	Water losses in water supply systems (%) (Statistical Office of the Republic of Serbia)	More than 100.000.000 EUR (150.000.000 EUR proportionally from the Water Management Strategy)	Budget International funds (Adaptation Fund, GCF, GEF)
	Improving protection of water springs and preservation of water quality	Establish monitoring of relevant parameters for surface and ground water quality, determine sanitary protection zones at water springs, implement protective measures, and control pollution inputs	Water Management Agriculture Environmental Protection Public Health	Ministry of Agriculture, Forestry and Water Management, Republic Water Directorate	Number of water springs with determined sanitary protection zones and established monitoring (Republic Water Directorate)	From 100.000 EUR to 1.000.000 EUR	Budget International funds (Adaptation Fund, GCF, GEF)
	Development of flood risk management plans	Development of hazard maps, flood risk maps, and flood risk management plans on a national and watercourses level.	Water Management Agriculture Forestry Biodiversity Environmental Protection Public Health Infrastructure Transportation Industry and Economy Energy	Ministry of Agriculture, Forestry and Water Management, Republic Water Directorate	Number of adopted flood risk maps and flood risk management plans (Public Water Management Companies, Republic Water Directorate)	From 100.000 EUR to 1.000.000 EUR	Budget International funds (Adaptation Fund, GCF, GEF)
	Improving protection against floods and flash floods	Building small barriers for flash floods and implementing additional anti-erosion measures on river basins	Water Management Agriculture Forestry Biodiversity Environmental Protection Public Health Infrastructure Transportation Industry and Economy Energy	Ministry of Agriculture, Forestry and Water Management, Republic Water Directorate, Republic Hydrometeorological Service of Serbia	Number of river basins with new barriers and/or implemented anti-erosion measures (Republic Water Directorate)	More than 100.000.000 EUR (120.000.000 EUR proportionally from the Water Management Strategy)	Budget International funds (Adaptation Fund, GCF, GEF)
	Improving the water management in drought conditions and water shortage	Development of drought management plans and recommendations for prevention and mitigation of drought effects	Water Management Agriculture Forestry Biodiversity Environmental Protection Public Health Transportation Energy	Ministry of Agriculture, Forestry and Water Management, Republic Water Directorate, Republic Hydrometeorological Service of Serbia	Number of river basins with adopted drought management plans (Local self-government, Republic Water Directorate)	From 100.000 EUR to 1.000.000 EUR	Budget International funds (Adaptation Fund, GCF, GEF)

	Improving protection against inland flooding	Constructing the water objects and hydro-meliorative drainage systems. Development of drainage network on new 100.000 ha of endanger areas until year 2034	Agriculture Water Management	Ministry of Agriculture, Forestry and Water Management, Republic Water Directorate Public Water Management Companies	Area under drainage systems (ha) (Statistical Office of the Republic of Serbia)	More than 100.000.000 EUR (about 150.000.000 EUR proportionally from the Water Management Strategy)	Budget International funds (Adaptation Fund, GCF, GEF)
FORESTRY	Reforestation using climate adaptable tree species	Mapping and reforestation of 5.000 ha per year using climate adaptable tree species, until year 2030	Forestry Environmental Protection Biodiversity Mitigation Co-benefits	Ministry of Agriculture, Forestry and Water Management, Directorate of Forests	Area under new forests with climate adaptable tree species (ha) (Directorate of Forests, Statistical Office of the Republic of Serbia)	From 10.000.000 EUR to 100.000.000 EUR (35.000.000 EUR Proposed Strategy of Low-Carbon Development)	Budget International funds (Adaptation Fund, GCF, GEF) Private funding Innovative climate funding (Carbon market, green credit lines)
	Adopting close-to-nature forest management and climate-smart forestry principles and approaches	Promotion of tree species that are habitat appropriate, promotion of mixed forests, preservation and increase of genetic variations of tree species and promotion of natural forest regeneration	Forestry Biodiversity Mitigation Co-benefits	Ministry of Agriculture, Forestry and Water Management, Directorate of Forests	Number of forest management plans with included principles of close-to-nature and climate-smart forestry (Public Companies responsible for forest management, Directorate of Forests)	From 1.000.000 EUR to 10.000.000 EUR (1.300.000 EUR Proposed Strategy of Low-Carbon Development)	Budget International funds (Adaptation Fund, GCF, GEF) Innovative climate funding (Carbon market, green credit lines)
	Conversion of coppice into high forests	Conversion of 7.000 ha of coppice to high forests per year until 2030, using natural seeds of prominent coppice trees and planting at appropriate selected locations	Forestry Biodiversity Mitigation Co-benefits	Ministry of Agriculture, Forestry and Water Management, Directorate of Forests	Area under coppice forest converted to high forests (ha) (Directorate of Forests)	From 1.000.000 EUR to 10.000.000 EUR (33.500.000 EUR Proposed Strategy of Low-Carbon Development)	Budget International funds (Adaptation Fund, GCF, GEF) Private funding Innovative climate funding (Carbon market, green credit lines)

	Reducing the negative risk factors of biotic and abiotic origin	Improvement of monitoring and forest fires early warning system, assessment of vulnerability from forest fires and development of recommendations for prevention and recovery from forest fires, insects and pests.	Forestry Biodiversity Mitigation Co-benefits	Ministry of Agriculture, Forestry and Water Management, Directorate of Forests	Forest area under forest fires, droughts, pests and diseases (ha) (PC for forest management, Statistical Office of the Republic of Serbia)	From 1.000.000 EUR to 10.000.000 EUR (500.000 EUR Proposed Strategy of Low-Carbon Development for developing recommendations only, without implementation)	Budget International funds (Adaptation Fund, GCF, GEF) Innovative climate funding (Carbon market, green credit lines)
BIODIVERSITY	Development of national assessment of biodiversity vulnerability to climate change	Development of a comprehensive analysis of climate change impact to biodiversity, vulnerability assessment and possibilities of adaptation and mitigation of impacts on the territory of Serbia	Environmental Protection Biodiversity	Ministry of Environmental Protection, Agency for Environmental Protection	Developed national assessment of biodiversity vulnerability to climate change (Ministry of Environmental Protection)	From 100.000 EUR to 1.000.000 EUR	Budget International funds (Adaptation Fund, GCF, GEF)
	Monitoring the impact of climate change to biodiversity and impact of biodiversity to mitigating climate change effects	Defining a number of species, habitats and ecosystems and developing methodologies and indicators for monitoring climate change impacts to biodiversity. Developing specific measure to protect species and habitats that are vulnerable to climate change. Monitoring the level of endangerment of biodiversity from extreme weather events.	Environmental Protection Biodiversity	Ministry of Environmental Protection, Agency for Environmental Protection	Number of indicators, species, habitats and ecosystems with established monitoring of climate change impacts (Agency for Environmental Protection)	From 1.000.000 EUR to 10.000.000 EUR	Budget International funds (Adaptation Fund, GCF, GEF)
	Capacity building and improving the cooperation among scientists and researchers	Improving cooperation among scientists and researchers from different research fields in order to investigate climate change impacts to biodiversity in Serbia.	Environmental Protection Biodiversity	Ministry of Environmental Protection, Agency for Environmental Protection Scientific and Research Institutes	Number of published scientific papers with a subject of climate change impacts to biodiversity (Ministry of Environmental Protection)	From 100.000 EUR to 1.000.000 EUR	Budget International funds (Adaptation Fund, GCF, GEF) International projects
PUBLIC HEALTH	Development of action plans for respond to climate change in urban areas	Development of action plans with recommended measures to respond to climate change in urban areas	Public Health Environmental Protection	Ministry of Health Institute of Public Health of Serbia	Number of developed action plans for urban areas (Ministry of Health)	From 100.000 EUR to 1.000.000 EUR	Budget International funds (Adaptation Fund, GCF, GEF)

	Establish monitoring of diseases introduced as a consequence of climate change and vectors that transmit them	Establish monitoring of diseases introduced as a consequence of climate change (West Nile, Chikungunya, etc.), as well as vectors (insects such as mosquitoes) that transmit them	Public Health	Ministry of Health Institute of Public Health of Serbia	Number of patients with diagnosed diseases that are introduced due to climate change and that have established monitoring system (Institute of Public Health of Serbia)	From 1.000.000 EUR to 10.000.000 EUR	Budget International funds (Adaptation Fund, GCF, GEF)
	Improvement of scientific research on direct and indirect climate change impacts to human health in Serbia	Improving cooperation among scientists and researchers from different research fields in order to investigate climate change impacts to human health in Serbia.	Public Health	Ministry of Health Institute of Public Health of Serbia Research Institutes /Academia	Number of published scientific papers and funded research projects with a subject of climate change impact to human health (Ministry of Health)	From 100.000 EUR to 1.000.000 EUR	Budget International funds (Adaptation Fund, GCF, GEF) International projects
DISASTER RISK REDUCTION	Developing an efficient and comprehensive system for risk reduction and assessment and monitoring losses and damages due to natural hazards that are caused by climate change	Development of detailed methodology for assessment of damages and losses due to natural hazards that are caused by climate change in all sectors. Establishing monitoring system for losses and damages in all relevant sectors. Improvement of using DesInventar.	All sectors	Ministry of Internal Affairs	Developed methodology for assessment of losses and damages and established monitoring system (Ministry of Internal Affairs)	From 1.000.000 EUR to 10.000.000 EUR	Budget International funds (Adaptation Fund, GCF, GEF)
	Improvement of monitoring, forecast and early warning hydro-meteorological systems	Improvement of meteorological and hydrological observation and monitoring systems. Improvement of operational meteorological and hydrological forecasts quality. Establishing an effective system of dissemination and information use in all relevant sectors	All sectors	Ministry of Internal Affairs Republic Hydrometeorological Service of Serbia	Number of users of forecast and early warning system (Hydrometeorological Service of Serbia)	From 10.000.000 EUR to 100.000.000 EUR (10.000.000 EUR for pilot region)	Budget International funds (Adaptation Fund, GCF, GEF)
	Integration climate change projections into national and other risk assessments	Update national and local risk assessments by including quantified impacts of climate change on frequency and intensity of natural hazards in the future.	All sectors	Ministry of Internal Affairs	Number of issued approvals for risk assessments with incorporated climate change projections (Ministry of Internal Affairs)	From 100.000 EUR to 1.000.000 EUR	Budget