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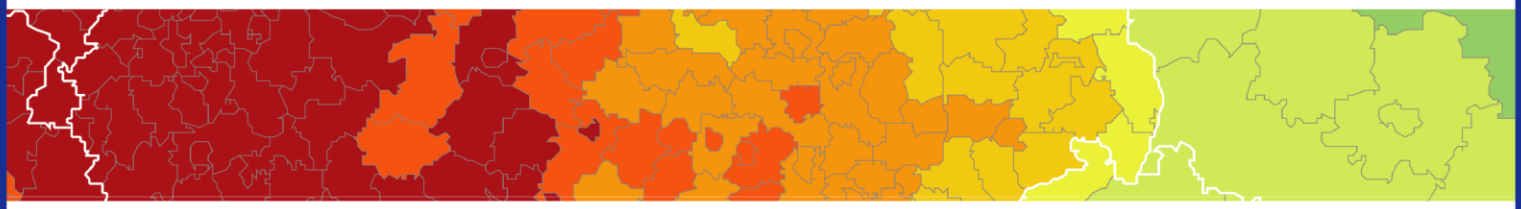

ESPON-TITAN
Territorial Impacts of Natural Disasters

Applied Research

Final Report – Case Studies Report
Prague (Czech Republic)

June 2021

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Case Study Report

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Abbreviations

EC	European Commission
ESPON	European Territorial Observatory Network
ESPON EGTC	ESPON European Grouping of Territorial Cooperation
EU	European Union
GDP	Gross domestic product
NBS	Nature-Based Solutions
NUTS	Nomenclature of Territorial Units for Statistics

1 Introduction

Prague is the largest city in Czech Republic. There are 1,3 million inhabitants (2019), 12,3% of the total inhabitants of the country (Eurostat, 2020), as shown in Figure 1. Prague is close to the Vltava riverbanks, which runs through the city for 30km; consequently, it has a rather rugged topography. Prague has a regional status, divided into 10 municipal districts, 22 administrative districts and 57 municipalities.

Figure 1. Prague location in Czech Republic and population density, 2020

Source: http://www.geo-ref.net/en/cze.htm

Prague has a unique position in Czech Republic: it is the economic centre of the state, which concentrates the principal political authorities of the state administration, most financial institutions and foreign enterprises, contributing to the regional economy.

It is politically, economically, and culturally the most developed city in the country. Moreover, Prague is among the most developed regions in the EU, especially in Central and Eastern Europe (Eurostat, 2020). The concentration of strategic, political, and economic functions and the proximity of key players in the capital makes Prague a distinct centre of development at a national level. In 2018, Prague contributed to the national GDP by 25,8%. This represents the highest share compared to other Czech regions (Eurostat, 2020).

Table 1. Economic situation in Czech Republic (CZ), 2019

Indicator	2012	2013	2014	2015	2016	2017	2018
Real GDP growth CZ (%)	-0,8	-0,5	2,7	5,3	2,5	4,4	2,9
Real GDP growth EU28 (%)	-0,4	0,3	1,8	2,3	2,0	2,4	1,9
Real GDP per capita CZ (EUR)	15.100	15.000	15.400	16.200	16.500	17.200	17.600
Unemployment rate CZ (%)	7,0	7,0	6,1	5,1	4,0	2,9	2,2
Unemployment rate EU28 (%)	10,5	10,9	10,2	9,4	8,5	7,6	6,8

Source: EUROSTAT (2019)

2 Main characteristics of the administrative structure and planning system

2.1 Brief introduction to the administrative structure

The Czech Republic is a representative democracy. It is a unitary State which comprises three levels of government: central, regional, and municipal. There are 14 Regions (Kraj), 76 counties (Okres), and 6.258 municipalities (Obec).

Prague is an administrative region and a city as well. Therefore, it has competencies at both regional and municipal governmental levels, besides being the Czech Republic's capital. Consequently, regional and national governance subjects are connected.

Prague is self-governed by its government elected by citizens. The elected Municipal Assembly consequently elects the Mayor and the Council – the executive body of Prague. The Council establishes its initiative and advisory bodies which help to manage issues to the extent defined by the Czechian law that is of interest to Prague and its citizens. Among such activities are e.g. education, social and housing, and environmental policies. Research and innovation are not a mandatory objective of the strategies of cities and regions in Czech Republic.

2.2 Brief introduction to the planning system

The planning system framework is Act No. 183/2006 Coll.[1] on spatial planning and building regulations. According to this act, spatial planning deals systematically and globally with the land-use setting the principles of area arrangement, and coordinates the construction and other activities influencing the land development as to their time and contents.

The authorities related to planning are (from local to national) municipalities, regions, and the Ministries for Regional Development and Defence.

Spatial Development Policy of the Czech Republic represents an obligatory tool for state-level agreed by the Czech Republic government (July 20th, 2009), resolution N^{o}929. They include among their contents: spatial planning tools and spatial development policy, spatial planning documents, and documentation, zoning decisions, zoning procedures (land management), zoning measures on building closures and land remediation, pre-emption rights, and compensation for the change in land-uses.

The current zoning plan in Prague, approved in 1999, defines the development in the city. It represents the basis for decision-making by the building authorities. It is compulsory to consider it for the proposed developments. The current zoning plan identifies publicly beneficial development, addresses transport and technical infrastructure and, above all, defines how to use the individual parcels of land.

[1] https://www.mmr.cz/getmedia/9a941cf5-268b-4243-9880-d1b169fb33d6/SZ_angl.pdf

The current zoning plan defines:

- Functional regulations. It indicates the permitted land-use of individual sites (e.g.: residential, industrial, sports and recreation, public amenity, transport...)
- Spatial regulations. It indicates the capacity of each area. Namely stabilized, developmental, or transformational areas.
- It is responsible for the location of housing in the city centre, green areas, flood plains, large development areas, publicly beneficial developments, transport infrastructure, and technical infrastructure.

The zoning plan is generally binding, although changes or adjustments are allowed. The Metropolitan Plan, currently being drafted for the City of Prague, will replace the existing Prague Land-use Plan. It has been an intense work-in-progress since 2012. The adoption of changes to the zoning plan is limited, aside from critical changes needed for the city's functioning.

The uncontrolled urban expansion is environmentally harmful and economically unsound, and tackling urban sprawl is among the plan's main priorities, proposing the definition of clear borders between the city and the countryside.

Another element of the plan is the use of the term "locality" to refer to the plan's basic planning unit. Localities are defined by their position in the city, the prevailing character of built-up areas and landscape, and their specific cultural and economic conditions. The new plan aims to support the existing urban character of the various localities throughout the city, i.e., different regulations will apply to different localities based on their urban context.

The plan also aims to set building height limits across Prague to help maintain the city's character, while allowing for some higher buildings where appropriate.

The Spatial Development Policy of the Czech Republic from 2015 does not mention climate adaptation explicitly. However, it contains several priorities relating to spatial planning for sustainable development, which deal with climate adaptation, e.g. in the field of flood damage prevention and biodiversity reinforcement. It also sets out the specific spatial planning tasks with a territorial projection of areas suitable for the accumulation of surface water and dams.

However, the Strategy of Regional Development of the Czech Republic 2014-2020, contains explicit references to climate impacts and the need to tackle them. Moreover, the Action Plan for the Regional Development Strategy 2017-2018, does contain specific references to climate impacts and the need for climate adaptation. The Ministry of Agriculture and the Ministry of the Environment (in line with the national Water Act) developed a general plan that defines a suite of protected sites that are morphologically, geologically, and hydrologically suitable for accumulation of surface water. This general plan is considered as one important documents supporting spatial planning.

3 Hazard profile and economic impacts of natural hazards in Prague

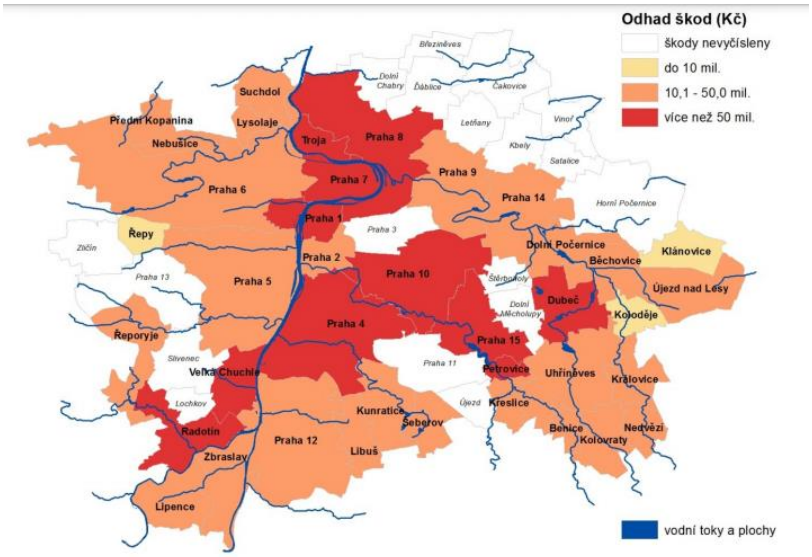
The main natural hazard in Prague is flooding. Although drought is also a natural hazard present in the area, it's approached secondarily in this case study. In terms of drought, major heat waves of summer 2003 and 2006 increased significantly daily mortality in Prague. While focusing on events related to river floods, two major floods – in August, 2002 and June, 2013 – have to be highlighted.

In August 2002, Prague experienced severe flooding (500-year flood) when the flooded Vltava and Berounka rivers arrived to the capital of the Czech Republic as a result of a large raining event that affected Europe. The major effects were caused by Vltava river that flowed at a rate of over 5.000 m^3/s (180.000 cu ft/s), reaching the peak of 5.160 m^3/s. Zbraslav, Velká Chuchle, Radotín, Lahovice, Lahovičky, Kampa, Malá Strana, Smíchov, Holešovice, Karlín and Troja were the main affected areas. During the flood, 50.000 people were evacuated, and 17 people from outside Prague died due to the massive damage and disruption produced. Charles Bridge, the oldest bridge in Prague, was left seriously weakened, requiring years of work to repair. At the riverside, several major chemical factories released dangerous toxic chemicals into the Vltava. Also, the Zoo and 18 metro stations were damaged. Altogether, this event affected 169 buildings and houses, killed 149 animals in the zoo, affected public transportation such as metro, bus and tram stations, sewerage and other technical infrastructure. The total damage caused was estimated at CZK 27 billion.

In June 2013, similar events occurred with river flood, as the rainwater has been brought from other regions due to heavy rains. Compare to the 2002 flood, the water to Prague came much faster than assumed. There were floods on several rivers at a time (e.g., Vltava, Berounka, Rokytka and Botič rivers). Vltava river flowed at a rate of 3.210 m^3/s. As a combination of floods from multiple small rivers, a much larger surface area was affected on smaller zones outside of Prague. The most impacted area was Prague 7 (Troja), especially the Zoo (half of the zoo was paralyzed for several months). Prague 10 and 16 (Radotin) were also damaged (outskirts of Prague), thus some agricultural land was impacted too. Figure 2 shows the different impacts of the flood in the area of Prague.

It's important to highlight that central areas of Prague were not impacted, since they were protected by the post-2002-developed flood protection measures. Parts of all three city metro lines were closed. Heavy machinery was brought in to protect the historic Charles Bridge. One thousand troops from the Czech Army were called in to help build flood defences. In Prague, Hostivař, Záběhlice, Modřany and Zbraslav, neighbourhoods were evacuated while some people in Lahovice and Velká Chuchle had to be rescued by helicopter. In June 2013, the Czech government declared a state of emergency in seven regions of the country including Prague, in response to the floods. The Czech prime minister announced that the government would release CZK 4 billion from the state reserves to repair the damage. Around 20.000 people were evacuated in the Czech Republic.

Figure 2. Damage in Czech Republic by 2013 flood



Source: Interview with Michal Novák (Prague Institute of Planning and Development)

The economic impact of the 2013 flood in Prague was lower than the 2002 flood, as after the first flood, some protection measures were developed. However, the impact was still high as showed in Table 2.

Table 2. Economic damage to the city of Prague after the 2013 flood

Damage class	Estimation of economic damages (thousands of CZK)	Estimation of economic damages (EUR)
Residential buildings and their contents	289.744	10.933.735
Infrastructure (powerlines, telecommunication etc.)	1.562.526	58.963.245
Transport (roads, bridges etc.)	362.615	13.683.584
Agriculture (both crops and livestock)	70.022	2.642.339
Environment (natural functions of water streams, damages to ecological stability, other damages to water streams)	265.150	10.005.660
Other	999.478	37.716.150

Source: Interview with Michael Novák (Prague Institute of Planning and Development)

Direct economic impacts were caused by the loss of properties (including 598 buildings damaged), sewerage, facilities of the zoo, roads and other technical infrastructure (metro, transportation service), cultural buildings, national heritage, schools and school facilities, and the livestock death. Indirect economic impacts were caused by water pollution (e.g., from wastewater), landslides on roads, etc… As a result, indirect economic costs have been mainly caused by the fact that services couldn't take place in the area and construction had to be paralyzed.

4 Disaster Risk Management in Prague

The main bodies involved in Disaster Risk Management are the Government of the Czech Republic, Ministries and other administrative authorities, as the Czech National Bank, Regional authorities, Municipalities and designated bodies with territorial competence. Their function in Disaster Risk Management is to ensure analysis and evaluation of possible threats to its security, planning, organization, implementation and control of activities in connection with preparatory measures and crisis management. Crisis management is ruled by Act No. 240/2000 Coll[2].

Legal framework for flood risk management is based in Directive 2007/60/EC[3] of the European Parliament and the Council on the assessment and management of flood risks - the so-called "Flood Directive". This Directive is complementary to the Water Framework Directive (2000/60/EC) and the process of implementing both Directives and the planning cycle should be addressed in a mutually consistent manner. The Directive was created in response to the catastrophic floods in Central Europe in the summer of 2002. The implementation of the Floods Directive in the Czech Republic began in 2009 with transposition into the Water Act, both in Title IV Water Planning and Title IX Flood Protection.

Water planning takes place in six-year cycles. The whole six-year cycle is always divided into three consecutive parts, where the previous phase is the necessary basis for the next. In the consecutive cycle, the created documents are reviewed and updated. The three phases of implementation of the Floods Directive are: 1) preliminary flood risk assessment, 2) flood hazard and flood risk maps, and 3) flood risk management plans.

Risk and hazard maps are used for flood risk assessment, and elaborated under collaboration with universities. As a result, plans are used to limit land-use areas with information based on historic events, and no projections are made to consider different scenarios.

Flood Risk Management in Czech Republic was mainly impulsed by the major flooding events of of 2002 and 2013. The extent of the first flood in 2002 was catastrophic, not just for the city of Prague but for the whole of Bohemia and also for the rest of the country. In the following 11 years, great improvements were made in flood risk prevention; the government managed to complete the planned anti-flooding measures (which were already planned before the 2002 flood). Vltava and Berounka rivers were controlled with construction measures. However, in 2013 a combination of floods from multiple small rivers (not only Vltava and Berounka) occurred and thus a much larger surface was affected. Nowadays, planned measures on these small rivers located in areas outside of Prague have not been implemented yet, mostly because of administration fragmentation and the lack of agreement between the land-owners.

[2] https://ec.europa.eu/echo/sites/echo-site/files/240_2000_crisis_management_act.pdf

[3] https://www.eea.europa.eu/policy-documents/directive-2007-60-ec-of

Several measures were implemented as a result of the 2002 flood. In areas prone to flood risk, land-use management has been implemented preventing certain services and buildings from being located there. Despite earlier constructed areas as industrial area in Prague, such as Radotín that are already established in these flood-prone areas, new developments are limited. The planned flood protection measures were implemented alongside the two main rivers (Vltava, Berounka), and finalized in 2012, with a total cost of CZK 4,3 billion. In the centre of Prague, mobile barriers were purchased for case of an event, which are built twice a year to regular revision and for firemen-training. In the periphery of Prague, a combination of fixed and mobile barriers was placed. The historical centre was somehow protected from damage as some plans were already implemented before the 2002 flood.

The flood of 2013 showed the weak points of the previously built flood protection, which were evaluated by experts that further proposed new solutions.

Table 3 shows the damages resulting directly from rivers Vltava and Berounka in both floods, and the investments made after the occurrence of those events. This data potentially shows the relation between the preventive measures and the reduction of the 2013 flood damage. The costs of the post-2013 mitigation measures were roughly CZK 200 million, as all the key parts of the protection measures were already in place after the 2002 event.

Table 3. Damages resulting directly from rivers Vltava and Berounka and the investments made after the events occurred

Flood	**Damages**	**Investments in prevention after the event**
2002	CZK 7 billion (only in Prague)	CZK 4 billion
2013	CZK 3,8 billion	CZK 200 million

Source: Interview with Michal Novák (Prague Institute of Planning and Development)

The financial mechanisms for risk management are public insurances, government budget assigned and European Union Funds. Private insurances do not cover flood damages.

5 Climate Change Adaptation in Prague

5.1 General remarks

Both the National and City-Region of Prague face the increase of frequency in extreme weather events related to climate change. Mean annual air temperatures have been increasing. The frequency, intensity, and duration of extremely hot periods (heat waves) are increasing in Prague. A risk of torrential rains and consequent local floods have also been increasing, as well as discharge fluctuation (droughts versus floods). Winter precipitation totals will increase, whilst summer precipitation totals will decrease. Also, the number of days in the period without precipitation shall be significantly increased as well as risks of occurrence of droughts. The climate models predict an increase in extreme weather events (windstorms, tornados, ...) frequency.

The Capital City of Prague Climate Change Adaptation Strategy[4] is connected with the Strategy on Adaptation to Climate Change of the Czech Republic[5], approved in 2015. It aims at reducing adverse climate change impacts through Nature-Based Solutions (NBS), using natural vegetation patterns. Green infrastructure has a key role in this strategy, to contribute to natural disaster prevention.

If NBS cannot be applied or are ineffective, suitable technological (also called “grey”) and soft measures, e.g. early warning systems or communication, education, and public awareness and environmental education campaigns, will be used. The strategy considers the Prague landscape, characterized by its high proportion of built-up areas (economic, technological, and transport infrastructure) and unevenly dispersed vegetation component distribution.

By Prague Council Decision No.3213 of December 12, 2015, the Capital City of Prague became a Mayors Adapt Initiative member, thus accepting a commitment to develop a climate change adaptation strategy and to monitor and assess the process and procedure of adaptation measures including risk assessment and elaborating biennial assessment reports.

For the development of the Prague Climate Change Adaptation Strategy, it is necessary to develop Implementation Plans containing specific adaptation measures and pilot projects, which contribute to climate change mitigation, their monitoring and effectivity, and effectiveness assessment.

[4] http://portalzp.praha.eu/file/3034151/Climate_Change_Adaptation_Strategy_Prague.pdf

[5] https://www.mzp.cz/en/strategy_adaptation_climate_change

5.2 Climate change impact assessment

Assessment of vulnerability to climate change effects in Prague, including the non-action option, is based on the scenario's policy. About floods and insufficient rainfall water infiltration, The City of Prague has been threatened by two flood types:

- Floods are caused by long-term regional rains in Spring and Summer, occurring mostly on the Vltava and Berounka rivers (the so-called river floods).
- Torrential floods on smaller watercourses in Prague are related to short-term highly intensive rainfalls affecting concrete areas (the so-called flash floods).

In the past, namely in 1830-2013, the City of Prague was affected by floods on the Vltava River. After the floods in 2002, the flood prevention was built and control facilities were improved in Prague, helping to protect and save lives and properties. In the future, stronger river flood impacts in West and Central Europe, thus in the Czech Republic, are expected.

Following this general rule, from past events experience, future measures are developed. The ability to forecast torrential floods is limited, due to high dynamics in conventional cloudiness where torrential rainfalls are formed. Although meteorological conditions for creating strong torrential rainfalls can be successfully forecasted, the particular site, duration, and intensity in torrential rainfalls and thus a threatened area cannot be exactly and precisely predicted.

5.3 Climate change adaptation

There are adaptation measures to enhance long-term resistance and reducing the vulnerability of the Capital City of Prague to climate change impacts. Following a step-by-step implementation, these measures are preferably NBS combined with grey, as technological, and soft measures, thus contributing to the Prague´s inhabitants well-being. This kind of NBS, using ecosystem services provided by blue and green infrastructures, represent the best alternative for climate change impacts (high temperatures, urban heat island and heatwaves, and insufficient rainfall water infiltration).

The green infrastructure, consisting of all greenery types in the landscape, naturally cools its neighbourhood by providing shade and evapotranspiration. The cooling effect is the highest in woody plants, particularly in full-grown trees, whenever there is a sufficient underground water source.

For stabilizing the hydrological cycle, it is reasonable to support water infiltration and retention at the site where they have reached the ground, by introducing water permeable and semi-permeable patches, and establishing sites allocated for rainfall and stormwater retention. NBS support the use of ecosystem services provided by the green and blue infrastructure, which conditions natural ecosystems, supporting human activities. Ecosystem services include various benefits for humans, provided by nature (photosynthesis, soil-forming, water retention in soils, positive effects on human health, forming aesthetically valuable environment, production functions, etc.).

Green infrastructure – a set of semi-natural and man-made structures that provide directly or indirectly multiple benefits to society (i.e. ecosystem services), and support and improve ecological functions. In other words, it is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It includes both a protected area network and the non-reserved landscape outside protected areas including various greenery sites in human settlements, from green roofs and greenery belts to urban parks of various sizes. Therefore, the green infrastructure concept considers land-use and territorial planning as a key tool allowing multi-purpose use of the landscape.

In a broader sense, the green infrastructure also covers water areas. Blue infrastructure consists of water elements, such as watercourses, water bodies, other wetlands, springs, wells, water infiltration vegetation belts, etc., helping to retain water in the landscape and slowing rainfall runoff from a particular area. The blue infrastructure supports water availability for the green infrastructure in towns and cities accumulation, i.e. polders, water reservoirs, artificial wetlands, and other blue infrastructure components.

Other benefits, as air quality improvement, enhancement of human health, provision of space for recreation and leisure, and incentives for sport practices, are provided by ecosystem services and the green infrastructure.

If ecosystem services cannot be used or are ineffective for mitigating the particular climate change effect, it is necessary to apply technological or grey solutions. It means, implement soft measures that help to enhance human society as individual inhabitants´ resistance by protecting them against climate change risks through early warning, communication, education, and public awareness/environmental education, etc.

6 Vertical and horizontal cooperation system in DRM and CCA in Prague

Czech Republic's inclusion into the European Union had a remarkable impact through their directives on the Czech administrative configuration and functioning. The difficulties in the administrative coordination and the excessive participation from the national level into local entities were criticized by Europe. For this reason, in the Constitutional mark, there was a reconsideration of the territorial structure to improve the situation. According to article 99, the municipalities represent the local level, and Regions, the territorial level for self-government. Between them, there is no subordinative relation but a competitive one. The 1/2003 n.314 law completed this model eliminating the district administrations.

Despite symmetry between the Regions, sharing the same autonomy and competencies (including planning as a regional competence), municipalities are far from this uniformity. It is possible to find three autonomy levels, i.e. municipalities with (i) delegated competences, (ii) with national offices, and (iii) with extended competencies.

In this context, coordination and cooperation represent a challenge due to fragmentation in administration. In the case of planning, this difficulty increases due to the private ownership of relevant pieces of land. The planning process involves politicians (they initiate the procurement of planning documentation and decide on its approval), officials (e.g. municipal offices with extended power procure plans and relevant authorities comment on them), and designers (who process the documentation). The process of issurance of binding planning documentation involves the engagement of the general public (citizens and civil society organizations). Real estate owners may present objections to the draft documentation and anyone may present their comments. All comments and objections must be addressed. The general public is in some cases actively engaged in the creation of planning documentation.

By Prague Council Decision Nº.3213 of December 12, 2015, and applying, the Capital City of Prague became a Mayors Adapt Initiative member, thus accepting a commitment to develop a climate change adaptation strategy and to monitor and assess the process and procedure of adaptation measures including risk assessment and elaborating biennial assessment reports.

Better results produce cooperation, as the international perspective presented on the Common spatial development document of the V4+2 countries[6].

[6] https://www.mmr.cz/getmedia/e29f36f6-df9d-468a-89e9-01673f5192ea/V4plus2_Document_eng_ok.pdf

It is the result of the Czech Ministry for Regional Development in an attempt to propose a close cooperation between six countries with similar interests and needs: Czech Republic, Hungary, Poland, Slovakia, Bulgaria and Romania. The main objectives were:

- Delineation by the common method of development poles, development axes, and transport networks (railways, roads, inland waterways, inland ports, seaports, and airports);
- Identification of cross-border no-continuations of development axes and cross-border no continuations of transport networks;
- Overview of spatial development systems in V4+2 countries, glossaries of special terms, websites;
- Solution of no-continuations of development axes and no-continuations of transport networks;
- Formulation of a V4+2 countries´ common spatial development strategy in the European context;
- Openess for participation in other neighbouring countries.

7 Lessons learned

Disaster risk management in Prague has been improved since the two major flood events that have occurred in the last two decades, which contributed to impulse boost it with a set of lessons learned. The 2002 event showed that the flood protection in place, that although planned was not implemented in the whole length, was not sufficient to prevent the whole city from the effects of floods. After this emergency, river dynamic was taken into account in order to prevent future events, even though the emphasis was more addressed to the large rivers (Vltava and Berounka), and for different reasons, not to all smaller rivers, neither on river basins and the whole city that, as a complex area, may also be indirectly affected by the hazard. The flood also highlighted some weaknesses of the alert system and following protecting activities that, for instance, should be more flexible, proactive and adaptable for such quick events.

As a consequence, currently several measures are under implementation, thus considered as positive lesson or **strengths**:

- Potential plans are currently being prepared for the city to better protect the zoo;
- Various studies are being developed on how the areas around small rivers can be protected. For instance, the update of runoff conditions are being done on small watercourses;
- In populated areas, plans on rehabilitation and revitalization of rivers are being implemented;
- After the overflowing of the Hostivar dam, some works are under progress to improve the dam (e.g.: increasing safety in relation to spill protecting-dike capacity). This is so far one of the largest investments of post-2013 measures, with an estimated cost of hundreds of millions of CZK;
- Prague is interested on finding solutions beyond rivers, i.e. a resilient landscape and environment, which are closely connected with water retention capacity and thus somehow able to mitigate flooding and droughts.

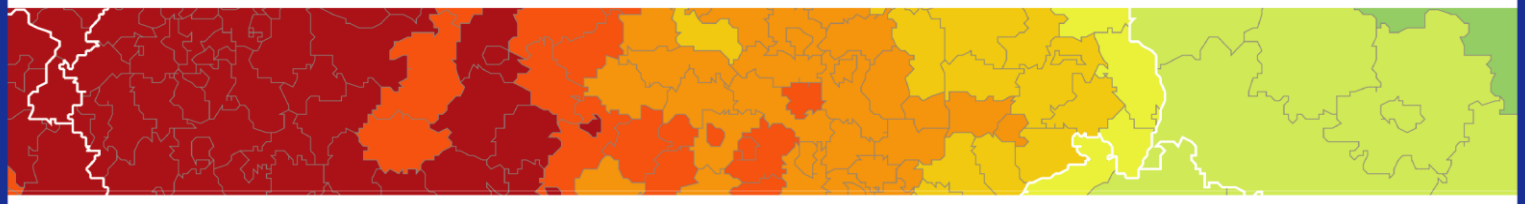
As a result of the learning process after each flood, Prague has improved its flood risk management plan and the information process associated with the civil protection activities. Besides, strategic plans for tackling climate change are put into evidence, as additional materials that help to improve people´s life and the environment.

The **weaknesses** of this model can be seen as critical points that need attention and as areas for future development:

- As discussed above, Prague authorities may have missed some foresight managing flood risks, although they have clearly learned from previous mistakes from the two main floods mentioned in this text, as well as smaller floods occurred in between. In

this line, some more intense benchmarking is recommended on analysing the cases of other territories with a more extended experience on managing this kind of risks.

- Finally, there is a need to anticipate risk events and in the case of Prague policies, rather small steps are made. By now, in Prague, no scenario policies are proposed, and the information available for risk assessment is based on historical information. Thus, it would be necessary to create further solutions triggered by climate change, such as flash floods.



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