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THINK HAUSSMANN !

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How to create space for ecosystem services in overcrowded cities?

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AVERTISSEMENT

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Formation par la recherche, Projet de Fin d'Etudes en génie de l'aménagement et de l'environnement

La formation au génie de l'aménagement et de l'environnement, assurée par le département aménagement et environnement de l'Ecole Polytechnique de l'Université de Tours, associe dans le champ de l'urbanisme, de l'aménagement des espaces fortement à faiblement anthropisés, l'acquisition de connaissances fondamentales, l'acquisition de techniques et de savoir faire, la formation à la pratique professionnelle et la formation par la recherche. Cette dernière ne vise pas à former les seuls futurs élèves désireux de prolonger leur formation par les études doctorales, mais tout en ouvrant à cette voie, elle vise tout d'abord à favoriser la capacité des futurs ingénieurs à :

- Accroître leurs compétences en matière de pratique professionnelle par la mobilisation de connaissances et de techniques, dont les fondements et contenus ont été explorés le plus finement possible afin d'en assurer une bonne maîtrise intellectuelle et pratique,
- Accroître la capacité des ingénieurs en génie de l'aménagement et de l'environnement à innover tant en matière de méthodes que d'outils, mobilisables pour affronter et résoudre les problèmes complexes posés par l'organisation et la gestion des espaces.

La formation par la recherche inclut un exercice individuel de recherche, le projet de fin d'études (P.F.E.), situé en dernière année de formation des élèves ingénieurs. Cet exercice correspond à un stage d'une durée minimum de trois mois, en laboratoire de recherche, principalement au sein de l'équipe Dynamiques et Actions Territoriales et Environnementales de l'UMR 7324 CITERES à laquelle appartiennent les enseignants-chercheurs du département aménagement.

Le travail de recherche, dont l'objectif de base est d'acquérir une compétence méthodologique en matière de recherche, doit répondre à l'un des deux grands objectifs :

- Développer toute ou partie d'une méthode ou d'un outil nouveau permettant le traitement innovant d'un problème d'aménagement
- Approfondir les connaissances de base pour mieux affronter une question complexe en matière d'aménagement.

Afin de valoriser ce travail de recherche nous avons décidé de mettre en ligne sur la base du Système Universitaire de Documentation (SUDOC), les mémoires à partir de la mention bien.

ACKNOWLEDGEMENTS

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INTRODUCTION

Urban planning has strongly neglected the importance of ecosystem services and of biodiversity. 68% of the habitats threatened at European level are found in metropolitan France, such as mowed grasslands and dunes. Moreover, artificial surfaces increased by 1.4% per year on average between 2006 and 2015. In 2015, 5.16 million hectares of the metropolitan territory are artificialized, being 9.4% of the territory (Lévêque and Cerisier-Auger 2018). As a result, most cities suffer a lack of connectivity between green and blue spaces. Ecosystem services no longer have a place in cities today. The MEA (Millennium Ecosystem Assessment) 2005, has classified ecosystem services into four classes: supply services (crop products, food, water, etc.) ; regulatory services (reduction of heat islands, limitation of diseases, etc.) ; support services (support to previous services e.g. primary production) and cultural services (cultural, spiritual and aesthetic values). Inconveniently, the artificialisation and waterproofing of soils do not allow nature to share its benefits with humans.

Moreover, the fact that many cities harbour large numbers of species leads to a problem of biodiversity conservation. As urban dwellers, both animals and plants, are very often generalist, pioneer, and r-strategist species, including a large amount of exotic, heat-loving invasive species. Whereas sensitive species, migratory, large-bodied or otherwise environmentally demanding species continue to become vulnerable, rare, or gradually extinct. In the same way, human well-being is compromised in different ways by the absence of functional ecosystems. Respiratory diseases and lack of perception of natural forms are some of the effects of ecosystem dysfunction (Wantzen et al. (2016) and citations therein).

Finally, climate change is literally deteriorating the urban climate and raising water management issues. Floods, droughts and heat waves are increasing, as is the frequency of extreme events. In 1950, 24 natural disasters were recorded, 296 in 1990 and 394 in 2015 (Magdelaine 2017). In 2017, the 335 natural disasters recorded caused the deaths of nearly 10,000 people, affected 95.6 million others and engendered $334 billion in damage (CRED 2018). Floods, one of nine categories, accounted for 38% of climate disasters in 2017 and affected 55 million people around the world (CRED 2018). Climate change therefore causes significant material and natural human damage, but can also be seen as an opportunity to restructure urban space. Upcoming concepts as the “Sponge City” include new ways to store and release water in a more controlled way, and to give room for rivers. The essential argument is space. Extremely high real estate prices in cities make river restoration projects much costlier (1,000 – 100,000 times) than those in open landscapes (Zingraff-Hamed et al. 2017). However, the increase in financial risk in flood-prone areas is reflected in a decrease in the willingness of insurance companies to pay for flood damage (Zurich Insurance Group 2013). As a result, house prices in some floodplains can be expected to fall in the future. In addition, due to social change from an industrial to a service-oriented society, many old industrial buildings located on rivers banks are becoming obsolete.

The facts and hypotheses outlined open the field for a thought experiment: Is it possible to restructure urban riparian areas to create space for nature, floodwaters and human well-being?
This report aims to examine different case studies. They will make it possible to analyse how nature has made it possible to respond to particular problems or expectations of project leaders. Based on a historical, radical change of an overcrowded city, Paris in the 19th century, this study analyses the cases of reopening blue-green spaces in French, Spanish and South Korean cities.

CASE STUDIES

I. The transformation of Paris by Haussmann

During the 19th century, France was an empire led by Napoleon III. After he was exiled abroad, and in particular to London where he found inspiration for the gardens of Paris. Indeed, he wanted to give a new face to the capital, which had been by that time ravaged by successive epidemics and poor traffic. Water was poorly drained, stagnant and waste was often left on the streets. In addition, the very close houses, often made of wood, limited air circulation and in the event of a fire, the damage was very serious. It was therefore necessary to find a solution to make Paris breathable and clean.
Population growth was also a major issue. At first, he confided the idea to the prefect of Paris: Claude-Philibert Barthelot of Rambuteau. Rambuteau did not want to create a debt and therefore only proposed plannings in accordance with the budget of the time. When Baron Haussmann became prefect, he proposed an almost total transformation of Paris, irrespective of existing structures. Haussmann created a series of open places and avenues to connect them and to allow the circulation of traffic and of air, which would put the city in debt for 50 years. One of the major transformations of the city was the creation of the boulevard Sébastopol requested by Napoleon III to access the Gare de l'Est. But the contrast with the old Paris is even more marked thanks to the evacuation of waste water. The creation of a large sewerage system and better distribution of drinking water have made epidemics disappear. The use of cement has allowed a low cost and a better construction of sewers, which can then be visited. (Des Racines et des Ailes, 2006)

The following analysis is based on the conference of Florence Bourillon, professor of contemporary history at the University of Paris-Est Créteil, who went to the IEA in Paris in 2017. We look back at the stages of the metamorphosis of Paris by Baron Haussmann in the 1800s.

Napoléon III wanted to « form arteries favourable to the development of the city by bringing the centre closer to the extremities, we will thus see each year large arteries open, working class districts being cleaned up, rents tending to fall and Paris thus responding more and more to its high destination ».

The emperor had given instructions:

- 95 km of new roads in the old Paris of the 12 districts included within the General Farmers' Wall
- 70 km in the new territories annexed in 1860
- Construction of public equipments and buildings
- Development of parks
- A threefold increase in the supply of drinking water
- Sewer reconstruction
- Public lighting
- Renewal of street furniture
- The doubling of the surface area of Paris via the annexation of the Little Suburb: between the General Farmers' Wall and the fortifications

Three main periods can be distinguished.

I.1. June 1853: initial situation, arrival of Prefect Haussmann

Several projects were in competition and had already started before the transformation of the capital was entrusted to Haussmann.

The first project was led by the Parisian administration and Rambuteau. It was validated after consultation and public inquiry. It concerned the opening of new roads, the reconstruction of hard-wall halls, the opening of the railway and a proposal on central districts to open them up.

A second project was presented by the Paris embellishment commission headed by Count Siméon. The documents concerning this project were discovered and acquired in the 2000s by Pierre Casselle, Director of the City Hall Library. The project plan followed very precisely a mission letter from the Emperor of August 1853 with a report expected in December 1853: clearing the train stations, creating a balance between the right and left banks and proposing an urban development that goes as far as fortification. Different construction rules also had to be followed.
In the notes attached to the report, planning proposals and advice for ports, districts, churches and opera were described. These notes would be used for future work.
The members of the commission analysed the city in a socio-spatial way and identified a geography of urban growth, these were the "phases of successive expansion". The current forms of the city should serve as references for the project to be developed. It also took into account the requests of the various commissions. Train stations were considered as a tool for distributing the population to the periphery (located at the limits of central Paris). The creation of a huge park in western Paris was also proposed.

The third project was led by Haussmann. It was not the city that interested him at the beginning of the work, but the district that extended from Les Halles to the Seine described in the municipal review published in December 1853. It was planned "to give a monumental character to the accesses to the town hall, the opening in the axis of its central pavilion of an avenue planted with two rows of trees up to the place du Chatelet". This avenue was Victoria Avenue, inaugurated during the Queen's visit to the 1855 Universal Exhibition. Haussmann imagined the town hall in front of the post office hall. An underground railway linking the Paris stations with each other, with the halls and extending to the Chatelet was also planned, it would be the first step of the subway.

These projects were not successful and were gradually shelved, so the following points can be retained:

- The importance of the urban issue in the immediate aftermath of the coup d'état
- The change of method and strategy
- A rejected overall project plan to encourage a step-by-step approach with multiple objectives

I.2. The challenges of the transformations in Paris

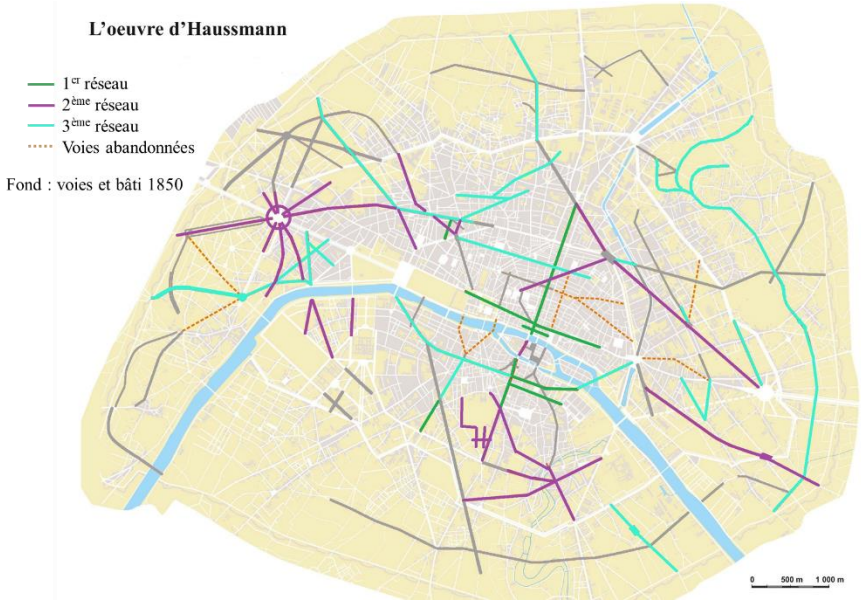

Figure 1: map of the different networks, realized by Adolphe Alphand. In green the first one started in 1852, in purple the second (1885), in blue the third which started in the middle of the 60's Source : Modified map of the Historical Atlases of Paris based on Florence BOURILLON's conference

The first network began before Haussmann was nominated prefect. It was financed by the city's money and two loans in 1852 and 1855. A grant of FRF 60 million from the legislature also contributed to the work of this first network. As its crossed shape indicates, it made it possible to cross Paris North South East West. It concerned the following measures:

- Boulevard Sébastopol was located halfway between streets Saint Denis and Saint Martin. The choice of work sites was considered to limit expropriations, which would have considerably increased the cost of the work. Indeed, this practice was used a lot for the metamorphosis of Paris
- The clearing of the Arcis district was planned just behind the town hall with the creation of two barracks
- The Victoria Avenue mentioned above has been conserved
- The construction of Haussmann islets with a homogeneous construction
- The creation of two theatres
- The design of the Halles was controversial: a construction project with stone facades was interrupted when Haussmann arrived. A metal structure with brick filling was then proposed to reduce costs

This network is both a road network and collective facilities.

The second network, in purple on the map, was framed by a treaty between the city and the legislature in 1858. The legislature indicated that this would be the last funding from the government for the renovation of the capital. The provincial deputies expressed their dissatisfaction with paying for the work in Paris that did not concern their territories. There would be a grant of FRF 50 million, the rest of the funding would have to be found by the city. To do this, it created a depreciation fund (*caisse d'amortissement*) for the work of Paris, which generated a legal floating debt instituted on November 14th, 1858.
This depreciation fund emitted bonds within limits set by the government. It would be quickly repaid through the resale of the land and the abandoned (*délaissés*) - what remains beyond the right-of-way of a street and lots. Haussmann used the law on substandard housing to expropriate land. He was moving from expropriation by parcel to expropriation by area. The Court of Cassation and the Council

of State would restrict and condemn this unfair acquisition for landowners. The owners of the abandoned then would continue to own the property and would enrich themselves by building along the new roads. This enrichment, which was supposed to benefit the city, was therefore a loss for the city, which would have more difficulty repaying its debts. In 1861, the Court of Cassation imposed compensations for renters. The financing of the continuation of the work is then very difficult.

The third network was entirely the responsibility of the city, which used bank concession companies and borrowing to finance it. It was the failure of one of the major arguments of the Haussmann project in 1854: productive spending.

The purple and blue networks are very linked because they are geographically close. The blue one is intended to complete unfinished operations. The purple one began in 1858 when the legislature granted its last grant. Blue began in the early 1860s.
In terms of planning, these networks offer:

- The clearing of the island from the city and the construction of the forecourt in front of Notre Dame. This makes it possible to strengthen the judicial and police function to the west of the city (prefecture and courthouse) and the religious function to the west of the island around Notre Dame. To affirm these two functions, Haussmann proposed the construction of the commercial court in place of the church of Saint Barthélemy, which was therefore destroyed. He also created the Republican Guard barracks built between 1863 and 1867, which would house the prefecture in 1871 after its fire.
- To the east, facilities related to the destruction and reconstruction of the Hôtel-Dieu, which disturbed the forecourt in front of Notre Dame and which was burned down in 1872. The reconstruction is a source of controversy because the hygienic proposals of the doctors of the time concerning air circulation must be respected. The 17th century Ursins district was therefore razed to the ground to install the Hôtel-Dieu, as shown in the figures below:

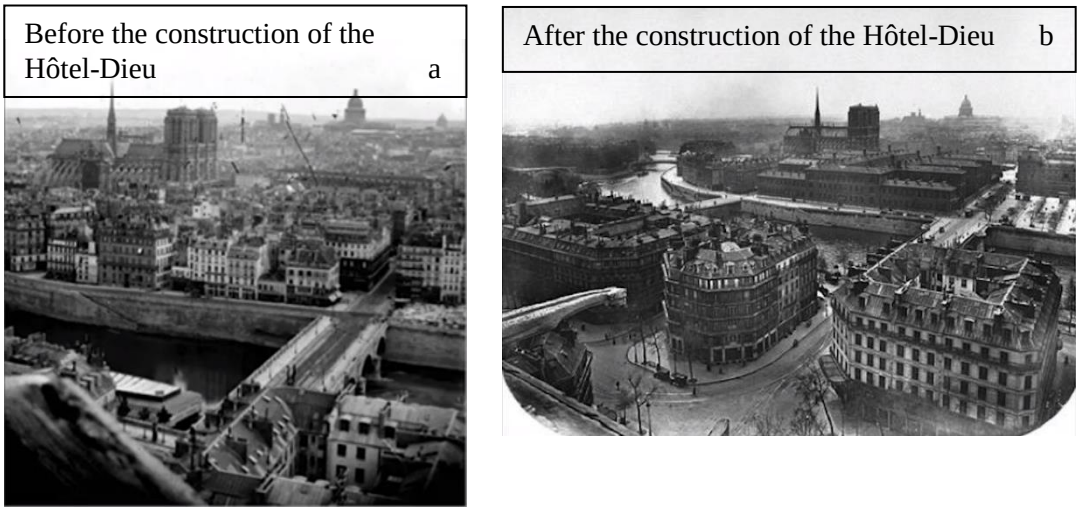

Figure 2: (a) panoramic view from the Saint-Jacques tower of Notre-Dame Cathedral in 1865. Paris 4th district. Detail of a stereoscopic view. Credit: Léon & Lévy, Roger-Viollet (b) Hôtel-Dieu, panoramic view from the Saint-Jacques tower. Paris 4th district. Credit: Charles Lansiaux (1855-1939), Carnavalet Museum, Roger-Viollet

The issues revealed are various:

Maintaining public services, clearing the forecourt in front of Notre Dame, standing back from the cathedral, accessibility to the Hôtel-Dieu and clearing the Republican Guard barracks. The forecourt will be completely cleared only at the beginning of the 20th century.

The purple and blue networks can be described as a decentralization operation - e. g. opera - to avoid asphyxiation and to enhance the city's margins. Avenue Garibaldi was finished in 1878 and have cost a lot of money because of the levelling of the mound of the Moulins.
The connection of the districts with Boulevard Voltaire to connect the Place de la Nation and the Place de la République.
The purple and blue networks are also intended to integrate the territories annexed between the Fermier Généraux wall and the fortifications of Paris in 1840.

I.3. The annexation of suburban territories

The doubling of the city's surface area has led to an increase in the number of inhabitants: between 300,000 and 500,000 new people. Suburban areas were very important because many industries were established there and new businesses, especially wine business.

No one was in favour of the annexation of these municipalities. At the beginning, the annexation was planned only in the east of the city and politicians disagreed with territorial inequality. This strategy on Haussmann's part led his opponents to talk about an annexation of East and West so as not to disadvantage a territory. A total refusal was still issued, and the commission's report was made public to keep a record of the decisions taken.
However, the decree of 16 February 1859 validated the annexation. Indeed, some ministers were corrupted to have the annexation validated. Public inquiries were carried out in the various municipalities concerned with a major proportion of people opposed to this annexation. This annexation is particularly disturbing for industries that will have to pay higher fees when passing through Parisian territory. Haussmann therefore agreed to make concessions, particularly for manufacturers who had a significant pressure on the Conseil d'Etat.

The annexation was therefore postponed for 7 years. For Haussmann, agglomerations were considered as "real parasites that live off the life of cities without bearing the costs". They have since become essential to the city.

A commission was appointed in 1860 to reorganize the street names of Paris and to create a common reference system. One third of the streets were modified. Town halls and other public facilities were built in the boroughs to give them an identity and to allow administrative decentralization in the new town halls built.
At that time, the State and the Church were still very closely linked, but only 12% of the population went to church, religious authorities took advantage of this reorganisation of Paris to ask for the construction of new churches.
The parks also took on an important role, such as the architecture of the so-called Haussmann buildings, which was reproduced until 1914.

I.4. Criticism of the modernization of Paris

The project met with opposition, particularly from opponents of the regime and especially republicans such as Jules Ferry, who regrets, among other things, the many expropriations associated with the project. For these opponents, the work led to the disappearance of the "real Paris". A generation was affected by the loss of their homes and neighbourhood habits. Criticisms of Haussmann appeared in the form of caricatures in the press.

Figure 3: Haussmann gâcheur » Affliliation de Badinguet, from La Tremblais, 1870

Explanation of the caricature: a pickaxe for destruction, a trowel for construction and a hand on the key of the state safe to remind the exorbitant cost and probably the corruption associated with the visionary's project.

The transformation and modernization of Paris continued until the beginning of the 20th century. Haussmann's bet met with success, he made Paris a unique and spectacular city. However, there are negative points to be raised: industries in the outskirts and in the centre caused significant air pollution. There was also a major contrast between the supply of bourgeois housing and the lack of popular housing. The building of facilities in western Paris was slower and until the arrival of the metro, traffic was mainly pedestrian. Finally, there was no relationship between the expanded Paris and the suburbs.

Table 1: measures put in place to deal with diverse pressures and their results. The case of Paris

Pressure	Action	Result	New uses
Health	Sewer system Large avenues for air circulation Parks	Better air quality Better quality of life No more epidemics	Sewer visits during a time Sports Family uses
Fire	Buildings made of stones	No more fire propagation Aesthetic and modern buildings	New identity for the city Tourism
Insecurity	Public gas lighting Large avenues	More effective police actions	Night walk
Bad traffic	Large avenues crossing Paris Symmetrical roads	Better circulation in all Paris	Used during national parades
Lake of space	Annexation of suburban territories Clearance of places	Displacement of poor populations Payment of more fees to the city	More attractive and renovated annexed territories

The ecosystem services regained by this transformation are mainly regulatory. They greatly reduced the epidemics of the time and still make it possible to limit the heat islands in the capital. In a certain form, there is also a cultural service with an embellishment of the city thanks to the parks. The parks also support the urban biodiversity that remains.

II. Examples of creating space for nature in Spain

II.1. Luis Buñuel River Park in Zaragoza

Figure 4: localisation of the Luis Buñuel River Park

The Zaragoza River Park was created to host the 2008 World Expo held in the city. The spaces for the pavilions and squares had to be redesigned. The choice was made to create a public space to improve the environment of the business and leisure park, which now includes a business zone, an aquarium and the convention centre, among other things. The park covers an area of 122 ha, where the Spanish facilities of Expo 2008 create a modern and symbolic landscape (Fyseg 2012). Indeed, the 76m high Torre del agua (Water Tower) shaped like a drop of water is emblematic of the city and its environmental wishes to recreate green and blue frames within it (Parque del agua (a) and (b)). Its label "water-saving city" and its designation as the headquarters of the Secretariat of the "International Decade for Action: Water for Life" for the period 2005-2015 demonstrate the international influence of the city for its water management.

Francisco PELLICER, professor of physical geography at the University of Zaragoza, explains the changes linked to the creation of the park in an interview in the TV programme Buenos Dias Zaragoza (Canal 15tv 2017). The table 2 below summarizes the actions carried out in the area, their causes and effects. The park is seen as stairs from urbanization to nature in a progressive way.
The 10 finalists in the competition for the creation of the park visited the site and were able to observe the different feelings of temperature and wind in two nearby locations in the park. The heritage of the area before the works was preserved, it is the uses that have been adapted to the wind, sun exposure and other specificities to give life to the new park. The Ebro, forming a meander, the Ranillas meander around the project, has a flow rate that can increase from 30-40m3/s to 2000m3/s, or even 3000m3/s as in 2015.
The river can therefore take possession of its major bed at any time. The park was therefore managed in a "floodable" manner so that its uses would be compatible with rising water levels. To limit the devastating effect of the water, the canal has been recalibrated: the protective stops that removed all contact with the river have been removed to widen the hydraulic section and recreate a visible and physical connection (fishing, water sports) between the citizens and the Ebro.
In addition, all the buildings have been designed to be resilient in the event of flooding: pumps have been installed in some areas and other lower parts are used in a way that is compatible with water supply. The Professor describes the park as a laboratory, where you learn how to live with water and manage its impact.

Investments related to the 2008 Exhibition are divided into three parts: the development of the basins and riverbanks of the Ebro (319 million €), the construction of major structures (581 million €) and the overall accessibility of the site (604 million €). The exhibition park therefore has an estimated total cost of more than 1.5 billion (Poulain 2006). The planning of the basins and riverbanks of the Ebro has been divided into different categories:

- Recovery of river banks - cost: 112 million euros
- The construction of a dam - cost 22 million euros
- The development of the banks to make them accessible - cost: 83 million euros
- Structuring of the Ranillas fluvial park - cost: 102 million euros

The Organizing Committee of the event paid for 16.5% of the total works, or 245 million euros. The rest of the expenditure was financed by public and private funds.

Table 2: measures put in place to deal with diverse pressures and their results. The case of Zaragoza

Pressure	Action	Result	New uses
Spatial: residential area facing a neglected agricultural and natural area	Suppression of agriculture Creation of green spaces and activity areas	Progressive transitions from urban to natural	Interconnection between economic and leisure activities
Social: insecurity of the place (prostitution)	Management of neglected spaces	Securing the site	Family and sport use
Hydraulics: meander area, fluctuating flow, flooding	Removal of protective stops Dam Adapted buildings	Flood resilience Man-river reconnection	Nautical activities: kayaking, fishing

The Expo could be built on the site studied because it was an abandoned place with little construction. In addition, there was insecurity and public authorities used Expo 2008 to solve it. The transition of the World Expo into a large economic and recreational park seemed to be complete, with little financial loss in anticipation, and even gains with the rental of offices. Six years later, the reality is quite different. The public company in charge of the Expo loses millions of euros in management every year. Equipment loses property value, and maintenance has a high cost. Indeed, by setting aside the equipment, the treatment of the Ebro water has made it transparent and invasive algae are multiplying (Es Zaragoza 2012). As for the offices in the reorganized Expo buildings, few have been rented, so much so that public services have been established. Expo Zaragoza Empresarial S.A. lost more than 600 million euros in 2014 (Pérez 2014). The State, the Aragonese government and the Zaragoza City Council thought they would revitalize the city and give meaning to the Expo park after 2008. It was without considering the 2008 crisis, which caused the country's growth to fall by 0.9% (Les Echos 2011).

The creation of this Expo park has erased a low-valued ecosystem service: the supply service. Indeed, the neglected agricultural areas could have been included in the project in the form of a community garden instead of simply being removed. However, this zone provides a regulation of the city's climate and allows recreational activities. These activities offer a reconnection with water. Regulatory and cultural services are therefore present in Zaragoza.

II.2. Comarca River Park, Pamplona

Figure 5: localisation of Comarca River Park

In the 20th century, Spain, like many other countries in the world, experienced a demographic explosion and the advent of industry. The three rivers crossing Pamplona suffered from these two evils. The water was polluted and the need for space reduced the rivers to simple canals ; which disconnected the inhabitants from the aquatic gentleness. A first step in improving hydrosystems was the construction of a wastewater treatment plant, so that wastewater would no longer flow directly into rivers. This wastewater treatment plant was inaugurated in 1990. (Mancomunidad Comarca de Pamplona (a) 2012)

This first step to clean up the water was followed in 2000 with the creation of a consortium "Consorcio del Parque Fluvial de la Comarca de Pamplona" bringing together the nine communities crossed by Arga, Ulzama and Elorz. Thanks to Spain's entry into the European Economic Community, 80% of the work of these two phases was financed by the European Cohesion Funds. (Master 2 GHCE 2008)

The first phase (1998-2001) concerned the development of the Arga River, and part of its tributaries: the Ulzama and Elorz over 11 km. Its purpose was to start the river park, restore the Magdalena meander and a mill, restore the banks and develop roads. To do so, the consortium had to expropriate some residents and destroy illegal shoreline constructions.
A second phase of expansion of the river park and its cycle and pedestrian access was carried out between 2003 and 2009. 6.5 km of additional watercourses of the Rivers Elorz and Sadar were redesigned in Pamplona.
In 2007, the federation of municipalities of Pamplona took over the management of the river park and the consortium was dissolved. Indeed, the objective was now to look at the water cycle in its entirety, and thus to integrate all the tributaries of the Arga. Today the park is 33 km long and an additional 70 km will soon be built as part of the project's expansion. It will connect all the cities with the capital of Navarre. (Mancomunidad Comarca de Pamplona (b) 2012)

The river park fulfils three objectives:

- Environmental: to provide a green and blue corridor for local fauna and flora
- Recreational for residents and tourists: a reconnection with nature through soft modes of transport and social mix through intergenerational infrastructures
- Cultural: restore bridges, mills and other facilities that are part of the territory's history

The river park respects all the hydraulic schemes which proposes a correction of the negative effects of floods, in particular by the acquisition of public land on the flood pain in the flood prone areas. The current Restoration Plan proposes a management plan linking the planning of spaces, social aspects and planned financing. All the arrangements made in Pamplona are based on a flood return of more than 25 years. (Valdenebro García and Ramírez Chasco 2011)

Table 3: measures put in place to deal with diverse pressures and their results. The case of Pamplona

Pressure	Action	Result
Considerable deterioration of water quality, contamination, loss of river fauna	Wastewater treatment plant	Better quality of water Presence of sensitive species
Deterioration of river banks, loss of riverine ecosystems	Screens of vegetation Replacement of poplar plantations by riparian plants	Fresh and humid environment Better view and air quality
Forgetting the historical heritage	Restoration of medieval bridges	Crossing of bridges is once again possible
Problems of erosion and individual measurements out of control	Stabilisation of riverbanks and slopes with plantations	Encourage soil formation Limit erosion
Illegal facilities in public areas along the river: loss of accessibility	Eviction of illegal residents and destruction of illegal construction	Better accessibility Appropriation by residents and tourists
Lack of crossing sections for vehicles and pedestrians	Routes parallel to the river: walkways Routes crossing the river: bridges for vehicles and bridges for pedestrians	Connection between the old city centre and the new urban areas

This green and blue frame across the territory offers a support service for all terrestrial and aquatic species. For the citizens, it allows a certain regulation of the climate, the banks are accessible by foot or by bicycle. The cultural service, through a new aestheticism and a face to face with the nature, is predominant.

III. Rouen Normandy Metropolis, France

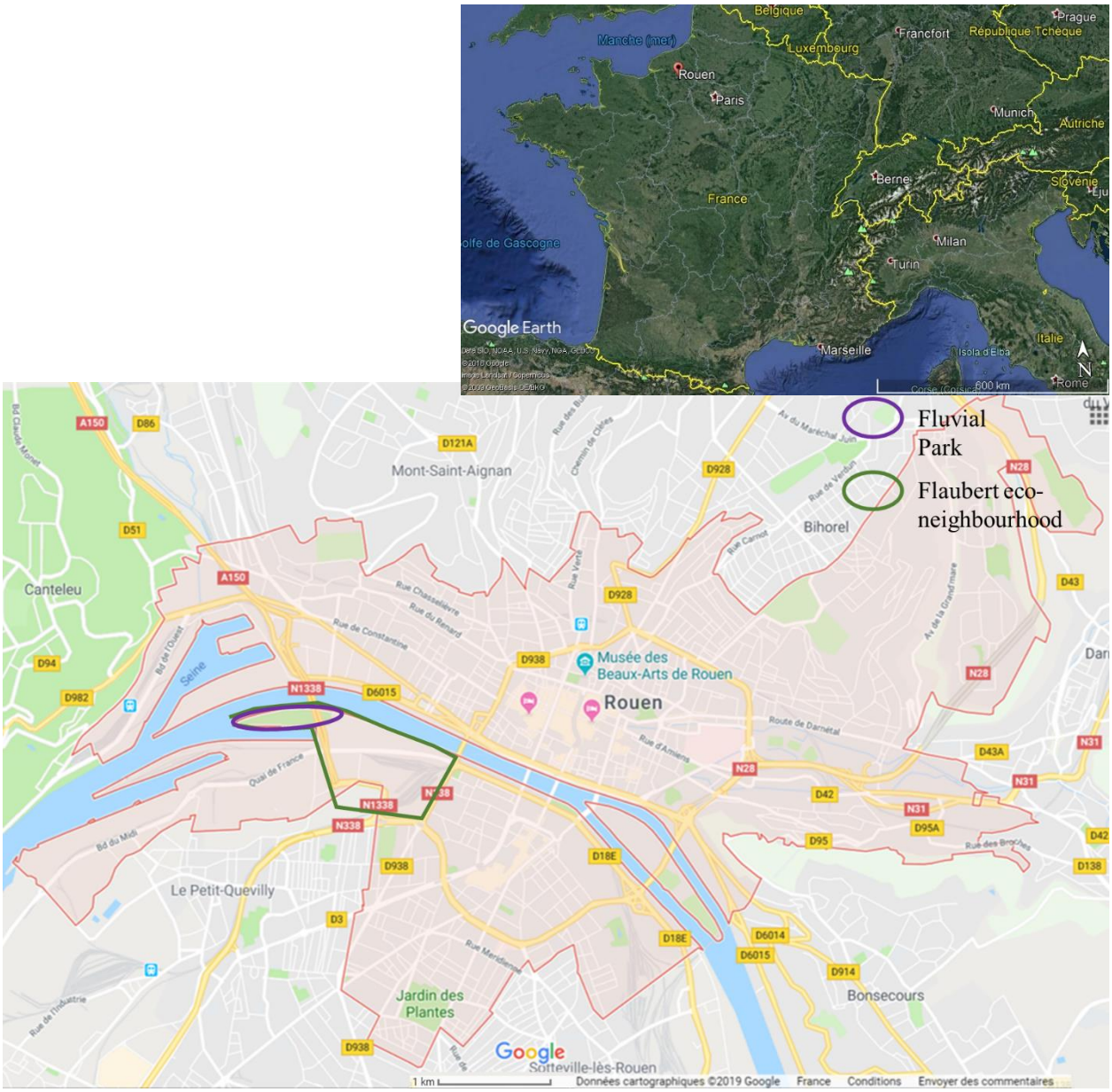

Figure 6: location of Rouen and study sites

In 2014, the DREAL (Regional Directorate of Environment, Development and Housing) Haute-Normandie reviewed the Territories at High Flood Risk (TRI). It turns out that Rouen is subject to two flood hazards: by the tributaries on the right bank of the Seine and the Seine itself. (DREAL Haute Normandie a, b). A scenario of a high probability Seine River overflow would impact 640 permanent residents and 1845 jobs in the city's floodplains. Rouen is therefore a city that can easily

suffer damage due to rising water levels. The city of Rouen and Metropole Rouen Normandie have joined forces to carry out two projects: The Fluvial Park of the Rollet Peninsula and the Flaubert eco-neighbourhood. These projects will make it possible to change the citizens' vision of the water of the Seine: it is no longer just a danger or a navigation route, it is an essential element of the landscape that can be appreciated.

III.1. Rollet Peninsula Urban and Fluvial Park

The Rollet Peninsula is a former industrial port area where coal storage was important. The new park is a link between the past and the present, with the reuse of materials such as rails and paving stones already present at the beginning. It is also the choice of a smooth transition between the urban environment and the natural environment with an evolution of the park from east to west, gradually evolving from a developed site to a site as natural as possible. The project is not only human, it is also benevolent to nature (Europe en France, 2013). Indeed, ripraps are planned in areas less exposed to the current to promote habitat diversity and allow the return and diversification of fish fauna (La CREA 2012). Moreover, the choice of plants was not only based on their aesthetics, but also and above all on their ability to be autonomous. The project managers thus wanted to maintain the park as less as possible in order to create the most natural space possible.

Figure 7: the fluvial park

This project is financed through various French public authorities and with the ERDF (European Regional Development Fund). Out of a total of €12,851,706 excluding VAT, the Haute-Normandie Region has a 35.18% share, the Seine-Maritime department 28.78%, the Rouen-Elbeuf-Austreberthe urban community (CREA) 20.15% and the ERDF 15.87%. (La CREA, 2012)

Table 4: measures put in place to deal with diverse pressures and their results. The case of Rollet Peninsula Fluvial Park, Rouen

Pressure	Action	Result	New uses
Spatial: abandoned industrial wasteland	Creating nature in the city	Progressive transitions from urban to natural	Interface between urban and natural space
Social: crossing but no stop, transition between the two riverbanks by the Flaubert bridge	Public equipment and tracks for soft mobility	Rest area, increase in visitation	Family and sport uses
Ecological: flora not very remarkable and invasive **Soil pollution**	Wooded hillock and meadow	Containment by a layer of vegetal soil, landscape attractiveness Fighting against heat islands	Recreational activities Valuation of nature

As this site is located outside the business areas, the regulation service is less felt in the city. As in Zaragoza, shared gardens could have been planned. The site is intended to be intergenerational and transitive between the urban and the natural. Further reflection on the choice of plants, edible for example, would have allowed a better connection with nature on this site. The cultural service is nevertheless found in the area with the past link present that the reuse of materials induces.

III.2. Flaubert eco-neighbourhood

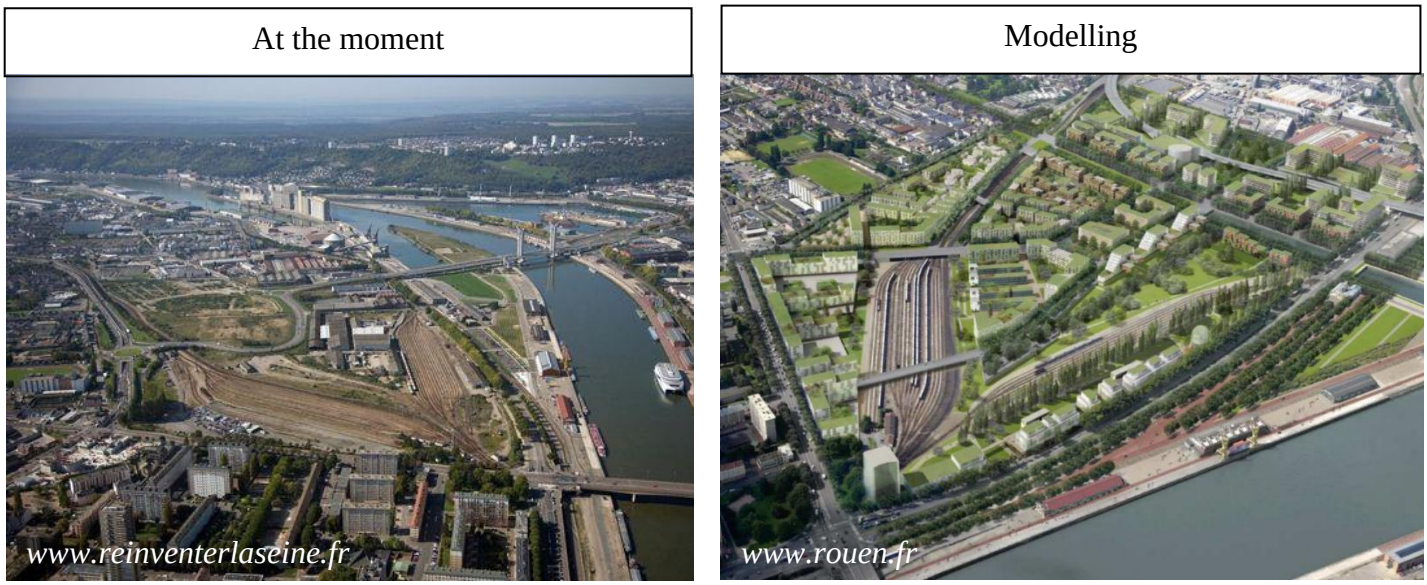

Figure 8: modelling of the Flaubert eco-neighbourhood

The Flaubert eco-neighbourhood of 90 ha should be an example of sustainability. As required by current French law, rainwater management must be done on a per plot basis for new construction. The project therefore integrates innovative stormwater management. This site also has a complex location: it is very close to the port of Rouen, which allows a significant export of cereals, its immediate proximity to the Seine makes it a neighbourhood subject to flood risk and the passage of

various important communication routes such as national roads, highways and railways can produce an apprehension of future inhabitants.
The project is ambitious and long-term: 20 years. The choice to define the project as a ZAC (Cooperative Planning Zone) is therefore a smart one. In the long term, the project owner (*maître d'ouvrage*) plans to have 10,000 people on site to live or work there. Up to 2,800 housing units, including 30% social rental housing and 6,000 m² of retail space. (La CREA 2013)
The will to create is mainly public. But unlike the Zaragoza Fluvial Park, its implementation will be private. The project management (*maîtrise d'œuvre*) is entrusted to four companies: Atelier Jacqueline OSTY & associés, ATTICA urbanisme et paysage, EGIS France and BURGEAP.
The project has 7 main goals:

- Integration into the urban environment: ensuring functional, social and generational mix and facilitating exchanges;
- Enable favourable conditions for alternative and sustainable travel → ecomobility;
- Create pleasant living conditions: reduce noise pollution and adapt the site's uses to its industrial past and port environment;
- Energy efficiency objective: reduce energy needs and their impacts at the district and building level;
- Conserve and strengthen ordinary and remarkable biodiversity;
- Take advantage of the site's situation on the banks of the Seine: strong presence of water on the site, anticipation of changes due to climate change;
- Participation of the population and stakeholders in the territory from the beginning of the project and throughout its progress. (La CREA 2014)

In practice, to ensure the neighbourhood's resilience to flood risk, the solution chosen is to raise the floor of areas subject to medium hazard, compared to the reference flood. This solution does not allow the area to be adapted to the flood risk. It is intended to avoid risk but not to manage it in the long term. In addition, in the face of future climate change, reference floods are expected to evolve and tend towards higher values. The project should therefore strengthen measures to ensure compatibility with PPRI, as recommended in the Deliberate Opinion of the Environmental Authority. (Autorité environnementale du Conseil général de l'environnement et du développement durable 2014)
Moreover, due to its industrial and port past, the site must also be depolluted.

Table 5: measures put in place to deal with diverse pressures and their results. The case of Flaubert eco-neighbourhood, Rouen

Pressure	Action	Result
Spatial: industrial wasteland	Offices, accommodation, sports facilities	Social mix and diversity of activities
Environmental: sound pollution	New buildings with adequate sound-insulation, sound screens	Limit the sound pollution and hearing problems
Hydraulic: flood risk	Raise the floor of areas subject to medium flood hazard	Flood resilience of instance (not in the long term)
Need of nature	Tree alignments, permanent water basins	Reconnexion to nature, fighting against heat islands

As the rehabilitation of this area is currently only in the planning stage, it is difficult to identify the ecosystem services that the nature of this site will be able to deliver. As with the previous projects, the cultural service provided by the Flaubert neighbourhood is the most important. The vegetation planned on the buildings will also allow for the regulation of the interior of the buildings, a new element in the projects studied so far. If the management of the neighbourhood is to be environmentally friendly, this area could accommodate non-domestic species and support the cultural service by connecting closer the citizens with nature.

IV. Cheonggyecheon stream restoration, South Korea

Figure 9: localisation of Seoul and the Cheonggyecheon River before and after the works
Source: landscapeiskingston.wordpress.com

Seoul has been the capital of South Korea since the beginning of the Joseon dynasty in the 14th century. Cheonggyecheon is a 10.92 km long river crossing the city centre from west to east. The original name of the river means "the way water should flow", its current name refers to its cleanliness. However, over the years, the river was channelled during the Joseon dynasty and lost its cultural value. Slums have developed, causing water pollution and socio-economic problems in the capital. To solve this problem, the simplest solution found was to cover the river. The work began in 1958 and was completed 20 years later. Among other things, they have made it possible to improve car traffic. In 1967, a highway was also built to cover the river a second time, which was then considered a sewer and forgotten by the population. The Cheonggyecheon area was crossed by more than a million people a day. It was a very important industrial and commercial district. However, with the advent of high technology, a sense of insecurity and the deterioration of urban equipment, particularly roads, have led to the idea of a major change in the area. In 2003, Myung-Bak Lee launched the river restoration project, which was part of his program during the municipal elections and which he wanted to complete before the end of his mandate.

Two important elements of urban replanning then appear: the citizens have certainly voted for the restoration project but no public debate has been held on the method. Secondly, since the theme of restoration was new in South Korea, the vision of the mayor and his partners was the only starting point for restoration. The wishes of politicians in the debates were therefore very well listened to and followed.

The mayor, former CEO of Hyundai Construction Company, has had a distinguished career in civil engineering. He has therefore adopted a developmentalist and environmental management approach, which has been criticized by ecologists. (Cho 2010)

The project was conceived as river engineering works rather than as a deep ecological restoration. The restoration of the river in the heart of Seoul was an opportunity for civil engineering companies to recover parts of the project. The planners' proposal was approved by research groups. However, these groups were not objective about the project. Indeed, the Workshop for Cheonggyecheon Restoration was composed by professors in river engineering. It was these same professors who gave the idea of restoration to the candidate Lee and the technicality to be implemented. The second research group: As Seoul Development Institute was an organ of the municipality, it supported the need for restoration focused on civil engineering. A citizen committee, composed of residents, academics, businessmen and journalists, was set up by the mayor to encourage participation and democracy in the project. However, the members of the committee often disagreed, which very frequently led to disputes and weakened the group.

As in any city-wide project, opponents wanted their voices to be heard. This was the case for four groups: the Green Seoul Citizens Committee, NGOs, local shopkeepers and academic groups.
The Green Seoul Citizens Committee criticized the sustainability of the restoration project. According to them, among the 70% of the population in favour of the project, 88.9% wanted the project to mature before starting it and nearly 80% preferred a more sustainable form of the project. *63.5%* of them wanted the *"Cheonggyecheon area to be reinvented as an ecological civic space rather than a new hi-tech space that the municipal government was pursuing"* (Green Seoul Citizens Committee 2003 *in* Cho 2010).
The shopkeepers had a very strong voice: more than 60,000 shops and 800,000 jobs, not to mention street vendors. However, they were not very unified: some asked for more compensation for the loss of their activity during the work, others wanted to join the NGOs and cancel the restoration project. Their actions were very active on the construction site and slowed the work down to such an extent that Mayor Lee had to make concessions to ensure that the project was completed before the end of his mandate. (Cho 2010)

The table below shows the main disagreements between the public authorities and the opponents of the project.

Table 6: main disagreements between the public authorities and the opponents. Source: Cho 2010

Goal	**Urban regeneration**	**Ecological and historical recovery**
Interpretation of restoration	Passive Instrumental	Active Purposeful
Scope of restoration	Stream course	Stream basin or stream ecological system
Restoration of stream	Flood control Water friendly space Running off of the water pumped from the Han River	Stream ecology Ecological axis Naturally downstream flowing water
Restoration of History	Part of urban planning	Maximum original restoration
Surroundings	High-density redevelopment Developmental gain	Maintenance as it is Employment generation
Time span	Short run	Long run
Post restoration	Daily maintenance	Reconstruction
Discourse & ideology	Instrumental environmentalism or Neo-developmentalism	Ecological environmentalism or Ecological modernism

With a step back, we can identify the positive and negative points of this restoration in 2 years and 3 months at a cost of 380 billion won (≈ 340 million US dollars). First of all, the good things: the river

has regained its place, in the open, of good quality and sheltering both animals and plants. Citizens are now connected with water again. They can take advantage of the riverbanks for recreational activities such as admiring the various exhibitions and festivals that take place along the waterfront. They are happy to hear the sound of the river again and no longer hear the noise of car traffic. In addition, the daytime temperature has decreased, so it is more pleasant to walk around the capital. (ARIRANG ISSUE 2015)

Although its planning was based on a 200-year flood return to minimize flooding, the restoration of the Cheonggyecheon River is not exemplary in its ecological functioning. The bottom of the river, like its banks, is concreted, which greatly limits exchanges with the alluvial groundwater. The municipality pumps 120,000 tons of water per day into the Hangangang River to keep the river afloat, or nearly US$ 8 million spent each year on pumping electricity. (Cho 2010)

Aware of these ecological dysfunctions, the city has launched a Masterplan to restore the river's ecological and cultural properties by 2050.

Table 7: measures put in place to deal with diverse pressures and their results. The case of Seoul

Pressure	Action	Result
Time: before the end of Lee's mandate	Realisation in 2 years and 3 months	Urban park at the detriment of ecological functioning
Spatial: traffic circulation, noise	Reduction in the number of roads	Limitation of noise pollution Fighting against heat islands Reducing temperature by 2.3°C
Environmental: pollution	Vegetalization Wastewater treatment	
Hydraulic	Pumping into Hangangang River Cementing of the river bottom and banks	Dysfunction of the Hangangang River Disconnection from alluvial groundwater
Deterioration and insecurity of facilities	Dismantling of installations	More security Fighting against heat islands
Loss of river culture and disconnect	Rehabilitation of old bridges Expositions and festivals	Reconnexion to nature and history

This impressive project shows that nature is important and can contribute enough to decide to give it a key place. Although the decisions regarding the implementation of the project are questionable, the services provided by nature are undeniable. The quality of life has greatly improved with better air quality. Citizens have reconnected with nature and their culture with the restored old bridges. Cultural and regulatory ecosystem services are ingrained in this part of Seoul.

DISCUSSION

The various case studies show an evolution of motivations for the creation of space in cities. In France, under the reign of Napoleon III, the main cause for Paris's major works was health. It was necessary to put an end to the epidemics and propose solutions to house the ever-increasing number of inhabitants. Already at that time, industrialists and traders made their voices heard. In the 2000s in Seoul, it was also these same actors who slowed down the Cheonggyecheon River Restoration project and imposed their conditions on a mayor who was very tough on business. In France, the path leading to urban development has changed slightly since Napoleon III. Although the willingness to change is always driven by a public body, the project must be in accordance with national, regional and local documents. However, we can criticize the functioning of the French response to the call for tenders (*réponse à appel d'offre*). Companies responding to the call for tenders are scored mainly on economic criteria (total cost of works) and then on their project proposal. This makes it difficult to set up innovative projects that are often more expensive.
The Spanish projects in Zaragoza and Pamplona are to be contextualized. Unlike France, water stress is very high and the increase of temperature forces Spanish municipalities to take measures to reduce temperatures in urban areas and to manage the use of resources drop by drop.
Thanks to an interview with Alfredo Ollero, professor of Physical Geography at the University of Zaragoza on the 30th of January 2019, some specifications have been provided. In Spain, ecological restoration is not the key word in projects. Redevelopment of urban rivers lead to recreate connexion between citizens and nature, but the ecological approach is, in most cases, neglected. In the case of Expo Park, the dam was not necessary to limit flooding. The dysfunction of the river could therefore have been avoided. In addition, the loss of agricultural land to an urban park has destroyed a rare area where nature had regained its rights. Although the inhabitants can now enjoy water activities, there is still no balance between the needs of man and those of nature.

In all the cases studied, the will comes first from the political intent, with significant lobbying for Seoul by construction companies close to the mayor. The inhabitants are often spectators of the projects, whether or not they agree with it.
In all studies, the ecosystem service of supply is non-existent. This correlates with changing lifestyles and diets. Citizens who cultivate their own vegetables themselves are often located on the periphery of cities or even in rural areas. The creation of community gardens would be part of all classes of ecosystem services. They would allow primary food production and urban climate regulation if the surface area is sufficient. The reconnection with the earth and its benefits would be more significant and these spaces would also be transit areas for urban biodiversity.
Regulatory and cultural services are the most sought-after. They are the ones who provide a more attractive and, in some cases, safer living environment, especially against floods.

By 2050, the number of inhabitants in urban areas is expected to reach 6.4 billion (United Nations 2014). This means that an urban transition will have to take place to accommodate this growing population. However, cities today are suffering from various evils and will have to be transformed to provide a decent living environment for its inhabitants. This transformation has already begun in many cities, including the construction of housing and facilities in flood-prone areas. Indeed, the memory of floods is only slightly present and few means are put in place to revive this memory. In some cities, one has to look carefully for signs that are sometimes as small as a palm of hand marking the water level during floods. But communication with the inhabitants is not sufficiently developed.

However, with global warming, precipitation is increasing during scattered rainfall events. This leads to very heavy runoff and flooding in the city. This sudden arrival of water in urban areas takes the lives of people and generates very significant material damage. As in the Aude, where the floods of

October 2018 killed 14 people and injured 70 others. According to the Minister of Economy Bruno Le Maire, the damage would amount to 200 million euros (Midi Libre 2018).
Floods in France and other European countries are not recent, but few lessons have been learned from previous events. The floods of 2002 and 2013 each caused 17 billion euros of material damage. (Zurich Insurance Group 2013)

However, solutions have been put in place, such as dikes and levees. But in the event of a very high flood, these structures could fail and insurance companies would have difficulty in reimbursing the victims. In addition, some buildings have been equipped with electric water pumps but when there is no power and no emergency generator, the system does not permit water to be evacuated.
Moreover, constructions in flood-prone areas are not always adapted to the risk. Different support systems could be put in place to address this lack of commitment. A Resilience Fund could be created by the State to help finance the rearrangement of buildings built in flood-risk areas. This aid would be granted on the basis of a detailed project to adapt the buildings to the flood risk.

A National or European emergency aid fund would be a good start to general awareness, but the costs of repair and reconstruction are often higher than the costs of adaptation (prevention). Insurers also have an important role to play in the resilience of cities by providing expertise and advice to their clients.
The State has a key role in terms of communication and action programme at the National level. *"In some cases, legal hurdles even block efforts to rebuild in a better, more flood-resilient way"* (Zurich Insurance Group 2013). The adoption of legislation promoting resilient and resource-efficient construction would be a good start to the adaptation of urban areas to the risk of flooding.

"Experience shows that collaboration between insurance operators, government authorities, and other key stakeholders is crucial when it comes to encouraging risk reduction in both the public and private sectors." (Zurich Insurance Group 2013)

On the other hand, the policy choice to reduce urban sprawl or use new land more equitably for urban development and the development of ecosystem services has to be considered. According to Stott *et al.* (2015), *"land sparing is a more favourable approach to maintaining urban ecosystem service provision"*. Moreover, planners should opt for a better distribution of urban intensity rather than focusing on poles. This is the choice Rouen has made by reusing an industrial port area to make it a dynamic district and thus transpose part of the activities to a forgotten urban area.

Finally, as Pinto and Kondolf reminded us during their conference The fit of urban waterfront interventions: matters of size, money and function during the I.S. Rivers symposium 2018, each waterfront has a different history and socio-geographical context, it is not appropriate to copy and paste a planning project into an area without adapting it to the risk of not seeing the expected effects.

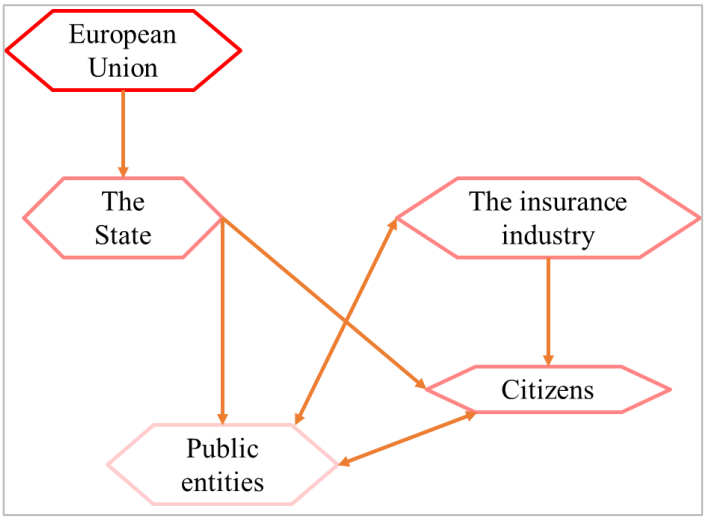

Figure 10:proposal of links between the actors of the French territory
Credit: Elise Ferlay

The above co-actors scheme presents the European Union as the first element in implementing the creation of space for the improvement of ecosystem services in cities. It is in fact the body that sets the directives to be followed by the Member States and ensures cohesion in their policies. It can also create a fund to support urban innovation to address issues related to climate change. The State is directly linked to the citizens because in the event of a disaster, it can release funds to participate in the reconstruction of housing and businesses. The State transposes European directives into French law and indicates to public entities which policy should be adopted in the planning of their territory. Public entities can create partnerships with insurers to develop communication with citizens and promote the construction of resilient and eco-friendly buildings. For a better management of the space and in particular a better visibility of urban areas. Public entities, for example at the departmental level, could set up a unit to analyse urban potential. This body would be in charge of analysing changes in land prices, green and blue frames, construction projects, abandoned areas and very active areas and carrying out public enquiries. Cross-referencing these data would make it possible to improve the documents that municipalities and project leaders must respect in order to better understand the city and to guarantee to nature a place of choice, present or future. Indeed, citizens, who are becoming more and more ecologically active, want to find nature in their daily lives and if we want to limit urban sprawl, we must replant this element in the city.

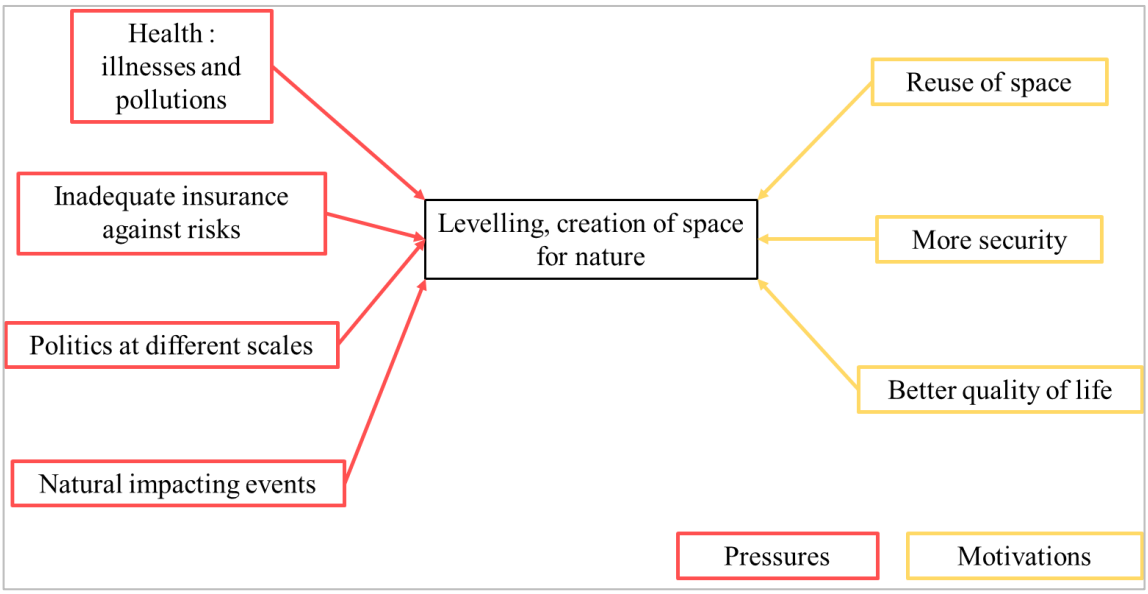

Figure 11 : diagram of pressures and motivations for levelling
Credit: Elise Ferlay

Sanitary pressure in the city is becoming more and more important. Air quality is bad, and as stated in the case of Paris in the 19th century, diseases can appear in an unhealthy city. Economically speaking, this pollution has a considerable impact. Between 68 and 97 billion euros, this is the annual cost of pollution of the outdoor area in France. (Commission d'enquête du Sénat 2015)

In addition, natural disasters are multiplying with climate change and the associated losses are considerable: storm Xynthia in 2010 generated 2.5 billion damages in France, of which only 1.5 billion were insured (Herreyre-Tournemaine 2013).

However, insurance for natural disasters is very high, especially in high-risk areas. The compensation period is 3 months (Fédération Française de l'Assurance 2018), which is relatively long for people who have lost their homes, for example. In high-risk areas, safety is the main motivation for levelling buildings.

Regarding motivations, space in the city is becoming scarce and expensive. For a city of more than 150,000 inhabitants, the average price of a building plot is 772€/m² in the city centre. 3509€, it is the average price of a square meter to be built in the capital (Immogroup Consulting 2011). For public entities, the acquisition of land is therefore very difficult or even impossible. How to find space? To deconstruct but still to acquire the land.

As studied through the various examples, nature in the city is made for citizens and not for nature itself. As in Seoul, the inhabitants want a return to nature, but a practical and practicable nature, whether by foot or by bike or canoe. This is why the creation of the Expo Park in Zaragoza required a dam: it allowed the citizens to appropriate the water, although it created an upstream-downstream disconnection that the project could have be done without it.

The creation of space for nature in the city is therefore a major but delicate issue. Indeed, today, mentalities are in favour of a return to nature for the services it provides us. However, this space must be accessible to all and, for the time being, this accessibility is a priority for citizens and not very well shared with the fauna and flora that would also need it.

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THINK HAUSSMANN ! : How to create space for ecosystem services in overcrowded cities?

Abstract

This research work involves the analysis of several ecological restoration projects at the scale of a city. Cases in France, Spain and South Korea are described. Projects are not motivated by the same needs, but the result is often focused on the recovery of nature by citizens rather than on deep ecological restoration. The study of older projects, such as Haussmann's transformation of Paris and the restoration of the Cheonggyecheon River in Seoul, are easier to study in a global context. Indeed, the actors' role with its pressures and criticisms is clearer. For studies of recent or even future projects, this analysis can hardly be complete as not all the stakeholders are identified.

For a better use of urban space and the reconquest of nature, European policies could help States to finance projects that propose to integrate nature and its ecosystem services. With climate change, floods are becoming more and more significant. National support and partnership with insurers could help rebuild resilient cities that integrate nature as an essential element.

Key words: green and blue spaces, city, restoration, ecosystem services