Urban development in riverbeds

An international comparison

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Table of contents

1 Introduction (J.Spits, T. Brinkhof)

Building in floodplains is of all times. People have inhabited floodplains of rivers for housing, business and recreation. The urban settlements in the floodplains vary from small individual dwellings to urban cities. The magnitude of the urban settlements in floodplains differs between river systems. Buildings in floodplains are facing advantages and disadvantages. Floodplains appear to be an attractive site for living and working. At the same time floodplains are highly dynamic areas because of regular flooding.

The Middle Loire river in France and the Sand Meuse river in the Netherlands are two comparable river systems. Originally, both river stretches are river valleys. The riverbeds are originally not-embanked but bounded by the higher grounds. For the German case, the Middle Rhine will be described.

There are a number of different sources of flooding including: rivers and streams, the sea, groundwater, overland flow (especially over tarmac and other hard surfaces), and blocked or overloaded drains and sewers. This study takes river flooding into account. Excessive rainfall, snow or hail, or a combination of high river levels and high tides can cause river flooding. Flooding occurs when surface water run-off from the surrounding area exceeds the flow-capacity of the river or stream,

Increase in occurrence of river peak discharges are a point of attention. There are different causes for this increase in river peak discharge. There is a common belief that increase in urbanization also increases the frequency and severity of flood events. Other mechanisms put forward are:

- Urbanization and infrastructure increase overland flow, by reduced infiltration capacity of the soil
- Canalization of rivers
- Deforestation, and thereby paired reduced interception loss of the trees
- Expected increase in rainfall (intensity and total amount)

These mechanisms contribute perhaps to the frequency and severity of discharge peaks; however the damage potential exists because people inhabited flood prone areas. Gradual development of building by rational choices in the past in flood prone areas, have resulted in irrational situations at present.

Although much is written about the causes of floods and its context on increasing occurrence of peak discharges, less is written on the objects threatened. “Modern flood management strategies have abandoned the position that structural measures may even create a false feeling of safety. Today, the strategic approaches are more often: do not keep the water away from the people, keep people away from the water, and the risk-taker should pay.”[1]

[1] Tollan Arne. Land-use change and floods: what do we need most, research or management? Water Science and Technology Vol 45 No 8 pp 183–190 © 2002 IWA

1.1 Scope of research

Part of this report is the evolution of urban areas prone to flooding throughout the last century for rivers basins in several countries. Spatial developments in floodplains are examined on regional and on local level.

This study explains the magnitude of the urban development in floodplains in modern history from an international perspective. The argument is that the high rate of floodplain occupancy which has occurred in the last century significantly contributed to a reduction of the riverbed. With respect to the flood damages, urban development and land use planning seem to be a critical factor.

The physical outcomes in the field (i.e. the urban settlements) will be contextualized with the guiding policy arrangements. The policy arrangements applicable for buildings in floodplains include main dimensions such as rules and legislation, actors, powers and resources and discourses.

The study will compare developments in France, the Netherlands and Germany. Regional and local cases will be studied along the Loire river in France, along the Meuse in the Netherlands and along the Rhine in Germany.

Finally, the study will provide perspectives for the future and a consideration of the impact on European legislation in the field of land use planning and water management such as the European flood directive.

1.2 Importance of research within Freude am Fluss project

The study is relevant for the policy making process of land use planning in riverbeds in France and Netherlands. Policy evolution takes place according to the cyclic phases of preparation, decision making, implementation and evaluation of policy. This study will especially be helpful in the phase of the evaluation of policies. The study approach of a country comparison seems a very powerful way to evaluate policies for identifying differences and similarities in policies and the physical outcomes in the field between countries.

The University of Tours will take care of research actions in the field of land use planning and river management along the Middle Loire in 2007/2008. Regarding the action plan, the reports are an important contribution to the deliverables of theme C (modification of regional plan) and D (modification of municipal plans) in France. The actions are necessary for a better understanding of the widely spread urban development in the Loire river bed and hence they are an important input for the Loire river flood strategies in the regional and local plans, with great relevance for the other partners because similar processes occur in Germany and the Netherlands.

Also in the Netherlands, urban developments in the riverbeds have occurred on large scale in the recent past, especially along the Sand Meuse. After the floods in 1993 and 1995, urban development in riverbeds became an important issue in land use planning and river management. The strategy of more room for river from 1997 no longer allowed any new buildings in riverbeds. This rigid ban of urban development resulted in some economic stand-still situation and other difficulties. However, at present, urban developments in the riverbed are allowed again but under strict (hydraulic) conditions and for merely economic and spatial planning reasons.

1.3 Objectives

The objectives of this research are:

- To analyze the similarities and differences in arrangements for building in floodplains
- To exchange knowledge and experience between researchers and experts from different countries.

1.4 Research questions

Within the context of each country, the aim is to answer the following questions:

- What is the magnitude of urban development in floodplains in modern history from an international perspective and how can it be explained ?
- What are the policies for buildings in floodplains and how are measures implemented ?
- What could be the impact of technical innovations such as floating houses for policies ?
- What are possible institutional innovations (i.e. legislation, insurances…) to improve the balance between land use planning and river management.

2 Methods and materials (J.Spits, T. Brinkhof)

2.1 Research design

This report is as a co-production of the University François Rabelais of Tours and the Radboud University Nijmegen. The research is an international comparative study between France and the Netherlands. Germany is also included in this comparison but to a lesser extend. In each country different scales, i.e. national, regional and local scales are identified. The local scale is covered by case studies.

2.2 Data collection

The following tools were used for the data collection within this research

Geographical Information System

A Geographical Information System will be used to carry out an analysis on developments of buildings prone to flooding throughout the last century. Hereby, flood records or safety norms will be used to assess the increase or decrease of developed urban area. For every country, the aim is to have same intervals in time (1945/1960/1985/2000) to make it possible to compare results. One part of the data is digital, data from older maps are scanned and will be manually drawn. The most accurate way for measuring urban growth in floodplains is therefore by comparing area, instead of number of houses. With this data, planning practices in the past can be examined.

Literature study

Relevant policy pieces and literature will be analysed.

Interviews

Interviews are meant to supplement data which is not possible to retrieve from literature. Main interview techniques used are semi-directed interviews with stakeholders. The aim is to retrieve information on the contents of arrangements for buildings at present. Interviews are taped then analysed with a previously determined grid, commonly shared by the interviewers.

2.3 Policy arrangement theory

The theory of policy arrangement is formed by Van Tatenhove, Arts and Leroy (2000), (figures 1 and 2). “Policy arrangements refer to the substance and the organization of policy domains in terms of policy discourses, coalitions, rules of the game and resources. This analytical framework aims to do justice to policy dynamics caused by both strategic and structural factors.” (Arts B., Leroy P., 2006) The application in this research is merely on giving the study a solid structure than the development of knowledge within the theory itself. The theory consists of two parts: contents and organization. Together they form the basis of the policy arrangement. The organizational aspect is subdivided in dimensions of actors, rules of the game and powers and resources. The contents are shaped by the leading discourse. This concept can be categorized as a descriptive tool, since it can be used for describing storylines and organizational aspects. According to Immink (2006),” the concept of policy arrangement provides a relation between discourse and the organization of a policy practice.” The policy practice in this research is building in floodplains.

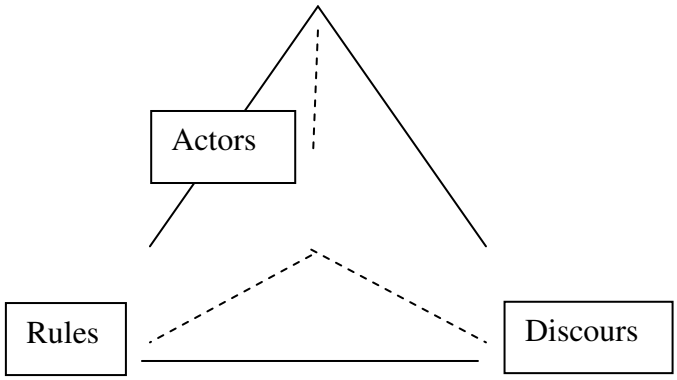


Figure 1 : The tetraeder as a symbol for the interrelation between the dimensions of arrangement (Arts B., Leroy P., 2006)

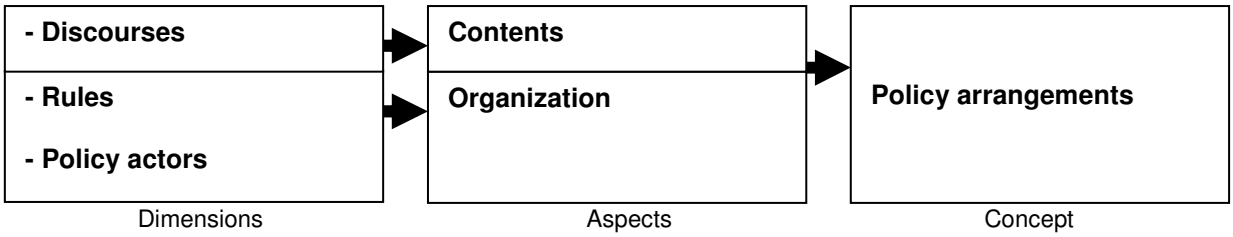


Figure 2 : The concept of 'policy arrangement' (Tatenhove et al., 2000)

The dimensions belonging to the PA theory can be described as follows:

Rules of the game :

This dimension refers to the regulations and legal context of a certain activity. Rules can be written down but can also exist of informal agreements. Informal rules are in this research closely related to the division of powers and resources. The aim of this dimension thus, is to show the legislation applicable for this specific arrangement.

"Rules of the game define the possibilities and constraints for policy agents to act within that domain…As such, these rules determine how politics is played, which norms are legitimate, and how policy outcomes are achieved, e.g. by which procedures, by which allocation of tasks, and by which division of competencies between actors and organizations ." (Tatenhove., J., Arts B., Leroy P., 2000).

For the reasons given above, it is a great deal to delineate the way in which rules will be described in such a manner, that it is clear what the possibilities and constraints are. In this research, the dimension of rules will be subdivided in means of legislation and policies on national level. Since the domains of spatial planning and water management are different for organizational aspects, the choice has been made to describe the rules of the game differently. In the other following dimensions, attempts are made to integrate them.

Policy actors :

"Sharing a policy coalition is considered to be a strategic choice by actors, aiming to achieve their goals, and therefore looking for partners with whom policy interpretations are shared and an acceptable consensus can be reached." (Ibid). The reasons for joining a coalition of actors can be of different nature. Likely, coalitions can be in favor or in opposition of a certain theme. As mentioned by Van Tatenhove et al. (2000), 'policy actors can be approached from an institutional and strategic perspective'. In this research a description of the coalition of actors will be given on national scale and on case study level. The choice has been made to describe national actors from institutional perspective, for the rationale that I assume that in every specific situation different strategies can be used. The institutional framework in relation to the strategic framework could be interesting for examining the robustness of the arrangement. For a particular case study I assume that strategic motives can be seen as guiding principle. For both descriptions, the actors will be characterized by their motive(s) for collaboration, general interests, roles and influence on the outcome.

Division of powers and resources :

Power can be explained in many different ways. "Power is an essential dimension of social and political life, and should therefore be part of any policy analyses" (Ibid). This is the more abstract dimension within the policy arrangement, since aspects of knowledge and powers are difficult to quantify. They are imbedded in agreements and negotiations between actors/coalitions. The allocation and division of resources is a dimension which is meant to clarify the interrelations between economy, decision making, knowledge and support.

Discourses

A discourse can be seen as an institutionalized way of thinking. "Discourses are a set of ideas, concepts buzzwords and stories which combined give meaning to a certain phenomenon in the real world" (Hajer M., 1995).

"Actors use discourses to give expression to their vision on reality and social relations with other actors during debates. Thus, discourses are constructed in policy domains by actors" (Immink I., 2006). Examples of this are the narrative of 'room for the river', or in this study 'building in floodplains'. "A discourse is a storyline that can be described as a specific ensemble of ideas and concepts which are produced and transformed in policy practices" (Hajer M., 1995). Discourses embody the contents of the theory. Discourses concerning building in floodplains are presented in buzzwords and stories. Stories are extracted from interviews with key policy actors identified. The PA theory can be used as a tool to describe a 'temporary stabilization of a policy domain at a specific level of policy making' (Van Tatenhove et al. 2000). The concept of building in floodplains seems to be such a temporary stabilization of a policy domain. The theory of policy arrangements has the advantage above other theories for its descriptive character. In this research the theory will be applied as a comparison structure. The dimensions of this theory can be described with the use of certain indicators. For the discourses these indicators can be a set of storylines merged which gives an indication of society's viewpoint.

2.4 Analysis

The analysis of the practices within the different countries of study, will be conducted in different ways. Analysis will be carried out by a team of beginning and experienced researchers, studying the practices of their country. On national, regional and local level,

similarities and differences in arrangements will be analyzed. For the analysis on urban development in the past a Geographical Information System will be used. Regarding the present policy arrangements, comparisons will be made with the use of the policy arrangement theory. Similarities and differences between countries will be examined with the use of a matrix.

3 Spatial developments: from past till present

This Chapter describes the evolution of building developments in selected river stretches in France, the Netherlands and Germany.

Definition of flood prone areas :

The importance of clearly defining flood prone areas has been evident in this research; therefore this is presented in this section.

Table 1 : Comparison of definition of flood prone area

Dutch definition (T Brinkhof)	French definition (J.-L. Yengué)
Floodplain: a plain bordering a river which is prone to flooding. In the Netherlands two types of floodplains can be distinguished: Plains bordering a primary flood defense (man made) and a plain bordering the natural contours of the river system. There is a spatial variability in the level of protection, differing from a safety level of 1/10.000 years and a level of 1/250 years.	Flood prone area (by overflow or infiltration). They are demarcated thanks to a so called "hydrogeomorphologic" method which studies the natural functioning (without taking into account the men's protecting works like dikes, dams, …) Thus, for a river, the borders suggested are those of theoretical flooding. This method results in the following definitions : - Low water bed : a never ending overflowed area or a very often overflowed area. - Medium water bed : an area regularly overflowed (every decade or less) - Major water bed : a hardly ever overflowed area. - Floodplain : maximum spreading area of the flooding, flood prone area in the hydrogeomorphological sense of the word. On rule matters, the flood prone area defined by the PPRI, is a crossing between hydrogeomorphological methods, historical studies ("Plus Hautes Eaux Connues") and the local constraints (agreement with local actors). Loire case : « lit endigué » : it extends between the 2 dykes and includs mean water channel and a little flood plain

3.1 Regional scale (J-L Yengue, J. Spits, T. Brinkhof)

On regional level, the context of spatial developments in floodplains becomes more apparent than on local scale, since differences between urban and rural settings can be placed better. The regional scales are more specific for river basins and sections.

3.1.1 Loire, France (J-L Yengué)

Flooding is a major risk in France, but also in Europe and all over the world. Because of economical, social, political or land ownership pressures, rivers have often been developed, covered, turned off, thus increasing men and good's vulnerability. In France, 13300 towns (1 out of 3) are concerned with flooding risks, to different extents, among which 300 big cities. For 160 000 km of rivers, a surface of 22 000 km2 (about 4% of the French territory) is known as especially liable to flooding: two millions of inhabitants are concerned. The damages caused by flooding accounts for 80% of the total cost of damages due to natural risks, which means an average of €250 M per year. Half the money goes to companies [2] .

3.1.1.1 From the disaster origin

The importance of damages much enhanced with the increasing of occupation in flooding areas. Some evolutions of human activities may have taken part in the changes of the local flooding intensity. Among these, let's notice urbanization, waterproofing of the soils, canalization and lack of maintenance of the rivers, or a wrong maintenance, removal of dump areas and flooding prone areas.

a) Urbanization

At first, urbanization enhances damages because it increases the number of people and goods in flooding areas. The urbanization of flooding areas appeared at the beginning of the industrial period, and hugely increased in the after war period (we will talk about it later in this work for the case of the Loire). Many main beds have little by little been occupied, often protected by dikes, which created a false impression of safety. This favoured the intense development of urbanization.

It also leads to increase, on a local scale, the level and the intensity of flooding :

- The waterproofing of the soils (car parks, roofs, industrial parks, roads) locally increases the flow. If the local consequences can be important, at the little scale, the effects of the phenomenon are limited.

- The limits given to the flow capacities (bridges, dams, dikes, canalization) create local rises of the flooding waters level.

b) Creating artificial water regime

Rivers canalization leads to a faster flood, with serious consequences for the downstream waters. The removal of the small flooding overflowing, created by the canalization and the increasing number of dams, built to retain water for different uses, cancels the natural cleaning of the river main bed and the supply of water of the dead branches. It also leads to an ecological degeneration in the lateral areas. The population watchfulness decreases. Then, the big flooding has more serious consequences on the one hand because of the congestion of the main bed, on the other hand because the inhabitants are less prepared to this phenomenon.

[2] Sources : site prim.net du Ministère Environnement et Développement Durable

c) The lack of maintenance in the rivers

The vast majority of the French rivers are owned by the riverside residents, who must maintain them to preserve a normal flood. Because of the depopulation of the country, the maintenance has progressively been reduced. The consequences are more frequent flooding, which can create local damages but which also can sometimes have positive effects for downstream waters, slowing the flood.

d) The removal of wetlands and flooding prone areas

Urbanization, embankment of flooding areas or dikes on agricultural lands have reduced the surface of flooding prone areas, which have thus lost an important part of their ability to naturally decrease the flooding, in particular for medium size flooding. The drying out of the marsh and dead branches, where flooding could spread while maintaining a rich nature, was done to the detriment of the refilling of the ground waters and of their self-purification (E. GauthierE., Touchart l., 1999 and B. Sajaloli B., 1996).

3.1.1.2 Typology of the rise in the Loire level

The example of the Loire River is especially interesting. It is the longest river in the whole country, covering 1020 km, from its source at the Mont-Gerbier-de-Jonc, in the Cevennes region, to its mouth downstream from Nantes, in Loire-Atlantique. It travels through six regions and eleven departments. Its basin (115000 km^2) takes up more than the fifth of France. Its hydrologic regime, a pluvial oceanic plain type, is compound and various : if the average flood is 185 m^3/s in Nevers, 345m3/s in Orléans and 935m^3/s in Nantes, it lowered to 11m^3/s in Gien upstream from Orleans during the 1949 low-water mark, whereas it rose until 7500m^3/s during the 1856 and 1866 floods (B. Barraqué, 2005).

The climate being the major factor concerning river flow, three types of Loire flood can be drawn (C. Bouchardy, 2002):

- The oceanic floods, the most frequent ones, are caused by rains coming from the ocean. They can spread in the whole basin and usually happen in the cold seasons. The flood levels are various, but in the medium Loire, their flow is always lower than the maximum that the levees can contain. In the low Loire, they can reach the levees limits.

- The floods from the Cévennes region are the most sudden. They result from stormy rains coming from the Mediterranean Sea. Usually, they happen in autumn (September, October, and November) or even sometimes in spring (May, June) on the Cévennes region and the high basins of the Loire and Allier Valleys. Confined to the high basins, they rapidly lower if they are not supported downstream by an oceanic flood.

- The mixed floods, the most dangerous in the medium Loire, are issued from the gathering of Cévennes and oceanic floods. They can lead to a general rise of the water in the whole basin. The most important floods which ever happened in the Loire Valley (1825, 1846, 1856, 1866, and 1907) were mixed floods.

3.1.1.3 Triptych Flood protection – human occupation of the soils – disaster: eleven acts play

Act 1: Warming up

The Loire, river made from water and sand (created by serious low-water marks and important floods) is constantly canalized between levees. Thus, as early as the way out of the Massif Central, the minor bed of the river is driven through dikes to Nantes, on a distance of 530 km. This dyking up, began in the 12th century, appeared at first to easy the traffic because it was used as a towpath. The merchants took a careful care of it as was becoming the main road to the most inhabited part of the plain. Before the building of the levees, it was impossible for men to build to last in the plain of the Loire River. The only towns or isolated houses had been built on unsinkable slopes (the "Montilles") or on soils artificially isolated by a raising process (the "Tertres"). Elsewhere, the plain was occupied by a spontaneous nature and at a local scale by an agriculture composed of sand growing plants (Dion R., 1961). The main bed was inhabited by groups who traditionally exploited these dump areas: fishing, hunting, breeding, wood fuel, hydraulic powers (Burnouf J., Carcaud N., Garcin M., 2003), and who knew and accepted the hydrologic functioning and the drawbacks.

Act 2: Building of the first levees

Nevertheless, to protect the roads and mostly the rich agricultural lands, the riverside residents have built some little discontinuous dikes placed where the floods happened which were called "turcies". They protected only rich and inhabited lands and had been created to disappear in case of stronger floods. The farmers who lived on the slopes did not felt threatened by the breaking of these dikes. On the contrary, the interests of the land owners, who earned money thanks to the valley, lied in the perfect maintenance of the "turcies". Hence they were an absolute necessity for the value of their lands. In 1160, they aked the King Henri II Plantagenet to settle some "hôtes" in Anjou. They were in charge of the maintenance of the dikes and lived in them. The idea then spread upstream in Touraine. The building of high and powerful dikes, supposed to resist to important floods began at that time. During the 13th, 14th and 15th centuries, these buildings resisted. The "turcies" then appeared to be liable works, thanks to their good maintenance. Their efficiency thus being proved, new dikes are built. Contrary to the "turcies", these modern levees prevent the river from its natural flow.

Act 3: First bursting

From the 15th to the 17th century, the development of the trade and the upper class gives to the levees new uses, in contradiction with the former agricultural uses. Indeed, the first works, which were sinkable, gave an alluvium supply with "quiet" floods. On the contrary, enclosing the river into too narrow a space, the king and the upper classes from the cities compelled the waters to flow more rapidly and higher than the valley level. Every overflow or bursting of the levee led to violent floods and damages for the agriculture in the valley. Thus, the levees were mainly appreciated for their roads, useful for the wine export (which was expanding at that time), and the trade. Contrary to farmers from Saumur and Angers, who kept on maintaining the levees as a personal property, those from the region between Gien and Tours, where the levees were more modern, did not feel responsible for works built on their lands by the upper classes. From the beginning of the 16th century, the dikes bursting became more numerous and serious (1494, 1519, 1527, 1549 floods). But this protecting system was not thrown back into question. Because of the lack of knowledge, people did not understand that the level of the waters would be too high if it could not overflow. With each dike bursting, the

decreasing level of the waters created by the opening of the breach gave the impression that the flood had reached its highest level and that a simple raising of 10 centimetres would be sufficient to protect the valleys.

Act 4: First doubts

In 1610, a first calling into question of the unsinkable levees happened, to find a solution more efficient on a technical point of view. Louis XIII Council (1610-1643) anticipated the setting and six spillways similar to that of Blois (spillway of La Bouillie finished in 1618) were built to allow the diversion of the flood to the valley. The King Council considered the destroying of some levees was an absolute necessity to secure the valley. Nevertheless, this 1629 program stayed unexploited: because of the upper classes settled in the valley refusal, none of the six spillways were built. Then, when Colbert arrived in 1944, these ideas were left apart. He believes levees can and must be unsinkable and that their bursting was due to a lack of maintenance. His purpose was to get the existing defence system stronger. He centralised the financing of the buildings, as well as the maintenance giving it to the fortification engineers. The works realized between 1682 and 1705 enclosed the Loire River from Gien to Pont-de –Cé into the widest and most powerful dikes than had ever been built at that time.

Act 5: First general program

At the beginning of the 17th century, to find a solution to the continuous floods of the Loire River (1707, 1709, 1710, 1711), a general program to fight floods, the first one in the Loire Valley, is implemented. It is composed of :

- The raising of the levees and their strengthening where breaches had appeared.

- The building of spillways wherever there were none of them, as it had previously been organized under the reign of Louis XIII. The spillways are only built between Gien and Tours, in the part of the Loire River where the dikes were the closest to one another.

- The building of spillways to stop the waters upstream, which was done for the fist time. Hence, three stone dikes were built in the gorges near Roannes, Which limited the width of the Loire to 20 m. They were supposed to half reduce the flow of the flood.

But the 1733 flood brought a doubt on the new system, bursting numerous levees such as in the Orléans and Tours Valleys. The damages were huge. The spillways revealed as inefficient as the levees. They even seemed useless, and even harmful for agriculture and dangerous for the inhabitants. The population claimed for the strengthening and the heightening of the levees and refused the spillways.

Act 6: First come back

From 1733, the country came back to the levees policy: the government suppressed the spillways, except from those built before 1711 (Saint-Martin-sur-Ocre and Blois) and heightens the levees very rapidly to 22 feet above the low waters level. But the contractors only covered the dikes with sand embankments without protecting the higher parts. This flimsiness will last until today. During the second half of the 18th century, the technical management of the spillways and levees was given to the "Ponts et Chaussées". They tend to reinforce, complete and spread the dikes network. Nevertheless, their works were different

from the former ones as they planned a wider space inside the dyke up bed for large floods. Some local changes were made, correcting the layout of the most threatened dikes, without solving the real problem. The absence of large floods increased the impression of security, all the more than the 1825 flood was restrained into the dyke up bed. This was felt as the results of the general policy to fight against floods. But these certainties were destroyed by three huge floods in 1846, 1856 and 1866.

Act 7: Never ending dramas

The violent flood, on the 22nd of October 1846, created at least 25 breaches on a length of more than 3.6 km on the levees in the Nievre region. Several dikes were even completely destroyed, some bridges partly or completely carried along. Third of the city of Nevers was overflowed. Then, the whole Loire Valley was touched by the floods. A hundred breaches opened on the levees between Briare and Langeais. The river carried along 30 km of the Orleans-Tours railways, opened six months earlier, and which had unwisely been build at the ground level behind the dikes. This illustrated the confidence people had regarding flood risks. The flow invaded almost all the Loire Valley, destroyed the Amboise railway station and reached Tours following the railways for which the levee had been pierced.

Just after this event, the flood of June 1856 happened. Today it is said to be the "reference flood". Exceptionally, the rains, cause of the floods, fell at the same time on all the Loire affluent, from Velay until Nantes. The Loire River upstream flood flowed to 4000m3/s in Nevers (these numbers are issued from the heights taken down at that time). For the Allier affluent, this is the largest flood which had ever happened since 1790: 3500m3/s in the Bec d'Allier. Thus, the flow reached 7500m3/s at the confluence, which rendered 6000m3/s in Tours. The dikes broke one after another, it's a disaster. From Bec d'Allier to Nantes, the river breached 160 times. Once more, Nevers was overflowed and all the low districts were evacuated. The Nievre river breached at least 32 times. The Loire River destroyed the bridges of Fourchambault, Cosne and Sully. The Jargeau breach destroyed 80 houses and dug a hole of about 10 metres depth. Tours was overflowed for a second time. The Loire River spread on a length of 80km and a width of about 12km, creating important damages until the Maine et Loire department. Many churches, houses collapsed, many roads and cattles were carried along, the railways were pulled out, the cemeteries broken up. The river overflowed 80km of railways, and destroyed 3200 hectares of agricultural lands. The "Ponts et Chaussées" engineer, M Comoy, deducted that if the dikes had not broken, the water would have risen to 9 metres above the low water, which no dikes could have retained. On the other hand, the dikes bursting have certainly allowed avoiding more damages downstream.

A similar disaster happened ten years later in September 1866 on the Loire River: 3900m3 in Roanne and flows as fast as in the former flood, on the Allier river. This was the strongest flood ever registered in the city of Nevers. The St Eloi levee (already rebuilt and reinforced in 1846 and 1856) cracked on numerous places, was about to collapse and overflow the lower part of the city. A breach opened in la Baratte and the flood reached its highest level which was 6.36 m. The Servoise levee bursted and the Loire River spread from Nevers to Plagny. This flood looked like the former one and it caused huge damages on a major part of the Loire Valley, Especially around Orléans, where the village of Jargeau has been devastated. However, between Blois and Langeais, it stayed one metre beneath the 1956 level. Hence, Blois and Tours have not been overflowed.

Act 8: dikes and reservoirs

The recurrent disastrous lead to a quest for new solutions, especially from Orléans to Angers, where urbanization is widely spreading. After 1856 flood event, Comoy, hydrologist engineer, points out the irrational development of the dikes and their effects on the increase of the water pressure. The higher the dikes, the more dangerous for people : higher dikes narrow the riverbed and permit more water to be stocked. Consequently, water has a powerful flow and put a heavy pressure on dikes. Risk of collapsing heightens consequently. Comoy underlines the only solution is impossible: dikes should be removed further, in order to enlarge the river bed ! The other solution would consist on creating discharge channel (spillway) in order to avoid breach due to high pressure on dikes. It is also impossible, considering that there are buildings and croplands of great value behind. The new proposal of Comoy consists in building storing reservoirs upstream. Reservoirs are becoming a well-known technique. The proposal consists in building 85 dams upstream, so that 520 millions m3 can be stocked. A flow at the "bec d'Allier" place could be contained to 6 000 m3/s. instead of 7 500 m3/s. (that is the real flow that happened in 1856). Since the higher flood that never break a dike is 1825 only had a 4 100 m3/s. The reservoirs and dams are thus very expensive, take long time to built and would not be effective enough. In 1866, the third major flood convinced the State to create spillways. It is easier and cheaper. This last argument is important because there is less and less financial means in Touraine, due to the decline of industrial activities and Loire shipping. The spillways planning is substantial: 20 spillways are supposed to allowed the water to flow in 18 of the 33 valleys protected with dikes. It represents half of the area, i.e. 96 000 ha. However, most concerned inhabitants are against the project and only 7 of the 20 spillways are built from 1870 to 1891. As for the dams and reservoirs, the study on where they could be is done, but none is built, but the ones made for producing hydroelectric power.

Act 9: railway versus water shipping

During the 20th century, the flood threaten is largely neglected. Nevertheless, issue is critical in 1907: water almost reach the edge of the spillways. Orléans and Blois are closed to be flooded. Even though, nobody is taking care of the dikes and in 1925, the administrative staff decide that no more enhancement will be done on dikes and flood defences. Indeed, most cities are interested on railways and main stations are built far away from the River. The Loire is no longer a strategic place and all economic activities move to the station's neighbourhood. Economic criteria become the most important issue concerning the management of flood plains. From the period before the industrial revolution, one century earlier, till the beginning of the First World War, human settlings are characterized by i) the reinforcement of urban spread (houses and industrial activities), ii) the enhancement of agricultural machinery. It leads to the loss of inhabitants settled in the Loire valley on the one hand (Dion R., 1933) and to the growth of agricultural plots and to the development of farms, agricultural and storage buildings on the other hand. They are bound to be the future urban nucleus. This urban spread is slow till the first WW and slows down during the two WW.

Act 10: new stakes

The increasing role of economic criteria concerning urbanisation in flood prone areas is illustrated by the return of the building dams' idea during the 1950's. Mains concerns are not only about high water level and the defence against potential loss but also about keeping up the water level during summer. More and more water is needed because of urban development, of new agricultural needs (irrigation and enlargement of fields in the valley) and of nuclear power needs (17 nuclear power stations are built along the river between 1963 and

1988, nowadays, 12 are still working. Consequently, an equipment programme is launched: it aims to keep up the water level, to derivate streams, to limit flooding, in a word, to regulate the flow by building major dams on the Loire River. Building dams becomes a necessity again, 7 dams are therefore planned on the Loire River. In 1995, most of the projects are cancelled, especially because of strong political, ecological and economical oppositions. Only two of them are built nowadays: i) Villerest Dam, located few kilometres from Roanne, limits floods higher than 1 000 m3/s. and keeps up the water level thanks to a 128 millions m3 reservoir; ii) Naussac Dam, located on the Donozau Riv, Allier River's tributary, intended for keeping up the minimum flow and water level needed by the nuclear power stations of Belleville (Cher) and Dampierre (Loiret)

Act 11: non-structural measures

The behaviour towards flood risk and its perception started to change radically after several events. First of all, on the international level, the Rio Summit emphasized the concept of sustainable development while many disastrous flooding occurred round the world (Chine, USA, Canada, etc.). Later on, on the French national scale, after several decades without any major flood events occurring, dramatic floods took place between the beginning of the 1980's and 1994: Nîmes (1988), Vaison-la-Romaine (1992) and more generally large floods occurred in France during winter 1993-1994. It quickly appeared that no matter the protection works that may be set up, the risk is never nil. Those events led to a quick evolution from an emphasis laid on protection works to face the flood risk to a new flood management policy, mainly focusing on the issue of flood prevention. Within the frame of such a new strategy, the ambition was to focus not only on the hazards but also on the issues at stake. It focus mainly on non-structural measures, that consist in modifying land uses or activities; land use planning, construction rules, rescue measures, etc. (Pottier N, 1998). Today, building of new embankments or dikes are forbidden unless they are meant to protect already built areas. Since the last few years, the idea of giving more room to the river appears.

3.1.1.4 Human settling since 1945

The multidisciplinary team of Plan Loire Grandeur Nature (Equipe Pluridisciplinaire Plan Loire Grandeur Nature) shows the potential impacts of a 1956 flood nowadays in the middle part of the Loire Valley : 300 000 inhabitants would be hit, 115 000 houses, 13 600 companies and 71 000 jobs would be involved. Those potential loss are due to the urban settling in the valley. This settling is the consequence of the economic growth that happen in the 1950's. After WWII, and till the 1973 oil shock, there comes a period of high economic growth in France, called the "30 glorieuses" (The Glorious Thirty years). The demographic growth and the important reconstruction activity due to the bombings lead to the enhancement of the flood defences. These works participate in the so-called "total flood risk control illusion" (Girardin F., 2001) ("l'illusion de la maîtrise totale des inondations"). The absence of flood events during these 30 years reinforces this feeling. Therefore, building activities and civil engineering are fully expanding. In 1958, the French State got involved in a real housing policy; The days of housing estates began. Because it is public funded, three main goals are underlined: "emergency", building up very quickly; "mass" building up a lot; "bargain", building up cheaply (S. Jacques, 1977). Thanks to improved architectural skills, projects grow quickly to a huge extent. Council housing and private homes are both concerned. This housing program took place in the districts of the city already built, where room was available, in a way, thanks to the bombings. However, most of these constructions needed a wide spare space to be set up. The flood plains, whose topography was flat and that were close enough to the city centre, were the first places where new construction took place. The

urbanisation of the Loire valley became one of the most important urban planning projects the river bed had ever issued (Lussault M., 1993). Indeed, during this period, flood probability never happened to be a concern in choosing (or not) the place to be built up. Tours, Nevers and Blois are some examples.

3.1.2 Meuse, The Netherlands (J. Spits and T. Brinkhof)

Dutch Delta

The river deltas of the major rivers Rhine, Meuse and Schelde are situated in the Netherlands. If there were no dikes in the Netherlands, about 65 percent would be flooded.

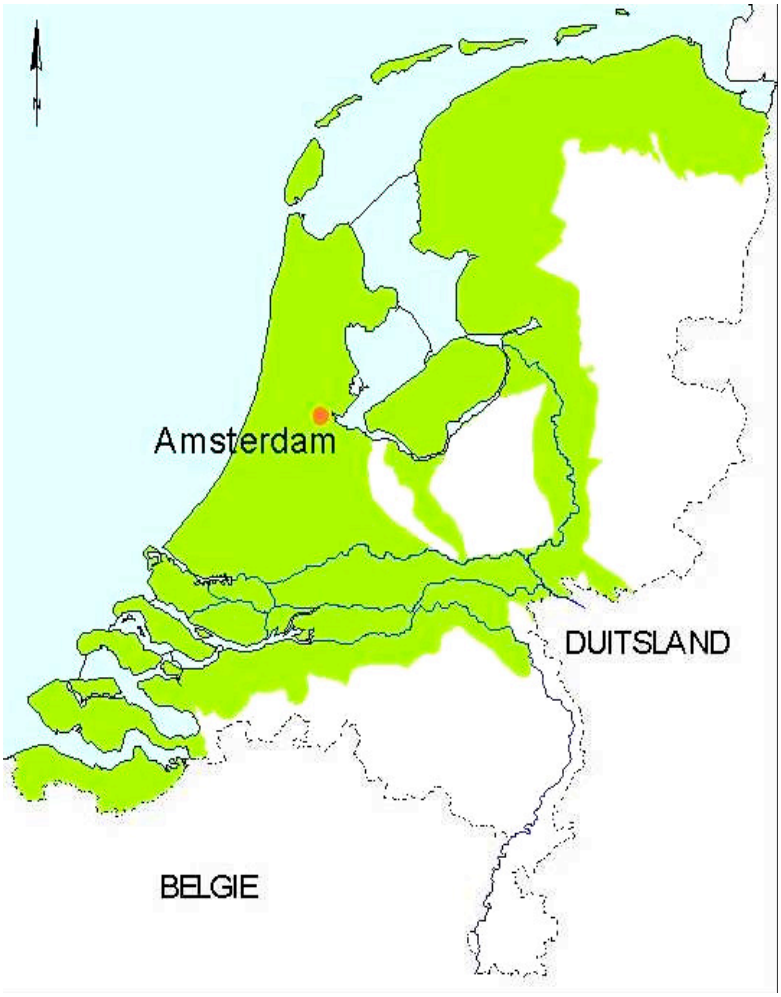


Figure 3 Dutch delta, the part of The Netherlands that would be flooded without dikes (Source: rijkswaterstaat.nl).

The first human occupation was largely restricted to the higher Pleistocene areas. However, man succeeded more and more in protecting himself by raising the dikes and by finding ways to reclaim land from the sea and lakes. In the course of time, the construction of dikes, the reclamation of land, the drainage of agricultural lands, marshes and lakes, have contributed to the total surface of land appropriate for cultivation. This contributed as well to the decline of land area regularly flooded. Rivers have been cut off from the sea and are caught within a narrow corset of dikes (rijkswaterstaat.nl). Between the Rhine and the Meuse, considerable differences exist in terms of discharge patterns. These differences are due to the size of the basin areas and the amount of precipitation. While the Rhine is next to rainfall also fed by

snowmelt from the Alps, the Meuse river forms for the most part a more direct rain fed river system.

The Meuse River has a length of about 925 km. Since the Meuse is a typical rainfed river, the discharge can vary enormous. The Meuse arises in France on the Langres plateau. From there, it flows northwards into Belgium. Afterwards, the Meuse forms part of the Belgian-Dutch border. In the Netherlands the Meuse continues northwards. Past Venlo, the Meuse turns towards the west. Finally, the river flows into the North Sea via the Haringvliet. The characteristics of the Meuse vary due to the varied geographical context: from the transition of a valley river into a delta region.. The Meuse river basin covers about 33.000 km^2 in parts of France, Luxembourg, Belgium, Germany and the Netherlands.

River embankment

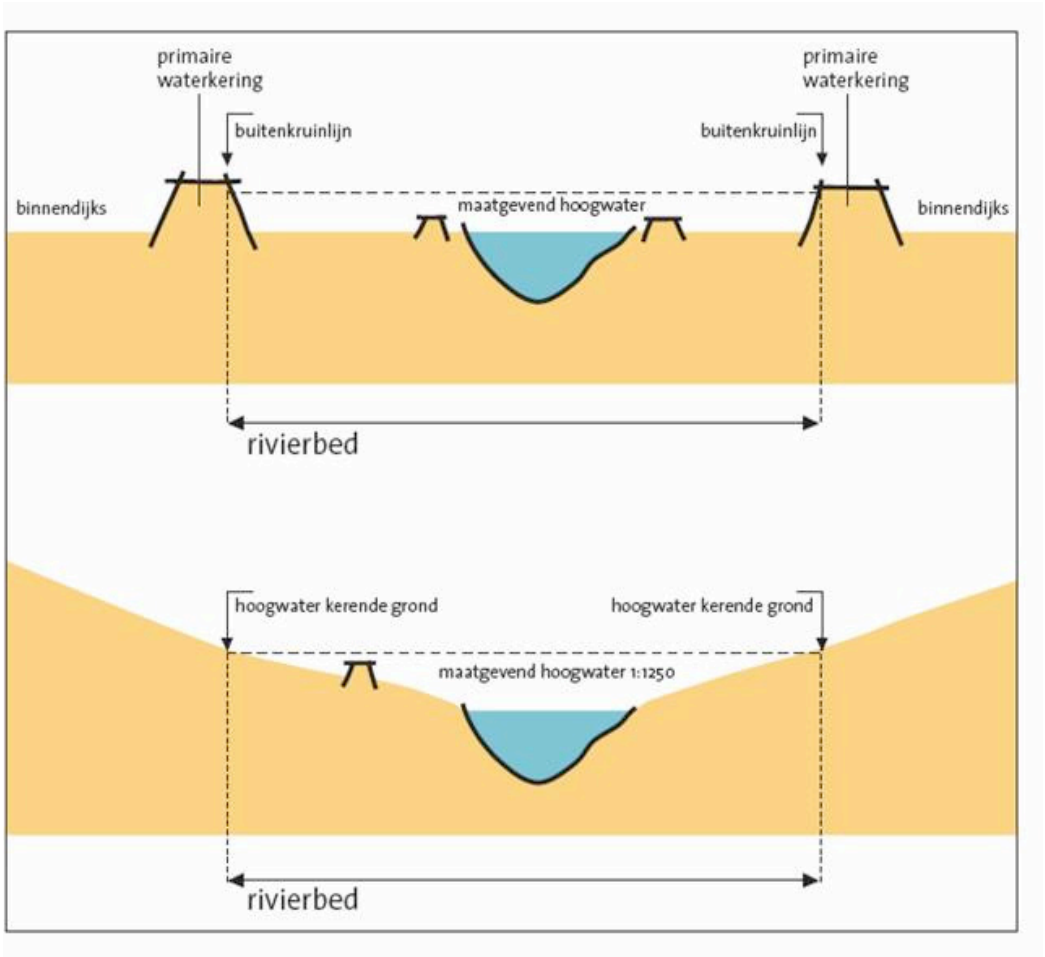


Figure 4 : Cross sections of embanked and not-embanked river systems.

All major Dutch river systems are located in the lower parts (at or below sea level) of the Netherlands, except for the Meuse river section that is upstream from the village of Arcen. In this South part of the Netherlands, the Meuse river crosses the higher Pleistocene areas in a river valley.

Due to the physical characteristics in the Netherlands, embanked river systems are dominant in the lower parts of the Netherlands. River valleys (not-embanked river system) only exist in

the higher parts. In figure 4, a schematization of two types of flood plains is presented for the Dutch situation.

Flood risk standards :

Flood protection is strongly regulated by dikes. Due to the physical characteristics, the flood risk level differs between the higher and lower parts of the Netherlands. Along the Meuse upstream form Arcen, the flood risk is limited to the river valley area itself. The surrounding, higher areas are flood free and need no protection against flood. However, the lower parts of the Netherlands are potential flood prone areas and are mainly protected by dikes. The flood risk levels here strongly depend on the height of the dikes. According to the national flood risk management strategy, the flood risk standard for rivers in the lower parts of the Netherlands is 1:1250. This means that a flood may occur once in 1250 years. Compared to flood protection in other countries this appears to be an extremely high protection level which brings about a sense of absolute safety for flooding behind the dikes. For the protection of land against floods from the sea, different standards exist. For the 'Randstad' for example, a flood risk standard exists of 1:10.000 years. (See also figure 5).

Figure 5 : Flood risk map of the Netherlands (Source: www.Rijkswaterstaat.nl)

Border and Sand Meuse

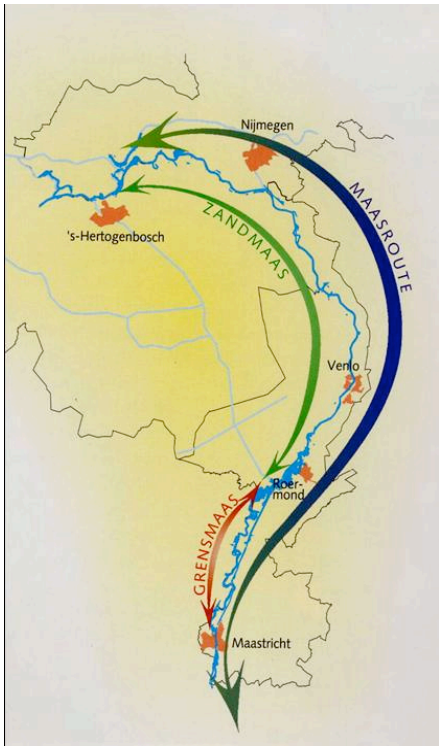


Figure 6 : Meuse trajectory: Sandy Meuse and Border Meuse (Source: www.rijkswaterstaat.nl)

This study takes into account the upstream part (approximately 150 km) of the Meuse river from the city of Venlo to more upstream villages Itteren en Borgharen. Originally this river section is a valley and therefore not-embanked. However, In the course of time, man has constructed dikes and quays at villages and cities and other more high valued stakes.

Border Meuse

The Border Meuse starts at Borgharen and ends at Maaseik. The river bed is very wide and meanders strongly due to the low slope. The embankments are very natural. There is no shipping on this section and the shipping canal follows the parallel Juliana canal. The winterbed is comparatively extremely wide. Over fifty percent of the land use consists of agriculture, grassland and urban developments.

Sand Meuse

Downstream from Maaseik, the Meuse enters a gorge. Because a lot of sedimentation of sand takes place on this river stretch, it is called the Sand Meuse. Many lakes and former sand pits strongly characterize this area. The higher plateau (Peel horst) from Neer to Arcen (including Venlo) is incised by the Meuse. This resulted in a deeper river valley with a low slope. The winterbed is smaller than at the Border Meuse (Source: www.Rijkswaterstaat.nl).

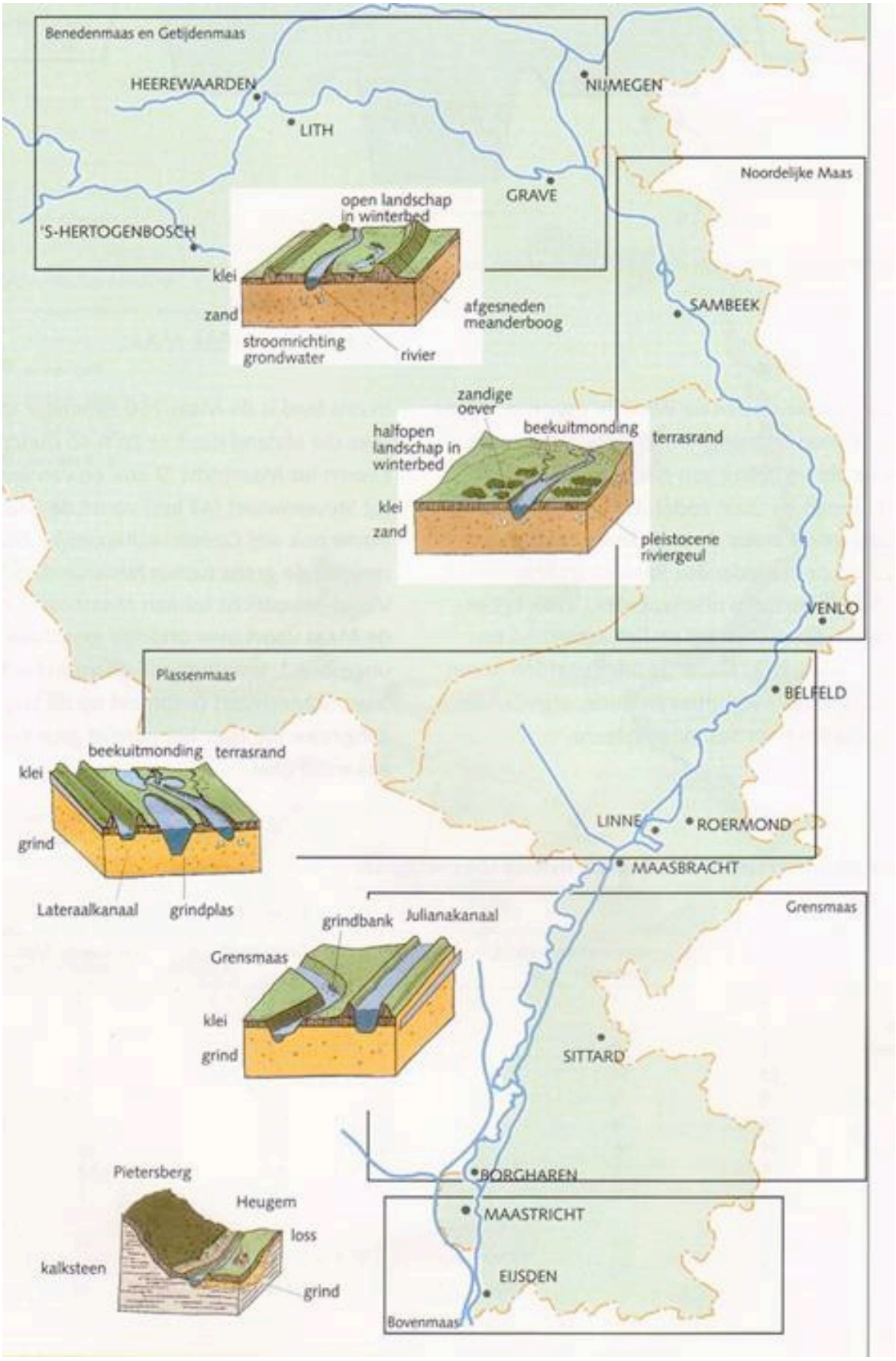


Figure 7: Geographical characteristics of Meuse river sections

Urban development :

In the course of time, the urban development in Dutch riverbeds appears to be most widespread in the Border and Sand Meuse.

Table 2 : Land use planning of Dutch floodplains (source: www.natuurdichtbij.nl.)

Between 1900 and especially after World War Two until the high waters of 1995, gradually developments of urban areas have taken place with the contours of the flood plains of the Meuse.

Soon after the flood of 1995 the national government started with the realization of quays to protect villages along this part of the Meuse. These are short term emergency measures with a protection level of 1:50 years. On the long term the project Meuse Works will provide a final protection level of 1:250 years by creating more room for river.

Spatial developments in the Dutch Meuse valley :

The floodplains of the Meuse have already been inhabited for centuries. Even old civilizations have existed, such as the 'bandkeramische' culture. The fertility of the soil was a reason for settlement. These soils received their fertility from sediment depositions as a result of regular Meuse flooding. It is thus not strange that these grounds were used for agricultural purposes.

The Meuse bed is lower than the adjacent land; and the riverbed shape can be described as a valley. This is a mayor characteristically difference from the rest of the Netherlands, where the natural river floodplains would actually be wider than the delineation of floodplains by dikes nowadays. In the rest of the Netherlands, protection against river flooding is primarily arranged by large dikes or quays.

The difference between these two systems is that when a flooding occurs, the impact is different. Where the floods from the river Meuse in Limburg would probably provide nuisance, floods in other areas would cause more life threatening situations. The

argumentation is that the depth of the water level, and forces accompanying a dike breach or likewise would have a larger impact.

The borders of the floodplains for the Meuse in Limburg are not clearly recognizable, in contrast to other areas in the Netherlands. In the past houses and industrial sites have been built in the winter bed, particularly on higher grounds.

Floods are happening more often in the last decades. “In the Meuse River, five out of the seven largest floods recorded in the period 1911-2003 occurred during the last decade.’ In the literature different arguments exist on which of the factors has the largest impact on flooding. “Over the past century, the forest area in the upstream basin has changed little and most changes in the forest types, agricultural land and urbanization occurred before the 1980s. The apparent changes in frequency and magnitude of floods in the Meuse River offer the last two decades can apparently be broadly ascribed to climate variability.”

As a result of the high waters of 1995, the national government increased the flood protection norm. After 1995, 140 km. of quays have been constructed along the banks of the Meuse. The original idea of the Dutch national government was to secure the flood risk by installing these quays. The quays were created on a risk level of 1:50 years.

Current developments :

At present, different spatial developments take place to reduce potential flood risk. For the Meuse, a project called “Maaswerken” (Meuse works) has been initiated. The main task is to protect the urban areas by reducing the flood risk to a 1:250 years standard. That target will be achieved through a combination of different, complementary flood protection methods and techniques. A package of different measures will be taken in and along the Sand Meuse to improve the level of flood protection, such dike construction, construction of retention areas, deepening of the river and flood channels.

3.1.3 The Rhine, Germany

The Rhine River is one of the largest rivers in Europe, with a length of 1320 kilometres and an average discharge of about 2000 m3/s. The Rhine origins at the Swiss Alps and flows through Switzerland, Germany, France, and the Netherlands. The basin covers nine countries including Switzerland, Italy, Lichtenstein, Austria, Germany, France, Luxembourg, Belgium and the Netherlands. The Rhine consists of different sections, i.e. the Alpenrhein, Hochrhein, Upper Rhine, Middle Rhine, Lower Rhine, and the Delta.

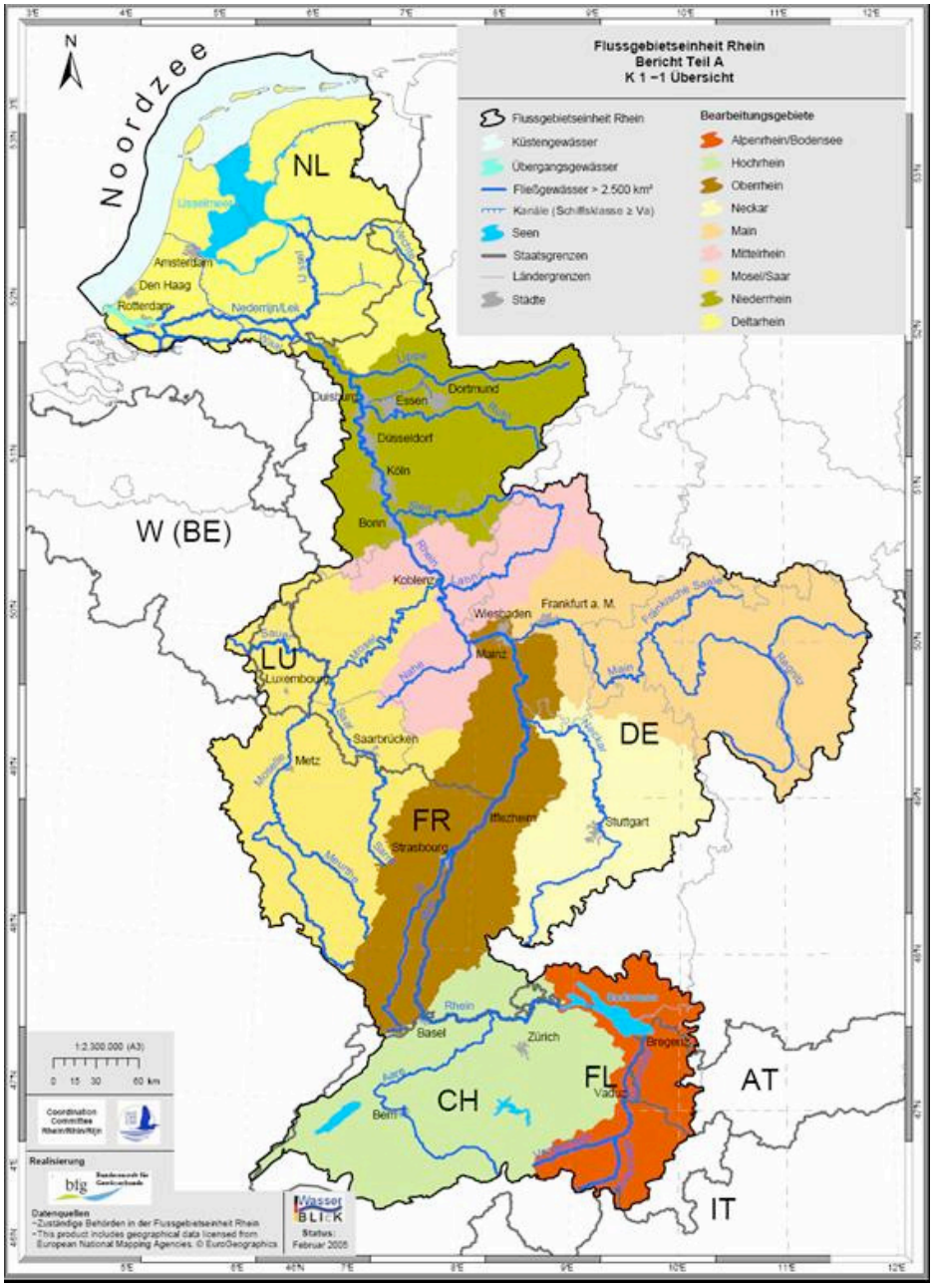


Figure 8 : Rhine basin

One objective set by these countries in the Rhine High Water Action Plan (Hoogwateractieplan voor de Rijn) is to reduce the high water levels an average of 70 cm by 2020. All countries in the discharge basin are implementing appropriate measures, including those described in the SPKD Room for the River. The German state of Nordrhein-Westfalen, the Dutch province of Gelderland and the Directorate-General for Public Works and Water Management (Rijkswaterstaat) for the Eastern Netherlands studied the effects of extremely high water in the border region. The volume of Rhine water that could eventually reach the Netherlands was also estimated. The three parties then investigated which measures could potentially provide flood protection for both the Netherlands and Germany. What emerged here was that both countries place a high value on coordinating efforts to this end. Measures implemented in Germany, however, cannot adequately maintain the required level of protection in the Netherlands, but this can be achieved by the package of measures in the SPKD Room for the River. (Adapted from the PKB).

3.2 Local scale (D. Andrieu, S. Servain-Courant, T. Brinkhof, J. Spits, V. Wattenberg)

Case studies are used to gain a better understanding of developments on local level.

3.2.1 France (D. Andrieu, S.Servain-Courant)

The Loire valley and the three towns Nevers, Blois and Tours are studied.

3.2.1.1 Study area, the valley

260 km of valley were mapped between two distinct areas located in 4 departments (figure 9):

- a transect of 160 km in the Indre-et-Loire and the Loire-et-Cher
- a transect of 100 km shared between the Niévre and the Cher

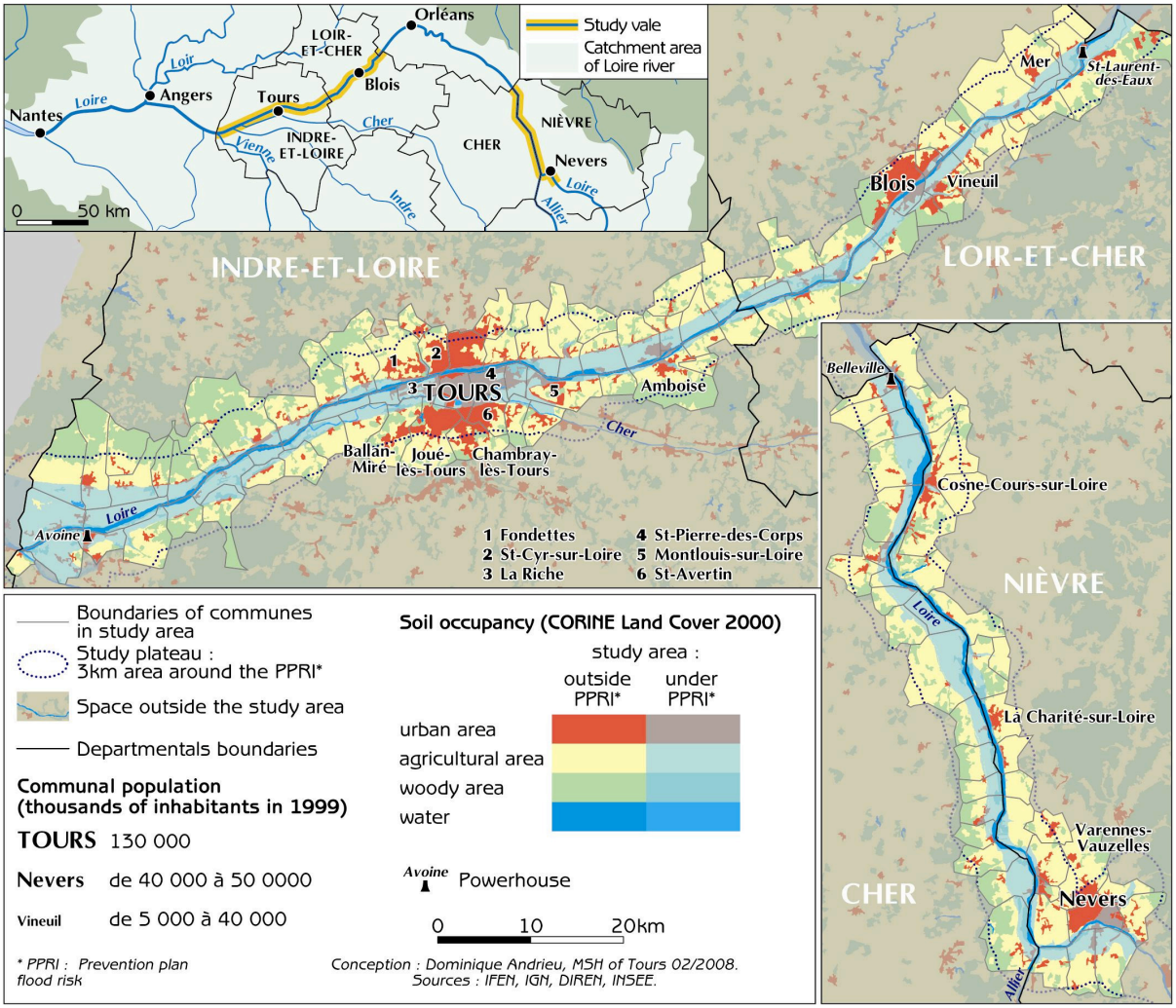


Figure 9 : Study area

The bottom of the valley is defined by the space between the hillsides or vale, it constitutes the zone potentially floodable. The PPRI, which is a hierarchical rule composed of 4 “aléas”, some of the places are not under any “aléas”. This can be proved in 3 cases :

- A natural elevated profile: 2 cases were recorded in Bourgueillois at the extreme West side of the Indre-et-Loire and in the North of Charité-sur-Loire in the Nièvre.

- The city centre of Tours: It corresponds to old occupied area where the topographic level was elevated due to human activities.

- Recent landscaping: it corresponds to vale zone completely modified for city planning where the recent cases are located along the Cher in the districts: the Fontaines; the Rives du Cher and the Deux Lions; Similar case is located in the study area Avoine, St-Laurent-des-eaux and Belleville with 3 nuclear power plants.

For understanding the urban extension in flooded vale, spatial-temporal parameters are defined for creating the data base.

(1) Spatial parameters

- 127 communes : They are elementary administrative entity in which first level of public politics is applied. Communes being under the PPRI are consequently part of the study. Around the agglomeration, the communes insuring the urban space continuity were selected: Varennes-Vauzelles in the North of Nevers or Chambray-les-Tours in the South of Tours

- The plateau : they are interesting study area because only 9 communes are entirely included in the PPRI. How was the urbanization dynamic in the main communes having their areas divided between flooded vale and dry areas in the plateau?

This space identified as plateau is a buffer zone of 3 km around the PPRI. Therefore, it is mainly constituted by higher topographical surfaces framed by the hillsides and by secondary confluents valleys, which are not under “aléa” of the PPRI. The definition of this “plateau” will allow appreciating if it brings spatial alternatives for recent urban development.

(2) Temporal parameters

The urban dynamic is analysed since the end of the Second World War. During this period the reconstruction, then the economic development, the social and demographic occidental society had deeply modified the soil occupation. Since 1946, (first census report after war in France and first homogenous map covering which represents the initial cover of the diachronic spatial data base realised for the project) population increased by 166% and urbanization by 182% (value calculated on the PPRI and the plateau parts of 117 communes strictly under flood risks)

(3) Data bases

The cartographical data bases were realised from the spatio-temporal elements. It is based on cartographical homogenous sources in time and area to cover. Thus, urbanization is identified in 1960, 1985 and 2005 from cartographical coverage at 1/100 000e and at 1/50 000 for 1946.

To those period it correspond 4 population census: 1946, 1962, 1990 and 1999.

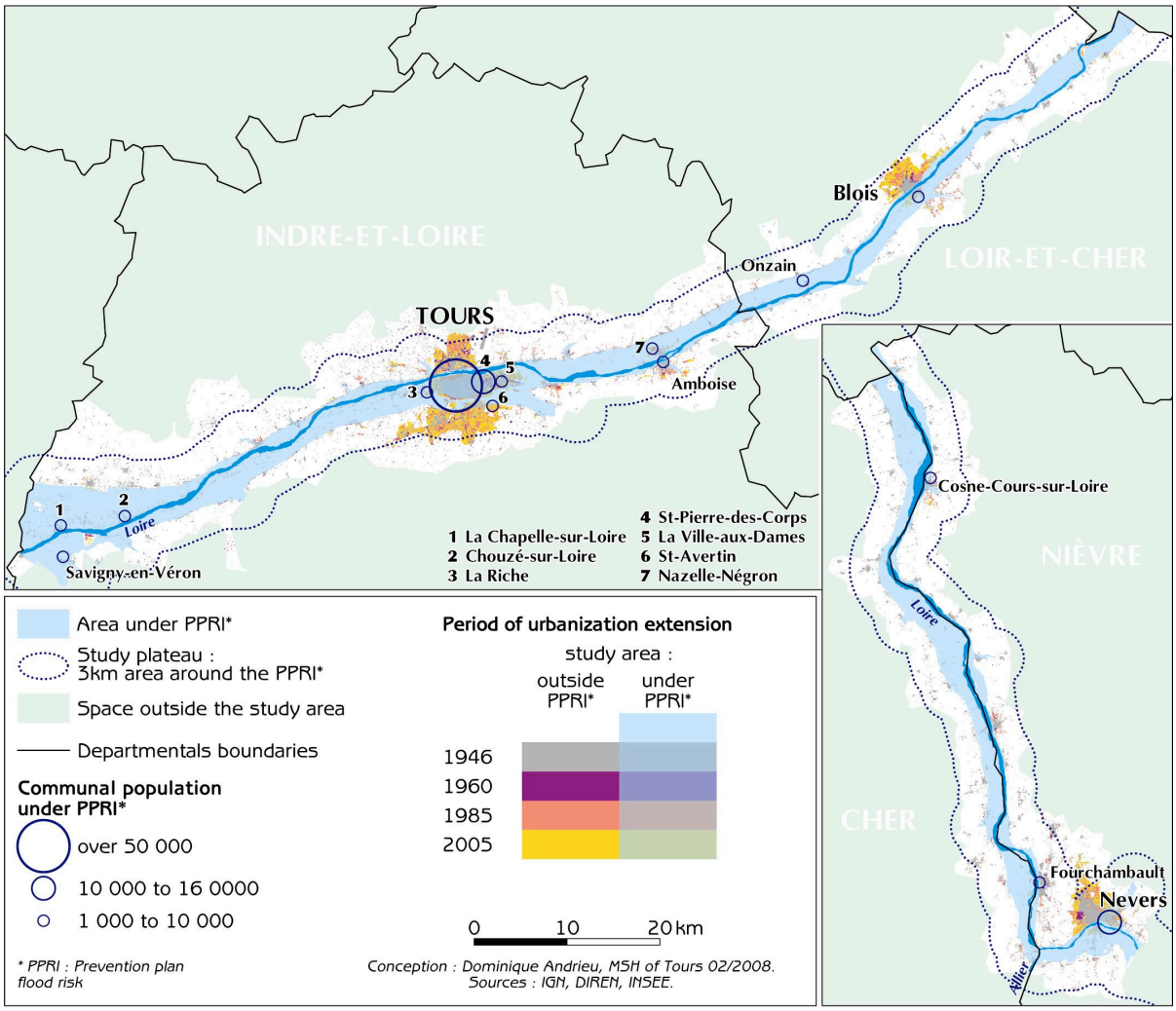


Figure 10 : Urbanization dynamic in the study area from 1946 to 2005

3.2.1.2 Urban sprawl

The figure 10 shows the urban diachronic realised at a small scale. This group is not densely urbanized: regarding to data base, less than 9% of the surface is urbanized. However its repartition is very contrasted and increased during the 60's. Thus, urbanisation was about 4.8%, 5.2%, 6.8% respectively in 1946, 1960 and 1985.

(1) Urban configuration

INSEE (French institute of statistics) defines 5 agglomerations with 436 000 inhabitants, 79% of the population are concentrated over 22% of the urbanized surface of the study area. Tours is the biggest agglomeration with 276 000 inhabitants. Followed by cities with similar size, Nevers and Blois with respectively 57 500 and 66 000 inhabitants which are living in the study area. The cities of Amboise and Cosne-sur-Loire constitute the last group with 16 000 and 12 400 inhabitants, respectively.

The settling of cities and villages is similar. They are generally historically located outside floodplain: downhill the vale like on the North side of the Loire river between Tours and Amboise, or on the side of the plateau like most vale configuration such as in the Niévre with the cities of Nevers, Charité, Cosne. Several villages have this kind of configuration, it allows taking advantages of the valley and to be protected from floods.

Other cities were historically implemented over the floodplain, and it concerns 9 communes which have their entire area under flood risks. The commune of la Riche with 8 500 inhabitants (Nearby commune at the West side of Tours) and Chouzé-sur-Loire (Bourgueillois at the west side of Indre-et-Loire) have only 2% of their territory which is not comprised under PPRi regulation. The communes of Tours, St-Pierre-des-Corps and Nevers are the 3 biggest communes located in the floodplain with a total of 80 000 inabitants concerned by the risk. The historical city centre of Nevers is not located in the floodplain area but Nevers is still part of the communes with the highest amount of inhabitants exposed to floods risks the cities show a recent urbanization which is essential for the understanding of the current situation.

(2) Urban extension

During the past 60 years, Nevers, Tours and Blois were the cities with the wider spatial extension (Figure 10) and imposed the orientation of the curves (figure 11).

When differentiating the dynamic between the space of the PPRI and from the plateau, it exists, for the Indre-et-Loire and for the Loir-et-Cher, a significant increase of the urbanization on the plateau, for example on the North side of Tours and Blois.

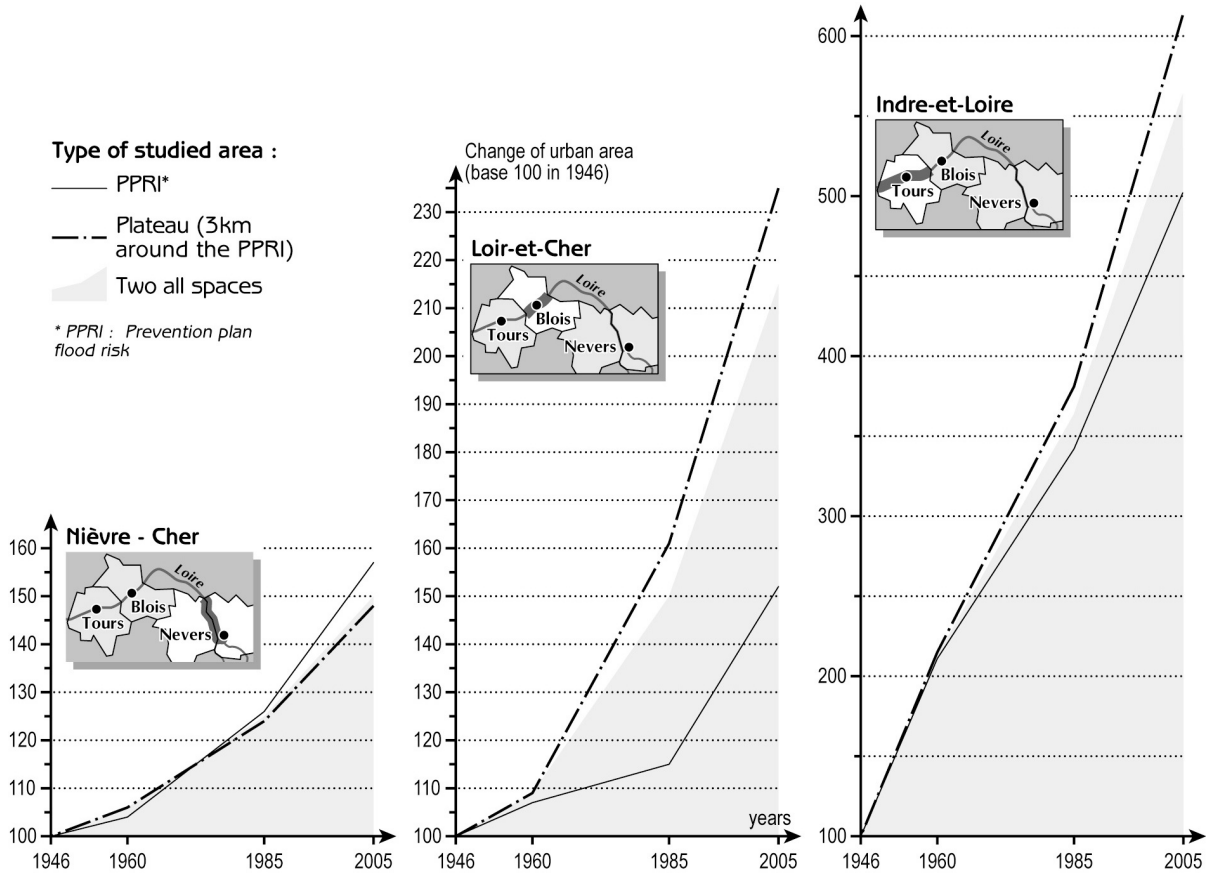


Figure 11 : Differentiated dynamic of the urbanization from 1946 to 2005

During the last 20 years, the urbanization in the PPRi area was stable and then increased significantly. It is justified by the impressive urbanisms plans along the Loire River (Nevers) and Cher River (Tours, les Fontaines) that were operated during 1960/1970. However, other important urban development occurred in area constructed after the second world and without any flood risks: in the agglomeration of Tours with the district Europe, and in Chavy located in Blois.

In the region of the Niévre, the dynamic is different from the two other departments (Indre-et-Loire and Loir-et-Cher). It can be explained by the geographical configuration of this valley part, which was a bit urbanized in the PPRi area during 1946. It does not exist any urban settlement in this area and in Nevers the wide valley is only inhabit along the old N7 road. Then, its development took place on the plateau, mainly in function of invested spaces in floodplain area starting from the confluence of the Niévre up-to the commune of St-Eloi at the Est side. The latter commune, with a protected city center, also had the strongest construction dynamic in floodplain area.

In 60 years, Nevers had multiplied by 9.8 its urbanized surface. Indeed in 1946, the city only had few isolated hamlet which had facilitated the extension of the industrial zone and of the contiguous district in the lower "aléa". The curve for the Niévre is steeper than the all study area because its development is still continuing. In other proportions, the two departement have the similar features. It can be explained by the "radiocentrical shape" represented by the development of urban system (Brunet and Ferras, 1992).

(3) Urban model

In an homogenous space without particular physical constraints, city grow along the road acces, the spatial development take the shape of an arc with its centre join with the city-centre.

Applied to cities along the Loire river, the system is forced by the river. The only bridge which allow crossing the river is not sufficient for reproducing the radiocaoncentrical shape on the other side (Figure 12).

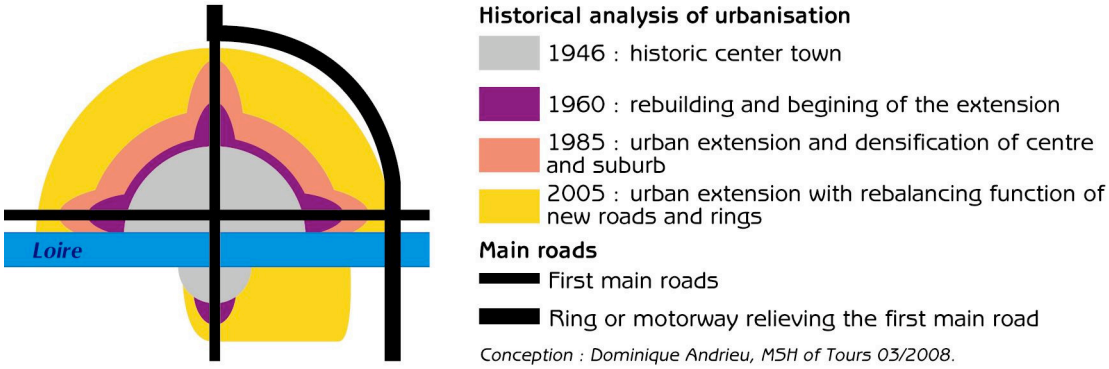


Figure 12 : Development model for the interpretation of the urbanization, cities of the Loire vale

The urban model works for the cities of Blois, Nevers, Cosne and Amboise. The multiplication of transports and bridges over the river, allow to overcome the historical constraint of the site, and brings interest to the other side. The great urban density on the plateau reduces the access to the city centre, where employment and commerces were developed. Thanks to the increase of bridges, that allows to transit traffic to circle the city centre. Thus, the other side becomes attractive for its new road access towards the city centre that was limited by the intensive development of the plateau.

3.2.1.3 Focus on three towns

3.2.1.3.1 Case study: Nevers

(I) presentation of geographic site and its particularity

The agglomeration community of Nevers comprises 10 communes, spread over three distinct areas: upstream the Loire river, downstream the Loire river and the Allier river.

A portion of the agglomeration lies in floodplain area because of the presence of three rivers, the Nièvre, the Loire and Allier and were nearly 15000 people who would be affected by a flood of the Loire and Allier river (Figure 13).

The last major flood took place in December 2003 (Figure 14) and considering the development of urbanization in the floodplain area, a process was initiated by the community of agglomeration with the objective to reduce the consequence of a possible major flood. L'Etude Globale du Risque d'Inondation[3], which began in January 2007 and that must be completed in spring 2010, focuses on reducing the risk of damage (direct and indirect) related to a flood and on the management of the crisis.

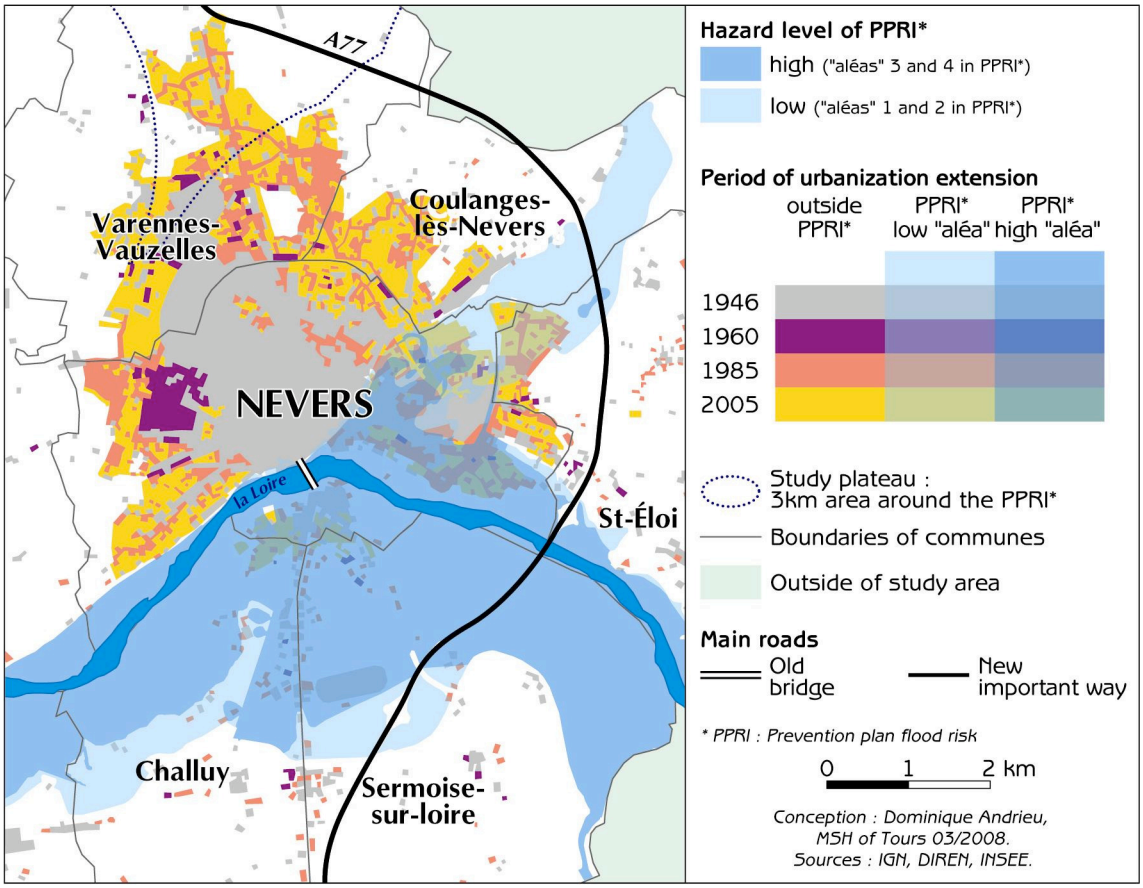


Figure 13 : Dynamic of the urbanization, Nevers from 1946 to 2005

[3] The Study of Global Risk of Flooding

Figure 14 : Flood of December 2003 in Nevers (EGRIAN)

The urbanization of the floodplain in the agglomeration corresponds to different situations. Thus, in Fourchambault the spread in the Loire River bed is linked to the industrial past of the city, with the presence of an industrial forge (the forges scoria were used as embankment) while in Challuy and Sermoise the recent extension of the buildings was promoted by the proximity of Nevers (Figure 13).

It is interesting to notice that the 3 last communes have several dykes for protection (Figure 15). Thus, in Nervers on the North side, the dyke of St. Eloi protects a ZAC. The dyke was reworked and strengthened on the occasion of the construction of buildings in the 1970's, but its bad state has hindered the development of this upstream sector. On the left bank, the system of dykes is more complex. On the shore of the Loire river, the dykes are built to protect an area including a large plant. The whole dykes have been diagnosed (EGRIAN study, November 2007) and should be partially restored.

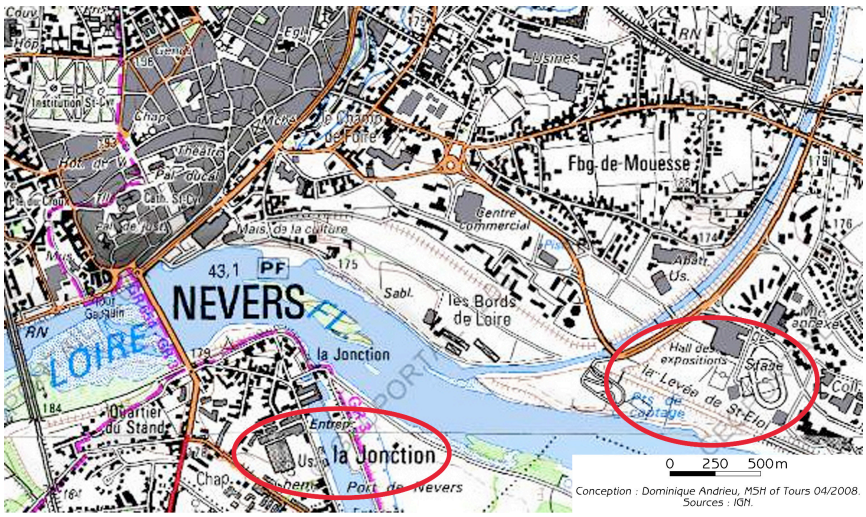


Figure 15 : Nevers, configuration of the urbanization in floodplain area and on the levee (IGN)

(ii) Communes of Sermoise and Challuy: current situation of urbanization

The communes of Sermoise and Challuy are located in the South of Nevers on the left bank of the Loire river, upstream from the confluence with the Allier.

There is an old urbanization in the floodplain, after 1946 for the districts of Nevers on the Loire river side in South and East between the Nièvre and the Loire river; It is the same situation in Challuy and Sermoise along the N7. Between 1946 and 1960, there is no extension of urbanization. The following period, from 1960 to 1985, sees the introduction of only a few isolated buildings in Challuy and Sermoise while the built located in the Eastern part of Nevers is extended.

From 1985 to 2005, there was an intensification and expansion of this district of Nevers, as well as the progress of urbanization, especially in Challuy.

The communes territory of Challuy and Sermoise can be distinguished into two entities: the North, an alluvial plain (175 m. average altitude) widely cultivated, stridden through the lateral canal to the Loire river and streams; in the Southern hilly terrain (Max. elevation 278 m.), and partly forested (Figure 16).

The built is not so extended and heterogeneous: a village outside the floodplain, and scattered hamlets within the communal territory, plus urbanization organized in a floodplain area along the road D907 that separates the two communes and links Nevers.

The two communes are not much urbanized, close to an urban center of 40000 inhabitants, whose population were increasing since 1946.

The population is mostly of humble origin (workers, employees shortly graduates), owner of his accommodation (more than 95%). The built of Challuy is unique because of its length: 43% of the housing is anterior to 1949; while in Sermoise 45.3% of the housing was built between 1975 and 1989 (Table 3).

	Challuy	**Sermoise**
Owners	76%	64,40%
Individual Housing	96,3% (592)	95,5% (557)
Collective buildings	3,7% (23)	4,5% (26)
Main residence	90,70%	94%
Vacant housing	5,90% (-30% since 1990)	5% (-31,8% since 1990)
Built before 1949	43,40%	29,70%
Built from 1949 to 1974	24,40%	17%
Built from 1975 to 1989	21%	45,30%
Built from 1990 to 1999	11,30%	8%

Table 3 : Challuy and Sermoise, Characterization of the population and housing (1999 Population Census)

The landscape of the communes is predominantly rural with small agricultural exploitation (17 and 10 farms, respectively in Sermoise and Challuy). They occupy an important part of the territory, more than the half being grassland (Area still occupied by grass) in connection with livestock (Table 4).

	Challuy	Sermoise
Area of the commune	1938 ha.	2468 ha.
Exploitation number	10	17
Land Labourables	1079 ha.	1290 ha.
(Headquarters exploitation)		
Land Labourables	406 ha.	494 ha.
Area covered by grass	672 ha.	792 ha.
Livestock: cows	418	458

Table 4 : Challuy and Sermoise, Characterization of agricultural activities (2000)

Figure 16 : The floodplain (Challuy et Sermoise-sur-Loire): a rural landscape (El Abida H.)

Figure 17 : Embanked River , canal and bridges, a drainage network management (El Abida, H.)

3.2.1.3.2 Case study : Blois

The vale of Blois (narrow valley) is located on the left bank of the Loire, from the city of Monlivault to the confluence between the Loire and the Beuvron river. It is about 25 km long and 1.5 km wide; there are few constructions in the vale but mainly cultivated areas and semi-natural lands. In this vale, urbanisation has only expanded around the city of Blois (Figure 18). Therefore it is located in a very small part of the vale, mainly in areas where the risk is low. Those areas are referred as the "quartier de Vienne" (a former suburb at the outskirt of the city centre) and "quartier de Bas Rivière" ; houses were also built along the RD 956 (departmental road) and in a former "boire", meaning old secondary channel (referred to as the "bras de décharge du déversoir de la Bouillie" (discharge channel of la Bouillie).

The site of Blois is specific in many aspects, if we consider hydrology and flood control management. First, the city of Blois settled on the right side bank of the Loire, on the hill. On this side of the river, the hill is really close to the river so the vale is not very wide (on the contrary of the left side, where the vale is much larger). Furthermore, the hydrological situation is complex on the left bank: the river Cosson (a tributary of the Loire) is running in parallel of the Loire and a system of dykes protects the area of "quartier de Vienne" located between the river Loire and the river Cosson (Figure 19). Eventually, a spillway is located there (Figure 20).

If we consider the urbanisation development in the flood-prone area on the left bank of the Loire river, it appears that only the area of Vienne was constructed in 1946, as well as a few hamlets such as la Fouleraie (high risk of flooding). Between 1946 and 1985, urbanization was quite limited and only expanded in continuity with the existing urban patch (Figure 3.16). However, it still developed in the areas where the risk is high (especially in the discharge

channel of la Bouillie). From 1985 to 2005, urbanization continued in the protected area of "quartier de Vienne", meaning behind the dykes but also along the departmental road RD956.

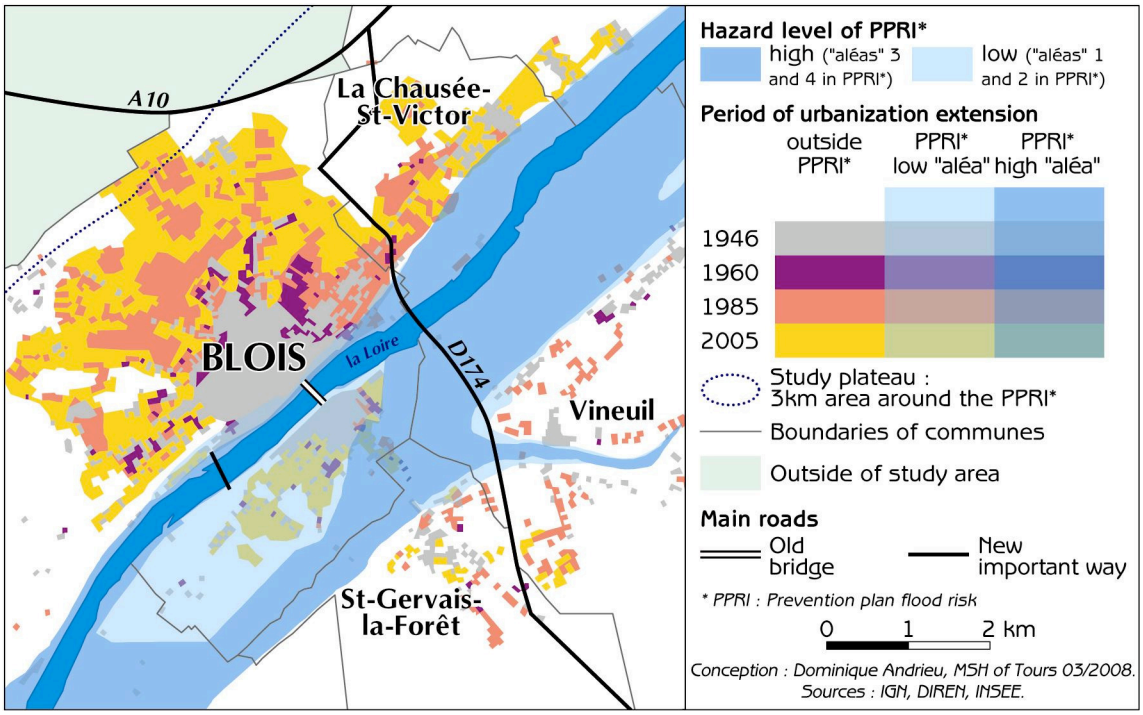


Figure 18 : Dynamic of the urbanization, Blois from 1946 to 2005

In the city of Blois, the protection system against floods is different than in other cities of the Loire Valley. Indeed, a spillway and a discharge channel which is about 570 meters long are located on the left bank. It is a protection structure that was meant to limit the water discharge in front of the city centre in case of major flood ; it would let a part of the water flow run into the vale on the left bank, meaning in the vale of the river Cosson. The spillway was meant to start working when the Loire river reached a water discharge of 3 900 m3/s (Figure 21).

The spillway has replaced in the 17th century an older structure called "déchargeoir" (that was mentioned since 1684). The structure was located on the dike and constructed with strong materials; at this location, the dyke was lowered and the spillway was equipped with a "fusible", meaning a fuse made out of ground that would collapse when the water would reach it. The spillway is also meant to protect the dykes and avoid breaches downstream. In the case of Blois, it was necessary as the main bridge linking the two sides of the river is quite short and reduces the width of the river bed. This protection structure was regularly used until 1907. Since then, the memory of the risk has decreased and many new constructions were built in the discharge channel (houses and sport infrastructures).

Figure 19 : Different sectors of the southern shore of the Loire river in Blois (Servain S.)

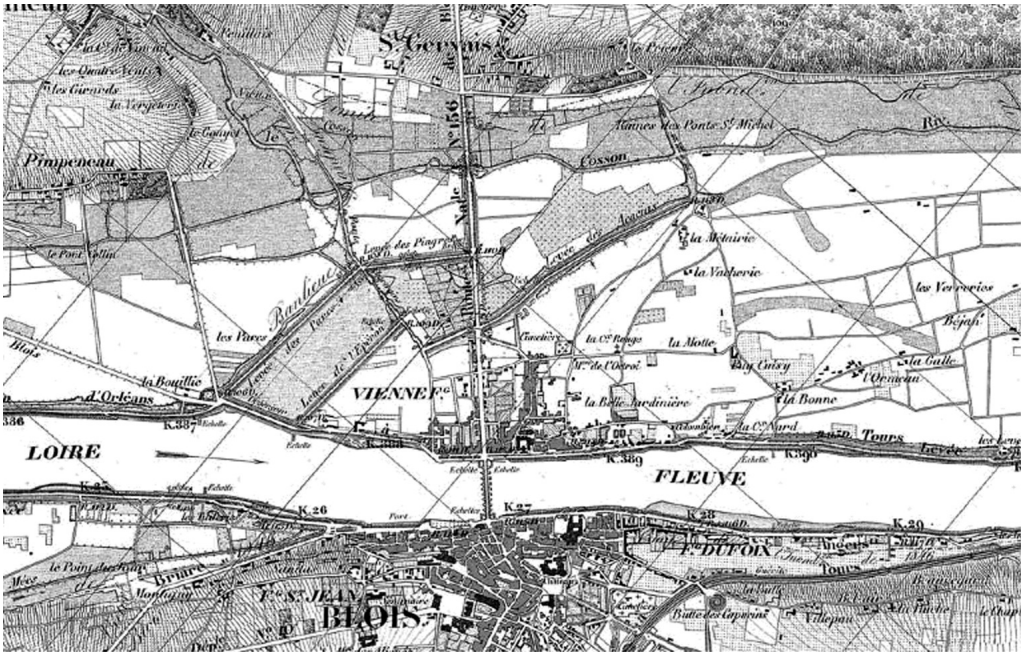


Figure 20 : Map of the Loire river in 1848

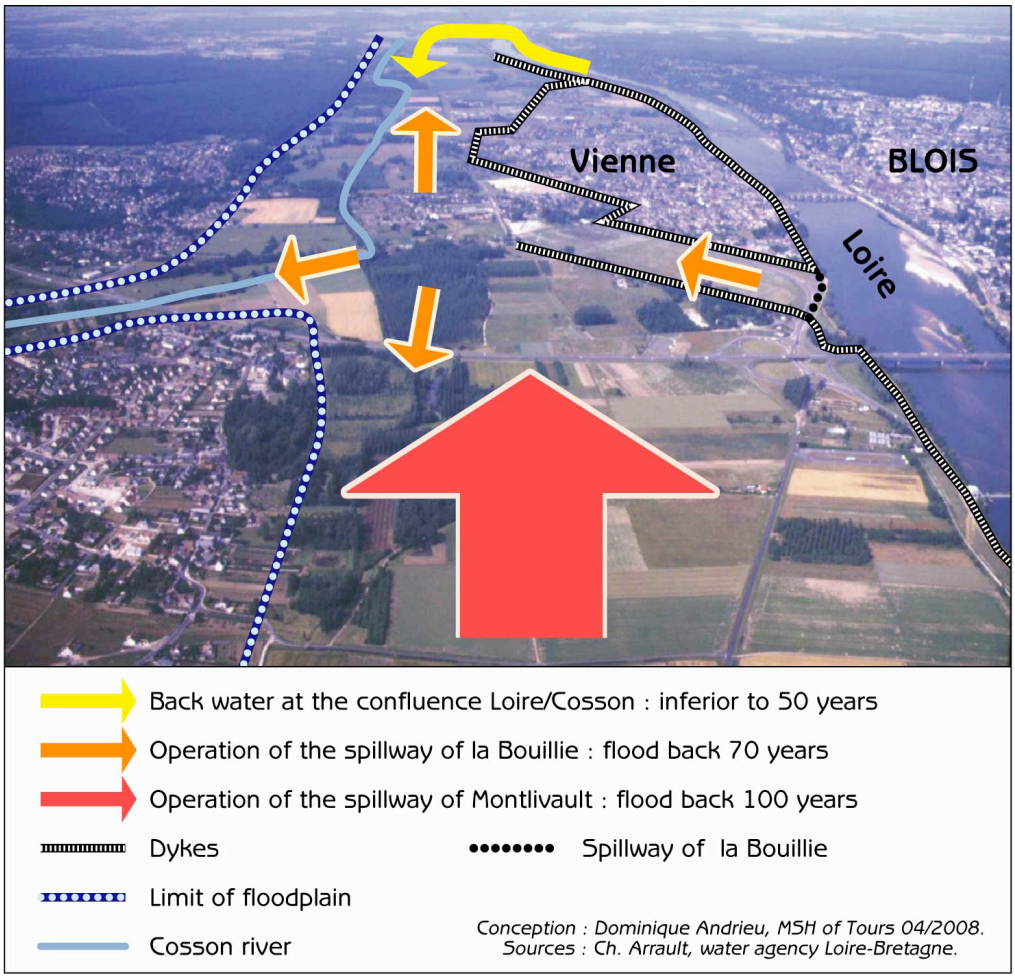


Figure 21 : The vale of Blois, The 3 phases in case of floods

3.2.1.3.3 Case study : Tours

(i) Geographical context of the agglomeration of Tours

Located on the South-West border of the outskirts of Paris basin, Tours is in contact with the urban network of Great-West. Historically installed on the banks of the Loire river, it has developed through exchange north-south (Paris-Province) and east-west (ligerian axes waterway, relayed by the railway). Tours has benefited from the geographical configuration which enabled a demographic and urban development following its two historical axes East-West along the Loire river and North-South perpendicularly to the valley.

Since the end of World War II, Tours is not immune to the well-known movement of population growth and space. Compared with other cities which are equivalent in size and located at the same distance from Paris, in Tours the population growth between 1990 and 1999 is twice their average development. The number of communes in the urban area was of 45 in 1982 and increased up to 80 in 1999. This spatial expansion is about 108% (communal area into the urban area) and it represents an increase of the population of 23% (87% is located peri-urban crown of the communes). In which sectors held the spatial extension? What is the situation observed in floodplain?

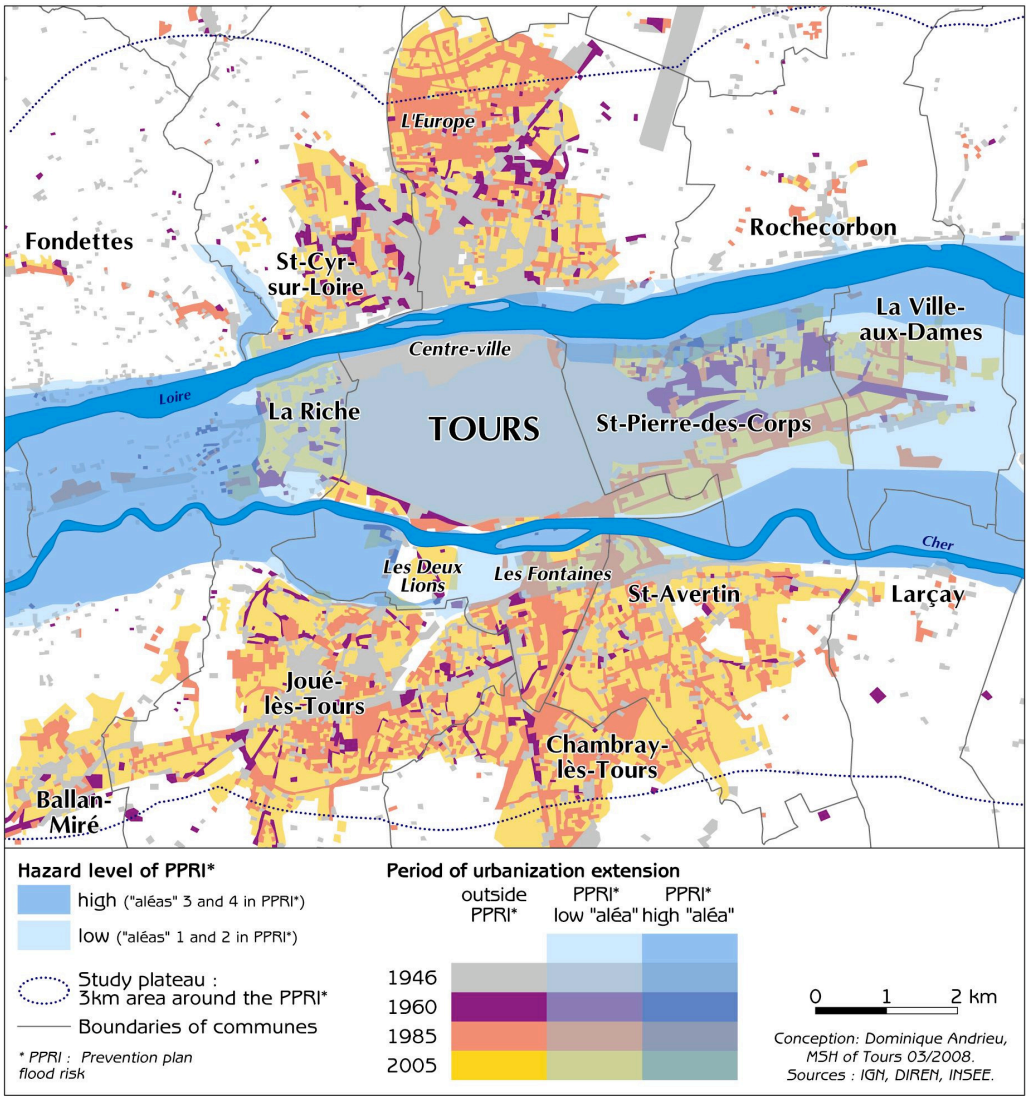


Figure 22 : Dynamic of urbanisation, Tours from 1946 to 2005

(ii) The urban extension and its features

The Loire and Cher river form a single fluvial corridor, excepted upstream close to Montlouis-sur-Loire. By comparing the urbanization extension, since the second half of the 20th century, to the radio-concentric shape of traditional urban model, the physical structure of the corridor has clearly differentiated two major parts in the form of the urban spot that are the alluvial floodplain areas and the plateaus.

In the alluvial plain, urbanization is shapeless in favour of the presence of the shunting station, located to the east, around which are installed large industrial activities in the commune of St-Pierre-des-Corps, then in La-Ville-aux-Dames (Figure 3.20). In contrast, Western corridor, especially in the areas of the interfluve, is very limited, because of its relative isolation to the city center of Tours and gardening activity is much greater. The urbanization of the corridor is quite old (site of the historical centre), and has very little developed in the 80's and 90's. However, in recent years a few communes located entirely within the corridor, including La Riche in the West and La Ville-aux-Dames, see is a resumption of construction.

The mapping of the urban extension dynamic shows clearly that most of the surfaces built in the post war to today are located on the plateaus.

(iii) Developments since 90 years

The progress of urbanization is important between 1954 and 1990 and presents the particularity associated with the presence of the Loire Valley, but after this period few changes have occurred throughout the agglomeration (Figure 3.20). It is mainly a progression of constructed area at the expense of agricultural land (arable land). In spite of the expansion of urbanization in the peri-urban communes, the cultivated areas and "semi-natural" remain very extended. Concerning the fluvial corridor, the changes are very localized: the extension of an industrial area or of a constructed area at the bottom of hill (outside the limits of PPRI), the construction and densification of communes in the urban buffer (Case La Riche and La Ville-aux-Dames).

At the scale of the agglomeration Tours, a typology of the communes can be built by coupling two factors which are the type of urbanization (urban or suburban commune) and the importance of the floodplain sector (commune totally or partially in a floodplain area).

a) Commune completely in a floodplain area and near Tours, like La Riche, Saint-Pierre-des-Corps and the City-aux-Dames,

They are located in the continuous built limit, where the land pressure is high. They have the specificity of being enclosed between the Loire and the Cher river; part of their territory is also in high and very strong "aléa". These communes were particularly concerned by the establishment of the Plan de Prévention des Risques d'Inondation[4] because they have no ground outside the regulated sector and a small part of their territory is not urbanized. For these communes, agricultural activities, which can be termed as residual, are located in areas where flood risks are highest, near the Loire and the Cher river. If market gardening and workers gardens are still part of the image of these communes, on the field these cultures are

[4] Arrêté préfectoral du 19/01/2001

not extended. Indeed, the market gardening parcels of small and isolated in the buil have almost all disappeared. Concerning the worker gardens, they have regressed and were kept in unattractive areas, for example in the vicinity of the water treatment plant of the agglomeration.

b) Communes completely in a floodplain area in a peri-urban context where agricultural activities are prevailing, like in Bertenay and San Genouph

These are two communes located upstream from the confluence of the Loire and the Cher river. This geographical configuration, coupled with the presence of the ring road and the railway, built a landlocked situation. The break in urbanization is visible: the built there is not extended, it leaves large tracts to agricultural land and semi-natural spaces.

C) Communes partially in a floodplain area in a suburban context, the case of Luynes, St-Etienne-de-Chigny, Rochecorbon, Montlouis-sur-Loire, Vernou-sur-Brenne.

The communal territory covers several landscape entities: vale, hillside and plateau. The development of urbanization does not have the same importance in these communes but had the particularity to take place outside the floodplain area, with the exception of some areas already built in 1946. Agricultural activities occupy a portion of plateaus and nearly all the flood-prone areas.

The interest of the analysis of the role of the actors must allow to understand how the risk is taken into consideration in the recent geographical configuration who did not suffer of major floods since 1866.

Is the risk a strong argument that could balance the urban pressure oriented by spatial planner? Is it an argument taken into consideration by citizen who decide to make their residential choice in function of parameters such as the road access, services and work distance in order to answer to their needs?

(iv) Economical development in the Touraine Vale

Group 1 = Commune having territory and zone of activities entirely or partialy under flood risk
Saint-pierre-des-Corps
La Riche
La Ville-aux-Dames
Group 2 = Commune having territory partially under flood risk and with at least one risky zone of activity (ratio: Z.A under flood risk/Nb total of Z.A)
Cinq-mars-la-pile (1/2)
Savonières (1/1)
Tours (1/11)
Saint-Avertin (1/3)
Montlouis-sur-Loire (3/3)
Noizay (1/1)
Vernou-sur-Brenne (1/2)
Group 3 = Commune with territory partially under flood risk but without zone of activity under flood risk
Lyunes
Fondettes
Saint-Cyr-sur-Loire
Ballan-Miré
Rochecorbon
Vouvray
Véretz
Group 4 = Commune almost without flood risk
Joué-les-Tours

Table 5 : Economical development: classification of the communes

The conscience of flood risk in the spatial planning is not perceived the same between communes in the Touraine vale. The fact is that there are economical developments in the vale. For the communes of Saint-Pierre-des Corps and La riche, which are entirely under flood risks, the economical development in the vale is compulsory due to the lack of space. Whereas for other communes such as Montlouis that have more space, the choice is more a strategically oriented.Indeed, the communes can be classified in 4 groups (Table 3.4). The Group 1 brings together the communes who does not have any alternative for their extension and who miss common cooperation. The Group 2 concerns the communes having land outside the flood risk but who made the choice, voluntarily or due to other kind of pressure, to create the zone of activity in the floodplain. The Group 3 brings together commune who did not generate risky zone of activity and the Group 4 concerns communes which are little involved within flood risk. The communes in the Group 1 have all their territory under flood risk, it is may be more difficult to attract companies due to the restriction and recommendation of the PPRi. The main advantages of the Group 1 is the proximity to Tours.

3.2.2 The Netherlands (T. Brinkhof)

The population density of the Netherlands is the largest of North West Europe. Because of this high population density there is a large claim on free space. The Netherlands exists for most part out of river delta. Urban developments in flood prone areas are logical from this point of view, since this practice partly legitimates the existence of the Netherlands. It is part of its history.

In the previous century, the Meuse discharged several extremely large amounts of water. This caused urban areas to be flooded in 1926, 1993 and 1995. As a reaction on these flooding, measures were taken. Between 1919 and 1939 the national government normalized large parts of the Meuse river, in order to improve the water discharge capacity. (Adapted from Van Heezik, 2007.) Mostly unemployed people were deployed to dig the areas to be canalization by hand.

The normalization was finalized in the end of the 1930's and resulted in a vast enlargement of the water discharge capacity, from about 1300 m^3/s towards 3200 m^3/s.

According to Van Heezik (2007), the normalization consisted two main parts, The Meuse Canalization (The Juliana canal between Maasbracht and Maastricht) and the Meuse Improvement (Canalziation between Grave and Lith and the river normalization measures between Grave and Appeltern)

In 1996, national policy contours are redefined for new buildings in floodplains in the Act on State Water Authority Operations. These contours are connected to three different water regimes; i.e. streaming, storage and a special exclusion for urban areas inside the floodplains. For the contours streaming and storage a so called WBR permit is needed from the State Water Authority (Rijkswaterstaat) The present policy "Large Rivers" describes that within areas of the streaming regime, water bounded activities are possible if there is no obstruction what so ever for the river discharge capacity and that safety aspects are taken into account. Under certain conditions, it is not necessary that the activities are river-bounded. This is in case of a higher public interest, an economical vital interest for present agricultural bounded companies, for change in function in existing buildings and if the activity gives more room for the river on a hydrological acceptable location.

For areas within the 'storage regime', the same conditions are applicable as the streaming regime, only here the activity does not have to be 'water-bounded'. The last regime is

referring to so called ‘article 2a’ areas. In these areas, no WBR permit is needed. The reason is that these areas are less important for the State Water Authority to protect since the river in hydraulic significance is lower than other regimes. Apart from this exemption, these areas remain part of the floodplain of the river.

The Waterboard is responsible for damage if dike fail in their protection. If it is shown that the flood is due to a natural cause, the water board is not accountable for flood damage.

Case study Meuse

Three urban areas adjacent to the Meuse banks have been analyzed on their spatial development. The analysis is carried out with the use of a Geographical Information System.

Within the study area selected for the Meuse, the density of buildings inside and outside the floodplain has been calculated for the year 2000. Within the legal floodplain as defined by the State Water Authority (Rijkswaterstaat), the builded density is higher (2.65 % of land cover), compared to a buffer area of 3 km. outside the floodplain (2.10 % of land cover). The average of building density in the Province of Limburg is 3.20 % (source: CBS).

For different urban areas in the study area, spatial analyses have been made on the historical development of urban areas inside as well as and outside the floodplain. One medium sized city and three villages have been analyzed in terms of urban development, i.e. Venlo (1), Itteren (2), Borgharen (3) corresponding with the map as shown in figure 23. Venlo has been selected since it forms one the few larger urban areas in this trajectory of the Meuse. Also the city front does not start directly at the river; instead there is space in between, which is interesting to investigate. Besides, the analysis method it less suitable to calculate area already occupied. Maasbommel is the only village not located in the province of Limburg, since it is located in the province of Gelderland. The analysis concerning this case study has more the focus on recent developments.

The reason to incorporate this case is because of its interesting casuistry.

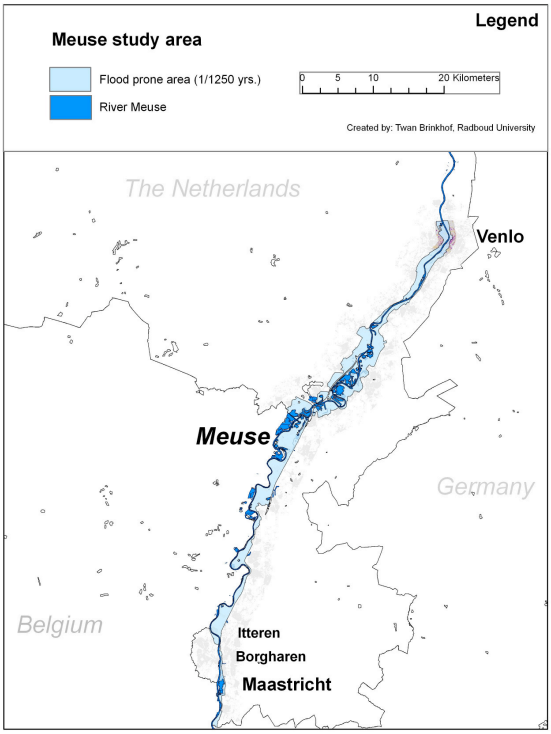


Figure 23 : Study area Meuse

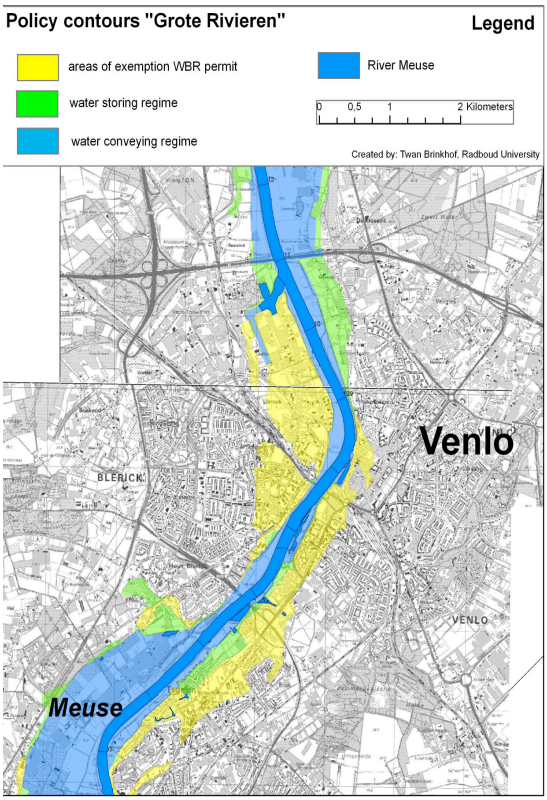


Figure 24 : Study area Venlo

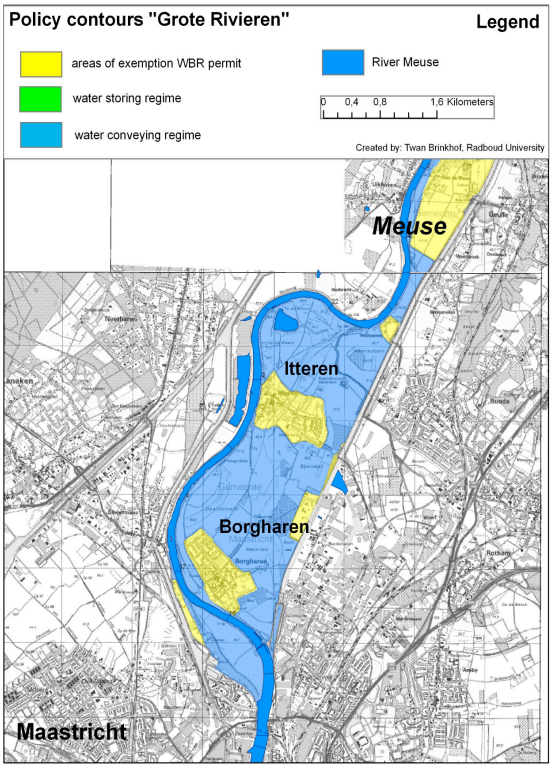


Figure 25 : study area Itteren and Borgharen

3.2.2.1 Venlo

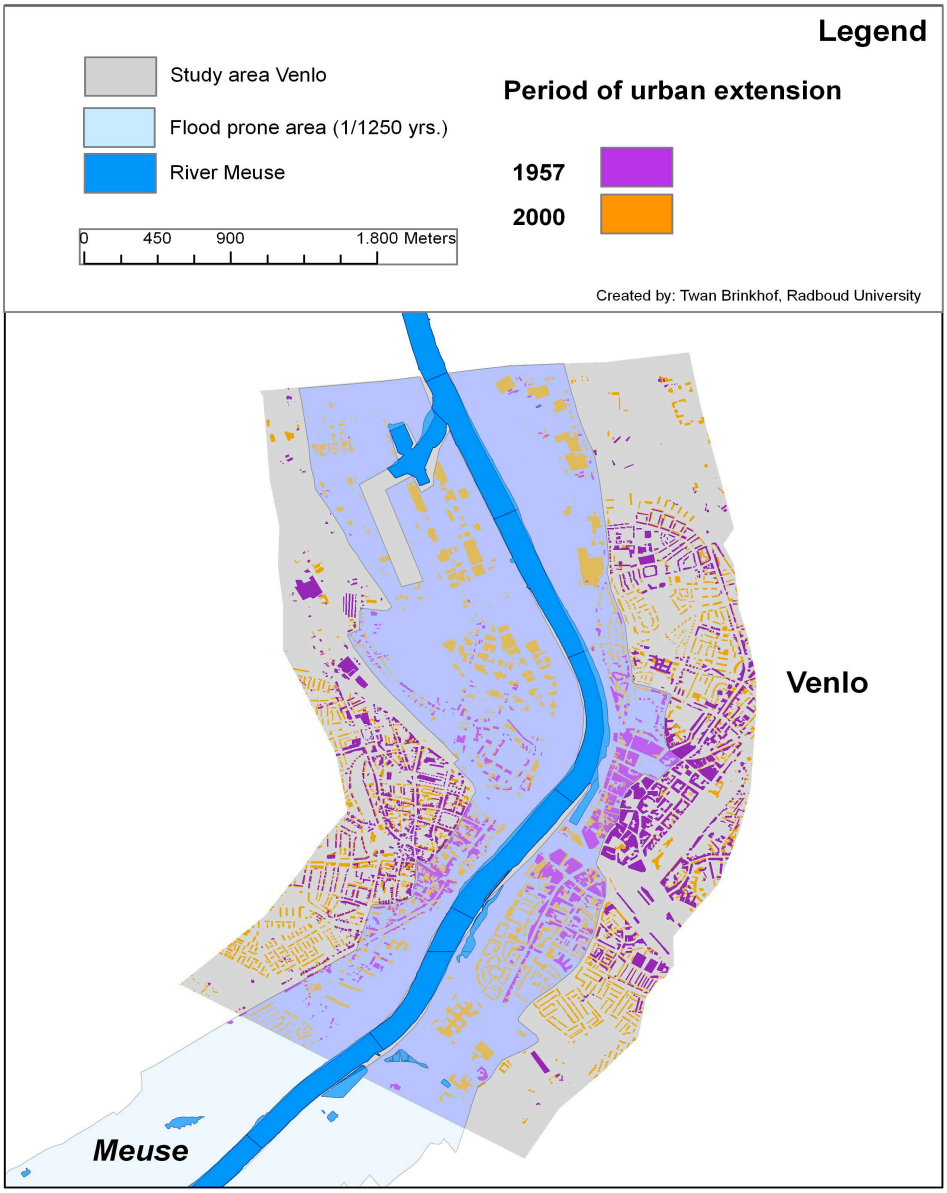
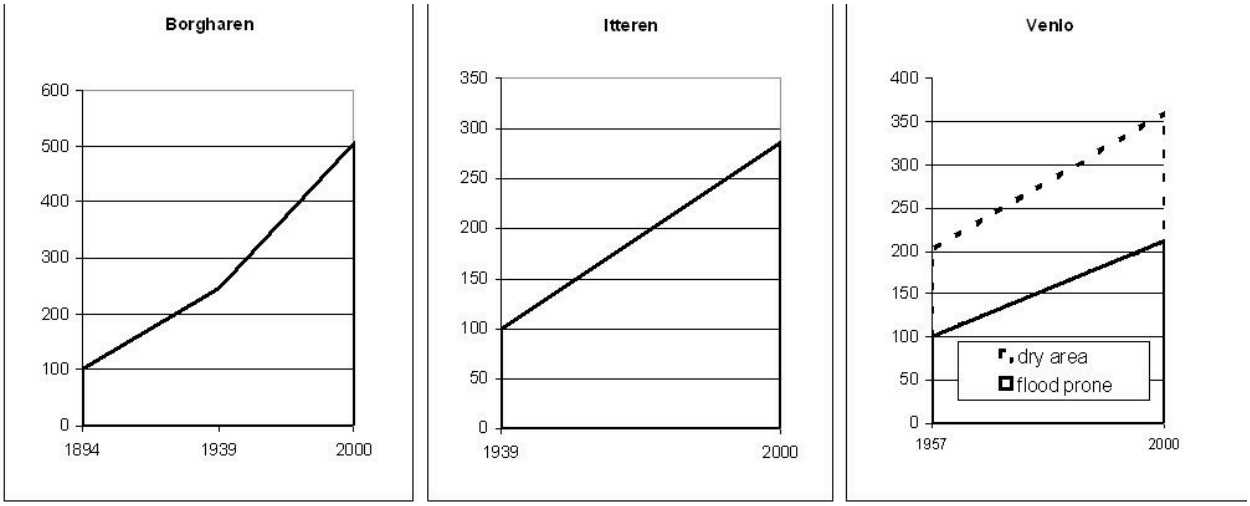


Figure 26 : Urban developments in Venlo adjacent to the Meuse between 1957 and 2000

Venlo is a middle sized city, with presently about 35.500 residents, within the larger municipality of Venlo (about 92.000 residents). The city is located in the Province of Limburg. This is the most southern Province of the Netherlands, bordering Belgium and Germany. The city has a rich history, since it has been already inhabited since the roman times. It received city rights in the year 1343 ac. (source; stadsrechten.nl). Urban areas such like Venlo are difficult to protect with the traditional approach of building dikes. Dikes consume space and for that reason it is difficult to apply. The solution applied for the city Venlo to increase the safety level in times of high water is the installation of removable dikes, consisting of aluminium sheets which can be placed between slots.

The spatial analysis covers both the developments within the defined floodplain of 1/1250 years as an area within the same order of size on the 'dry' side of the river bank.



Evolution of urbanisation for different time periods. Basis is 100 for the reference year.

Figure 27 : Increase of builded area in flood prone areas, and flood free areas for the city of Venlo since 1957

Figure 27, corresponding to the GIS images (figures 24 and 25), shows the increase of urban area for the city of Venlo between 1957 and 2000. The green zone in images 24 and 25 represents the riparian not prone to flooding. The blue zone represents the theoretical floodplain of 1/1250 years. The increase of urban area between 1957 and 2000 is 150%. For the flood prone area, the increase in buildings is 210%.

Different kinds of buildings have been constructed between 1957 and 2000. In the north of the city mainly industrial developments took place, where before only a few solitary houses existed. Another remarkable event is the construction of a hospital in the theoretical floodplain. This hospital is located south of the city centre.

3.2.2.2 Itteren

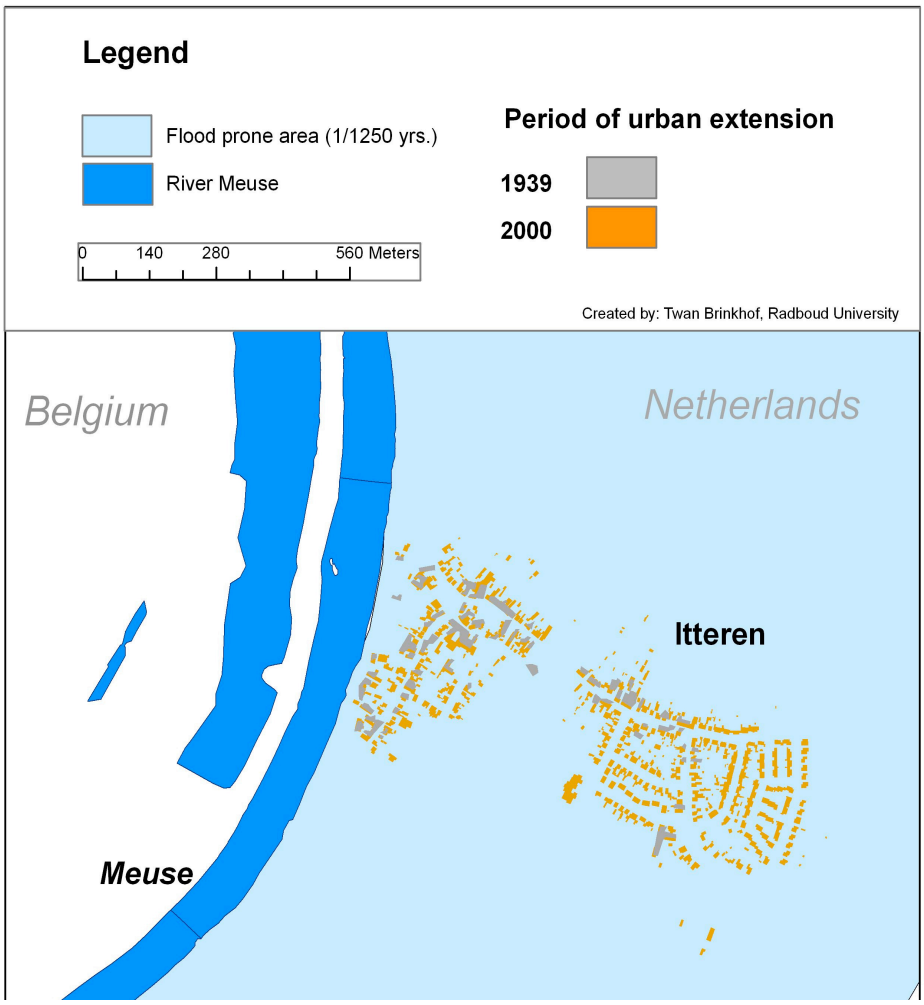


Figure 28 :Urban developments in Itteren adjacent to the Meuse between 1939 and 2000

Itteren is a village located in the municipality of Maastricht. The village flooded during the high waters of the Meuse in 1993 and 1995. (See Figure 28) The population of the village counts nowadays about 1000 residents. Throughout the previous century, the village developed gradually. Between 1939 and 2000, the urban area increased with a factor 2.9.

3.2.2.3 Borgharen

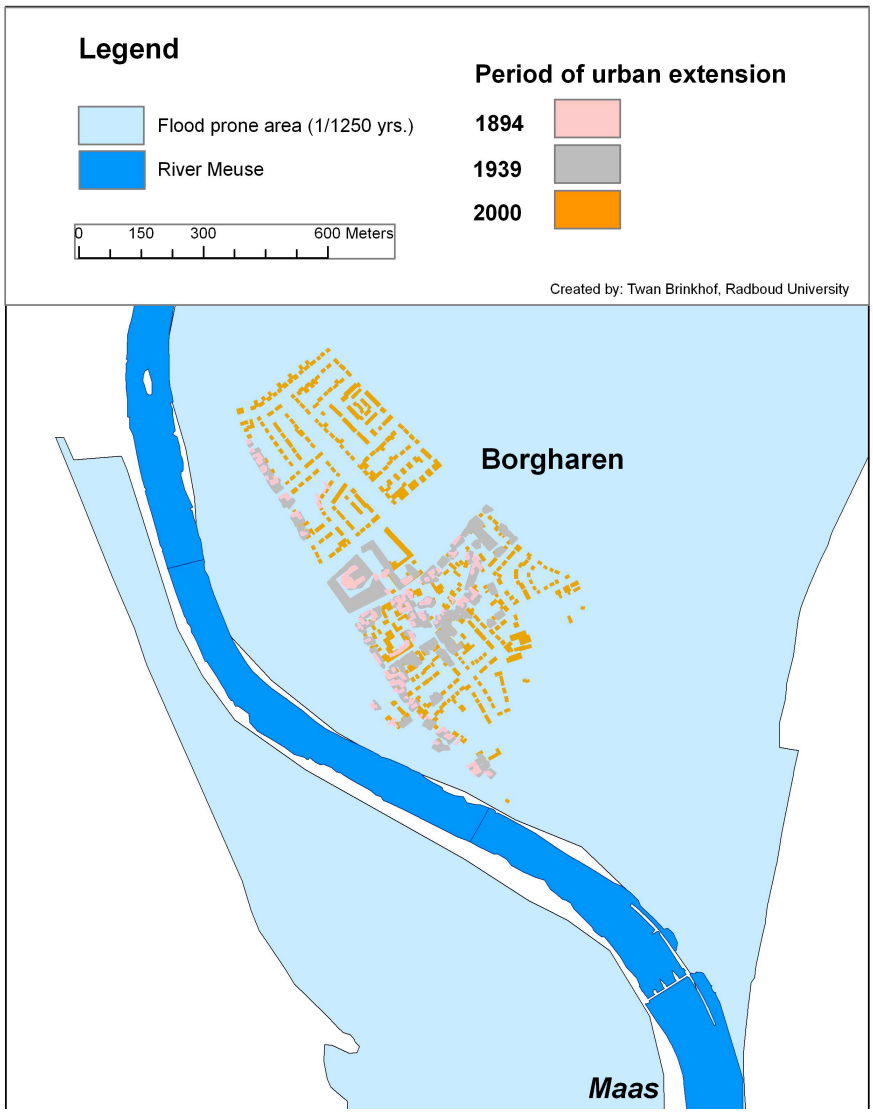


Figure 29 : Urban developments in Itteren adjacent to the Meuse between 1939 and 2000

Borgharen is a village with about 1850 residents. It is located in the municipality of Maastricht.

In general, the infrastructure of the village remained unaffected throughout the last century. The city is situated between the river bed of the Meuse and the Juliana canal.

Between 1894 and 2000, the village expanded with a factor 5 (Figure 3.24). Most of the developments took place after the World War II. (Figure 3.24). The figures show that urban development in floodplains happened gradually but steady throughout the last century.

Project Meuse Works

Improvement of the safety level of Borgharen falls under the plans for the border Meuse. Broadening of the Meuse river bed at the south, west and north of the village will be the measure taken.). River gravel is won with the excavation. The intentions are to give nature the freedom to develop itself in this area. This will connect with the location Itteren by means of a

nature corridor at north of Borgharen. A consortium starts in 2009-2010 with the activities in Borgharen.

3.2.2.4 Maasbommel

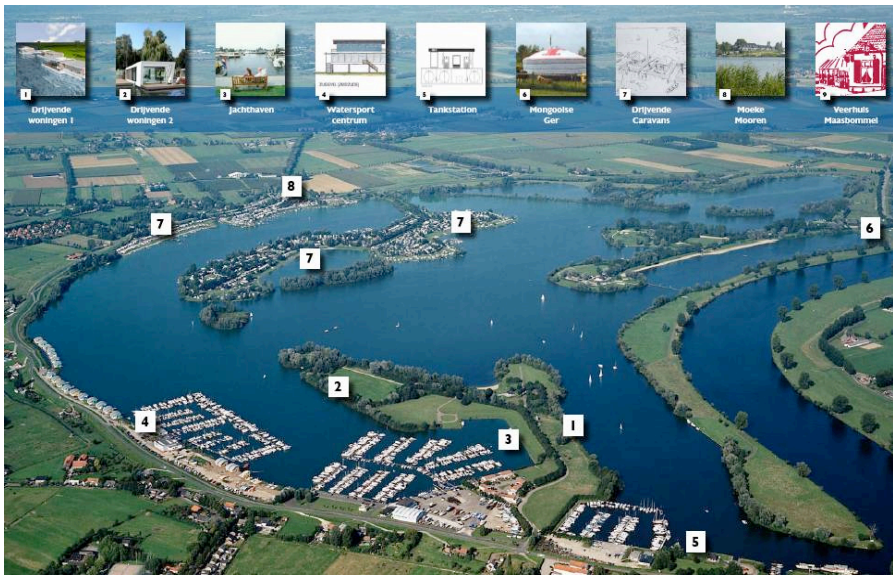


Figure 30 : De Gouden Ham area

As already mentioned in the introduction, the village Maasbommel is different from the other case studies. In Maasbommel, there has not been build in the floodplain before 2005. The case is interesting because this is the first example of flood adapted houses.

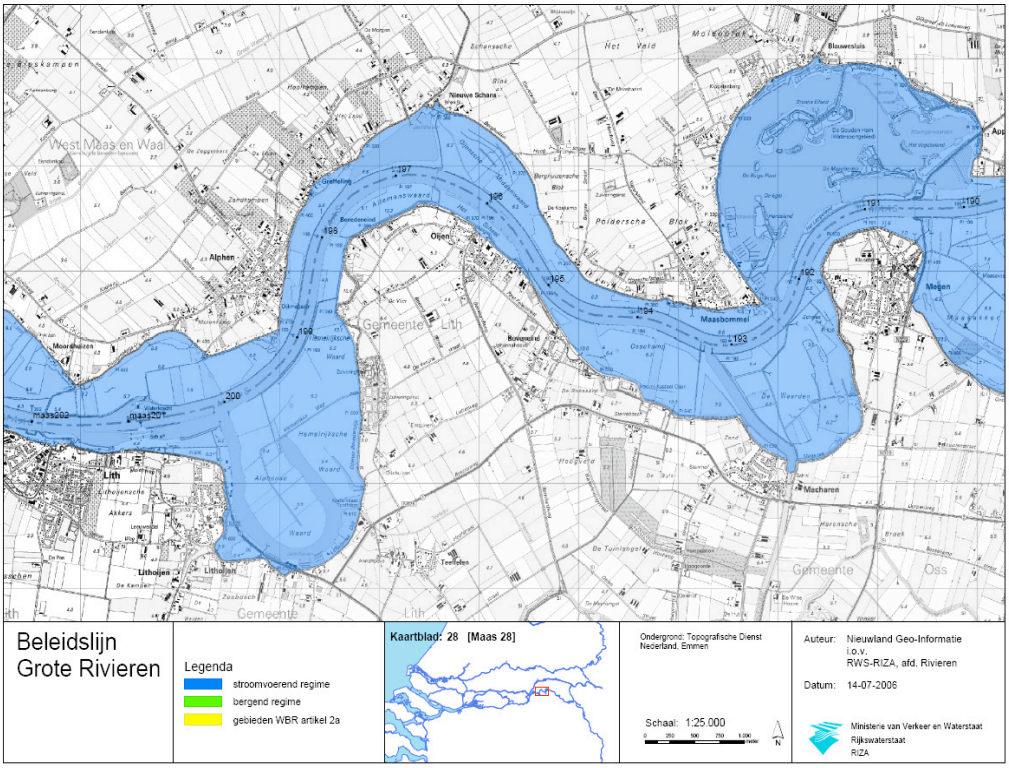


Figure 31 : Study area Gouden Ham

The area 'De Gouden Ham' is located in the village Maasbommel which is situated in the municipality of West Maas en Waal. 'De Gouden Ham' is part of the river Meuse. In the past the area was part of the river flow (see maps). Later on, in the period of 1960 until 1980, this area was used for the extraction of clay and sand that was used for building purposes. After that, the area saw a more recreational development with the arrival of camping's, recreational harbours, hotels and restaurants.

High waters :

In 1993 and 1995 part of Holland, in particular the area of the rivers Meuse, Waal and Rhine, was affected by dangerously high water levels which caused a lot of material damage as well as concern in people's minds. This situation also affected the area of 'De Gouden Ham'. The near catastrophic effects of the high waters and in addition to that the expectation of still more negative effects of climate change in the future, made clear that sustainable protection against floods was necessary.

The Dutch government reacted to the floods with an emergency act entitled 'Delta wet Grote Rivieren' (Delta Act Large Rivers).[5] This act made it possible to implement dike reinforcements and to construct quays at the most vulnerable locations within a year's time, i.e. before the end of 1996.[6] This act was a special legal device, because it implied an arrangement of decision-making, participation and legal protection in one. At the same time it by-passed other legislation involved. In a case like this, in Dutch legislature one normally would need decisions or licenses based upon at least ten different acts from different governments to be able to reinforce the dikes. This Act was only valid for one year.

Dike reinforcement :

'De Gouden Ham' was also part of the dike reinforcement plans, although this reinforcement wasn't all that urgent. For measures that had no priority - and were only due to finish before the end of 2001 - the government issued another act entitled 'Wet op de waterkering' (Flood Defense Act). This act also contained regulations to make large reinforcements possible. In the past, dike reinforcements stagnated because there was not much scope for it. A lot of different interests, like environmental planning, nature and landscape, were involved which made the procedures very laborious. After 1993 and 1995 and with the introduction of the Delta Act Large Rivers and its successor the Flood Defense Act, this passive attitude changed immensely.

To reinforce the dike in the area of 'De Gouden Ham', the owner had to give up approximately 22.500 square meters of his land. This land was obviously closely situated next to the dike. To compensate the owner for his loss, not only the economical value of the land had to be taken into account but also the restriction of the recreational possibilities of this particular area. A plan for the building of 50 (semi)floating houses was drawn up to regulate this compensation. [7]

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[5] Act of April 13th 1995, Stb. 1995, 210

[6] Vulnerable, in this context, means places with a flood risk of 1:100 (for dike reinforcements) or 1:50 (for quay constructions).

[7] According to the regulations of the Flood Defense Act the negative effects of the dike reinforcements should be compensated by government.

Policy ‘Room for the River’ :

‘The Delta Act Large Rivers’ was seen as interim legislation in response to the floods in 1993 and 1995. In the meanwhile the government also worked on a policy entitled ‘Ruimte voor de Rivier’ (Room for the River). [8] The consensus view was - and still is - that sustainable protection against floods does not only imply raising the dikes, but also requires more capacity for rivers to deal with more water in the future. The main goals of this policy were: more room for the river, sustainable protection against floods for people and animals and restriction of potential damage.

As a result, the policy allowed new activities in floodplains only under strict conditions. Permission of new activities closely related to the river (e.g. bridges and boatyards) was subject to the effect on the water level being relatively small. On the other hand, new activities not related to the river were only allowed if a serious social issue was involved. Moreover, the project should not be situated but in a floodplain and finally, the project should not affect the capacity of the river. In every day practice this meant building in floodplains was seriously restricted.

The ‘Room for the River’ policy was introduced in 1997 which meant that the earlier introduced compensation plan had to be reviewed by this policy. Regarding ‘De Gouden Ham’, because the project of fifty (semi)floating houses was regarded as not related to the river, it was difficult to fulfil the conditions mentioned above. There was no serious social issue involved and this project was not bound to this location. To satisfy the requirements of the policy this project was seen as an existing situation, instead of a new activity which meant that the severe conditions of the policy could be avoided. Apart from this, the floating houses demonstrate a unique concept because of its innovative building aspect.

Experiment with adaptive building:

In perspective of water management, the policy worked well, but some flood prone areas declined because the spatial and economic development stagnated. Empty buildings and “spatial pollution” of areas proved to be inevitable.

In a move to reverse this undesired effect, an experiment was launched to revitalize a limited number of locations in Holland. Another reason for the introduction of the experiment is to explore the possibility of other kinds of building forms (e.g. houses on poles and semi floated houses), as well as to promote water neutral building.

To develop the selected areas, the project is required to improve spatial quality, not to increase the water level and in addition to that create more room for the river. These conditions are less strict than the ones in the policy ´Room for the river´, so this experiment has to be regarded as an exception to the current government policy.

“De Gouden Ham’ is also part of the list of exceptions. The area suffered from the restrictive effects of the government policy. For many years, new developments and expansions to keep the area attractive for leisure and tourism were not allowed. At present the parties involved (government, companies, citizens, et cetera) are exploring the potential to (re)develop the area. Not only the concept of floating houses is part of the plan, but also floating caravans,

[8] Stc. 1997, 87

buildings on poles and a floating gas station could see the light of day in the future. The planning for all this is still in its infant stage. The actual building plan has to fit the requirements of the experiment regulations and to other relevant legislation.

In addition to initializing the experiment, the government had the policy 'Room for the river' evaluated and as a result made a decision to adapt the existing policy. In future more spatial developments in flood prone areas will be possible, without increasing the risk of floods. The recently adopted Beleidslijn Grote Rivieren (Policy regulation Large Rivers) accommodates for this.

3.2.3 Germany (Cologne) (V. Wattenberg)

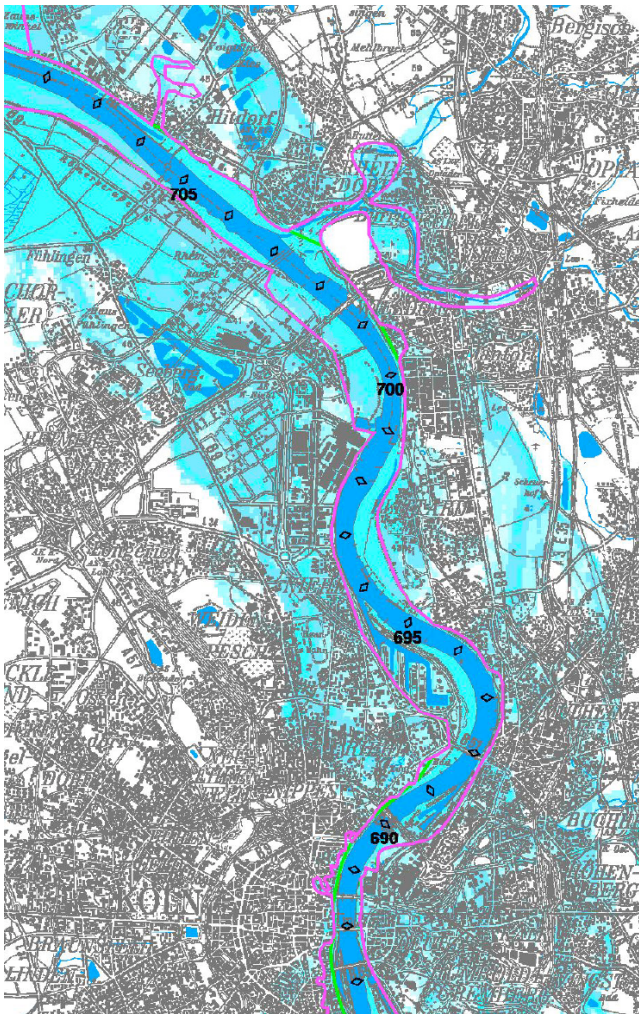

Figure 32 : Flood risk map of Cologne (source: IKCSR)

Cologne, a city in the state of North Rhine-Westphalia, is situated in the lowlands of the Rhine on both sides of the river. With 1.000.000 inhabitants, Cologne is Europe's most flood prone metropolis. In December 1993, Cologne suffered from a major flood of the Rhine. The total (material) damage was amounted to a sum of 75 million euros. Until that time the unprepared city had not experienced floods since 1926. The worst flood Cologne ever faced was in February 1784, the water level raised to a level of 13.55m, which meant 10 meters above the normal water level.

In 1995, again, a flood occurred. This time the total damage was 32 million euro. There are a couple of reasons mentioned for the decrease of damage in 1995. Not only the use of 125.000 man hours invested in emergency measures during the floods but also the establishment of mobile flood protection walls (app. 1400 meters) and the use of 400.000 sand bags contributed immensely to the damage decrease.

In The Netherlands as well as in Cologne those shock events led to a political and public awareness of flood risks. In reaction to those events, The Netherlands restricted building in floodplains seriously by introducing the policy line 'Space for the River'. The Cologne Municipality, however, developed a flood protection scheme. This protection scheme emphasizes the importance of water retention, reduction of potential material damages and the increase of preparations of the inhabitants. In Cologne, the municipality also invests a lot of money in the improvement of emergency management and forecasting facilities.

At the moment, Cologne has got a two step program which means that at the end of 2008 a new protection system will be finished. The standards of 1/100 in the South of the city (upstream) and 1/200 in the North (downstream) has to be executed. There are different reasons for the difference in protection level. First in the Southern part of the city it is technically not possible to have high protection measures due to the huge amount of ground water. In the northern part of the city there are a lot of companies which means that the damage potential will be much higher in case of floods.

In August 2002, the flooding of the rivers Elbe and Danube claimed a lot of lives and caused over 10 billion euros of damage. This time, the Federal government reacted with a new legal framework, the Act to Improve Preventive Flood Control (Flood Control Act). For the first time, a federal act lays down uniform and stringent legal provisions for the prevention of flood damage on a nationwide level. According to this Act the States have to define their floodplains. Not only floodplains but also flood prone areas have to be defined as a flood plain. In both areas no new buildings are allowed.

Exceptions are only possible if nine requirements are met and fulfilled completely in every new building project. The nine conditions include, in short, that the Municipality concerned, has no alternative for human settlement development, no lives are at risk and no significant property damage is to be expected and that the structure of new buildings is adapted to flood events. For the construction or extension of a single building, there are only four conditions, closely related to ones mentioned above, to fulfil.

Despite of the introduction of the restrictive Flood Control Act some major projects along the Rhine have been executed. One of the projects, Rheinauhafen, is a re-design of the Rheinau harbour and one of the largest urban development projects in Germany. Across an area of 15 hectares, functions like living, working and recreation are combined. Luckily for this project, the required permits and decisions were already made before the introduction of the Flood Control Act.

The project contains, only marginally, a flood adapted element: under the apartments, offices, shops and restaurants is a parking garage. This large garage must function as a retention area in case of floods. Engineers, however, state that the water will be caught in the parking garage but can not flow away. This makes the retention function of the garage very limited and almost negligible.

Figure 33 : Redevelopments and new building at Rheinauhafen project

Figure 34 : Mobile flood protection sheets at entrance parking lot

In Cologne there is a lot of building pressure in the floodplain and flood prone areas. A lot of old harbour houses, directly situated along the Rhine, need some renovation or replacement. Because of the strict conditions of the Flood Control Act this renovation and replacement is not allowed. This causes empty houses and desolate areas at very attractive spots in the city centre. The future will show if the Flood Control Act can still stop the development of those areas.

4 Policy arrangements

This chapter describes the policy arrangements for the countries France, the Netherlands and too a lesser extend Germany. The arrangements are described according the dimensions of rules, discourse, actors and power and resources.

4.1 France (M. Amalric, S. Bernier, M. Fournier, J. Serrano, L. Verdelli)

Today, flood risk policies promote three types of measures :

- Protection measures: hydraulic works (dikes, dams, spillways) are used to control or mitigate the natural hazard

- Prevision measures: in France, a national network is making daily previsions concerning the hazard of flooding

- Prevention measures: prevention measures are usually of different types but one can mainly evoke: public information, vulnerability reduction policies and rules for town planning

Within the following part, we will mainly focus on the policy arrangements dealing with flood prevention, at the national and local scales, and even more precisely on the planning documents that are implemented.

4.1.1 Rules

In the field of flood prevention policies, different regulation systems succeeded since the beginning of the 20th century in France. One can consider 4 phases (last phase being the current one) where both mapping tools and planning regulations were implemented. The following table summarizes those phases.

Phases	**Flood events**	**Regulations**	**Mapping documents**
1st phase (1930-1982): the first legal tools and maps dealing with flood are created 2 objectives: - to facilitate flows and preserve the open lands where floods can expand - to protect housing and the built environment against floods (R111-3)	**1930:** major floods of the rivers Tarn and Garonne ; about 400 people died	**1955:** the "Urban planning Code" and its article R111-2 and R111-3 restrict urban sprawl by creating "*Périmètres de risque"*	**1935:** the "*Plans de Surfaces Submersibles"* are created
2nd phase (1981-1994): a new mapping tool to better take into account the issues at stake - new planning and mapping tool: the *PER* - objective to reduce damages by controlling	**Winter 1981-82:** winter floods on the Saône, Rhône and Garonne Rivers **1983:** floods on the most river basins **Summer 1987:** flash flood in le Grand-Bornand (23 people	**1982:** new regulations concerning victims indemnification **1987:** law on the organisation of civil security, protection against forest fires and major risks prevention	**1984:** decree creating the "*Plan d'exposition aux risques naturels prévisibles"*, *PER*

urbanisation and imposing prevention measures (on the existing and future issues) - information for citizens - objective of an integrated water management	died) **Autumn 1988:** flash flood in Nîmes (11 people died) **Summer 1992:**flash flood in Vaison-la-Romaine (34 people died) **Winter 1993-94:**massive floods in the North and Eastern parts of France	(the "Atlas des Zones Inondables" (Atlases of Flood-prone Areas) are created for public information) **1992:** Water Act (Loi sur l'eau)	
3rd phase (1994-2003): the PPRNP are created to clarify and reinforce the legal system - The State clarifies the objectives of its prevention policy against natural hazards - The PPRNP are created and replace the former mapping documents (PSS, perimeters Art. R111-3, PER). They are the only legal document for prevention against natural hazards.	**Beginning of 1995:** floods in 43 districts (*départements*) and about 40 000 houses flooded in the northern part of France **Autumn 1999:** flash floods in Aude, Hérault, Pyrénéées-Orientales **Winter 2000-2001:** floods along the Somme river and in Brittany region	**1994:** circular on flood prevention and management of flood-prone areas **1995:** Law on the reinforcement of environmental protection. **1995:** Decree on the possibility to expropriate owners when a natural hazard threaten human lives **1996:** Circular on specific dispositions for the built environment in flood-prone areas	**1995:** decree on the creation of the"*Plans de Prévention des Risques Naturels"* (PPRN)
4th phase (since 2003) The main objectives are : - the identification of areas where water retention could be done - a better information for the people - vulnerability reduction		**2003:** law on prevention against natural and technological risks and damages repair	

Table 6 : The four majors steps in risk regulation in France- Inspired from N. POTTIER, 1998 in V. MORINIAUX, 2003

Hence, the major planning document concerning flood risk is the *Plan de Prévention du Risque d'inondation* (PPRi).

4.1.1.1 The PPRi document

By creating the PPRNP and among them the PPRi in 1995, the objective of the State administration was to propose a single planning document that would replace all the PSS, Art. R111-3 perimeters and PER that existed. None of those procedures had really been successful and implemented locally. Hence, the PPRi's objective is to be a simpler tool to identify flood-

prone areas and impose planning regulations on them (for instance there is no more complex feasibility studies for carrying out a PPRi).

Who is responsible for the PPRi?

The State administration is responsible and carries out the studies and mapping of the PPRi. Hence, it is a planning document (maps and rules) which constraints local planning documents (PLU and SCOT (see below)). The Prefect's administration (head of the State administration at the departmental level) identifies the areas where a PPRi should be planned. Then, the State administration (DDE Direction Départementale de l'Equipement) carries out the project. A negotiation phase is planned with the local authorities and a public inquiry before the PPRi is approved by the Prefect.

What are the main rules given by the PPRi?

The PPRi applies not only on urban zones but also on rural and periurban zones. It prevents urban spread in the areas were the water flow could still expand (zone d'expansion des crues) and slows down or stops any further urbanisation development according to the identified level of risk (there are four levels of risks, depending on the height and speed of water).

To identify the level of risk, the PPRi procedure considers the highest water level ever known (limite des plus hautes eaux connues) on the river basin. On most rivers, Atlases of Flood-prone areas (Atlas des zones inondables) were made before realising PPRi. Hence, the PPRi are based on them. These atlases have improved the knowledge on floods: their regime, the areas where they expand and have mapped the information. Very often, they have been for a great help when creating the PPRi and deciding on what urbanisation limits should be.

The four different levels of risks are so defined in the Atlases :

- level 1: low risk, deepness of submersion <1m, no reference to speed
- level 2: medium risk, deepness of submersion between 1 and 2m, with a speed from none to low or deepness of submersion <1m with a medium to high speed
- level 3: high risk, deepness of submersion >2m, with a speed from none to low or deepness of submersion <2m with a medium to high speed, completed by a particular danger zone of 300 m behind the dikes
- level 4: very high risk, deepness of submersion >2m with a medium to high speed, completed by a particular danger zone downhill spillways and others river works.

The PPRi is annexed to the POS/PLU (planning instruments at the local level). The PPRi follows 3 major objectives:

- to forbid human settlements in most dangerous zones where people security cannot be guarantee, and to limit any new settlements in flood prone areas
- to preserve the capacities of flowing and of flood expansion as to avoid the increasing of the risks upstream and downhill
- to protect the environmental balance and the quality of landscapes, often remarkable thanks to water presence.

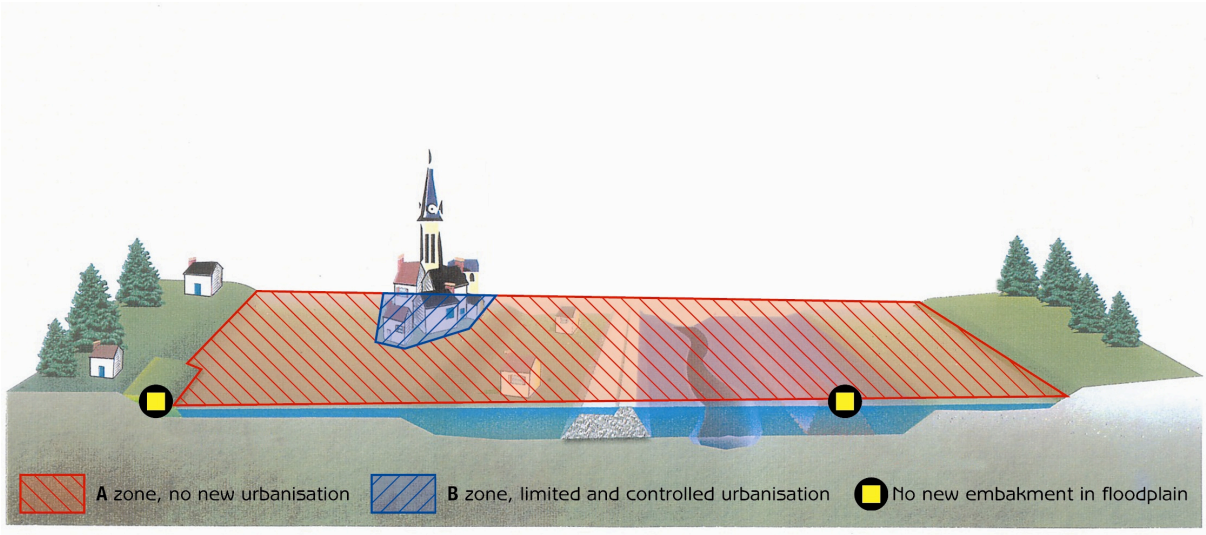

Figure 35 : Urbanisation control in flood prone areas under PPRi regulation

As to control the development of urbanisation in new sectors, the PPRi simply defines two zones (See figure 35): non urbanised floodplain (A) where any new building is forbidden and already urbanised floodplain (B) where urbanisation is limited to some restrictive rules connected to the risk level. On B zones, even at high level of risk, urban development cannot be reviewed. Even though, protection measures search for a better arbitration among the necessity of evolution of urban tissue, the limitation of population and goods exposed, and the reduction of vulnerability of new buildings that could be authorised.

4.1.1.2 National and local effects of the PPRi

As a fact, one can say that both Atlases (Atlas des Zones Inondables) and PPRi have been conceived to raise awareness on floods. The Atlases were strictly created for local information and for involving the stakeholders: the State wants them to be conscious of and responsible for the flood risk. Even if atlases are not part of the juridical arsenal, they help to get more involvement from the public decision makers: precedent shows that the "case of absolute necessity" is less and less taken into account when catastrophic floods happen. The implementation of the PPRi also quickly revealed that large urban areas are at high risk, even though they are protected by dikes.

At the local level, to what strictly concerns the surfaces located in flood prone areas, municipalities and their groupings have to compose among the most recent generation of planning documents (that includes some sustainable development matters), the observation of the constraints imposed by the PPRi (Plan de Prévention des Risques d'inondation) and the willing to develop the territory.

Through the so called SRU law (Solidarité et Renouvellement Urbains), dating the 13th of December 2000, which constitutes the last French legislation concerning urban and land planning, the new planning documents, both at the municipal and the metropolitan levels, are being introduced. The new instruments are the PLU Plan Local d'Urbanisme (that substitutes to the POS Plan d'Occupation du Sol) and the SCoT (Schéma de Cohérence Territoriale), which takes the place of the ancient SDAU (Schéma Directeur Aménagement Urbain). They both include as a necessary condition a PADD (Projet d'Aménagement de Développement Durable) through which a coherent urban project should appear. These strategic documents must follow what defined in the local PPRi that cancelled the former procedures.

4.1.1.3 Discourse on risk policies in planning documents

Apart from the regulation system, it appears that discourses have also evolved progressively. Indeed, for decades, the ambition to control floods thanks to protection works was dominating. Dikes and dams located in the upper part of the river basin have been progressively built on the French rivers to prevent floods. In most cases, those works also had to meet different new needs that were rising: agricultural needs (irrigation), industries (cooling) and new urbanisation (drinking water). Major works where launched on the River Rhône, the River Rhine or the River Seine from the 1920s to the 1980s.

But even though those works were more and more numerous and constrained the watercourses, they progressively faced their limits. After several decades without any major flood event occurring, dramatic floods took place in the beginning of the 1980s (on the Loire) and then in the end of the 1980s and beginning of the 1990s: Nîmes (1988), Vaison-la-Romaine (1992) and more generally large floods occurred in France during winter 1993-1994. It quickly appeared that no matter the protection works, the risk was never null (See also Part 3). What is more, several flood protection projects faced strong oppositions, mainly with the rise of environmental and social issues. Some had to be abandoned (example of the dams planned on upper part of the Loire River).

Those events led to a quick evolution of the flood control policies. As some protection works had face oppositions, more attention was paid on the issue of flood prevention and the restoration of areas for flooding. Within the frame of such a new strategy, the ambition was to focus not only on the hazard but also on the issues at stake. As we've already said, the PPRi's objectives were to restore or keep areas for flooding. As a consequence, urbanisation was stopped or strongly controlled in the flood-prone areas. But the PPRi also consider the vulnerability of the flood-prone areas. Hence, specific rules are imposed concerning construction in those areas. The ambition to reduce vulnerability in the flood-prone area was clearly defined in the State's doctrine. The service instruction of the 24th of January 1994 had already mentioned that the two main States' objectives were :

- to ban human settlements in the most dangerous areas: any new construction had to be banned in the areas with a high risk of flood and any new embankment was banned

- to reduce vulnerability (that is to say to better adapt settlements and activities to the flood risk)

- A new philosophy on building beyond the dikes

But since the beginning of the 21st century, two main issues have appeared (or have been highlighted) :

- the urgent need to reduce vulnerability in flood-prone areas, even though those flood-prone areas are protected with dikes (risk is never null)

- the need, on river basins to keep room for the river or to give more room back to the river.

As a fact, in 2002, a new service instruction reminded the objectives of the 24th of January 1994's instruction (ban human settlements in the most dangerous areas/refuse any new increase of the vulnerability in the areas at risk) but also stressed that those principles concerned all flood-prone areas, even those that were protected with dikes. Indeed, those

areas protected with dikes were endangered in case of breaches or submersion of dikes, with extreme consequences, whatever the protection level in theory. Hence, a general discourse has been developed on some river basins (such as the Loire's) mentioning the fact that a dike is never safe and that a risk is always remaining. In accordance with that discourse, a major effort started to be put on flood adaptation in all flood-prone areas. Methodologies to diagnose the activities or housing vulnerability were developed and started to be implemented. Eventually, the possibility to give back room for the rivers was enhanced, especially on rivers that were already modified or where the dikes already canalised the natural flows. For instance, this is the case on the rivers Loire or Rhine. In this case, the objective is to restore or create spillways in the dikes in order to let the water flow into the ancient floodplains but in a controlled way.

In accordance with that strategy, the law of the 30th of July 2003 developed new initiatives in the field of information and prevention and launched the identification of retention areas.

4.1.1.4 Local arrangements in planning documents

Locally, we can study, through an analysis of the planning documents and projects, which factors have oriented the urban sprawl in the flood plains and how do single municipalities face the constraints of PPRi.

As more and more PPRi's are being launched and implemented, urbanisation is facing a halt in flood-prone areas. Institutional stakeholders try to find new strategies to tackle both issues of flood protection and local development in their districts or territories. Today, one major trend is the emphasis laid on those flood-prone areas as important and valuable assets in terms of quality of life for the districts where they are located (open and green space, landscape, natural and cultural heritage…). This trend is even reinforced on the Loire River, as the valley is inscribed on the UNESCO World Heritage list (within the category of the living cultural landscapes).

Political interests developed by institutional stakeholders for those areas often clearly appear in the planning documents.

- The agglomeration of Tours (Indre et Loire department) can be divided into 3 groups:

1. In the zones located on both hills and floodplains, urbanisation has now stopped in the flood-prone areas; planning documents confirm that position. The municipalities stress on the amenities (natural or cultural heritage) of flood-prone areas and plan urbanisation on the hills, where lands used to be traditionally dedicated to agriculture (it creates a new pressure on this activity). All those municipalities show their will to strengthen their cultural dynamism and reaffirm their links with the Loire River (they try to preserve the image of a wild river) but also to develop their potentialities for tourism and leisure activities. They lay the emphasis on the uniqueness of their identity and the architectural (with the massive use of slate and freestone, the maintenance of cliff dwellings) but also the natural heritage (hills, vineyards and green belts) of the Loire Valley. If we consider the case of Tours, the last step towards urbanisation on the Cher floodplain (Gloriette plain) is different from what used to be done in the last decades. The current project is a mix between a city and a leisure park.

2. Some rural zones are completely located in flood-prone areas. In this case, urbanisation also stopped and now those municipalities tend to focus on new activities such as the

development of cultural events for instance. The most striking example is the municipality of Bréhémont, about 50 kilometres away downstream from Tours. This municipality exploits a wide variety of tourist assets enhancing the natural and cultural heritage of the place. Regular events introduce the old traditional activities of the place: trips on the Loire River on typical boats from the region, organisation of the "Hemp festival", during which the elders organize exhibitions of their former activities (hemp culture or traditional navigation). In order to set up such events, the traditional port and its embankments and quays have been restored. The conservation and restoration of the built environment is also a major concern; in Bréhémont, it has led to the reconstruction of the whole traditional urban landscape. Eventually, thanks to some large marketing events, such as the opening of the European Rivers Biking Road that follows the Loire River on the "Loire à vélo" (Biking by the Loire) and the indirect fame gained from the UNESCO inscription, the municipality of Bréhémont gets revenues from tourism. In order to build new housing even though new constructions are not allowed, old traditional barns will be restored with special care on the fact that they are located in flood-prone areas; hence, they will be adapted to floods.

3. The last case is the one of the urban outskirts whose territory is completely located in flood-prone areas. In their case, tourism is not a good strategy to find new revenues as they lack typical landscapes and present a very plain urban landscape and pattern. Hence, they are excluded from the tourist circuits (if we omit the green areas they can offer to the inhabitants of the urban area close by). As a consequence, they tend to adopt a mixed position, as they try to maintain their demographic and economical development but also have to respect the constraints of the PPRi. In practice, they tend :

- to preserve the agricultural activity which used to be and is still remaining a strong characteristic of those areas. They try to make it appear as added value for their territory, especially among young couples that wish to live in a so-called “natural” environment. Planning documents do lay the emphasis on that aspect, even though it remains difficult for the municipalities to reach that goal. Indeed, their ambitions and resolutions have very little influence on the protection of those open lands as it mainly depends on the wealth of the local farmers and private owners.

- to densify and extend their built-up environment, within the rules given by the PPRi (densification is possible in some flood-prone areas that are already built, especially if the level of risk is low). Thus, they try to optimise the land use so that the plain urban sprawl might become an urban continuum. New constructions have to conform to very strict rules taking into account the flooding issue (wiring and gas diagram are fitted in the ceilings, houses must be only two-storeyed with their living rooms elevated to be kept dry and their windows accessible as a potential exit). Since the mid-1990’s, those areas are the only flood-prone areas where urbanisation has kept developing, for instance in the municipality of La Riche, downstream from Tours. This municipality is still considering its development through the densification of its urban pattern and its residual spaces; the town council considers that there is still a possibility for about 7 hectares to be built.

- In the case of Blois (Loir-et-Cher department), the spillway of la Bouillie is an exemplary project

La bouillie is a project very much advanced already. The "new" strategy that has been developing for the last few years starts to be confirmed: the will to give more space for the river and the set-up of some areas for that possibility are becoming real.

With the implementation of the PPRi in 1999, the area of the spillway was classified as being a high-risk zone (with a water submersion that can reach 3-4 meters and currents with a high speed in case of flood). Hence, a procedure was launched by the local authorities in order to protect the people living in the discharge channel and give back to the hydraulic work its initial function. Indeed, if a new flood was to occur and the spillway to be in use, the houses and infrastructures would constitute real obstacles for the water flow and have the same impact than a dam. Therefore, it would increase the risk of flooding in the "quartier de Vienne" (which is protected by dikes) and on the right-hand bank.

In 2000, the local authorities asked for a study with a first diagnosis and planning propositions for the discharge channel. It was the first step towards a real planning operation to reduce vulnerability in the flood-prone areas of the left side bank. The study made an inventory of the constructions and activities located in the discharge channel and revealed that very few areas were cultivated; in this peri-urban area, there are mainly small individual gardens and some arable lands and meadows for the cattle (horses and cows) in the western part of it (Table 4.2). After that study, a procedure of Zone d'Aménagement Différé (ZAD) (Zone for a Delayed Planning) was launched by the city of Blois and its partners in the project (State administration and local authorities (Région, Département)). This procedure faced strong critics at the local and national scales. The ambition of the city, when using that procedure, was to buy little by little all the houses and eventually destroy all of them, so that it would become an empty zone.

The ZAD procedure is planned to end in 2018. While the acquisition of properties is still going on, an information campaign has also been launched in order to inform the people leaving there; several public meetings have been organised since the beginning of the process. Even though the risk is still denied and considered as being fictitious by some people, the houses are destroyed little by little, following the pace of acquisition. Those destructions encourage the people still remaining there to sell their houses to the local authorities. In February 2008, a new subsidy (coming from the Fonds Barnier (circular 2007)) brought new financial means to the local authorities; the main issue is now to find new houses for the inhabitants, in a city where prices for housing are high. It is even more difficult as this area was very attractive: close to the city centre and at the same time benefiting from a "rural" environment. In March 2008, half of the properties have already been bought by the agglomeration of Blois and about one fifth of the demolition work is planned until September 2008.

Spatial analysis on the discharge channel of la Bouillie
Properties being at risk Properties on the commune of Blois: 67 houses, 6 flats, 23 firms' premises Properties on the commune of St Gervais la Forêt : 57 houses, 2 flats, 4 firms' premises Total value of the properties: 9.2 million Euros Vulnerable sites: electrical transformer located just below the spillway, a classified facility (ISORUB, on the way towards Chambord, located on the commune of Vineuil), a cycle stadium, a reception centre for foster children Consequences: For escaping the site (48h in advance): the people located below the spillway must be evacuated (about 150 houses) Main roads cut: D174 (North to South axe in the department of Loir et Cher (Blois to Romorantin)), D956 (Blois/Contres), D951 (Vineuil/Montlivault), D751 (Vineuil/Cande sur Beuvron). Communication between the Northern and Southern parts of the department is still possible via the D112 (Mer, Chambord).

Table 7 : Spatial analysis on the discharge channel of la Bouillie (Main source: HYDRATECH, December 2000)

While the first phase (acquisition/demolition) is still continuing, the second phase consisting in the redefinition of the uses of that area (which have to respect the PPRi rules) is also going on. The future of that area is an important issue: what could be the functions of that area, which clearly is a city gate for Blois?

A new study is trying to find solutions after that some first proposals had been made by students from the Ecole Nationale Supérieure de la Nature et du Paysage (National High School for Nature and Landscape) (Figure 36). First, it could be possible to create a footbridge crossing the Loire; it would also be possible to valorise outskirt's type of agriculture and create a new agricultural landscape; production would be used for producing energy dedicated to street lightning and fuel for agricultural engines and urban transport (De Boiscuillé, Servain, 2007). In this case, it is interesting to note that eventually a strong and constraining regulation, the PPRi, would lead to new agricultural uses in an area located nearby the city (areas where it is more and more difficult for such uses to remain). In March 2008, the project of footbridge has been proposed within the Contrat de Plan Etat-Région (contract concluded between the State and the Région Centre and related to a 5-year plan) but the project for the agricultural land reclamation has been rejected by the State administration, DIREN Centre, which has been formulating some doubts and reserves about the proposals.

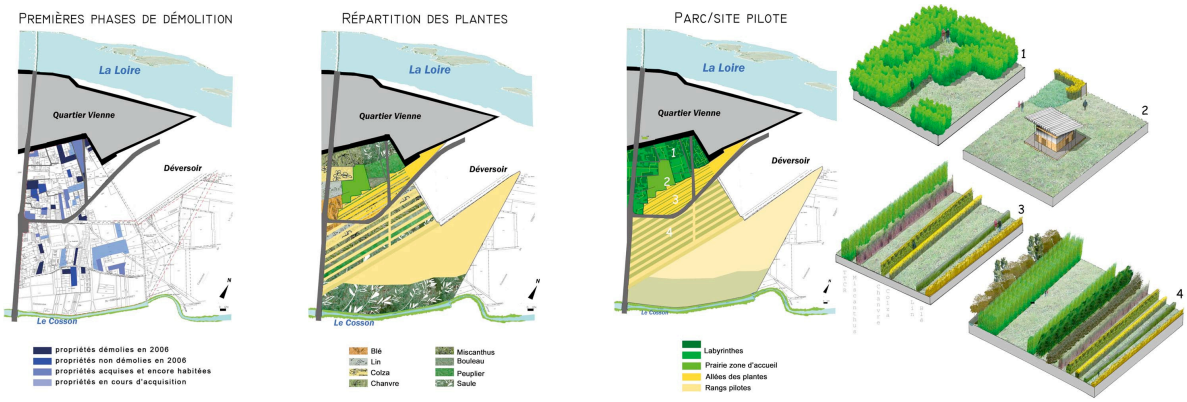

Figure 36 : The project planned for the discharge channel of La Bouillie (De Boiscuille 2007

For the district of la Bouillie, the commune has undertaken a project conforms to the implementation of the PPRi and in a direction similar to the one defined at the time of the spillway planning.

This option was chosen because it provides effective protection to the city centre and to the neighbourhoods: the Vienne and Bas Rivière districts. It has been possible (from a technical, conceptual and regulative point of view) to focus the efforts on a small sector in order to act in the general interest of the agglomeration.

This decision was difficult to take, it is a strong commitment for local elected people, and it was very badly perceived and experienced by the concerned inhabitants, despite many actions of communications. In fact, some inhabitants were still convinced of the lack of causes for the demolition of their neighbourhoods and suspected the existence of a construction project.

What are the plans for the floodplain of Blois, outside la Bouillie? The ongoing planning document is a Plan d'Occupation du Sol (POS) acting as Plan Local d'Urbanisme (PLU, lastly updated in November 2004).

The general provisions on floodplain areas "where the urban character is prevailing" concern rules of construction in order to "limit the degradation risks" and to "facilitate evacuation" in case of flooding.

What can be find in detail in the regulation of various urban areas correspond to the recommendations of PPRi, and any building must have: the floor at a height of 0.5 metres above ground level, one habitable floor and no basement. It is therefore possible to build in areas already urbanized. This corresponds to the areas of Vienne and Bas Rivière, which are protected by a system of dikes (at low risk level): parcels can be urbanized in the core of the already built zone, in logic of densification.

For high risk level areas, as on the shore of Cosson, the farmlands are privileged and it is the same situation in the Western district of Bas Rivière at low risk level where the built is discontinuous.

In the POS, on the left side of the river, the territory of the PPRi regulation is organized in three sectors that are: the embanked neighbourhoods (low risk level), which can be urbanized; the arm discharge (high risk level, ZAD) that will be released from construction and permanent activities; the vale of Cosson and its continuity in the area of water flow in case of spillway functioning which are not constructible.

The urbanisation projects follow logic in continuity of the 19th century spatial planning: protection is provided through structures such as embankments and spillway, which allows development in a floodplain area. It raises the question of maintenance of these structures and their reliability, in the case of dykes there is not total protection. Is the risk of flooding perceived by the people who live in these neighbourhoods? The reaction of the inhabitants at the establishment of the ZAD Bouillie shows that the culture of risk was lost and that the outreach efforts have limited impact.

The case study of Nevers agglomeration (Nièvre Department) is another good example of a will to give more room to the river

On the river banks of the Loire, in south of Nevers, municipalities of Sermoise and Challuy, are little urbanised and show an important rural character.

The historic development of the municipalities of Sermoise and Challuy, was partially located in flood prone areas, along an ancient royal road created by Colbert (RN7 than RD907). Due to the PPRi, the future urbanisation, as foreseen by studying planning documents, will take place out of these zones. In spite of the available space, it will be of small size. This means that politics projects are oriented towards a reasonable development, as to preserve the landscape features, in spite the proximity of a highway entrance (A77).

At the level of the communauté d'agglomération of Nevers, an "Etude Globale du Risque d'Inondation" started in January 2007 and should be completed by spring 2010. It focuses on one hand, on the flood risk and damages (directs and indirect) reduction and on the other on crises management. This study was launched following a local thought; December 2003 flood showed the vulnerability of urban sectors in flood prone areas and the need for a global approach at the level of the agglomeration. That is why public local bodies, both permanents members and politics, entered the state of mind of taking risk into consideration (as their implication within Freude am Fluss project clearly demonstrates).

For the municipality of Challuy, the report presenting the PLU (June 2005) integrates constraint as the floodplain area and thus taking into account the risk of flooding, resulting in the interdiction for constructing in the most dangerous zones. In the chapter on the perspectives and guidance, this point was raised as the Northern part of the commune is therefore "totally frozen".

Challuy is presented as a "small residential area with strong rural tendency" and that character should be preserved even in sectors that can be developed (in Plagny Bourg too).

The orientations of the Projet d'Aménagement et de Développement Durable (PADD, planning project for sustainable development) consider the flood risks as part of the municipally surface concerning the limitation of hamlets urbanization (ban of construction) and the preservation of natural areas on the Loire river sides ("protected due to the flooding risks").

The assessment of flood-prone areas is not directly mentioned, but it may be assumed that it is indirectly considered due to the protection of agricultural activities on the whole municipality.

The landscape appears as mostly related to the living environment, and it is not put in the foreground as in the urbanism documents of the municipalities of Nevers's agglomeration.

Indeed it is mentioned several times that green areas will accompany constructions in order to "preserve the rural character".

In the municipality of Sermoise, the urbanized areas are medium density and consist mostly of individual or grouped houses in the burg of Sermoise and Plagny (near the district road D. 907). In the urbanism document revised in March 2002, urban areas (UI) at high risk level are therefore excluded from the scope of expansion floods. The constructions are regulated in order to limit the impact on the water discharge.

Areas which are intended to be urbanised (2 NA) are limited to three areas outside the floodplain area (including the place known as “les Religieuses”, near the intersection of the highway A77).

Part of the "natural areas" (ND) are in the floodplain area, at all the four risk levels. It is only possible to rearrange existing buildings and to change the destination use to one related to tourism and recreation.

The PLU is underway and will accompany a PADD that will integrate the risk of flooding in accordance with the principles of sustainable development, and this should promote a landscape valorisation in these sectors.

In conclusion, the historic development of the municipalities of Sermoise and Challuy, close to Nevers, was partially located in flood prone areas, along an ancient royal road created by Colbert (RN7 then RD 907). Due to the PPRi, the future urbanisation, as foreseen by studied planning documents, will take place out of these zones. In spite of the available space, it will be of small size. This means that politics projects are oriented towards a reasonable development, as to preserve the landscape features, in spite of the proximity of a highway entrance (A77).

In a way, this new approach can appear as a step backward or, more positively, as a “flashback”, i.e. a comeback towards traditional habits and adaptations to the reality of flood-prone areas.

The strategy of giving more space for the river flooding is indeed not something new on the Loire River. It had already been enhanced in the 19th century and even much earlier in the past. Therefore, it seems that the whole history of flood management on the Loire River has been continuously swinging from the ambition of maintaining the water flows between the dikes to the recognition that there was a need to give it more space.

4.1.2 Policy actors

The French organization: responsibilities split among several actors

The main source for this section is a publication by the CEPRI (Centre Européen de Prévention du Risque d’Inondation) (www.cepri.fr).

The French system divides responsibilities in the field of flood protection among four categories:

- Mayors

- State and State administration

- Inhabitants leaving nearby

- The owners of hydraulic works and of the goods located in a flood-prone area

In his municipality, the mayor is the first responsible for maintaining order and security. In the field of flood protection, he must :

- prevent the risk of flooding and breaches by taking the relevant measures ; for instance, he must remind the owners of hydraulic works or dikes that are not properly maintained that those works are likely to be dangerous and that they are responsible for guaranteeing their safety

- inform the local population on the existing hazard through public meetings, the constitution of an information document on the municipality (Dossier d'Information et de Communication sur les Risques Majeurs (DICRIM)), the restoration of historical marks left by the floods (repères de crue). They must also inform the population when a PPRi and an AZI (Atlas des Zones Inondables) are implemented

- organise safety plans in case of a major crisis (when a flood occurs) (Article L 2212-2 of the Local Authorities' General Code)

He is also responsible for the urban expansion on the municipality, as he gives the building permits. Those permits must be in accordance with the PPRi if there is such a planning document on the territory (decree 5th October 1995 modified).

Eventually, the mayor can take some prevention measures such as actions to reduce vulnerability of housing and activities.

The State must inform the mayors about the hazards existing on their municipality. Hence, the prefects' services (head of the State administration at the scale of the *département*) have to produce a Document Départemental sur les Risques Majeurs with maps identifying the municipalities at stake for every risk.

The State also has the responsibility for determining the urbanisation rules in the flood-prone areas. Indeed, the prefect's services carry out the PPRi procedure and control its implementation by the local authorities. The prefect's services also decide on the way they involve the local stakeholders in the procedure of the PPRi.

The State services are also responsible for the safety of the dikes, whatever it owns them or not. In order to do so, the State has to make an inventory of all the works and impose prescriptions to their owners (very often, the State itself is the owner of the works).

The riparian inhabitants are responsible for their own safety. They cannot demand the State or the local authorities to build new dikes or embankments (law of the 16th of September 1807) for their interest. However, local authorities can also decide to restore defense works if it is for the general interest. It is also important to mention that the State has often chosen to build the protection works itself and is the owner (that is the case on the Loire river).

Eventually, the owners are responsible for different aspects. The owners of houses located in the flood-prone areas must inform the potential buyers or renters. The owners of the protection works are responsible for their maintenance and safety.

4.1.3 Division of power and resources

Within this system, responsibilities are very much split among several stakeholders. As a consequence, conflicts are very likely to occur, and especially when the State administration wants to implement new regulations or projects. As an example, Y. Veyret explains that in many cases when a PPRi is carried out, the State administration communicates only on the evolution of the studies itself but do not let much possibility for a negotiation with the local interests on the future opportunities for those territories to develop (Veyret et al., 2004). In some other cases, the State administration carries out local protection projects without involving local inhabitants. In the case of La Bouillie in Blois, public participation started very late, when most of the project was already decided.

In order to facilitate flood prevention and water management policies, there is now a possibility for the local authorities to gather within a public body (Etablissement Public Territorial de Bassin). They are recognised by the law taken in 30 July 2003 as major actors for flood prevention and integrated management of water resources. On the Loire river, the Etablissement Public Loire is such a public body.

As a consequence, one could identify three major stakeholders in the field of flood protection on the Loire River :

- the State administration (Préfectures, Directions Départementales de l'Equipement DDE and Directions Régionales de l''Environnement DIREN Centre/DIREN de bassin): on the Loire, the State administration is responsible for the PPRi and for informing the municipalities on the existing risks. It is also responsible for the safety of the works. Eventually, the State administration is the owner of most protection works

- the Etablissement Public Loire: the EPL gathers local authorities located in the Loire river basin and gives them assistance in the field of flood protection and water management. In the field of flood protection, it is responsible for some major works in the upper part of the river basin (dams of Villerest and Naussac). It is also helping the municipalities to better adapt to the flood risk by promoting vulnerability reduction measures and helping them for carrying out the Plans Communaux de Sauvegarde

- the municipalities and their groupings (Communautés de Communes for instance): they are responsible for the local safety; they must carry out procedures such as the Document d'Information Communal sur les Risques Majeurs DICRIM and the Plan Communal de Sauvegarde PCS. They also play a major role when giving permits. Eventually, they can take vulnerability reduction measures.

Because responsibilities were very much divided, it was decided within the frame of the Plan Loire Grandeur Nature 3, to clearly identify a leader for each aspect of the plan. The Plan Loire Grandeur Nature has been created in January 1994 at the beginning to last for ten years. Then, in 1999, on a 2000-2006 horizon, 3 priorities where approved :

- to guarantee security of populations facing flooding risks

- to improve management of water resource and of natural and rural valleys spaces

- to valorise natural, landscape and cultural heritages along Loire's valley.

Today, the third intervention frame, lasting from 2007 to 2013 and based upon five operatives platforms is ongoing. The five platforms are about: prevention of flooding risks; public hydraulic works and water security; water, spaces, species, heritage; research/data/information; estuary.

As a consequence:

- the Etablissement Public Loire is the leading partner for the flood prevention policies on the Loire : the EPL is a public corporation which gathers local authorities (Regions, Departments, Communes) located on the Loire river basin. It is meant to give them assistance and promote a integrated and common approach in the field of water management and flood prevention.

- the State administration (DIREN Centre/DIREN de bassin) is leading for all the issues concerning safety and the public hydraulic works

Some other stakeholders can also be mentioned in the specific case of the Loire river :

The PNR Parc Naturel Régional Loire Anjou Touraine, created in March 1996, is in charge to supply specific tools of landplaning and territorial development, within territories in fragile balance holding a rich and threaded natural and cultural heritage, being object of a development based on preservation and valorisation of patrimony. Its major objectives are in two different fields :

- Environment and heritage: to protect natural, built up and landscape patrimonies

- Tourism, Culture, Education & Communication: to contribute to landplaning, economic, social and cultural development and quality of life; to ensure the reception, education and information of the public; to realise experimentalist or exemplars actions within these frameworks and contribute to research programs.

The Agence de l'eau Loire-Bretagne manages the water policy along the entire basin of Loire river and its affluents. Its comity is composed of representatives of public bodies (at national and local levels) and users. The comity is referred to for water policies and draws up the planning documents concerning water management (SDAGE schémas directeurs d'aménagement et de gestion de l'eau).

And finally, there is a "virtual" actor, the inscription, as Cultural landscape, of The Loire Valley between Chalonnes and Sully-sur-Loire within UNESCO World Heritage List in year 2000. The site is inscribed in the category of organically evolved landscape (resulting from an initial social, economic, administrative, and/or religious imperative and that developed its present form by association with and in response to its natural environment), in the sub-category of continuing landscape, which retains an active social role in contemporary society closely associated with the traditional way of life, and in which the evolutionary process is still in progress

4.1.4 The French planning culture

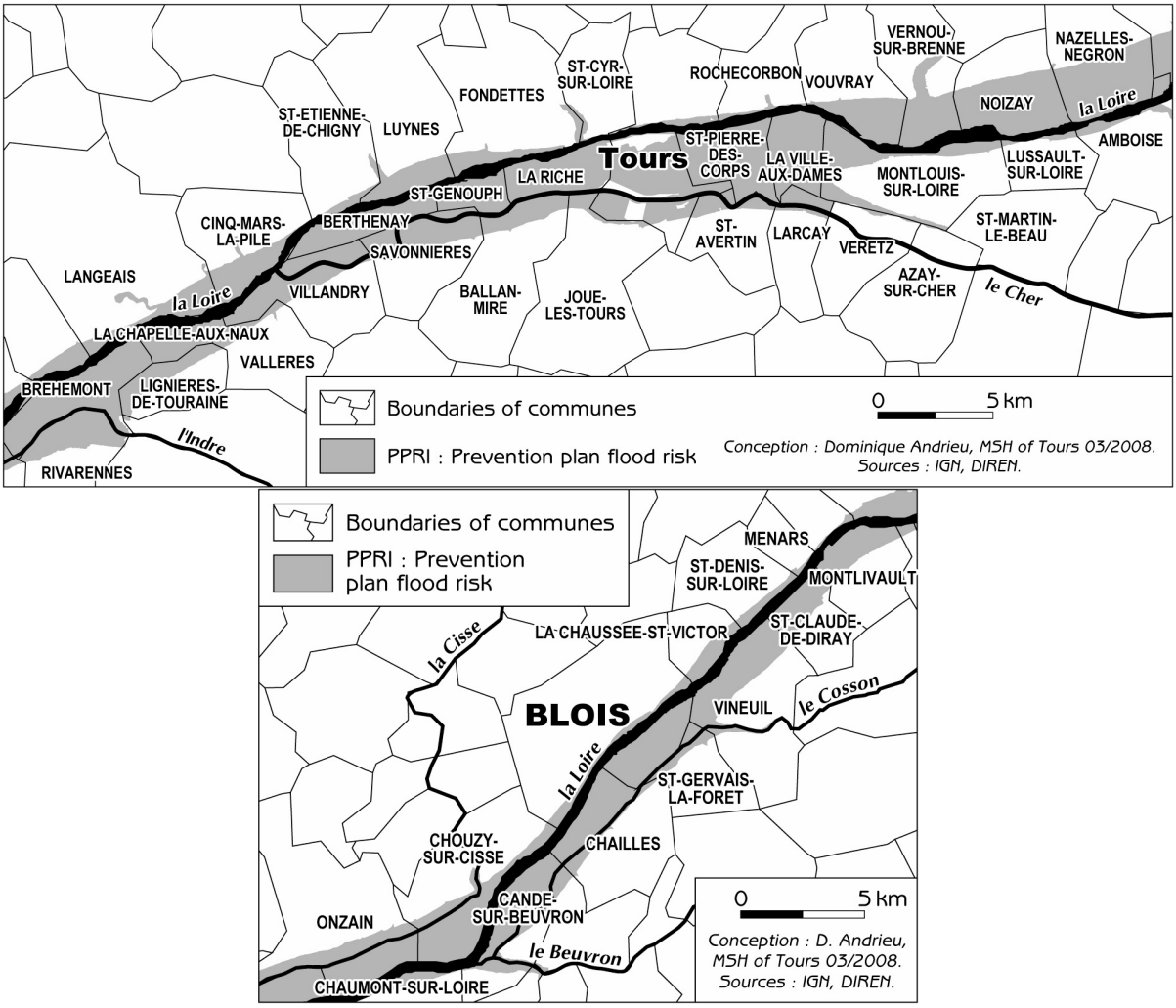

Figure 37 : Maps of the district where people were interviewed (Tours and Blois)

Discourses studied in planning documents need to be compared with oral discourses of stakeholders in charge with risk policies. To do so, interviews were made on perceptions and representations of flood risk, in order to analyse discourse of actors on the risk policy and on regulation. About 20 interviews were conducted with officials agent from the State service such as elected people or officials of the urban services from municipalities concerned by flood risks in the basin of the middle reaches of the Loire river, in Tours and in Blois (see figure 37). Generally, the interviews show that the will to urbanise exists, despite the awareness of flood risk, it includes physical properties of the territory, as well as their cultural and historical past.

4.1.4.1 Risks perceptions to understand how urbanization is maintained in floodplain areas

4.1.4.1.1 Unanimous acknowledgment of flood risks

The presence of flood risk is recognized by all stakeholders, but their perceptions are guided by the presence of multiple stakes. The understanding of the risk means to localise the exposed space and the sense of being exposed, but the perception remains after all subjective and legitimised by the existing regulations.

The several State services encountered have uncovered a technical approach and strictly defined by the mastery of scientific tools of their knowledge of flood risks. All believe that flood may occur or will occur beyond doubt. If flooding occurs, it will have major visible and predictable consequences thanks to rising waters models. These simulations bring to light the modifications realised by man on the environment, the magnitude of the consequences to be expected and the means to put in place or available in order to provide the best management.

For these interlocutors the flood risk is real and can occur, local decision makers (elected people or municipal services) are aware of it. They know they can be exposed during their mandate. The different people of the State services interviewed consider the technical and scientific flood monitoring as a benchmark in terms of risk. They bring effort for the maintenance of collective structures, which is part of their expertise. These actors are sure that new major flood will happen. The elected people, by their legislative and more by their role in administrative management of their communes, are aware of the risk through rules impositions and by the history of their territory. They hope that no flood will occur but obviously without having certainty.

According to an agent of the DIREN: The risk is perceived as huge, comparable to what happened in New Orleans. The role of spillways is to slow the rising water down. The disaster will happen and it will be grave.

For a person of DRIRE: *"Elected people do not deny the risks and devices are planned to cope with the floods"*.

The existing technical devices such as dikes, spillways, dams along the Loire river are subject to a constant and regular maintenance by the State services and elected people monitored the water level. These constructions result of past political consciences as a result of centennial floods or to the implementation of reinforcements due to the destruction or broken dam. However, the physical, historical and cultural characteristics of each territory tend to bring out 3 types of particular territory: a zone 1 north, north-east, a zone 2 "interfluve" (between the River Loire and the River Cher) and a zone 3 south, southwest (See figure 4.4). Those territories were determined and analysed according to interviews, separately from the planning document analyse, but they match ideas presented in part 4.2.

In zone 1, it comes out that it is a territory with agriculture identity (market gardener) and wine with AOC value. This sparsely populated territory is composed of small communes, which have developed partly in the valley, in a floodplain area, when they still have space outside floodplain area, on the plateau. The growth in these territories is hampered by the desire to maintain agricultural activity on the plateau. It is a source of wealth in terms of prestige and heritage for the communes and therefore it brings economical incomes but hinderance the rapid urban development. The choice of exploiting the plateau follows a need for significant space and follows the practices that were traditionally made in that territory.

In the municipality of Fondettes, the risk is taken seriously, including the dyke break. In Luynes the risk of dyke break is discussed, but without conviction: *"That risk does not appear to be very restrictive because the city can develop on the plateau. The perception flood risk is linked to the fact that water serves as a reserve to agriculture"*.

The will to urbanise is present but this is limited by the weight of agricultural activities and vines that prevail over the commune extension. The legislative constraints of the PPRI imposed are accepted and very few are the subject of negotiations or reclamation.

The zone 2 is comprised between the Loire and the Cher river. It includes the agglomeration of Tours and part of its periphery to the east (St Pierre des Corps, La Ville aux Dames and Montlouis sur Loire), to the West (La Riche) and also more rural territories (Berthenay). This space intersect landscapes with complex variables of human density, urban, industrial and under land market pressure and also the countryside where agriculture has greatly declined and the population diminished.

Elected people and other public services are used to diverse lifestyles of the inhabitants, to the multiplicity of habitat types (dense and residential area, farm surrounded by fields), to stories of neighborhoods and settlements industries. Therefore they prioritize a number of risks present in the territory of the commune. They first identify various possible threats such as flood risk, the risk of ground sliding and the risk associated with industrial sites classified SEVESO for very urbanized communes.

For the municipality of La Ville-aux-Dames*: "The flood is the largest and most present risk in the minds of people and the industrial risk".*

For the municipality of Tours: *"There are two hazards: flooding and slope movement. There are two levels in terms of construction and development".*

The risk of flooding itself can present two faces: the spread of water caused by a very large water discharge generated by the Loire, and in particular by a breach of dyke. The second one is the water rising by seepage at the level of the Cher river. The presence of water is partly perceived as a danger referring to the image of the wild river, which keeps his rights despite the infrastructure in terms of human protections.

For the municipality of Tours: *"In Tours, there is the Loire river and the Cher river, for us, the water rise of the Cher river is most to be feared".*

The various people interviewed expressed knowledge in respect of flood risks, be they from communes very industrialized and densely populated or more rural communes and sparsely populated. This knowledge prove to be basic and bring to light a blurred vision and distant from reality. The risks are estimated and adjusted according to the risk perception of their territory. They take into account the human density of the commune and activities that are performed. However, these actors retain the idea that flood risk is possible but in proportions and according to events difficult to visualise. The flood risk is considered and taken into account because it is integrated in planning documents. Furthermore, the dikes bring sense of protection for these communes between the Loire river and the Cher river, and in the mean it maintains the memory of the water presence and the imprecision surrounding the management of major flood events.

Some testimonies show the ambivalence with the flood risk consideration, for the municipality of Saint-Pierre-des-Corps: "*Do we believe in the reality of the risk or not?"*

For the municipality of La Riche: *"We feel immune behind dikes, we believe to have tamed floods. The main risk is the dyke break, we are not prepared for such a fracture".*

For the municipality of Berthenay: *"We know that the risk is present and it is taken seriously even though the Loire river is very dry. The pre-cursors are visible in the burg".*

For the “group of municipalities of the Eastside” (CCET) (Montlouis-sur-Loire): *"Every commune has an interest in having knowledge of the risk when it was not always matter, but today, yes".*

Finally, zone 3 includes the municipalities concerned mainly by the presence of the Cher river as Joué les Tours, Ballan-Miré, Savonnières, Villandry or Véretz, Azay-sur-Cher, Larçay. A portion of communal land is located in floodplain as in the flood expansion area of the Gloriette for Joué-les-Tours particularly and the other parts on the plateau outside floodplain area. Urbanization has grown in the valley and also at higher elevations. Water is both remote and close to all these municipalities who do not benefit from dykes and who see the water rise every year although this is still far from the centennial flood value. The vulnerability to flood risk is perceived as a very small but concrete and manageable because the Gloriette is regularly flooded and the risk is "accepted". The municipalities of Ballan-Miré, and Savonnières, and Joué-les-Tours said having frequent experience relatively to "small" floods (about 50 cm) but that does not change anything on their perceptions.

Urbanization can continue on the plateau of communes having part of their territory in the riverbed and a part on the plateau (as Joué-les-Tours) or at least aside from the Cher river (as Larçay or Véretz).

The perception of danger is real and covers concrete aspect. A flood is still possible, and it manifests itself in varying proportions, while remaining under control. There are two scenarios. The first consists of communes such as Joué-Les-Tours or Ballan-Miré who seek to maintain a significant urbanization and have few opportunities in or attempting to create them. The second case of communes such as Azay-sur-Cher, Véretz ou Larçay who still have available land, but who are trying to emphasize a lifestyle rather rural, aside from the agglomeration and therefore urbanise rather moderately.

For the municipality of Joué-les-Tours : *"The vulnerability is low and the centennial floods are to be expected".*

For the municipality of Savonnières: *"The vulnerability is perceived as weak, floods are predictable but they are quite manageable".*

For the municipality of Ballan-Miré: *"We must regulate the river and dykes but the risk remains as it occupies the entire space".*

The various interviewees are all aware of the reality of the flood risk, but the perception is different depending on the model of thinking of each of our three types of territory. The communes of the zone 1 seek to maintain a farming operation on the plateau, they have an interest in developing urbanization in the valley even if it is in the floodplain area. The communes of the zone 2, of the interfluves, who see the expansion of their territory very upset, mainly seeking to maintain their heritage already built and to urbanise on islands that are not concerned by the flood risk. Finally, communes in the zone 3 are aware that part of their territory is floodable and get flooded regularly, make a space left in a floodplain area or an area for practical use, consisting of demountable structures enabling the establishment of recreational and leisure areas. The area left to the flood expansion does not avoid common development on the plateau or more away from the presence of water.

4.1.4.1.2 People perceived as unaware of the risks

The elected people or people from urbanism services in zone 2 denounce the attitudes of their inhabitants disinterest, negligence and to a certain extent a nonchalance towards the flood risk. These actors come from communes with the most important human stakes and also from the most exposed to urban and industrial stake and to complex risks.

Some municipalities like the Ville aux Dames, Montlouis sur Loire or Tours denounce a lack for the culture of risk from their inhabitants. These defaults would come from a lack of interest or from a lack of credibility for the people in being exposed to this threat. They want to set up tools to deal with this lack of awareness.

For the municipality of La Ville aux Dames: *"My role is also to provide information about these risks and I was surprised because that does not stop the population. People are not necessarily aware of the risk. There are some who choose to sell".*

For the municipality of Montlouis-sur-Loire : *"The culture of risk of new residents… they stick to the opinion of the manufacturer, but I believe that there is even a will to close our eyes, "it is not possible, it will never happen"".*

For the municipality of Tours: "*But people say that it was never flooded".*

For the same municipalities, the lack the culture of the risk culture decried the lack of interest to concentrate on the issue of the risk of beyond accident period. The inhabitants seem to be in favor of the location and life quality criteria than in professional constraints and for services accessibility and other collective structures rather than the actual risks.

For the municipality of Tours: *"They maybe do not want to see, but in the context of PLU, we will do exhibitions but we haven never hidden it".*

For the CCET (Montlouis-sur-Loire): *"I do not believe that people will leave. When they choose an area or a place, it is first the price, the location in relation to the workplace and then it is services of the commune, schools, shops".*

Some municipalities located in urban area like La Riche or in rural area like Berthenay, express a desire to inform their residents to the presence of risks. However, according to them it is very difficult to educate people as to obtain the necessary budget for the creation of appropriate media and arriving to achieve the expected goal.

For the municipality of Berthenay: *"The training of the people to a culture of risk is beyond our means".*

Highly urbanized or not, the different municipalities mark their difficulties in reaching their residents when it comes to raising awareness of flood risks.

4.1.4.1.3 A collective memory-maintained, but without substance

Different people encountered on the three areas denounce a lack of collective memory. This deficiency is apparent throughout the need to use written documents to name and locate the presence or threat of the water. The risk is abstract, vague and lacks concrete benchmarks. The northern zone, north-east following a moderate development maintains a real souvenir but with approximation of the floods because they have little impact and consequences on the

territory of the commune. Documents are written that constitute and reconstitute the memory of the past because they have not been exposed recently.

For the municipality of Luynes: *"We know that we are never at the shelter, so we adopt a prudent behavior but it has never experienced such an event".*

For the municipality of Larçay: *"I did not reach to overcome from the risk of flood, even to classify landslides and flooding. There is a danger because there are documents. These are the documents that embody risk and make it existing".*

The communes of the interfluves seem those who express the most memories of recent flood or of older like centennial flood. Indeed, in terms of destruction that were observed and transcribed in the form of written documents or maintained in the form of marks included in the stone (including bridges and habitats). The major floods constitute a considered reality but any trace was no longer visible to human memory. The individual memory of the flood remains superficial and approximate.

For the municipality of La Riche, it seems that there is more tangible evidence of the risk, even though it was aware that it is there.

For the municipality of La Ville aux Dames: *"For flood, it is the same, it is based on flood which dates from the nineteenth century, early twentieth century therefore, we need to remind it and this Is the collective memory. People, the elders have memory of locations in the commune but young newcomers are not necessarily aware of it".*

For the municipality of Tours: *"The recent floods are from 1910, I do not remember, I don't have them in mind. The banks had failed".*

For the municipality of Saint-Pierre-des-Corps*: "The flood of 2001 has raised the suspicion of a reality that may emerge one day. It has turned people's minds. If the aquifer were had, we would have been good for it, it was 6000 m3 second and not 3000 as it was then".*

For the cities of the East (Montlouis-sur-Loire*): "I do not know because in the area, there were no major floods, apart from that of 2000".*

Concerning zone 3, the observation of the water rise of the Cher river remains not so disturbing because, as in zone 2, no major flooding is regrettable since the nineteenth century. However, the Loire and the Cher river frequently overflows from their bed in moderate proportions and it is certainly not a source of danger but it reminds to residents and other decision makers of the commune its presence.

For the municipality of Véretz: *"The latest floods were a very, very long time ago, unfortunately, there is no one to see them. There were 1846, 1856 and 1966 I think, so regularly they say no, it is not floodable, we never saw water, in man-memory for being scared. Regularly in Véretz, there is the Cher river rising and that gets close to the former national road but nothing, to our regret, not alerting enough for marking people's minds. Yes, it can be felt because nobody has ever seen anything that can remain fixed in our memories therefore the culture of risk, it is not really very fixed".*

The memory of ancient flood (centennial flood of the Loire river in the nineteenth century) or recent (those of the Cher river in 2003) is even more maintained that the consequences were dramatic and were the subject of stigma on buildings.

4.1.4.1.4 State services: the "memory" of flood

Municipalities conserve memory without much substance of floods, but those which are the most urbanized and most vulnerable to this threat who are trying to maintain a vivid memory, even if it became a blurry and is based on written evidence or sketches. The presence of dikes and collective protection has developed and provides a sense of security in zones 1 and 2, justifying to some extent to forget or to neglect previous floods. In addition, the analysis of different floods shows that they are not alike, that a combination of factors has modulated these waters rise, making them unpredictable to some extent. The degree of confidence in the protection of dikes varies among municipalities that prefer more monitoring by the State departments to anticipate a flood.

The municipality of Luynes said that they trust in the dikes, in their maintenance and established warning systems.

For the municipality of Tours: *"If a centennial flood happens today, it sets up the system "batardeau" between Tours and Saint Pierre. We inondate Saint Pierre, no but it's a reality".*

For the municipality of Saint Pierre des Corps: *"With the safety communal plan, we start to be aware because we simulate the real case".*

For the municipality of Fondettes: "*The risk is there, dikes can break but there would be warning before the disaster".*

The protective barriers are put in place and develop a sense of control and safety for the communes exposed to the flood risk. This feeling of protection is maintained and extended by the regulatory framework that defines risks and the unpredictability framework of the dyke break, for example.

For the municipality of La Ville aux Dames: *"There were taken into account flood risk with Vaison-la-Romaine".*

For the municipality of Tours: *"These are accidents, but also insurance who are pressing for tougher legislation".*

More municipalities are urbanized (built and operated in terms of agricultural and/or industrial resources), more they become sources of issues that we are trying to protect from risk with walls protection ever higher, ever more reliable but finally that always break in front of the natural element strength.

The communes trust in the structures of collective protection, as well as state services. The floods were generating awareness relayed by a strengthening of the protection system. The State services are the referents for the normal water level state and for flood warning when it reach the threshold. These thresholds are defined by using written materials like regulations and the memory of the flood levels. The actors interviewed rely on State services also for what they represent and for their technical skills.

Written materials constitute a criterion for homogeneity and objectification of hazardous situations. Policymakers and other urbanism developer elaborate their risk perceptions relying on what is written in the texts and official definitions. However, even if they give their trust to such warning systems, they do not forget that some uncertainty remains, that the risk is

renewed for each situation and that the actual risk prevention refers to technical management, because people are not so aware of the flood threat.

4.1.4.1.5 A perception of risk primarily technical, which neglects the human aspect

The communes of zone 2 are the most affected by the survey of dikes because they know they are directly exposed in case of dyke break or just in case of floods. They are trying to improve the daily water management, facilitating its discharge or limiting the consequences in case of floods and of the water storage capacity with the establishment of retention basins.

For the municipality of La Ville aux Dames: *"a breach of dyke is not taken into account, but it is under consideration".*

For the municipality of Tours: *"If structures in the Gloriette must be dismantled, they must not impede the water discharge progress. The retention basins allow not having floods we had in the past. We make sub-tanks that will store the rainwater, which stop the water so that it flows quietly".*

Existing measures to improve the water management, whether in the store or by facilitating its flows or by constructing barriers are only preventive measures that we do not know the limits in case of floods.

The return to normal life after flood remains actually poorly planned. It is the subject of an early reflection though still in its infancy stage and still treated differently depending on the territory.

4.1.4.1.6 A resilience capability difficult to plan

The levels of resilience are perceived differently depending on the urban and rural areas. For the communities of the zone 2, the most urbanized, finding levels of resilience remains difficult to envisage for the multiplicity of factors that may hamper everyday awareness and the establishment of actions and means of action, effective. The historical heritage must be preserved and is more important than the risk. The presence of companies that they must comply with security measures a priori but their departure is not desired.

For the municipality of Tours: *"There are perimeters of protection for historic sites. (…) The people do not want to be embarrassed".*

For the municipality of Saint-Pierre-des-Corps: "In terms of vulnerability of companies, business leaders meet with the cards they have, how they fit into the PCS and how they made the right action to save jobs and have less significant damage. Companies come here in the varenne, because of networks: the TGV, oil depots so you have all the services. Companies will go to the agglomeration, but there is no questioning around these stakes for damage".

Seek to develop the capacity for resilience of a municipality is proving to be a difficult position to take for an elected official who may fear for a possible mandate to come and take the risk of scaring some of its inhabitants face with the presence of risks.

For the cities of the East (Montlouis-sur-Loire): *"It is not easy, it is to accept that we are fragile. Imagine not being able to cope with a situation. I recognize that this is a situation not easy to take for an elected person. But I think we could improve information for people (at schools, local risks…). DICRIM can be scary in some cases but should inform people".*

Perceptions of risk that arise from the discourse of elected people and other municipal services show an awareness of the water presence following multiple events but blurred. These events are due to the gradual disappearance of the last major floods in the collective memory, as well as research for the establishment of protective barriers, which are essentially preventive agenda. The preventive aspect should be pursued with public information. The levels of resilience have still to be tackled. It is easier to look for rural communities where the consequences of flood are lower since in daily life they are already subject to less pressure from the population density and urban or industrial activities in particular.

Industrialisation and urbanisation in the river bed have made the society vulnerable and fragile to the water presence and have complicated prevention measures as well as to establish the means for management to increase the possibility of resilience to a more improved and adapted rules.

4.1.4.2 Discourse on regulations and laws

The interviews allow us to analyze how the stakeholders consider the regulation. Is it fair, is it appropriate and accurate, is it negotiable? Two majors analyses can be done: first, different points of view can be show depending on the role the actors play in managing flooding; secondly, the double positioning of the districts representatives is both made with resignation and contesting.

The main difference between the discourse about regulation remains on the opposition between, the district representatives' point of view and the state agents points of view. On the first hand, state technicians are widely aware of the risk and of the importance of the regulation. Interviewed people are mainly working for the DDE and for the DIREN. They participated to the elaboration of the PPRi, therefore they are conscious that the risk is high. More particularly, they are sure that the dikes will collapse sooner or later and that there will be a major flood. Hence, they have a good knowledge of the potential water level, the speed flow and possible damage due to the flood. Flooding is very concrete in their mind. As they have been working on the Atlases of flood plain (AZI), they figure out precisely how the calculations have been made, they know models used and how they have been conceived. They also have a good knowledge on how the 1856 flood took place: they are familiar with the water flows, with the pressure on the dike, with the pattern of the flood defenses at that moment. They also are acquainted with the way the flood happened and developed: they identify the first broken dikes, the way the water flows through, the weak dikes and the dikes that broke secondly. They consider very precisely the flooding extend. Those atlases (atlas des zones inondables) are the first draft of the maps used in the PPRi. Therefore, these technicians very well know the category of each alea zone and the accuracy of their limits. For these people, the way the regulation is made in France, through the PPRi, is the least protection that can be provided. Alea categories rely on models showing high water level, but those levels could be under-estimated. In the same time, the PPRi still allows building in dangerous areas. According to State technicians, less building permits should be given and more room should be left to the water. The regulation could be stronger and stricter, new spillways could be planned and some houses and building could be destructed (Cf. interview of the technician who compared the Loire valley situation to the major floods that happened in New Orleans in 2007).

Nevertheless, these actors don't have much power in implementing the PPRi, because, the mayors and the local technicians are those who apply the regulation (as shown before). They have another type of discourse on the regulation. Their representation of the regulation is decisive because it explains to what extend the PPRi is implemented.

Interviews with mayors and district technicians' analyze demonstrates that local discourses on risk regulation show both resignation and contesting. People are resigned because they know, for a long time, that the PPRi has to be implemented. They have a good knowledge of the document, its maps and texts. Those papers help them to take into account the risk and its reality. However, they are discussing about it and they question it. Questioning concerns the boundaries of the PPRi, the way, they have been defined and the rules of negotiation about their limits. Indeed, some PPRi are slightly different from a district to another when the topography remains similar. Mayors and technicians are consequently wondering why the flood limits or the zones of the PPRi vary. The underlying idea is that some district have been clever enough to negotiate the definition of the areas and of the limits of the PPRi, so that they can keep areas were building is still possible. Actually, it is true that DDE worked on the PPRi with the districts to reduce the errors made in the flooding model and in the maps. It is true too, that the zones called ZAC (concerted planning zone) already planned in the local planning act (POS or PLU) are out of the PPRi, even if they are in flood prone area. Consequently, districts aware that the PPRi would be implemented soon had the possibility to write down a ZAC in their local plan, to avoid some areas to be considered as impossible to be built. The Gloriette plain in Tours was in this case. In Saint-Pierre des Corps, this situation reached its height when the mayor refused to implement the PIG (General Interest Project) drawn on the Atlas (CERTU, 1998). The District negotiates with the State and finally get a "compromise" so that some areas in the district were not in high "alea" zone. In those cases, the district accepts more or less the regulation and show a resigned position.

On the other hand, districts also have a contesting discourse. They are not complaining on the limits anymore, but they are questioning the vulnerability of their district. Actually, even if the risk is accepted, most municipalities intend to receive within the next 10 years new authorisation for building in flood plains. Their discourse is not only made with resignation but also with contesting.

"What is the use of keeping space without any building for 4 or 5 days of flood by year? We intend to build a road in the flood plain, to do so, we hope the regulation will be more flexible within the next years" (Urbanism technician in Blois Agglomeration).

This contesting speech on building in flood plains is the basis of future planning project in most of the municipalities where interviews were made.

4.1.4.3 Future planning projects according to the risk regulation

Whatever the situation of the commune, the floodplain area brings attention to the municipality who give them a vocation. These spaces are flooded but they can be allocated to agricultural or recreational activities, or to urbanization. This perception depends primarily on the topographical situation of the commune and on the scarcity of the non-floodable land market as well on the dynamism and interest of the agricultural industry.

4.1.4.3.1 Urbanisation of the plateau and « Holly » floodable space

"[The floodplain area] is not at all a constraint for development. We have a natural barrier that is the edge of the plateau. The desire to urbanize is made along roads on the plateau. [Flooding] were things known, and we have saved agriculture in these areas. If tomorrow, we put the land [in a floodplain area] to be built, it would be sold quickly. The plan for risk prevention has been written as the "plan d'occupation des sols" (POS). It clarifies things. It is more precise. The plan for risks prevention has never been a constraint. Because varennes

were not supposed to be urbanized. They had an agriculture vocation. Fondettes, is built from the beginning on the plateau. "

A technician of Fondettes

For the communes that have both a part of their territory that is occupied by the flood vale and another by the plateau, the urbanization of the valley liable to flooding does not arise and was never really an issue. The valley liable to flooding was spared and urbanization was translated on the plateau. The spaces on the plateau are sufficiently vast to get development. The infrastructure of communications vehicle economical and residential development and are not localised in the vale. Thus, the prohibition to build in the floodplain valley is not an issue and it is easily accepted. It is obvious and it is endorsed by urbanism and regulatory documents. The documents become valuable argument for a refusal to build for anyone (owner or elected people.) that would have ambitions of installation in the floodplain area.

"We do not have vital needs [to urbanise the vale, there is the plateau], so what would be the interest to make it complicated? Fighting floods, raising the height, why? We go on the plateau. "

A technician of Joué-les-Tours.

"Luynes is turned towards the plateau (…). The plan for risks prevention has helped us because there was a lot of litigation [to be able to build in a floodplain area]. (…) All of this happened because there was room elsewhere. If they was no plateau [to urbanise], the idea would not be the same. "

A technician of Luynes

Seeking to circumvent a ban on construction in the flood vale would be absurd because it would require searching for adjusting expensive devices. It will complicate the spatial planning. Finally, even with technical adjustments and protection structures, facilities remain vulnerable. Those efforts to reconcile development and risk are unnecessary since there are available lands protected from floods.

By renouncing to implement the development of their communities in the floodplain area, the elected people seem to show the most basic wisdom. However, the acceptance of the ban to develop in a floodplain area appears to be fragile and mainly due to the possibility of building elsewhere. What is crucial is to continue to grow. Since this possibility exists on the plateau, preserving floodplain areas from conflicts is not limiting and is accepted. It would be entirely different if the land that could dedicate to urbanization was scarce.

When the commune is in between the plateau and the floodplain vale, the floodplain space remains a non-building area.

However, it remains to assign the use of these spaces. The communes of this category can be classified into two subgroups. For some of them, the space is dedicated to agriculture. The communes step a little in this space and allow farmers to exploit it. Thus, we note that these municipalities turn away from the river. For another part, the flood vale becomes clearly a recreational area. They invest more or less strongly to encourage leisure activities and equip it for that purpose.

"Even if we regulate the water discharge, nothing should be built because we are not immune from an exceptional flood. We must raise livestock, and environmental park, we need air and to restore water quality. The floodplain areas are zones of recreation and of environmental buffer. In, Ballan, we just bought 60 ha. We leave these areas open for wildlife or we plant Poplar when agriculture is failing. These are lands that remain for grassland farming, market gardening. But attitudes must change; we need production for local markets. These are also areas with florists (…). This will remain an area of recreation or nature. It will be necessarily a pathway for the "Loire à vélo". There will be areas of bike gathering at the old mill. There will be tables, parks of cultural animations around the mill. These are touristy areas. There is also fishing, inland water shipping. This will evolve towards the activities related to water. "

An elected person from Ballan Miré

The issue of urbanization being resolved on the plateau, then arise the issue of the flood-prone areas vocation. The municipalities surveyed are suburban communes. They are close to the dense agglomeration. The presence of open areas is an asset that allows them to both stand out from the metropolitan area and put forward a pleasant living environment for their inhabitants. This area acts as a "green lung". The municipalities will be based on the heritage to highlight this area and develop recreation and tourism activities. The classification of the Loire river as a listed site from UNESCO World Heritage, the passage of the "Loire à vélo" are assets that reinforce this vision. Even agriculture is seen as participating in the development of recreational area. For the communes, the vocation of agriculture in this area is mainly to maintain it and to meet the social demand for leisure activities and proximity. Elected people do not want an agriculture oriented towards intensive production but an agricultural activity that has direct contact with the urban people (gardening, horticulture…), which are involved in the function of recreation. Indeed municipalities intervene on these areas to maintain the friendly character. They maintain the built heritage and avoid the wild land due to the agricultural depreciation by planting Poplar. They want to bolster the development of recreation activities (camping, biking…) that will attract tourists and city dwellers.

"We can always say that there is this no man's land between 2 cities. What is essential is the river. This is an area of floodable grassland, where it does not happen very much. This is not an area to be appropriated. Before it was too terse agriculture. Now it should be organized for the population. This is not anymore the neglected. This becomes recreational areas. We develop it slowly. We will replant hedges. We make a demonstrative and playful agriculture. We keep agriculture for cost reasons. It will be a public space of hedged farmland demonstration, wetlands, wildlife, and flora. It's a return to a controlled nature, a domesticated nature. (…). We are within the city. We can not build, we makes it an urban vegetation milieu. "

A technician Joué-les-Tours.

Joué-les-Tours, which is the second commune in the department, has more resources to push the logic up to shape the floodplain area in natural recreational park. Its idea is to recreate a hedged farmland and places for observing nature. Agriculture is totally at the service of the maintenance of this area, the productive function is occulted. The completion of the park allows the municipality to take possession and to occupy the flood space. It may be noted that in its desire to create places for nature interpretation, the municipality does not want to work on the flood characteristic of the plain. This is not a place to teach about the risk of flooding

(eg showing ecosystems related to temporary submersion.), but it is a place to show a comforting nature.

Finally, for other municipalities, the flood space remains an open area. It keeps its agricultural vocation. It is not considered as a recreational or leisure area but as an area of agricultural production.

"The boom of the urbanization during the 60's and 70's has been on the plateau because on the plateau farmland were poor while in the vale, they were richer. Luynes was an agricultural district known for hemp. "

A technician of Luynes

Long time ago before the existence of urbanism documents and regulation, the flood vale was preserved from urbanization. It was postponed on the plateau where agriculture was less prosperous. The difference in potential agronomic is due to the nature of the soil. The sandy varennes suit to grassland, gardening market or specialised crops such as hemp and wicker while on the plateau soil is of poor quality and supported mainly vineyards and woods. Flourished agricultural activity was preserved in the vale. Nowadays, the specialised cultures such as hemp and wicker are gone replaced by nurserymen and great culture. Nevertheless, the image of a dynamic agriculture stays. It is seen as an singular economic activity designed to occupy the vale. The municipalities invest little space meant for production.

"I do not have the feeling that the Loire is an element of Fondettes because it does not pass through the commune. It is far. The RD 952 acts as a barrier. At Fondettes the Loire is wild, it is not an accessible Loire. There are only fisherman and regulars who go there "

A technician of Fondettes

"The commune turns more and more its back from the Loire. We are is in UNESCO Zone. This reinforces the idea that the flood vale is an area to be protected and we can not do anything. (…) If one day the north road [on the plateau] is created, we put a bell on the centre and it is not moving anymore. The burg centre will be a space museum where you can stroll on Sunday. "

A technician of Luynes

The Loire is perceived in a negative way as a repellent area. Access is difficult and it does not deserve the trip despite its World Heritage designation. The Loire and the flood vale are not perceived as being part of local heritage, or as an element of identity. The communes turn its back from the Loire and from the vale and focus its development on the plateau. The municipality of Luynes whose access to the city centre is relatively difficult envisages a gradual transfer of the city centre towards the plateau as soon as the new road will be connecting the plateau with the new highway A28. The old centre with a traditional and picturesque architecture become a place for walking and will be listed in heritage. The flood vale is remotely in the projects and the commune is left to the "care" of farmers.

4.1.4.3.2 Urbanization reserves and renegotiation of the limits on construction in flood-prone area

The communes whose entire territory is in a floodplain area have a fundamentally different approach to the risk of flooding. For them the challenge is to continue to grow despite the inherent restrictions in the recognition of the flooding threat of flooding.

"For a time, I said that it was necessary to revise the plans of risk prevention. Now I am less certain. Now, I think that we should not change the zoning but modify the regulations. For example, all new construction cannot extent more than 10%. [With this threshold there] OPAC does not build because it is not profitable. We were accumulated with constraints. I can no longer do anything. I still have a potential for 35 houses. It is a matter of a few years. After we can do nothing more than rehabilitation. We will not built more, we will not extend more. (…) What I fear is that we may have an aging population. At maturity of 15 to 20 years, I am concerned for the school. We have lost an age- class a few years ago; we require a renewal of the population. "

An elected people of Berthenay

At the time of its preparation, the plan of risk prevention has been the subject of negotiations between local authorities and the prefect. The ban on construction in areas of high and strong "aléa" was accepted locally because plans for risk prevention endorsed areas of future urbanization, which had been scheduled before the advent of the plan of general interest and before the plan of risk prevention. As a result, communes have disposed of constructible sectors under technical requirements but still constructible. Today the communes are in the process of filling what is the last land market reserves allowed on their territory. For the communes the opportunity to continue to grow is a vital issue. Waive to grow is the stagnation or the decline of the commune because of the opportunities offered by the rehabilitation of existing housing are considered insufficient to maintain the demographic dynamism of the commune. They begin to anticipate the end of their reserves and want to open new negotiations.

"Finally the effect of the plan of natural risk prevention was to curb urbanization, but not to stop it. There was an agricultural activity that has vanished. It is hard to imagine spaces without uses near cities. What to do in these areas [in wildland]? The housing estate is a solution. (...). The plan for risk prevention is a plus [it has brought awareness of the risk]. So, we gave up. There is a proposed extension of economic activities. It is well located. We have requests; we start to think about it. We can modify the plan of soil occupation. We must renegotiate with the State. This could be revised. That's what I say that if we incorporate the risk of flooding, the prefecture could agree. It is not static. What we oppose is to impede the flow discharge. It's something to work on it. The prefect is not obliged to accept. The plan of risk brought an end to uncontrolled urbanization. But it is too much. There may be a fair compromise that would be interesting between all and nothing (…). The future is a little frozen. There is a 1000 of housing to be completed for 10 years. Afterwards, we will have arrived at the end [of building space]. It will no longer accept new residents (…). We know that for a commune does not see its population decline too much, we must build. "

A technician of Luynes

For the communes, it consists in reconciling development and flood prevention. They believe that there are ways to make the facility compatible men establishment or economic activity with security in a floodplain area. This may be done through technical measures, which are to

secure from water (upstairs) networks (electrical, telephone…), machinery, goods stored… Or to be built on stilts in order to let the water flow… Some communes like Montlouis-sur-Loire wants dykes to be strengthened in order to reduce the level of "aléa" behind the dyke and to benefit from fewer restrictions for the extension of an economic zone. When land is scarce or that the entire territory is floodable, suburban communes do not renounce the pursuit of urbanization. They will not deny the possibility but seek a relaxation of the rules. In this, they remain consistent with the way in which they has the flood risk representation. We have seen that the perceived risk of flooding is abstract and is shaped by regulation. When seeking to modify this regulation by making it more flexible, elected people only reconcile their desire to continue urbanization and their responsibility for the security of people and goods. In other words, by lowering level of risk on the documents they can afford to implement housing and activities in a flood zone.

4.1.5 Conclusions

The French policy arrangements are complex and likely to changes. The regulation has been evolving towards a higher protection of houses and industries against flood damages. The philosophy towards the flood defenses has been changing as well. Less and less confidence is accorded to dikes and spillways are considered again as wise solutions. In the same time, some municipalities stick on the idea of developing in flood prone areas. Economic pressure remains important and the will to build houses is often stronger than the fear of the flood. The French policy, based on the PPRi, is strongly implemented by the State services (Préfet, DDE), but most case studies show that local powers are negotiating the regulation or its implementation. When they do not, inhabitants distrust the project of protection towards the flood. The all regulation, its implementation and its local agreement seem to rely on a future major flood.

4.2 The Netherlands (V. Wattenberg, T. Brinkhof, J. Spits)

4.2.1 Rules

The table below shows an overview of the relevant policies and laws introduced during the last century in relation to flood risk management. As the overview demonstrates, laws and policies are mainly introduced in reaction of disastrous events. On the level of concrete protective measures these result in the construction and reinforcements of dikes along the river bed.

Nowadays, laws and policies moreover prepare for future developments, e.g. the rise of the sea level and land clinch. These look to alternative solutions to the problems facing flood risk management; instead of only raising or reinforcing dikes, more space for the river will be created.

Table 8 : Overview of the relevant policies and laws

Phases	Flood events	Law	Policy
1900- 1953	1926 - Dike failure along the Meuse river resulted in flooding of the middle part of The Netherlands.	- Water Administration Act 1900 was already operational, regulated the general administration of public water works	- No national policy concerning flood risk management. This was the concern of local water boards which were restricted in financial resources. - If a dike broke or did not protect adequately it was reinforced. Therefore the highest water level

		- Rivers Act (1908), prohibited activities in the river bed without permit	known was taken into account when constructing the new dike.
1953- 1975	1953 - The sea inundated 20% of The Netherlands, about 1800 people died.	- Delta Act (1958), introduced a programme to reduce flood risks from sea surges by dike reinforcements and closing of the river arms in the South-West of the Netherlands (the delta of the Rhine and Meuse rivers).[9]	- Flood protection became a national issue resulting in the Delta Act. - Introduction of safety standards for flood defences instead of highest known water levels.[10] - As an after effect a river dike reinforcement plan was developed.
1975- 1992	In this period no serious flood events occurred.		- The river dike reinforcements caused destruction of landscapes, nature, and cultural heritage and aroused public commotion concerning these issues. This resulted in lowering the safety standards, public participation in the reinforcement process and issues like landscape, nature, cultural heritage and spatial planning were taken into account in the decision making

[9] van der Grijp, N.M., A. Olsthoorn, in: *Floods, flood management and climate change in The Netherlands*, Institute for Environmental Studies, Vrije Universiteit, Amsterdam, 1998

[10] For the Western part of the Netherlands the embankments had to be reinforced to an extend of a 1/10.000 years occurrence. The river dikes had to comply with an inundation risk of 1/3.000 years. This meant that 550 out of 650 kilometers of river dike had to be reinforced.

[11] The safety standards for river dikes were lowered to a 1/1.250 years occurrence.

			process more carefully.[11]
1992- 2004	1993 - Flooding of the river Meuse, 8.000 people were evacuated. 1995 - Flooding of the river Meuse. The water of the Rhine, Waal en IJssel rivers rose to a dangerously high level, 250.000 people were evacuated.	- Delta Act Main Rivers (1995), temporary legal provision to speed up the process of river dike reinforcements. Replacing all legislation then in force pertaining to flooding.[12] - Water Embankment Act (1996), structural basis for water embankment projects (dike reinforcements) aiming to guarantee a certain level of protection against floods.[13] - Act of State Water Authority Operations (1996), the Rivers Act of 1908 was incorporated in this Act.	- Policy *Room for the River* (1997), in view of expected climate change, land clinch and the increased vulnerability of protected areas, safety could no longer be expected from dikes only. - The approach to water management was moving away from building higher dikes towards adjusting and extending the territory in which rivers run - and occasionally flood.[14]

4.2.1.1 Policy *Room for the River* (1997)

In the past building in floodplains had taken place on a large scale. With the introduction of the Beleidslijn Ruimte voor de Rivier *(Policy Room for the River)* in 1997, building in floodplains was restricted. After the flood events of 1993 and 1995 the consensus view was - and still is - that sustainable protection against floods does not only imply raising the dikes, but also requires more capacity for rivers to deal with more water in the future. The main goals of this policy were: more space for the river, sustainable protection against floods for people and animals and restriction of potential damage.

The new policy allowed activities in floodplains from then on only under strict conditions. Permission of new activities closely related to the river (e.g. the building of bridges and boatyards) was subject to the effect on the water level being relatively minor. On the other hand, new activities *not* related to the river (e.g. housing) were only allowed if a serious social issue was involved. Moreover, the project should be situated but in a floodplain and finally, the project should not affect the capacity of the river. In every day practice this meant building in floodplains was seriously restricted.

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[12] Dekker, M., *Het water meester. Het recht rond de overheidszorg voor de beveiliging tegen overstroming*, Apeldoorn, 2002

[13] Van der Grijp, N.M., Olsthoorn, A., *Floods, flood management and climate change in The Netherlands*, Institute for Environmental Studies, Vrije Universiteit, Amsterdam, 1998

[14] Wiering, M.A., Driessen, P.P.J., *Beyond the art of diking: interactive policy on river management in The Netherlands*, Waterpolicy 3, 2001

In the perspective of water management, the policy worked well, but some flood prone areas declined because the spatial and economic development stagnated. Empty buildings and "spatial pollution" of areas proved to be inevitable. In a move to reverse this undesired effect, the Ministry of Transport, Public Works and Water Management and the Ministry of Housing, Spatial Planning and Environment launched an experiment with adaptive building in 2005.

4.2.1.2 Experiments with adaptive building (2005)

Figure 38 : The 15 experiment locations (source: EMAB brochure, 2005)

At 15 locations along the Meuse, Waal, Lek and the Rhine river, municipalities are allowed to experiment with innovative building forms in the river bed. Only innovative building forms, e.g. building on poles and floated houses, are taken into consideration in the frame work of the experiment. These types of construction possess the required safety qualifications in cases of high water levels. In addition, these building forms will not have a significant impact on the existing space of the river bed. The locations, which are part of the experiment, are mostly empty and desolate monumental buildings, declined city fronts and water recreational areas. Through the building development, these 15 locations will generate the desired spatial quality.

The experiments cannot be considered as a general government policy. It has to be regarded as a separate policy trajectory within its own conditions. In the first of these conditions, the initiator, i.e. the project developer, has to ensure that the building activity will not frustrate future measures for creating more river space.[15] Furthermore, the initiator is obliged to create more room for the river at the building location or its immediate surroundings. The deepening of floodplains, the removal of obstacles from the riverbed and the detour of dikes are possible examples of increasing the available space of the river.

In addition to these conditions, the initiator has to execute the project (including the measures required to generate more space for the river) at own expense. Apart from the conditions mentioned above, all projects naturally have to comply with other (environmental) legislation.

[15] For measures to create more space for the river, see paragraph 'Spatial Planning Key Decision *Room for the River*' and the paragraph 'Maaswerken'

It is important to notice that Dutch national government is legally responsible for safety behind the dikes. Safety norms, i.e. 1/1250 years occurrence, are enforceable for those areas. The 15 experiments however, are situated in between the dikes which means that the initiator is building at own risk and responsibility. The safety aspects involved with building in floodplains are a matter for local government.

4.2.1.3 Policy Large Rivers (2006)

In 2005 the policy document *Room for the River* was evaluated.[16] The main shortcoming of the previous policy was that activities *not* related to the river, were banned. These activities include making flood prone areas more attractive and creating, in some cases, more space for the river. With the precise purpose to authorize new developments in flood prone areas without decreasing the safety of the areas behind the dikes, the *Beleidslijn Grote Rivieren (Policy Large Rivers)* was introduced.[17]

Water management and spatial planning

At present, the *Policy Large Rivers* is the main planning document concerning building in floodplains. With this policy, water management (sector planning) and spatial planning (facet planning) are brought together.[18] The policy aimed to maintain the available space of the river bed and to avoid obstacles which would frustrate future enlargement of the discharge capacity of the river bed.

The *Act of State Water Authority Operations* stipulates that it is prohibited to use a waterstaatswerk *(public water work)* without permission of the Minister of Transport, Public Works and Water management.[19] The object of the act and its predecessor, the *Rivers Act*, is to protect the public water works and guarantee its safe and efficient use. To achieve this, all activities in floodplains are legally subject to a permit system.

Through this permit system the *Policy Large Rivers* is implemented in the sector of water management. The regulations of the *Policy Large Rivers* are applied to ascertain if permission may be obtained by the initiator.

For spatial planning (facet planning), the regulations of the *Policy Large Rivers* are taken into account in various planning documents, like the 'streekplan' (regional plan) and the 'bestemmingsplan' (land use plan). In Dutch spatial planning law, building (including in floodplains) is not allowed without a permit of the municipal executive board. To obtain a building permit, the building activity must comply with the land use plan in which the regulations of the policy are incorporated.

Building activities in floodplains are thus brought in line with the *Policy Large Rivers*. The policy document is part of the spatial planning process. Irrespective of the permits outlined

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[16] Royal Haskoning, i.o.v. Ministerie van Verkeer en Waterstaat en Ministerie van VROM, Evaluatie Beleidslijn Ruimte voor de Rivier, Royal Haskoning, april 2005

[17] *Staatscourant*, 12 juli 2006, nr. 133

[18] Sector planning: for policy domains like transport, nature, landscape, water management et cetera the national government produces separate plans. Facet planning: for each of these sectors, specific spatial planning is involved

[19] State water works are waters, flood defenses and roads administered by the State, article 1 sub 1, *Act of State Water Authority Operations*

above, each building project must comply with all other, especially environmental, regulations.

Scope of the *Policy Large Rivers*

The scope of the policy includes the entire river bed (subject to the permit procedure) of the Meuse, Waal and Rhine river. In the first illustration the river bed is shown in an embanked area. The next illustration shows the river bed in a river system that is not embanked.

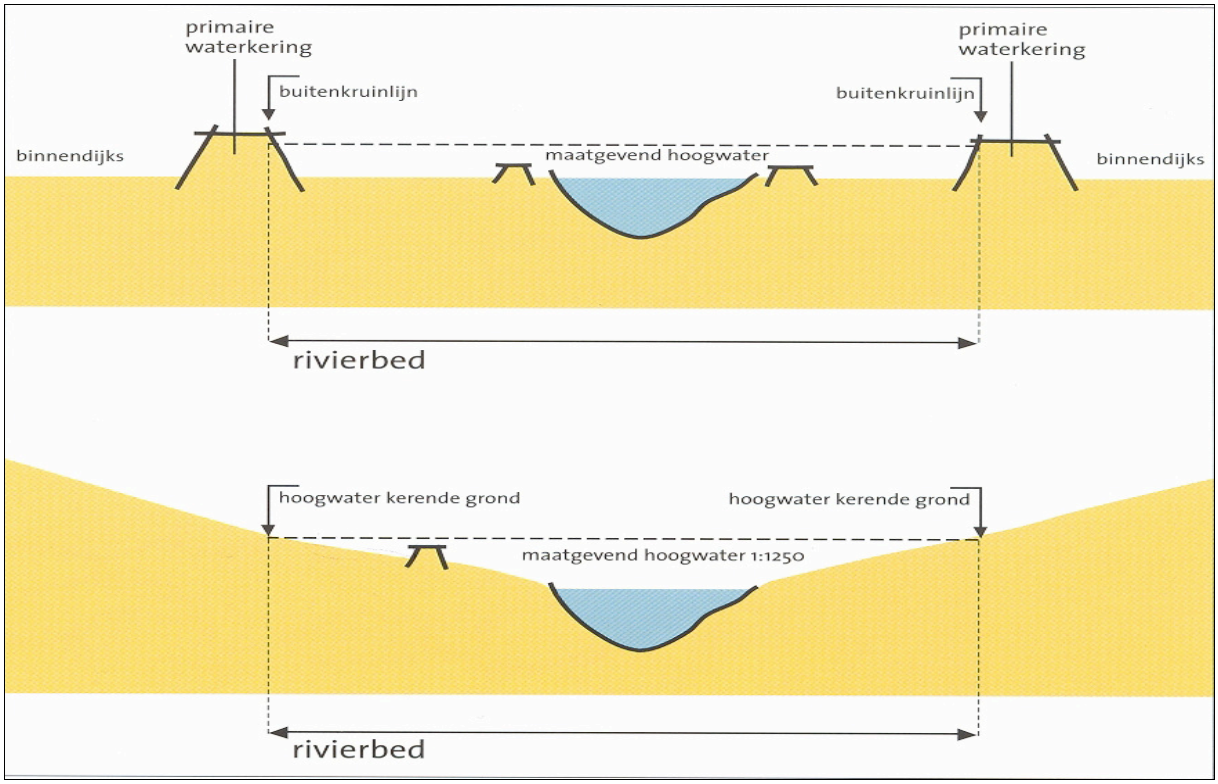

Figure 39 : Cross sections of embaked and not-embaked river system (source: Guide-book Policy Large Rivers, 2006)

Concerning the application of its policy, the document distinguishes between two regimes:

a) 'Stroomvoerend regime' *(discharge regime)*, relates to part of the river bed in which river related activities are allowed under general conditions.[20] Activities *not* related to the river are illegal, although possible under strict conditions exceptions (see the blue zone in the illustration)

[20] Examples of which are the construction of bridges, groynes, shipyards, the expansion of existing brickyards, the development of nature, et cetera

b) 'Bergend regime' *(retention regime)*, relates to part of the river bed in which, in principle, all activities are possible under general conditions (see the green zone in the illustration)

Not all parts of the river bed are given the same importance in the consideration of safety. From the point of view of river management, the relevant conditions differ from one location to another. This explains the distinction in the two regimes.

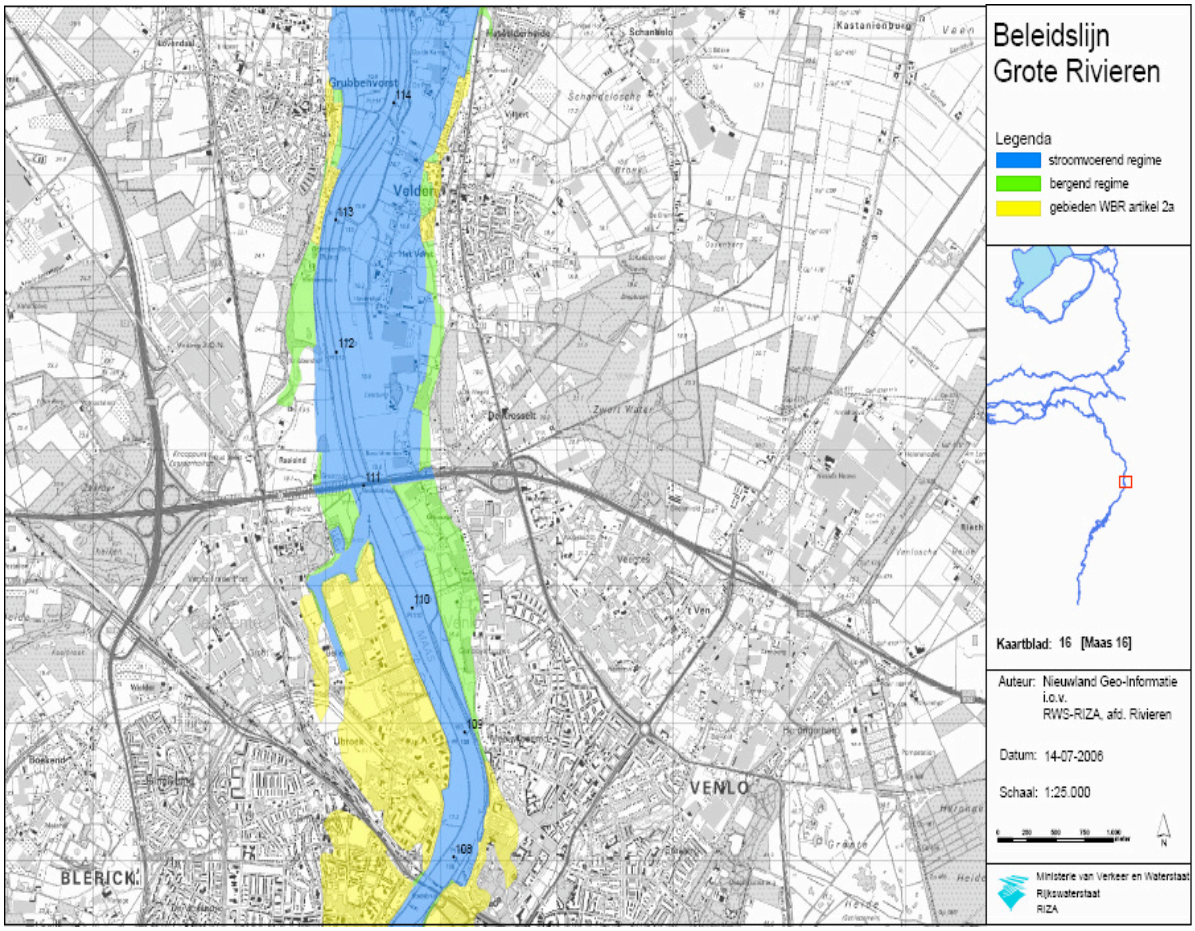

Figure 40 : Beleidslijn Grote Rivieren (Source: Maps Policy Large Rivers, 2006)

Small, temporary or for river management necessary activities are allowed in both regimes but must comply with general conditions.[21]

These general conditions are:

a) the activity must be situated and executed in a way that the state water work will function safely;

b) the activity must not frustrate the enlargement of the discharge capacity of the river;

c) The activity must not cause a higher water level or decrease the retention capacity of the river.

[21] For example the enlargement of existing buildings with a maximum of 10%, activities necessary to enlarge the river, temporary bridges and roads, caravans, et cetera

Discharge regime

In this regime, activities which are related to the river, are only allowed under the general conditions. However, there is one additional condition prescribed by the *Policy Large Rivers*: the effects on the water level and the retention capacity of the river must be compensated by a sustainable method. The initiator should take measures to compensate the increase of the water level caused by the new activities.

Activities *not* relating to the river are also required to meet the general conditions, but can only be allowed if a serious social issue is involved and the project lacks alternative locations. Furthermore, permission is granted to agricultural companies in need of economic expansion and unable to develop but in the floodplain.

Some other activities are also allowed. Part of the legacy of the old policy *Room for the River* is empty and abandoned buildings. By changing the function of the buildings a new boost is given to the area.

Finally, activities creating sustainable enlargement of the discharge and retention capacity of the river are tolerated.[22] It is crucial to generate capital to enlarge the discharge and retention capacity of the river. After all, responsibility for the (financial) execution of the measures is firmly placed on the initiator in the *Policy Large Rivers* document. Large scale building plans are a possible method in financing the measures to achieve this. Although large building projects are not river related activities, they contribute to the objective of the policy, i.e. to create more space for the river.

Retention regime :

All activities in the retention regime of the river bed are permitted, but at the same time the initiator has to take into account the general conditions. In this regime, the additional condition that the effect on the water level and the retention capacity of the river must be compensated in a sustainable way, is a requirement of the *Policy Large Rivers* as well.

The illustration not only shows the discharge and retention regime, but also yellow zones of more built-up areas, which historically have often developed on higher ground. The impact of these areas on the discharge or retention capacity of the river can be neglected and are therefore not relevant to the objective of the policy.

In conclusion it is obvious that the *Policy Large Rivers* offers more room for developing flood prone areas than its policy predecessor *Room for the River*. Although this may provide opportunities to citizens (initiators) and government alike, one must still take into consideration that building in the river bed take place at the initiator's own responsibility and risk.

Under the terms of the *Policy Large Rivers* document, damage due to flooding will no longer be compensated by government.[23]

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[22] For example the widening of the river bed, the construction of retention areas and by-passes

[23] Wet tegemoetkoming schade bij rampen en zware ongevallen (*Law Damage Compensation*)

4.2.1.4 Spatial Planning Key Decision *Room for the River* (2006)[24]

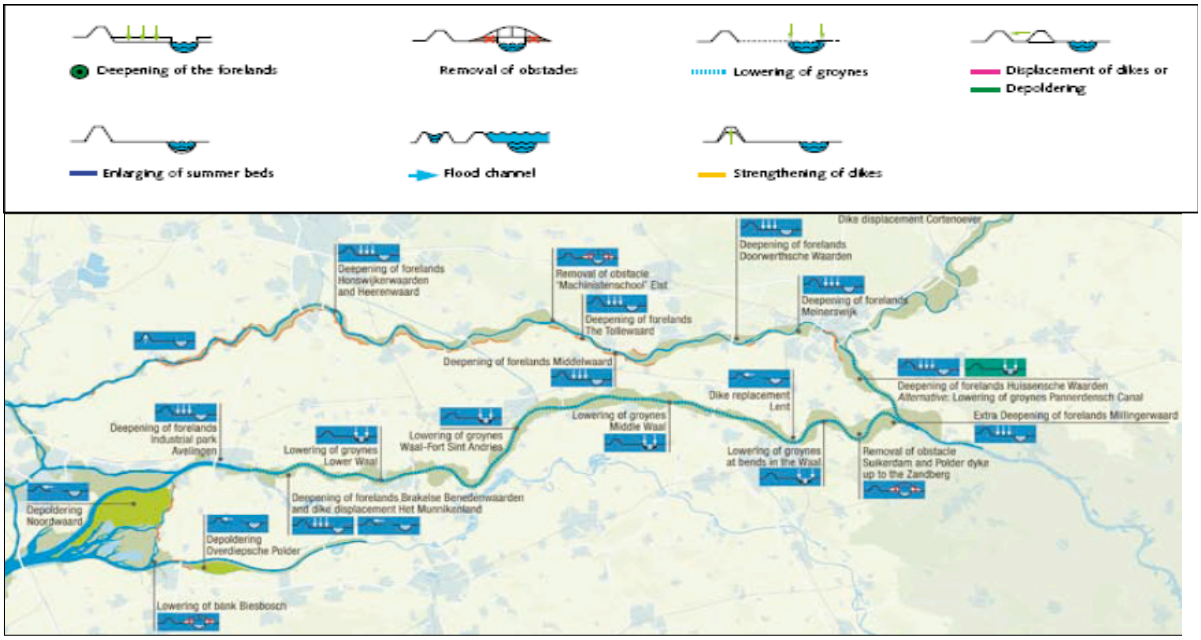

Figure 41 : Policy room for the river (Source: Spatial Planning Key Decision Room for the Rive, 2006)

Throughout the centuries space for the rivers has decreased steadily. The policy documents *Room for the River* and *Policy Large Rivers* were and are not primarily intended to rectify this situation and create more space for the river. Both policies only try and restrict activities in the river bed.[25] In view of recent research in climate change, rise of sea level and land clinch it is imperative to not only maintain the current space of river beds but also to create more space for rivers. Because of this the Dutch government introduced a policy document in which measures are drawn up to enlarge the capacity of the river. This document is entitled Planologische Kernbeslissing Ruimte voor de Rivier *(*Spatial Planning Key Decision *Room for the River).*[26]

The main objectives are:

- in 2015 the Rhine branches will safely cope with an outlet of 16,000 cubic meters of water per second;

- the measures implemented to achieve the above will also improve the quality of the environment of the river basin;

- The extra space the rivers will need throughout the coming decades subsequent to expected climate changes will remain available.[27]

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[24] Note that the policy *Room for the River* and the Spatial Planning Key Decision *Room for the River* concern two separate policy documents

[25] F.A.G. Groothuijse, Beleidslijn Grote Rivieren, nieuw toetsingskader voor activiteiten in rivierbed, *Toets: vakblad over effectrapportage*, 2006

[26] *Staatscourant*, 25 januari 2007, nr. 18

[27] PKB Ruimte voor de Rivier *(*Spatial Planning Key Decision *Room for the River)*

To achieve these objectives, the Planning Key Decision sets out a range of measures to be executed by government. The measures, to create more space for the river and lowering high water levels, are primarily aimed at deepening the forelands of the rivers, replacing dikes further inland, lowering groins in the rivers and enlarging of the summer beds. The reinforcements of dikes, which took place on a large scale in the nineties, will only be executed if other measures are too expensive or inadequate. The first illustration below shows the various measures taken to create the desirable space. The second illustration points out the measures and related locations in the Waal and Rhine river.[28]

Execution of the Spatial Planning Key Decision

The Spatial Planning Key Decision *Room for the River* contains a general description of the types of measures, the locations for most of the measures and the expected effects. Before actually implementing a measure, it has to be elaborated upon in a planning study for determining the exact location and details. An environmental impact assessment is required for many of the measures, giving local residents, authorities and other stakeholders the chance to participate in the process. Then, depending on the type of measure, permits must be obtained for excavation, construction work and environmental protection. One of the public authorities involved, municipality, water board, province or the Directorate General for Public Works and Water Management, will take charge of each measure. The Ministry of Transport, Public Works and Water Management in addition may create a project organisation to oversee the work. This organisation will then ensure that the objectives of safety and environmental quality will be achieved and that deadlines and budgets are met. [29]

In the recent past various planning studies regarding different locations have been devised. Some of these projects are already in their executive stage.

4.2.1.5 Maaswerken

While the Rhine and Waal river systems are dealt with in the Spatial Planning Key Decision, the river Maas (Meuse) stands on its own in the project entitled Maaswerken (Meuse Works). The river Maas crosses the border of The Netherlands in the southern province of Limburg at a height of 45 meter. The subsequent Dutch sections of the Maas include:

- the Grensmaas, between the villages of Borgharen, situated at the Belgian-Dutch border, and Stevensweert

- the Zandmaas, between the villages of Stevensweert and Mook/Boxmeer in the Northern part of Limburg;

- the Oevermaas from the villages of Mook/Boxmeer to the North Sea.[30]

The Grensmaas is not embanked and at various places used for the extraction of gravel. This part of the Maas is not suitable for navigation. Ships use the bypass channel, the

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[28] Idem

[29] Idem

[30] Rhijnsburger, E., Van driehoeksverhouding naar drie-eenheid. Een onderzoek naar bestuurlijke knelpunten bij de implementatie van het Grensmaasproject, *Interfacultair Project Grensmaas, rapport nr. 2,* Wetenschapswinkel, Universiteit van Maastricht, 1997

Julianakanaal. The Zandmaas is not embanked either, and is used for the extraction of sand. The Oevermaas, however, is heavily embanked.[31]

The history of the project Maaswerken, in the beginning only concerning the Grensmaas, already started in 1991. Traditionally, the river bed of the Grensmaas was used for the extraction of gravel. From 1984 until 1994 the extraction companies excavated about 90 million tons of gravel in the valley of the Maas, meeting a contractual obligation with the Dutch national government.[32] In the opinion of the local population and the environmental organisations, the extractions were detrimental to the quality of the landscape. This public concern resulted in a governmental plan for the Grensmaas, combining the ongoing gravel extraction with nature restoration, entitled Groen voor Grind *(Green for Gravel).*[33]

In 1993 and 1995 the Maas rose to a dangerously high level. Although the situation was not life threatening, the flood still caused a lot of material damage. A commission, installed by the Minister of Transport, Public Works and Water Management, was given the task to explore the possibilities in reducing the flood risk of the Maas.[34] The commission came up with the following recommendations and measures to be executed in the period 1995-2015 :

- to deepen the Maas in Northern and Central Limburg
- to broaden the Grensmaas, while developing values of nature and landscape, approximately 1200 ha
- lowering the floodplains
- to provide additional protection by the construction of embankments along the not embanked sections of the Maas
- to prohibit future building activities in the winter bed of the river (this recommendation is in accordance with the policy Room for the River).

Because of the floods, opinion shifted and priority was now given to the aspect of safety instead of the development of nature along the Maas valley.

The start of the planning process for the project entitled Zandmaas/Maasroute started in 1995. The objectives for this part of the Maas were to ensure a flood risk of 1:250 years, to improve the navigability of the river Maas and Julianakanaal, and to restore natural values to a limited extent (1,500 hectares).[35] Protective and river bed enlarging measures like the building of

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[31] Van der Grijp, N.M., Warner, J., Planning and decision-making related to the Maaswerken project, in: *Floods, flood management and climate change in The Netherlands*, Institute for Environmental Studies, Vrije Universiteit, Amsterdam, 1998

[32] Rhijnsburger, E., Van driehoeksverhouding naar drie-eenheid. Een onderzoek naar bestuurlijke knelpunten bij de implementatie van het Grensmaasproject, *Interfacultair Project Grensmaas, rapport nr. 2,* Wetenschapswinkel, Universiteit van Maastricht, 1997

[33] Van der Grijp, N.M., Warner, J., Planning and decision-making related to the Maaswerken project, in: *Floods, flood management and climate change in The Netherlands*, Institute for Environmental Studies, Vrije Universiteit, Amsterdam, 1998

[34] The Commissie Watersnood Maas (Commission Flooding Disaster Maas)

[35] Van der Grijp, N.M., Warner, J., Planning and decision-making related to the Maaswerken project, in: *Floods, flood management and climate change in The Netherlands*, Institute for Environmental Studies, Vrije Universiteit, Amsterdam, 1998

dikes, retention areas, deepening of the river bed, creating natural banks and flood channels, are works in progress. Regarding the creation of natural banks the work involves the removal of hard surfacing from the river banks to allow processes of erosion and sand deposition to take place, whereas regarding the construction of flood channels (in cases of a rise in water levels) involves the diversion of water into the flood channels so that it can be discharged more rapidly downstream. In 1997 the separate projects Grensmaas and Zandmaas/Maasroute continued under the collective name Maaswerken.

The Maaswerken project is still running and is aimed to be completed in 2019. For the project concerning the Grensmaas, government and (gravel) companies are working together in a so called public/private partnership to achieve the safety, environmental and economical (extraction of 52 million tons of gravel) objectives. A remarkable aspect of the Grensmaas project is that the capital generated by the extraction of gravel, will be used to bring about the safety measures while simultaneously developing nature and landscape.

4.2.2 Discourse

The high waters and floods in 1993 and 1995 have been the main cause for a change within one decade in attitude from fighting against water towards an approach which is aimed on considering water as a companion (living with water).

For centuries, dike reinforcement has been the main river flood strategy in the Netherlands. At the same time, the river beds have been more and more narrowed by dikes and the urbanization of the riverbed has continued over time. As an emergency after the peak discharges in 1993 and 1995 and according to the Deltaplan Grote Rivieren (Delta Act 1996), many dike reinforcements (heightening and widening the dikes) and quays have been executed to protect property and other stakes. However, this strategy of raising the dikes has led to many protests from environmentalists and residents. This appeared not the most sustainable strategy for flood management. In 1997 this resulted in a shift in policy geared on more room for the river. This new approach to water management was interplay of river management and land use planning, resulting in more new room for river on one hand in protecting the existing riverbed on the other. The room for river measures creates more discharge capacity by widening or deepening the riverbed. Along the large rivers many measures have been planned and partly realized yet. The protection of the existing riverbed resulted into a ban on new urban developments or other land reclamation activities in the large rivers. However, an important side effect of this ban on new urban settling was a detoriation and standstill of the economical development of river areas. To solve this spatial blight, the ministry of water management together with the ministry of water management started an experiment with flood-adapted building in the riverbed in 2005. For fifteen locations small scale experiments with building under strict hydraulic conditions were allowed.

At present, building houses on water is a hot topic in the Netherlands. This seems to be connected to a common sense that living on water has an important position within the accepted discourse of 'living with water'. Not only in flood prone areas, but also in flood protected area this belief seems to settle down. Building is allowed in the Netherlands on certain locations under certain conditions. This can be considered as a recent shift in policy.

Presently, there are different opinions about the topic of buildings in floodplains and on how this should be taken care off. There seem to be contradicting ways of looking at this topic. Especially in the Netherlands doubts exist on the position of buildings in riparian landscapes in relation to flood risk management. This appears to be based on different belief systems, however all related someway or the other to the broadly accepted principle of ‘Water as a

companion, instead of an enemy'. Partly, changed viewpoints on flood management in the last decade tend to the recognition of the power of nature. This changed view has become operational in an approach aimed to give more space to the river. This view opposes the traditional approach of dike enforcements. This approach was based on the belief that risks are manageable. Buildings in floodplains are at present often seen as an opportunity, more then a threat. Since potentially, building in floodplains is technical possible, economical profitable and safety improving.

Recent developments in water management have brought new insights in possible ways to deal with rivers, and how to cope with flood events. There are different possible scenarios to illustrate the possible contradictions within a collective belief such like 'water as companion', zoomed in on the topic of buildings in floodplains. Example one: the belief that enabling buildings in floodplains create opportunities for developments. Such developments could be considered as viable once they strengthen the interrelation between safety, economy or sustainability. Within this perspective, buildings in floodplains can be considered as solutions serving multiple purposes within complex problems. The power of nature is seen as manageable with respect to certain principles, and water is still a companion. The other perspective stands for the belief that the river should have the function of a river. Herein, buildings are regarded as hydraulic obstructions and threatened objects. This latter perspective considers buildings as an unwise decision. This contradiction in beliefs seems to be about disputes over water management versus spatial planning within the domains of risk management. But moreover, it shows the diversity in ways a broadly accepted philosophy such like 'water as an companion' can be interpreted.

In the Netherlands, the present policy arrangement for allowing buildings in floodplains can be seen as a combination between flood risk policy from water management perspective and land use planning. There are some possible advantages and disadvantages for building in floodplains. Strategic advantages can be found in economic benefit of building in floodplains. By making the connection between buildings in floodplains with flood prevention management, profits of building can be translated in room enlarging measures. This can have the effect of a better protection area on the land side of the dike. For house owners in the river bed, the exclusivity of living in a floodplain and the feeling of 'freedom' could be attractive, perhaps even taking occasionally high water levels for granted. For river bounded industries, the possibility to develop in floodplains can mean an improvement in the connection for transportation. Technical and physical limitations can be found in the way houses and industries constructed in floodplains have to deal with water fluctuation, ice, water velocity, ships, and connectivity with dry areas in times of high water. In general, building with water can be looked upon as a threat. Though considering it from a more positivist side it can also bring in smart solutions within complex situations.

Improvement of the attractiveness and perception of the riverine landscape have been spelled out by the Ministry of Transport, Public Works and Water Management (VenW) in a guideline in combination with the technical report on water defences : "Spatial quality. The spatial quality of safety measures for the rivers" (2007). This subject seems to become an important component in the contents of Dutch river management.

Another policy development is the focus on the remainder of flood risk. Since the central government acknowledges the severity of consequences of a possible flood event, the government has the belief it is necessary to be well prepared. In addition to the technical flood defense system, the government thinks it is possible to improve organizational aspects for

example in times of evacuation and communication, as well on physical level. Creation of different physical risk compartments is a current point of discussion.

As a summarization, the following landmarks can be identified:

1926 – 1993 No major changes in paradigms. Dominant technocratic approach towards risk management

1993 - 1995 High water events

1996 Dutch Act Large River (emergency act as a reaction on high water events)

1997 – 2001 Dike reinforcements: increase risk standard

1997 Policy Room for River: new developments in river bed banned;

1997-2005 Change in attitude: from fighting against water towards living with water:

2005 EMAB experiment: small scale experiments with building in riverbed in combination with hydraulic compensation

2006 PKB Room for river. Enlarging discharge capacity of the Rhine branches.

2006 Policy Large Rivers: more theoretical possibilities for building in floodplains.

2007 Guidelines Spatial quality Rhine river branches

2008 Sustainability approach: from prevention towards consequences (wv21)

4.2.3 Policy actors

In the Netherlands, various policy actors are connected to arrangements of building in flood prone. Important policy actors are the National Board for water works (Rijkswaterstaat), municipalities, provinces, regional water boards, the ministries concerned with Water management (VenW), housing and spatial planning (VROM) and the ministry of Agriculture and Nature (LNV).

The National Board (Rijkswaterstaat) is a powerful actor, since it is responsible for a safe water disposal of the river. Because of this responsibility, the Board has powerful tools to control activities in the riverbed. An important tool is the WBR permit (Wet Beheer Rijkswaterstaatswerken). The applicant has to meet certain conditions to be able to get this permit. The conditions however, differ enormously, since RWS would like to combine the tasks they have of improving the safety of rivers for a certain location.

In the policy document of RWS, it is described that new activities in the winter bed should give net more room for the river, so that it has a bigger discharge capacity. Without a permit, it is not possible to build.

Another important policy actor is the local municipality. They have as well a very powerful tool to control building activities in floodplains. This tool is the municipality plan (bestemmingsplan). Next to this plan, the building ordinance of the municipality has an importance position on the contextual layout of the building plan.

4.2.4 Division of powers and resources

Economics

The national government allocates the financial resources within the 'space for rivers', translated towards so called PKB measures to improve the protection level. The governmental money involved is about 2.2 billion euros.

In the context of buildings in relation to the safety program 'space for rivers', buildings are mentioned as a way to reduce spatial pollution and economic standstill. Hence, a desire exists to improve the spatial quality and economy.

There are economic incentives to build in floodplains. This seems to be connected with land prices, accompanying growing scarcity of ‘free’ space for developments. Floodplains are known to be cheaper than ‘flood protected’ land on the other side of the defence system. Naturally, this depends on the location.

Decision making power

The Sate Water Authority (Rijkswaterstaat) and the Municipality are crucial decision makers, as they are final responsible for the permits to be given out. There is at first sight not much freedom in the interpretation of rules concerning the municipalities; in particular the building ordinance is very detailed.

The decisive power is shared between different organizations. Each of these organizations plays a vital role in the process of decision making. Within spatial planning, there is vertical co-ordination between National, Provincial and Municipal level about a certain decision. On level of water management, the State Water Authority is decisive.

In general, two different steps have to be taken. First, the decision to allow building has to be taken. This can be seen as a planning decision on designation a certain function to an area. On local level, this is a political decision, accompanied by the approval of the Province on this decision. Afterwards, an initiative taker can propose a building plan. This will be checked on local level on technical aspects and appearance.

The initiative taker of a certain project has to conform to different rules by different organizations. If an initiative taker has a desire to build, he/she has to fulfil all the conditions of the governmental organization involved. This means, that besides the normal planning permits and procedures of approval, additional permits are needed.

This makes building in floodplains more difficult compared to areas on the land side of the flood protection.

4.2.5 The Dutch planning identity

The Dutch identity is partly shaped by the struggle against flooding coming from the sea and rivers. In order to cope with problems of flooding, solutions such like building dikes and making polders have been introduced throughout the centuries. This could explain the technocratic approach of Dutch water managers and urban planners. This approach is based upon a confidence of managing risks. The drawing table has an important position in Dutch planning culture, since the origin of most plans is from this table. An example of this is the land re-division. Governmental interference took place on large scale in the previous century. Herein, division of land was established in the most efficient way. Another characteristic is

the manner in which consensus is 'build' on decision making, the Dutch word for this is 'polderen'. One often used expression by proud Dutch individuals, shows one of the perspectives on Dutch cultural identity. 'God created the world and the Dutch created the Netherlands'. "In the last few years, the approach to water management has changed. It is expected that more water will fall on the land and flow in the rivers and that the sea level will rise."[36] It is expected that this will have large implications for the management of water in the Netherlands, since most part of the Netherlands is prone to flooding. In addition to these predictions, there are other mechanisms which contribute to this uncomfortable situation. In the west of the Netherlands, lowering of peat soils is a mayor issue. This is due to maintaining water tables low to guarantee 'dry feet' for land users. Because of this, peat soils oxidize and disappear, if they are prone to more oxygen. If they disappear, the ground level lowers, so pumps have to work harder to keep the ground water table at the required level. In riverine areas, dikes contribute to relative lowering of land, since deposition of sediments accompanied with flooding is not happening anymore on the 'landside' of the dike. Deposition of sediment does happen on the 'river side' of the dike. Also, consolidation of clay soils is ongoing process on the land side of the dike. Hence, the land is continuing to subside. "So the 'struggle' against the water is being turned into co-existence: 'living with water' is the name of the new policy. But that is not a capitulation, rather a new way of managing the dangerous 'wolf'. And that too requires building and rebuilding, huge new developments projects and ambitious planning schemes".[37]

4.3 Germany

The German guiding principle concerning building in floodplains is closely connected to the national flood risk strategy of nature oriented flood protection, by means of creating retention areas upstream to protect downstream settlements. By this, more space is created for the river Rhine. The German policy is to regulate building in floodplains in a restrictive way, by restricting new settlements in flood prone areas. If, however the municipality can show it can fulfil nine conditions, such as prove that building in another place is not possible, exemption is feasible. Existing building in floodplains are allowed to stay. Within existing urban areas it is possible to build if the responsible authority allows this and the development is constructed in a flood adapted way. This can be seen as a window of opportunity. The responsible authority will be the Region in most cases.

A severe flood event struck Germany, Austria, the Czech Republic, and Slovakia in August 2002 in the catchments of the Elbe and the Danube. In Germany, 21 people were killed and substantial parts of the infrastructure were destroyed. The most affected German state was Saxony, where the total flood damage estimate had risen to 8.7 billion euro by December 2003 (Thieken et al., 2006). The Central Government initiated a plan, called the 'high water prevention plan', or, '5 points program', by Jurgen Trittin, the former Minister of the Environment. For all the 16 states he sought after to have a coherent standard system. Each state has its possibility to formulate policy. Jurgen Tritten has attempted to introduce a standard framework regarding high water protection. This is the background of the law. In 2005 this new law has been implemented. With this, other laws have been changed, such as the federal water law and the spatial planning law.

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[36] Barrie Needham. 2007. Dutch land use planning. Planning and managing land use in the Netherlands, the principles and the practice. Sdu uitgevers bv Den Haag

[37] Idem

4.3.1 Rules

In Germany, the subject of building in floodplains is integrated amid the policy domains of water management and spatial planning. The tendency in Germany is to give more room to the river. Since 2005 a Federal Law is operational which bans new plan construction sites in flood prone areas. The logic behind it is that this Law prevents the creation of new damage potential. An important aspect concerning the organization of floodplain development in Germany is that the function of building has to be according to the land use plan of the Municipality.

4.3.1.1 Land use planning

In Germany, spatial planning is organized in a co-operation between the National Government and the Federal State governments. There is no legal binding plan at national level; however there are legal frameworks which have to be followed by the Federal States. There are basically two national laws on spatial planning in Germany, i.e. the Raumordnungsgesetz and the Baugesetzbuch.

4.3.1.2 The Law on Spatial Planning

The Law on Spatial Planning (Raumordnungsgesetz) of 1998 is divided in four parts with different field of regulation. The first part contains prescriptions, which are general and of immediate concern for the spatial planning in nationwide. This task confines the outline and principles of spatial planning. The second part handles the legal framework, which have to be respected by the Federal States. The third part handles mainly communication flows and relations between National and Federal State level. The fourth part is about usual transition arrangements and prescriptions.

4.3.1.3 Federal Planning Act

Permission to change to building usage is regulated by the Federal Planning Act of 1997 (Baugesetzbuch/BauGB). A zoning plan (Bebauungsplaene) is for areas which change the function of land use. The Federal Planning Act (BauGB) requires that local authorities (Gemeinden) produce land-use plans (Bauleitplane). The plans are in two stages. First of all, the preparatory land-use plan (Flachennutzungsplan) presents the main features of the intended land-use for the total municipal area (Gemeinde). This plan still does not give the individual property owners any rights by which they can realize this new use. For this the second stage is necessary, which is the binding building plan (Bebauungsplan). Building plans are produced for the required parts of the Municipality as soon as it becomes necessary, which means, as soon as the Municipality intends to release new building land. (Source: European Environmental Yearbook`). The Central Government decides the guidelines for spatial planning and water management. The planning competence and the legislative competence are the responsibility of the 16 Federal States (art. 75 sect.1 Grundgesetz (GG)) working within the guidelines set by the Central Government. Implementation is then responsibility of the regions and the municipalities following the decisions of the Federal State. The following table shows the competency regarding spatial planning of the various levels of government. In table 7, these responsibilities are shown in more detail:

The legal procedure in Germany for composing land use plans as well building plans is elaborated in table 8. There are 11 procedural steps which have to be taken into account. In an early stage, the public is involved in the process. The procedural for elaboration of time can vary enormous.

1 Decision of the municipality council for composing a land use plan/building plan and the usual publication.

2 Development of a primarily draft

3 Information and consultation of the citizens (advanced citizen participation).

4 Involvement of the agencies which look after the public interest

5 Development of a design plan and decides of the design plan by the municipality Council (examination decision)

6 Possibility for everyone to see the design plan and to do suggestions (public examination)

7 Treatment of suggestions

8 Development of a definite design plan

9 Decision of the municipality Council

10 Approval of the higher governing body (District)

11 Legality by means on usual publication of the permit. [38]

4.3.1.4 Water management

The Basic Constitutional Law (Grundgesetz) forms the basis for the allocation of powers for the management of water resources. More room for river is also the main trend in Germany; however the Germans related it more to nature development and economical sense. Regarding floodplain development, there seems to be no place for building. The policy is to remove obstacles out the riverbed and to appoint retention areas. In Germany, there is a sense of balance between possible damage and the investment costs of the measures regarding flood safety. (Van den Beld, 2005) The national policy on flood protection is described in the 5 Punkte Program; new city plans have to be constructed in such a way that building of houses and industries in floodplains will be forbidden (Pressemitteilung 05/02 2002). The Integrated Rhine Program (IRP) encompasses an important role when it comes to flood protection measures in the State of Baden Württemberg. At the moment, the IRP program is the largest project on flood protection in Germany. The aim is to ensure the safety of downstream communities by upstream retention. In total, 13 retention areas have been appointed. To ensure a flood protection level of a 100 year flood event a total retention volume of 167 Million m3 is needed in the state of Baden-Württemberg. These concern 27 municipalities between Weil am Rhein and Mannheim with more than 500.000 inhabitants[39].

4.3.1.5 Federal Water Act - WHG (2002)

This Act is called in German the 'Wasserhaushaltsgesetz)'. It regulates matters pertaining to water. It can be seen as a general framework in which the Federal States have to set up its

[38] Source: German planning procedures. Source: Gerd Turowski, Dortmund 2000 (page 343 Duits Handboek van Planning begrippen

[39] Source: IRP program

own water law. The laws on Federal State level are called Landeswassergesetz. According to the Wasserhaushaltsgesetz, future plans have to be made on river basin level.

Another interesting part in the Federal Water Act is the inclusion of the obligation for Federal States to identify all floodplains on the basis of flood risk maps. There are three types of floodplain to be determined :

- areas between surface water bodies and dikes or high banks
- areas that are flooded or run through in case of a 100-year flood event
- areas that are claimed for emergency spillways or flood detention, based on plan approval procedure and final approval of the plan.[40]

The Federal Waterways Act - WaStrG – (1998)

The 'Bundeswasserstrassengesetz', or Federal Waterways Act is relevant for all navigation issues related to the federal shipping ways. This is a responsibility of the Central Government.

4.3.1.6 Flood Control Act – (2005)

From Federal level, a law became operational in 2005 with the name of 'Gezetz zur Verbesserung des vorbeugenden Hochwasserschutzen', (Source www.bmu.de) which can be translated as 'Act to Improve Preventive Flood Control of 3 May 2005. This Law is described in the Federal Law Gazette I of 9 May 2005 page 1224. For the first time the planning of new construction sites is forbidden in flood prone areas. Thus the creation of new damage potential is to be prevented by new buildings.

With the introduction of the Act to Improve Preventive Flood other national laws are being changed. Such as the Water Act, the Building ordinances, the Spatial Planning Act, the Law on State waters, and the Act on Weather forecast. Main objective of the Flood Prevention Act is creation of more uniformity on national level. The Law did not change the institutions and organization structure. Plans around the coordinated of flood protection along the rivers have to be set up by the Federal States within four years (before 2009). This obligation does not exist, if already appropriate flood protection plans exist. The new Law restricts the building in floodplains more than before. Federal States are obliged to map before the year 2010 settlements area for the 1 in 100 year flood. In these flood prone areas new developments are not allowed. For areas with other land use functions, this mapping has to be done before the year 2012. In the flood control act existing buildings, in the urban internal area and in the external area, are new buildings in principle permissible. They require however a permission from the responsible authority. This is given only if there are no negative impacts on the flood protection exist and the new development has to be built in a flood-adapted way. In the end, this law describes that the flood prone areas and flood prone areas with high damage potential are implemented within existing spatial instruments.

Contents of the Law:

• The Federal States are obliged to determine their flood water levels, by high water levels measured or by the level of damage expected;

[40] Source: Reich, 2007

- Within five years, flood prone areas have to been determined with high damage potential, especially in settlement areas;

- It is the first time that a prohibition to plan new construction sites in flood prone areas. Thus, the creation of new damage potential is to be prevented. From this new law, there are exemptions under strict conditions. For example, when the municipality can show that there is no space to expand other than the floodplain, that there is no life threat or danger for property and that the building has to be flood adapted;

- The States have to set op a coordination of flood prevention within four years;

- The flood prone areas have to be mapped for spatial planning goals in the future.

Concerning building in floodplains, it is possible to construct under the following conditions. With the exception of land-use plans for harbours and shipyards, no new development sites must be designated by land-use plans in flood plains. The competent authority may allow the designation of new development sites as an exception, provided that :

1. Alternatives for human settlement development do not exist or cannot be created;

2. The area to be newly designated borders directly to an existing development area;

3. A risk for life, significant health damage or material loss may not be expected;

4. The floodwater run-off and the water level are not negatively impacted on;

5. Flood retention is not affected and at the same time the loss of retention space is compensated for with respect to capacity and functionality;

6. Flood control conditions in place are not affected;

7. No negative effects on upstream and downstream riparian may be expected;

8. Flood prevention concerns are being observed;

9. Construction projects are implemented in such a way that in the event of a design flood that has served as the base line for the designation of flood plains no structural damage is to be expected. [41]

It might be difficult to meet these conditions, for the explanation that it might be complicated to proof that for example no alternatives for settlement exist. At this moment, there are a few examples of houses built in a floodplain.

4.3.2 Discourse

The German discourse regarding building in floodplains is strongly related to the ‘buzzword’ of ‘nature oriented flood risk prevention’’. The installation of retention areas upstream to top of the peak flows of the river, in order to avoid flooding downstream is the most important German river management approach. Federal States in Germany have a lot of freedom in defining their laws, within the legal framework of National Government.

[41] Source: www.bmu.de

In Baden-Württemberg, the governmental interests in the floodplains are at first on flood protection and flood damage reduction. In principle building in floodplains is not allowed in Germany, there is a general building embargo. If flood prone areas are appointed, it is not allowed to make a municipal land-use plan for that area, unless the 9 criteria which the Law describes are being endorsed. It is extremely difficult to meet these criteria thus new building in floodplains is not expected to happen. However, existing buildings can be situated within a flood prone area. Examples of this are cities like Cologne, which has been recently flooded. Redefinition of floodplains, for example a safety norm of 1/200 years instead of 1/100 years, can make existing buildings theoretically prone to flooding.

4.3.3 Policy actors

In Germany, the National Government has the responsibility for the legal framework and enabling legislation. On national level, there are different Ministries involved.

The most important are the Federal Ministry of Transport and Environment, together with the Ministry of Economics and the Ministry of the Interior. Their task concerning building in floodplains is on informing and educating the public about environmental issues. The Ministry of Transport and Environment presented a brochure on how to deal with risk in flood prone areas. This is called the 'Hochwasserschtuzfibel – Bauliche Schutz-und Vorsorgemassnahmen in hochwassergefahrdeten gebieten', which can be translated as 'High water brochure – Structural protection and precaution measures in flood prone areas'.

The Federal States (Laendern) are responsible for floodplain policy and execution of several tasks concerning water management and spatial planning. e being advised by water experts, such as the bundesanstalt fur gewasserkunde (water knowledge institute) .Between states and Central Government, communication and tuning takes place by means of the LAWA, free translated Water Work Group of States and Central Government. The Regions as well the States are the executive body concerning the Integrated Rhine Program.

- The Region- (Regerungsprasidien) – The region, as a representative of the State, plays an important role i since they coordinate and execute the 13 proposed retention areas according to the Integrated Rhine Program.

- District (Kreise) - The district is a level between the region and the municipality. They are directly linked to the State when it comes to permits and procedures for regulating the building in floodplains. From the other side, they also represent the interests of the municipality. 'The Districts are the controlling government for the flechennutzenplan.

- Municipality – The construction of a building plan (bebaaungsplan) which fixes future developments is a task of the municipality.

4.3.4 Division of powers and resources

The resource constellation concerning new floodplain developments are mainly organized around the Federal States. This can be illustrated by the IRP program, where the Federal States have access to as well financial resources as well as the ability to take decisions. The influence of the Federal States is also high, since they decide the contents of the law and policy within the legal framework set out by the central government. Since 2005, the content of the legal framework is more condense with the operationalisation of the Flood Prevention Act. The level of room for interpretation of the Federal States has become more limited; however on essential parts the Federal States remain autonomous.

Knowledge

In Germany, the public is informed about high water protection, by means of the 'Hochwasserschutzfibel', a brochure which is aimed on provision of information on structural protection and precaution measures in flood prone areas. Specific knowledge is at the level of Federal State. Consultancies play a vital role in knowledge exchange, since much of the expertise used by policy actors is brought in by these consultancies.

Decision making

Decision making is in Germany to a large extent in the hands of the Federal State. The district (Kreise), which represents the State level locally, also has a significant role in decision making. The District approves land use plans. The flood act of 2005 is a legislative framework which they have to obey, however still different interpretations can be made. Some projects are realized within the Integrated Rhine Program.

Economical resources

For the measures concerning the Rest Rhine project, 115 million euros are reserved.

4.4 Socio-economical aspects (H. El Abida, V. Wattenberg)

4.4.1 France

4.4.1.1 Land Market Study

The general thinking is that properties along rivers may be devaluated because of the conscience and experimentation of the risk, and by the implemented regulation relative to natural risk disaster, which is transcribed in the PPRi by maps, recommendations and constraints of soil occupation. The reality is different; indeed the conscience of the risk is not the same from one commune to another, it depends on the flood exposition and on the prevention articulated by the elected people, and urbanism services. The application of the PPRi, which is supposed to be controlled by the state services and by the insurance company, is not always respected and incentive. Therefore, the motivation of the study is to point out the real situation and to see what the consequences are created by floods on the land market.

The study of the land market is complex and it is difficult to give a real value of flood risk influences due to many parameters such as: the conjectural aspects, the general activities and features of the land market, the local context, relative features of the district (Hubert G. 2001), In order to carry out the impact of the flooding, it is necessary to isolate the parameter "flooding" from the interference between all above parameters. The main approach recognised by economist is the hedonist methods which consist on explaining the relations between the cause and its effect between the price of the good and its different features, considered as many explicative variable that needs to be organised by priority (Hubert G.2003). There are several disadvantages of this method: the entry of the tremendous amount is time consuming, the access to the information is not sufficient and reliable, because of its confidentiality and the specificity of some goods.

Another experimental method, consist on the study of the Déclaration d'Intention d'Aliéner (DIA) which corresponds to the land price declared to the municipality for property transaction and on the interview of the main actors for real estate transaction (real estate agency and notary) (Capblancq J; and Hubert G., 2002). This approach brings behaviour on

particular local cases that indicate the influence of the regulation documents and of the risk perception.

Several studies were conducted concerning the flood risks and its influence on land market. The studies realised by Hubert Gilles and Julianna Capblancq were taking place in Orléans, Montauban and Champs-sur-Marne. It is difficult to compare those results with our study cases because each city has its own urban extension, politics and perception of the risks. Their results show that the frequency of floods and the recent events are factors that influence more the prices of goods within the floodplain than the regulation itself. The writers indicates that the results of their research has to be considered with a certain distance because of the methodology which is not always accurate due to the uncertainty of the DIA, which are documents fulfilled by citizen and that contains often some mistakes. However, our results reinforce their different hypothesis.

The studies take place along the Loire river at two different levels. The first site concerns a quantitative analysis which is made through three communes located in the reaches of the middle Loire river: Tours, Saint-Pierre-des-Corps and La Riche. It was motivated for their sectors homogeneity concerning the urban typology and by their specificity concerning their risk exposure, and to their evolutionary perspective.

For the upper stream of the Loire river, the city of Challuy-sur-Loire and Sermoise-sur-Loire and Nevers were chosen for several reasons: the specific location along the Loire river and their past history concerning major floods, for the heterogeneity concerning the surface of the "aléa" defined by the PPRi, and for the spatial symmetry conferred by the National Road N7 that divides Challuy and Sermoise.

The first part of the study is dedicated to the results of studies in our topic that was carried on communes located along the reaches of the Middle Loire river: Saint-Pierre-des-Corps, La Riche and Tours and will exposed results based on the price per square metre of the land market. The second part will concern the analysis a sale tendency which reflect the money invested and the number of transactions in the floodplain in the period between 1998 and 2007 in communes upstream of the Loire river: in Nevers, Challuy-sur-Loire and Sermoise-sur-Loire.

Fid	References proposed by the cadastre	
Alea	Zone defined by the ppri	Aléa 1
		Aléa 2
		Aléa 3
		Aléa 4
		Out of the ppri zone
Euro/m²	price per square metre	
CADASTRE	cadastral ref	
Total Surface m²	Declared surface	
Price	Declared price	
Year of transaction		
Description	CONS = building, house, industry	
	FIELD = empty land, garden, agricultural field	

Figure 42 : Data organization

For the study of the middle reaches of the Loire river, it is based on the price per square meter of the built land among the year and was realised by master student in "Management of the urban territory" for their final assignment.

For the study of the middle reaches of the Loire river, the table (Figure 42) is then transferred for the spatial mapping for GIS purpose and coupled with cadastre and digital PPRi that allows to indicate the location of the transactions.

An indicator was used for the study of the land market in the middle reaches of the Loire river. Indeed, the land market and the house transaction being subject to many parameters, it was interesting to render the transaction homogenous. The indicator is calculated by dividing the total amount of transaction by the ratio Surface of the "aléa" by the total surface of the commune. Thus, the indicator shows the amount of transaction proportionally to the surface of the "aléa" in the commune. Indeed, it is difficult to compare numbers of transaction when surface defined by the "aléa" have wider areas than others.

Middle reaches of the Loire river

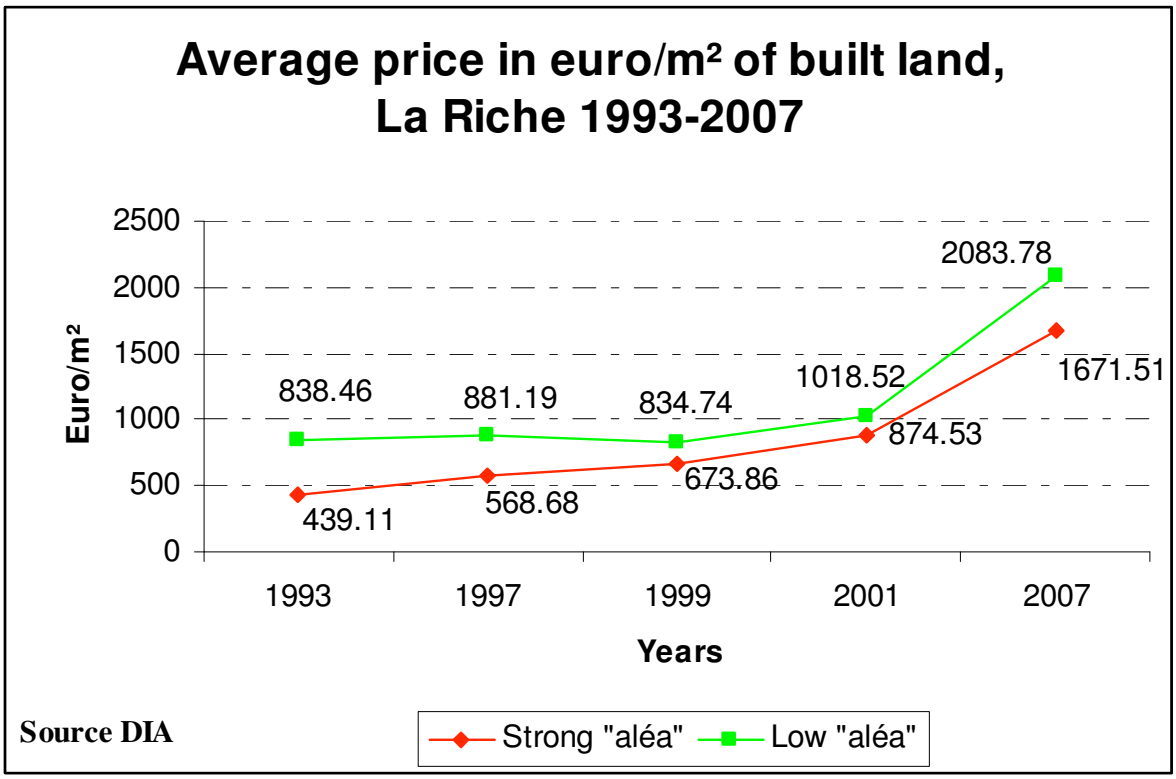


Figure 43 : Average price of built land in La Riche, 1993-2007, Auchard et al 2008, Modified

The study indicates that the PPRi influence the urbanism but without lowering the price of the land market. Indeed, the PPRi oblige to implement specific constraint on the built, but it does not avoid the extension of the urbanisation in area defined by the strong "aléa". Thus, the hypothesis in which the land market price is harmed due to the zones defined by the PPRi is not validated in the Middle reach of the Loire. Indeed, the example of La Riche shows that the zones defined as low and strong "aléa" follow the dynamic of the market with an increase from 1993 to 2007 of +2.5 and +2.48, respectively (Auchard et al, 2008). The lower prices in the strong "aléa" are due to other parameters than the exposition to the risks. The cities of La Riche has a clever use of the PPRi rules through the implementation of recommendation in

the built, therefore it allows the city to continue their extension in their restrictive floodplain areas but with structural approach of urbanism. Since the region did not suffer from major flood since 1910, citizen and elected people do not see the danger of the flood.

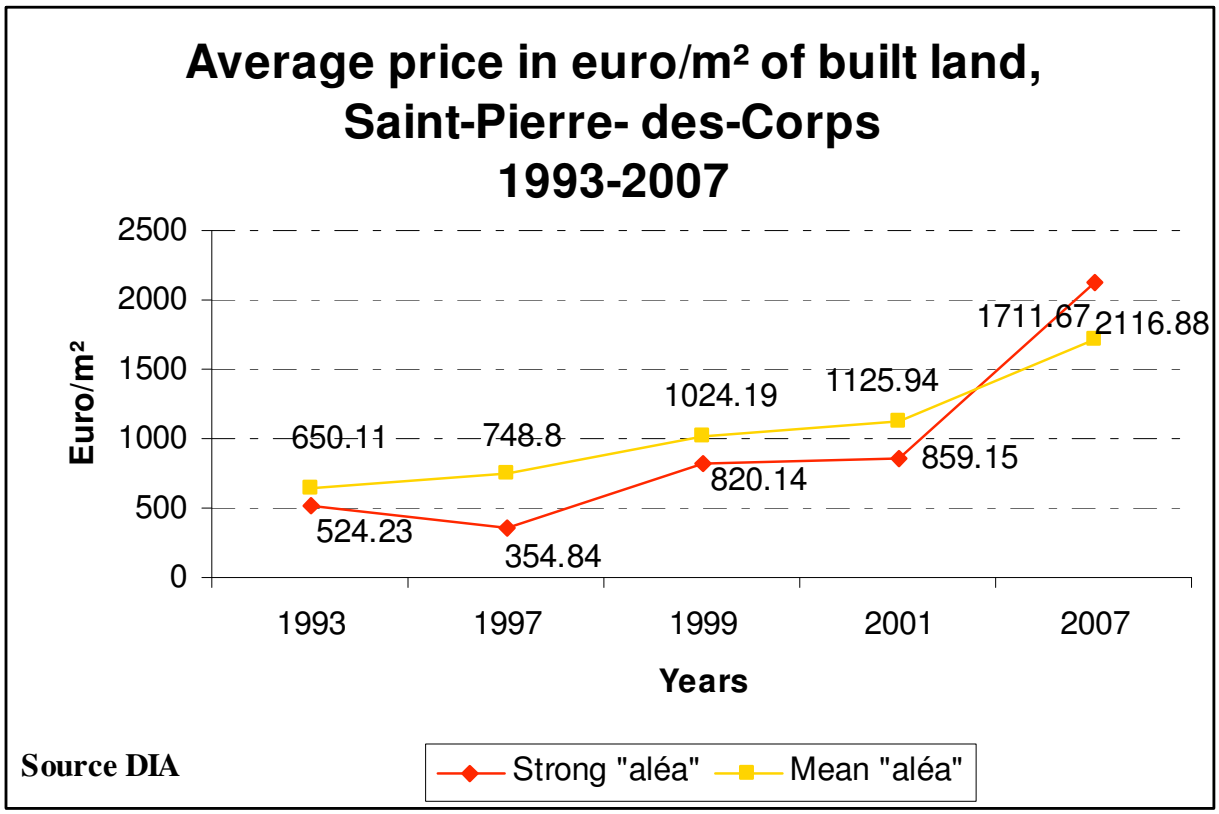


Figure 44 : Average price of built land in Saint-Pierre-des-Corps, 1993-2007, Auchard et al 2008, Modified

In Saint-Pierre-des-Corps (Figure 4.10), the reasoning is the same as in La Riche. The prices of the built land in strong and mean “aléa” have a steady increase in the period 1993-2007 (+2.08). Thus, the flood risk would not appear to play a role in the functioning of the housing market. (Auchard and al, 2008). The only influence of the flood risk is the approach and design of the new constructions. New urbanism project proposes to live with the risk and to extent the urbanisation by taking care on respecting the PPRi recommendations. After the translation of the PPRi into maps, the city is preparing the transcription of the PPRi through architectural values protecting goods and citizen. The specific confinement of the city and the lack of preventive information made people forgotten the danger of flooding.

The results in the city of Tours are valuable but the comparison made in this study is delicate due to the small size and to the low number of transaction that have been recorded in the district Ile Aucard. However, the value of the data brings interesting results (Figure 44). In the district Tonnelé, the increase in prices seems to be the general trend of developments in the land market over the past fifteen years (+ 2.63). It is hard to give an explanation concerning the decline of the land price in the Ile Aucard during the period 1999-2002. The sharp increase in the average land price in 2007 is due to the sale of one property. However, it indicates that the area is still considered as a valuable place to live, mainly due to its ideal position in the river bed, between the river and the dyke. It has been confirmed by the Directeur Départemental de l’Équipement d’Indre-et-Loire: Lately, it seems that there is a

strong enthusiasm to live in the Ile Aucard. This area is popular and tends to gentrify and it would tend to raise property prices.

This behaviour and results show that the flood risk does not affect the land market and real estate.

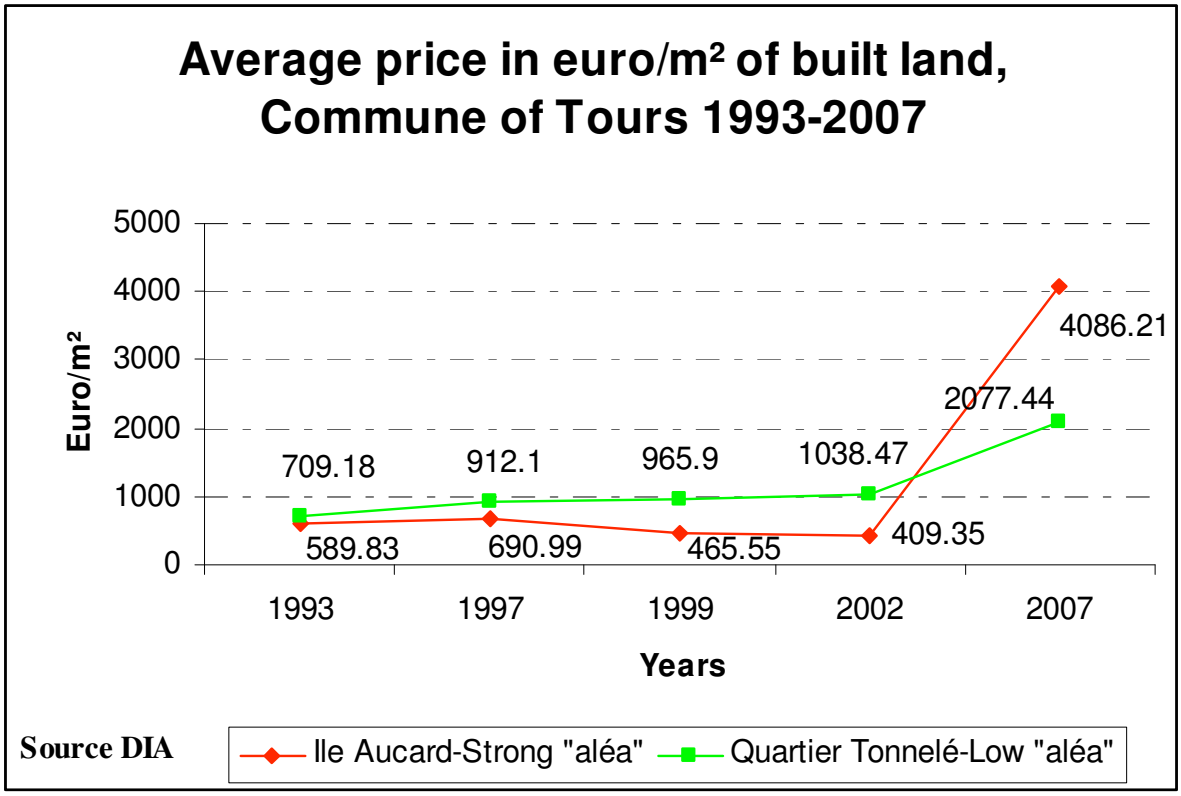
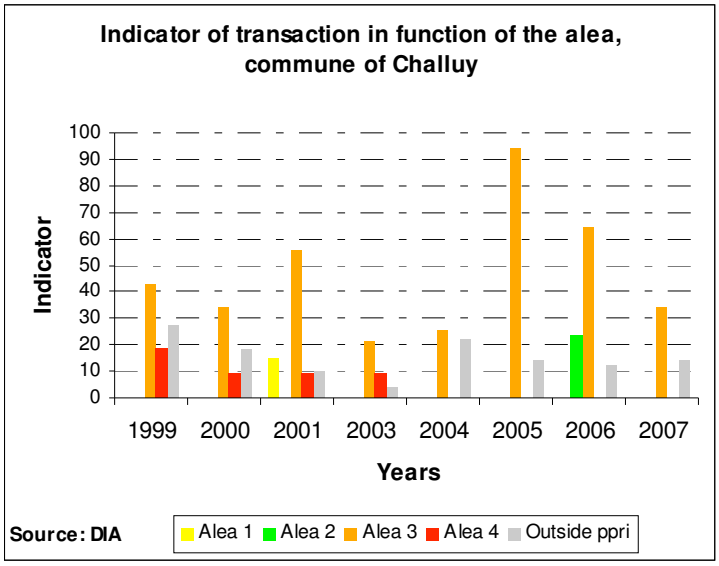


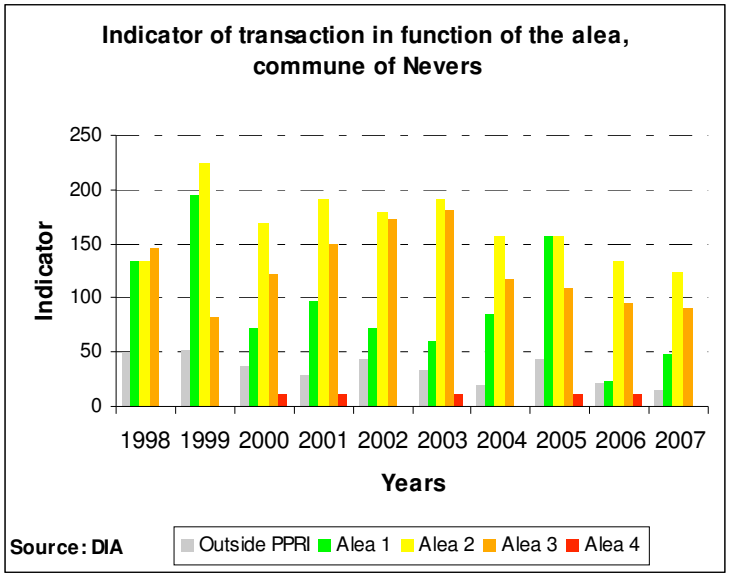
Figure 45 : Average price of built land in Tours, 1993-2007, Auchard et al 2008, Modified

The general trend is that the land value of building land increase faster than the general price level in areas of urban development, and the share of land in housing prices tend to increase. However. some work show that, beyond fluctuations in the short and medium term, prices of land to build follow approximately the general trend in prices. By simplification, the average price of the land, on a specific geographical area, is a reference price resulting from all transactions on this space, to regulate those transactions. It is clear that within this space prices vary from one district to another according to a quantity variable.

Upstream of the Loire river

This part of the study takes place upstream of the Loire river in the cities of Nevers, Challuy-sur-Loire and Sermoise-sur-Loire. In 2003 the agglomeration suffered from a significant flood but not exceptional. The water level was at 3.88 metres, far from the record in 1866, when it was at 6.36 metres. However, in 2003 the river was wider of 3 km and 10 000 people had feet in the water (Le Point, 24 February 2005 in Egrian website).





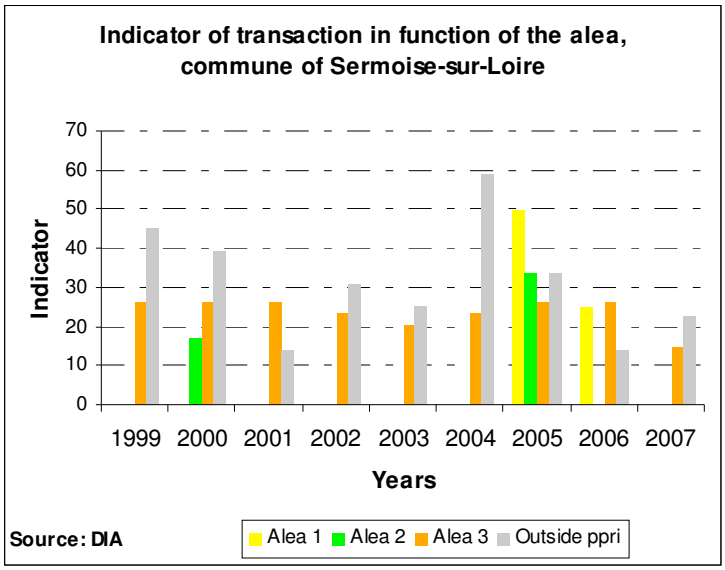


Figure 46 : Indicators of transaction in Challuy, Nevers, Sermoise-sur-Loire

The indicator of transaction[42] (Figure 46) shows the number of transaction in proportion of the space occupied by the different "aléa" in the commune. In Nevers, the indicators are high due to higher density and bigger number of transactions. Most of the transaction takes place in the "aléa 1" and "aléa 2". However, Nevers also have great number of transaction in the "aléa 3". It is surprising considering the fact that Nevers has a strong politic of prevention against flood risks, even if construction are respecting the PPRi rules, finally we assist to the increase of the vulnerability by goods and people exposition to the risks. The location of the study can explain the feeling of protection (Figure 47), the area is mainly occupied by the ZAC and is protected by the levee, which can enhance the feeling of safety.

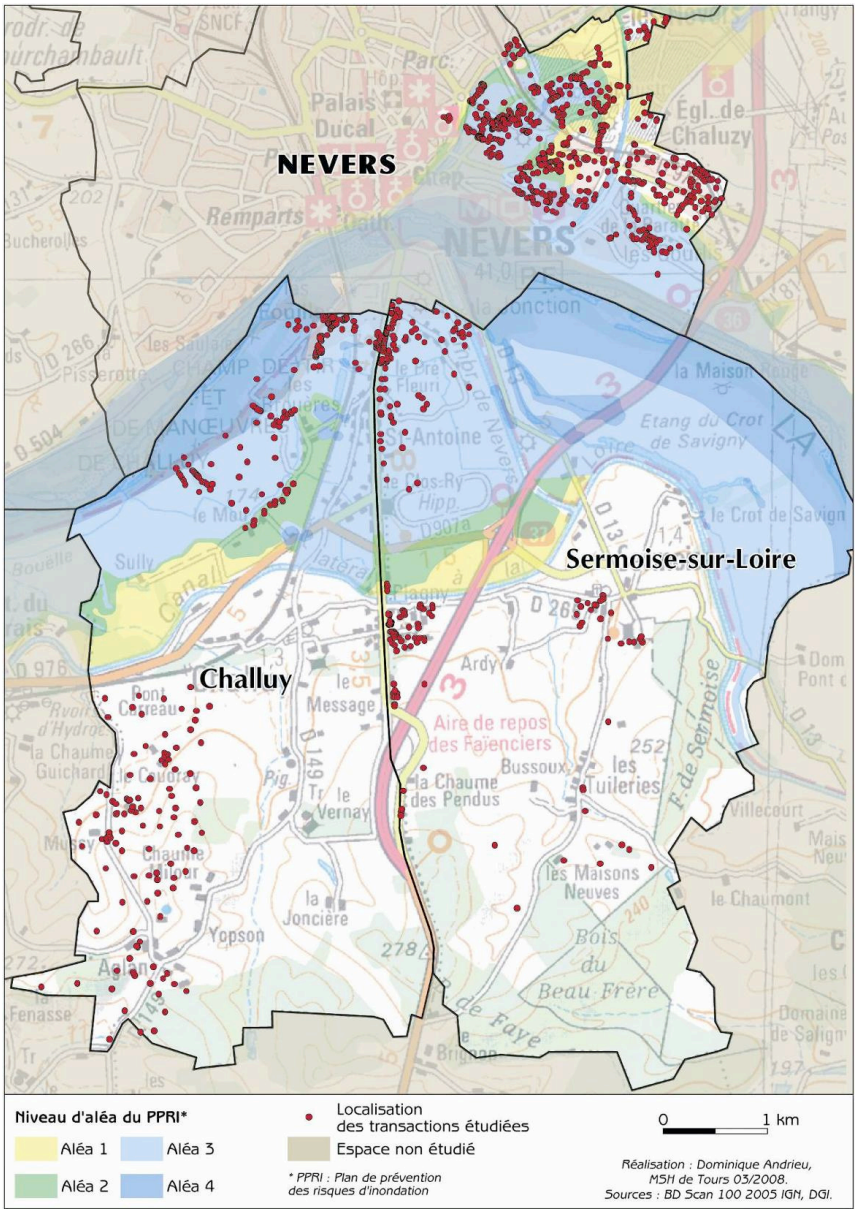


Figure 47 : Location of the transactions in upper part of the Loire river

[42] the indicator represent the amount of transaction divided by the ratio surface of the "aléa" over the total surface of the commune. It indicates the tendency of the transaction

In Sermoise-sur-Loire and Challuy-sur-Loire, the indicator shows constant transaction in the "aléa" 3. In Sermoise the highest values of the indicator are in the zone outside the PPRi when for Challuy the indicator shows that transactions are located in the "aléa" 3 and "aléa" 4.

In Challuy It is interesting to notice that there is no more transaction in the "aléa" 4 after 2003, which corresponds to a flood event. Maybe there were no more properties to sell or people got afraid to buy land in zones defined by "aléa" 4 just after a flood event. Finally it was not enough to discourage to buy in the zone "aléa" 3 and to increase the vulnerability. Most of the transaction in the "aléa 3" from Sermoise-sur-Loire and Challuy are close to Nevers and concentrated along the main road axes N7 that deserves Nevers and separate Challuy and Nevers (Figure 47). Those areas were planned for the extension of the cities before the application of the PPRi (General Secretary of Sermoise), now no more construction are allowed, except for the extension of existing house that must respect the ratio imposed by the PPRi. However, The other transactions are located in the city heart and close to services (figure 47) People look first at the distance from their job location and services than to the risks of floods. In Challuy-sur-Loire during the period 1998-2007, there were no transactions along the N7 in the place named Le Message, Le Vernay and La Joncière. Indeed those areas belong to groups of families succeeding after heritage or the houses are rent to people working in Nevers (Mayor of de Challuy:). This situation indicates that the proximity to Nevers is an important factor for the establishment in the commune.

The money invested corresponds logically to the indicator (appendix1). Most of the money is invested in the "aléa 3" The communes of Challuy, Sermoise-sur-Loire and Nevers recorded investment in the real estate of 1 million of euros, 2 millions of euros and 3 millions of euros in the "aléa 3", respectively (Appendix 3). It implies that the zone defined by the PPRI do not dissuade people to invest money. In spite of the adoption of the PPRI, the zones included in the strong alea are considered as valuable. It increases the vulnerability and in case of flooding people will have more to loose.

Conclusion

The previous research (Hubert G., Caplblancq J., 2003) indicate that the absence of flooding in a territory reduces the perception of risk of the local actors (real estate seller, landowners, elected people and technicians) a frequent floods and a very constraining rules can cause severe devaluation on the land market. Thus, transposed to the case of the Middle reach of the Loire river that did not suffer from a major floods since 1910 and where the regulation is encountered, one can easily understand the behaviour and the occultation of the risk. There is no devaluation and even more values and transaction are taking place in dangerous zone, which is apparently due to the proximity of rivers and therefore a part of life more pleasant, or even a phenomenon of rarity.

The example of the middle reaches of the Loire river also indicates that the PPRi influence the urbanism without lowering the price of the land market. The PPRi is not anymore a constraint against extension but more like rules to encounter thanks to housing adaptation. In addition, the important number of transaction in the upper part of the Loire River shows that people are not afraid by flooding, even in a city like Nevers who was recently touched in 2003 and who has an important politic against flood risk. The consequences are visible in the spatial organisation of the city. In the three communes, transactions takes place in the dangerous area defined by the PPRi, mostly in the zones defined by the "aléa" 3 as well in zones outside the PPRI which is also the most represented type of zone in the three communes. It seems that people look more on their job location, road and service access, and on their life quality close

to the river than to flooding risk. Finally, the urban tissue is denser in the zone “aléa 3”, and by consequences it increases the vulnerability regarding the amount of money invested and the people living or working in these areas. Limiting human vulnerability and material in areas subject to such risk has become an issue that the PPRi can not comfort. The implementation of regulatory documents in the reality is difficult for elected people This inefficiency of the PPRi is partly justified in the chapter dedicated to insurance company. Indeed, the application of the PPRi, which is supposed to be controlled by the state services and by the insurance company, is not always respected and incentive to avoid extension of urbanisation.

These few remarks did not constitute definitive conclusions because of the functioning land market under conditions of risk is a subject that remains largely to be explored. The multiplicity of factors to take into account and the difficulty in obtaining reliable data makes the task difficult (Hubert G., 2001). However, the similitudes among the different research tend to comfort the hypothesis.

4.4.1.2 Role of the insurance company

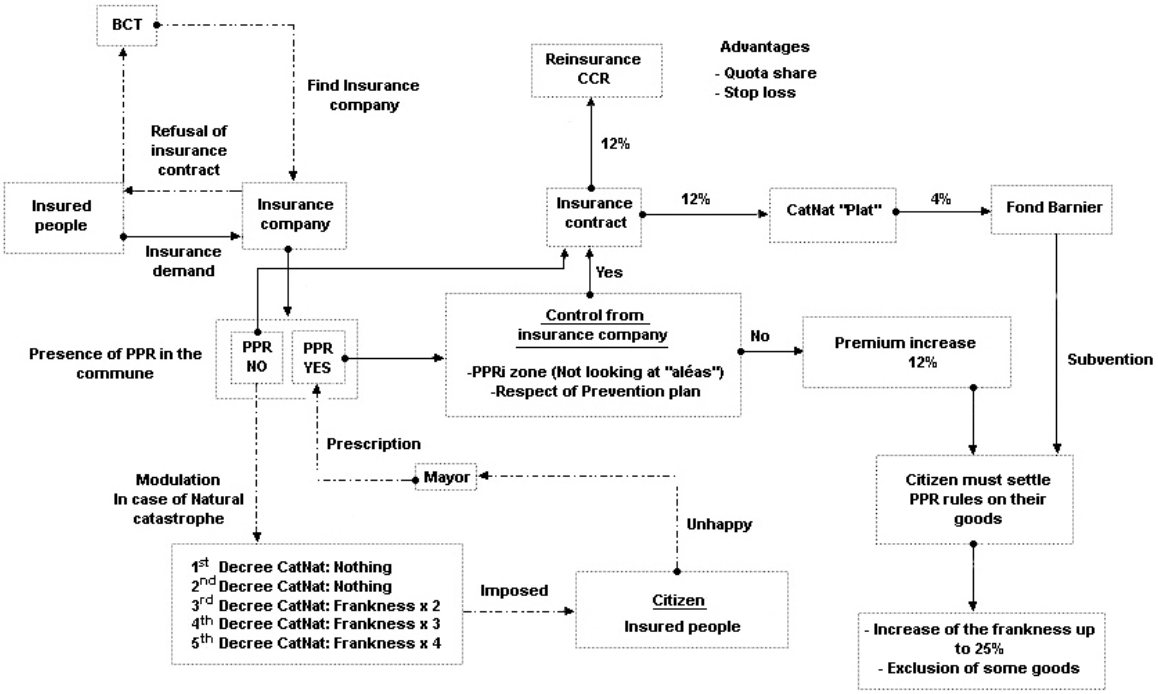


Figure 48 : Approach of the administrative prevention against of natural disaster system, El Abida H.

The French insurance system on natural disaster is defined by the law “Cat-Nat”, law of the 13th of July 1982: “The effect of natural disaster are direct materiel damages considered as non insurable, having as a cause the abnormal intensity of natural factors, when usual protection implementation against those damages did not avoid their occurrences or could not being taken”.

Lawmaker considered floods as natural disaster notably because it is not insurable due to “anti-selection”. For the insurance system, “anti-selection” concerns risks, which are partly

unpredictable, hard to quantify and to localise, even if floods always occur close to river. It was justified by the fact that free market would have differentiated compensation for people living in the defined risk area with other people living outside the defined area. Thus, lawmaker founded the law based on a hybrid system on collaboration between the State and the insurance companies for offering national solidarity. The idea is to make a mutual insurance system by collecting money from everyone for compensation of the natural disaster damages and as an extension of compulsory guarantee, thus annual damages costs are shared between a great numbers of insured people.

The role of the insurance company is articulated in 2 axes: the prevention and the compensation. The following chapters will describe and comment the condition of guaranty application and will discuss the role of the insurance company within the prevention and compensation system based on literature and interviews realised with an insurance company.

Conditions for the natural disaster insurance

Flood risks is one of the events concerned by the insurance against natural disaster, based on the article L125-1 code des assurances, floods are natural abnormal factors and defined amongst other type of events (earthquake, ground-sliding, etc..) by the circulaire n° 84-90 du 27 mars 1984. The text indicates that “damages can be covered only if the floods events are the evident cause”.

In application to the natural disaster guaranty, the occurrence of floods can give rights to compensations. Floods events is defined in the circulaire du 19 mai 1998 in order to constitute the demand for recognition of natural disaster state.

Goods covered or excluded from the natural disaster guaranty

The article L125-1 du code des assurances indicates that goods are covered by the natural disaster insurance if located in France and if included in the insurance contract “Goods damages” (Damages caused by fire). The circulaire du 27 mars 1984 defines the goods guaranteed against natural disaster. It includes buildings and furniture such as :

- Habitation and other goods contained in it
- Commercial and industrial installations and other goods contained in it
- Buildings from communes and other goods contained in it
- Agricultural building, harvest, machines, animals contained in the building
- Greenhouses
- Forests
- Tent, caravans and camping materials

The article L125-5 du code des assurances defines the goods excluded from the natural disaster goods :

- The non-insured goods which are excluded from the insurance contract “goods damages”

- Harvest, seedbed, soil, agricultural structure (stables), animals which are outside the building

- Public road, civil engineer structure which are not insured

- The vehicle : aerial, seaborne, fluvial, sailing boat and transported goods

- Inherent costs like rent

- Venal value of the business, for example the lost induce due to no client

Financing of the natural disaster guaranty

Insurance companies are responsible for collecting money into a “plat” for application of the compensation. The term of “plat” differentiate funds because those last are provided by the state whereas the “plat” is under responsibility of the insurance company1.

The article L125-2 du code des assurances dispose that the natural disaster guaranty is financed by an additional due called premium. The rate of the premium is nationally fixed by the law-maker and applied to everyone. The premium is calculated based on a fix rates applied to the principal due of the insurance contract or on insured capitals. It means that the price of insurance contract depends on the value of the insured goods.

The article A125-2 du code des assurances determines the premium rates applied for each type of insurance contract. The premium rates are about 6% of the contract on terrestrial vehicles with engines and 12% for the other goods.

In France the insurance contract is compulsory, code des assurance L125-6, which means that the money collected for the “plat” comes from everyone (company and individual) living in France, thus annual damages costs are shared between a great numbers of insured people, it is the base of the national solidarity.

Provision of the reinsurance and guaranty of the State

The insurance companies have the possibility to benefit of insurance, provided by reinsurance company, the “Caisse Central de Réassurance” (CCR) which is a public company (Thourot and Fougére 2006). The system is well structured and insurance companies have support from the CCR who benefit from unlimited guaranteed of the State. In case of depletion, the government will make good a deficit. It means that the State is the insurance of the CCR, in exchange the State takes 1.8% of the premium given to the CCR (Thourot and Fougére 2006). This state-run cover does not, however, give to the CCR a monopoly in natural disaster reinsurance. In fact any insurer may seek cover for itself for the reinsurer of its choice, and may even take the risk of not underwriting reinsurance contract (Prim.net). Nevertheless, CCR remains the only company within its sector of activity which can offer a whole range of reinsurance solutions with unlimited cover” (CCR 2005, loi de 1982, l’article 4). For motivating insurance companies, the CCR proposes interesting advantages formulas for compensation such as the quota-share and the stop-loss (OCDE). The quota-share means that insurer gives 50% of the premiums collected to the reinsurer and the latter in return, undertakes to pay the same proportion (50%) of losses (CCR, 2005). The stop-loss frame the situation, indeed if at the end of an exercise the sum of several events or if one important event is higher than 200% of collected premium, the reinsurance will take care of the expenses thought the help of governmental provision (CCR, 2005).

The system of compensation

Declaration of the occurrence by insured people

The circulaire du 27 mars 1984, relative to compensation for natural disaster victim indicates that there are several delays for sending declaration of occurrence to insurer. When insured people are informed of the occurrence, they have a delay of 5 days for sending declaration to their insurer. The second delay is of 10 days after the publication of the natural disaster decree in the "Journal officiel" for direct materials damages and a delay up to 30 days for loss exploitation. If the delays are not respected the insurance company have the right to refuse the compensation of the loss.

Procedure of the natural disaster decree declaration

The circulaire du 27 mars 1984, relative to compensation for natural disaster victim and the circulaire du 19 mars 1998, relative to the constitution of natural disaster claim, evoke the procedure to follow for official report of natural disaster (Fiche informative, Prefecture du guard).

The announcement of natural disaster by inter-ministerial decree is declared by the State and is the compulsory act for receiving compensation from insurance company. The responsibility is taken by the Prefect who must collect data concerning the flood events. If the Prefect considers that the different declarations claimed by communes are justifiable, then he proposes to the inter-ministerial commission to observe the natural disaster state. The inter-ministerial commission is composed by the Ministry of the Interior represented by the DDSC (Direction de la Defence et de la Sécurité Civile), by the Ministry of economy and completed by 2 technical consultants from the Ministry of Ecology and Sustainable development. (Prim.net)

The Prefect has a delay of 1 month for transmitting a general report concerning the occurrence to the ministry. The Prefect must provide a report with the main information such as the intensity and origins of the occurrence, list of concerned communes and their claimed declaration, and the past, present and future prevention measures. He must deliver a technical report with information concerning meteorological, geotechnical, hydrological and seismological conditions depending of the occurrence (Prim.net). The appendixes must contain map with location of the disaster and of the concerned communes, a report from the "gendarmerie" and fireman, and photos of the event. For floods events, particular documents are required and are provided by several organisation such as the DIREN (Direction regional de l'Environnement), the DDE (Direction Départmentale de l' équipement), the RTM (Restauration des Terrains en Montagne), the BRGM (Bureau de Recherches Géologiques et Minières), and the DDAF (Direction départementale de l'agriculture et la forêt). (primnet2)

Based on the general report, the Ministry of the Interior asks the inter-ministerial commission for taking decision of the natural disaster decree application.

Compensation by insurance company

Based on the code des assurances and on the circulaire inter-ministérielle du 27 mars 1984 modified, relative to compensation on natural disaster victims (primnet1). Insurance companies receive damage declaration claimed by insured people. Then they consult the deliberation of inter-ministerial commission for the announcement and publication of the

natural disaster decree in the "Journal officiel". At the reception of the decree, insurance companies have 3 months for giving compensation for the non-insurable damages based on the contract signed by the insured people. The amount of the deductible is fixed by article A125-1 du code des assurances (Table 9)

Guaranty	Goods	Deductible for floods
Direct damages	Habitations	381 euros
	Professional use	10% of the amount of material damages (minimum 1143 euros)
Exploitation loss	Depends on the exploitation	Deductible equivalent to 3 open day (minimum of 1143 euros)

Table 9 : Amount of Deductible, Primnet Guide juridique de la prévention des risques majeurs, December 2002, modified

Coupling of prevention and compensation

Economical incitation

The system of prevention is related to the compensation system. In return of damage compensations, the law of 1982 for natural disaster had introduced prescriptions against risks and for reduction of vulnerability which are stipulated in the PPR (Plan de Prevention des Risques). The law-maker had introduced two types of procedure for economical incitation: the modulation and the increase of the deductible and this depending on the existence or not of a PPR in the commune or in case of non-respects of the rules prescribed by the PPR prescriptions.

Communes without PPR

Rules are applied relatively to the current situation of the goods to insure and to the presence of PPR in the commune. Based on the arrêté ministériel de septembre 2000, if a PPR is not elaborated in a commune, policy-holders have insurance contract without prerogative but will see modulations of their deductible in case of repetitive natural catastrophe decree. Indeed, after the third, the fourth and the fifth natural disaster decree, the deductible is respectively multiplied by 2, 3 and 4. The economical incidence is that citizen will be unhappy of the large increase of deductible and they will put pressure on elected people for the elaboration or for the prescription of a PPR in the commune.

Communes with PPR

	Modulation	Individual	Companies
3rd natural disaster decree	x2	760 €	2 280 €
4th natural disaster decree	x3	1 140 €	3 420 €
5th natural disaster decree	x4	1 520 €	4 560 €

Table 10 : Modulation of deductible for vehicle with engine for professional use, (DDSC, Novembre 2003), modified

When PPR is elaborated in the commune, the constructions must respect administrative rules included in the PPR for tending to prevent damage caused by natural disaster. If it is not the case, insurer who notes the non respect of the prevention regulations, can ask the BCT to re-examine the conditions of insurance.

The policy-holders have obligation to subscribe for insurance against effects of natural disasters, it is fundamental for the collect of the "plat" and for the principle of national solidarity. The law L125-6 article du code des assurances, leaves possibility for insurance companies of excluding liability from normally insurable goods. Indeed, the article lays out that, except for goods and activities that existed before the publication of a plan of prevention of risks (PPR), insurance companies are not obliged to ensure goods and activities located in the red zone which is the non-constructible area classified by the approved PPR.

However, policy-holder who sees himself refusing the guarantee by insurance companies can ask the Bureau central de Tarification (BCT). This last will force one or several companies to share the guarantee of his goods against effects of natural disasters and will fix conditions to be applied by the insurers. It results in an increase of deductible or a limitation from extended the guarantee, but the policy-holders will always have the possibility to get insurance contract.

When a PPR is prescribed or elaborated, insured people have 5 years to realise the prescription indicated in the PPR. After this delay, the modulation is again applicable. An example of the modulation is given for vehicle with engines for professional use (Table 4.5).

Barnier funds

Policy-holders have rights on financial help from the "Fonds Barnier" (law Barnier du 2 février 1995 relative to reinforcement of environmental protection.) It corresponds to financial help whose goal is to support owners who wants to settle measures for vulnerability protection on their goods. The "Fonds Barnier "is managed by the CCR. The "Fonds Barnier" is funded by insurances companies who paid-in 4% from the 12% of imposition from natural disaster contract for the constitution of the "Fond Barnier". The law Barnier indicates that owners have a delay of 5 years after the adoption of the PPR for putting infrastructures into norms or moving. If rules are still not respected after the delay, insurer can ask the BCT to settle new insurance contract conditions. The consequences will be an increase of the deductible up to twenty five times its initial value, and certain goods could be excluded from the insurance contract (Art. L125-6 and Brochure MRN)

Synopsis of the compensation/prevention system

The following figures show synopsis of the compensation and prevention system.

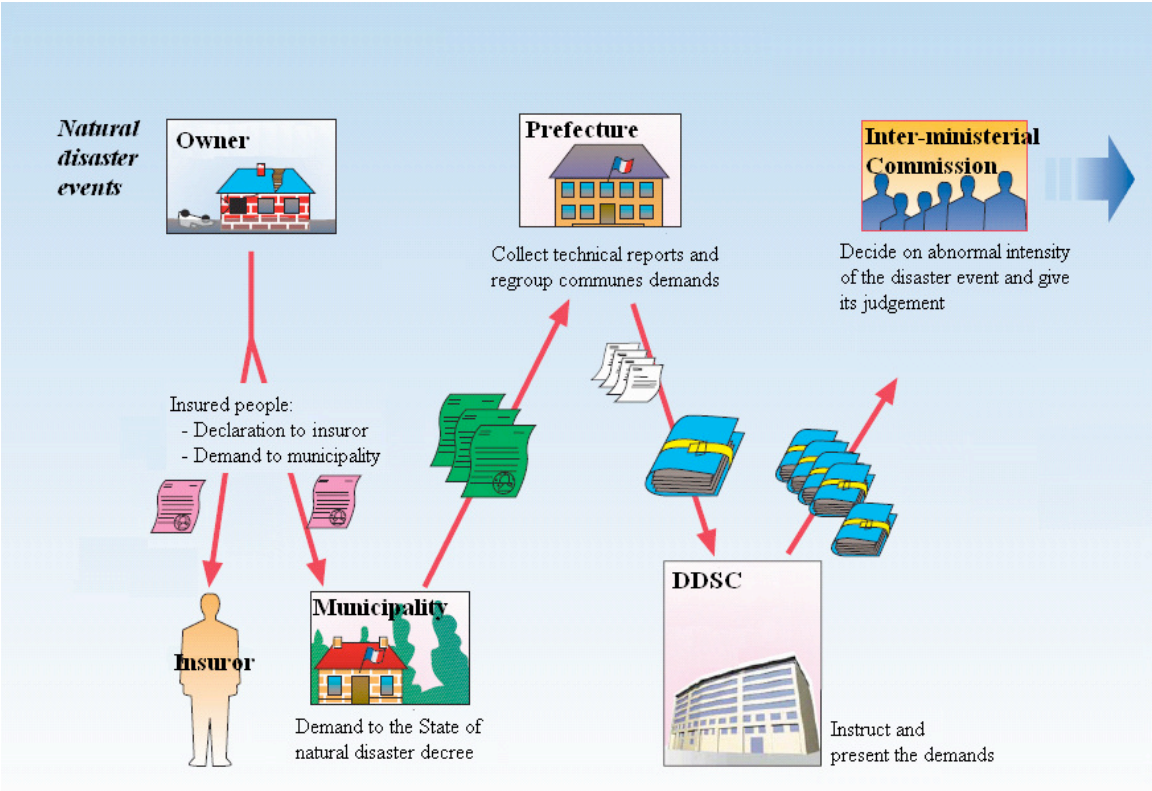


Figure 49 : French compensation system for natural disaster, part 1, DDSSC, 2003 modified

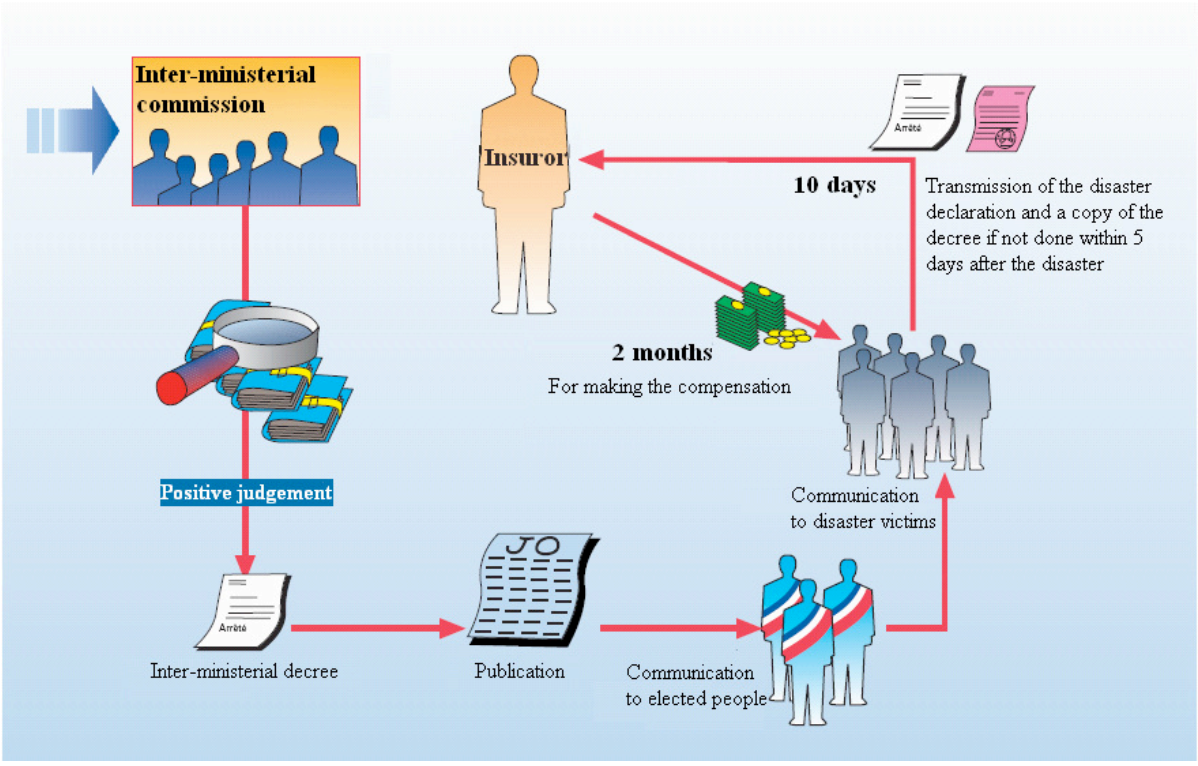


Figure 50 : French compensation system for natural disaster, part 2, DDSSC, 2003 modified

Limits of the French insurance system

Good principles

The Catnat system offers a wide cover for a low price contribution and the insured people feel positive about it (Rapport mission interministeriel, 2005). The system of national solidarity implemented by the law du 13 juillet 1982, relative to natural disaster victims had improved the compensation for risks that was previously depending on weak funds allocated by the "Safety founds for disaster and calamity victims, created in 1956. In that sense the mission considered that the principle of the compulsory insurance and of the mutualisation of the premium should not be revised.

Decline of the reserve

	1984	1985	1986	1987	1988	1989	1990
Contribution (millions €)	427	481	498	525	552	574	601
Net earnings (%)	11%	14%	11%	8%	-1%	29%	16%
	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Contribution (millions €)	607	640	661	729	747	773	776
Net earnings (%)	15%	4%	-2%	6%	7%	6%	15%
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Contribution (millions €)	763	777	965	995	1096	1165	1213
Net earnings (%)	-3%	3%	11%	9%	5%	-16%	10%

Table 11 : Dynamic of the net earning for Natural disaster, source FFSA/Catastrophe naturelles. chiffres-clés 2004, in Thourot 2006, modified

The insurance companies, the CCR and the State made good benefit out of the system. Indeed, the insurance companies arrived to collect about 1 milliard of euros in 2004 (data from commission de contrôle des assurances des mutuelles et des institutions de prévoyance (CCAMIP) in commission report). 45 % of this money is spent for the constitution of the reserve defined as "provision d'égalisation", which is the money used for facing the natural disaster events. Each insurance company is controlled by the CGI (Code General des Impôts), in order to prevent the investment of the dedicated money .

However, the reserve and its constitution start to decline since 1992, which corresponds to an increase of flood disaster and the drought disaster was insert in the Catnat law (Table 11).

We can notice the impact of the different flood events on the net earning, like in the flood in Nimes in 1988 with deficit of 1% and the flood of 2003 with a deficit of the net earning about 16% (Thourot and Fougére, 2006).

The current accumulated reserve is still positive due to the previous good years but it will not sustain for the coming years when considering the increase of population and richness concentration in flood prone area . The cost of the damages increase more rapidly than the premium, there is no guaranty for equilibrium in the long term. In the period 1989-2003, the disaster cost increased with an average of 5.3% in euros when the incomes from premium rise with an average of 4.1% in euros per year (Rapport mission interministeriel, 2005).

Lack of incitation

The actual system is good but has disadvantages within the prevention. Thus, the law-maker decided to have a financial approach consisting by increasing gradually the rates of the

premium. The effect is that it increases the discrepancy between people who benefit from the Catnat regime and people who have a lower probability of risk (Rapport mission interministeriel, 2005). Another effect is that it contributes to weaken the prevention system because in practice the increase of the premium and of the deductible does not depend only on the "alea" neither on the implementation of recommendation indicated in the PPR. Indeed, the PPR is lacking mechanisms of incitation. The applications of the PPR imply measures that rely upon the capacity of control from the State that turns out to be extremely expensive. In octobre 2001, a report realised by the Senat concerning floods in the Somme expressed doubts about the material capacity of public power to insure the role of administrative police concerning the PPR application and of its respect by communes and by private owners. Public power suffers of employees and budget reduction and sees its power of action limited (Brinkhof, 2007). The compulsory contract imposed by the law-maker had certainly offered the opportunity to make more profit but also gave them the entirely responsibility of prevention against floods by controlling goods when establishing the contract. The fact is that in France, insurance companies have no clue of how to use the information such the "alea" defined in ppri. Nowadays, articulated around this logic, insurance companies propose contract based on the value of the goods (for example, for a house it refers to numbers of room, surfaces, etc...) without taking care of the type of "aléa". As explained in chap 1.4.2, there is a decline of the natural disaster reserve. The insurance company cannot take the risk to spend the money collected for the payment of the compensation in order to send expert and for developing tools that allows controlling the respect of the PPR rules. Therefore, the only possibility for insurance company to have money dedicated for prevention is to send expert for the control of the insured goods and to apply the increase of 12% on the premium if goods do not respect the PPR rules. In average, house damage insurance is about 200 euros; So, an increase of 12% of the premium represents the modest benefit of 24 euros. In consequence, insurance companies cannot play their role of prevention; and there is no pressure on insured people to respect PPR rules. It is the same mechanism for the modulation of the deductible. The control for the respect of the PPR is difficult and finally the cessation of the modulation depends only on the municipality who has to start the prescription for PPR and its adoption within 5 years. The cessation does not push people towards vulnerability reduction. The difficulties for the State managing the system and the reduction of the reserves show that the system is probably arriving to its limits (Rapport mission interministeriel, 2005).

The reform of the system

The different weakness of the system were tested especially after severs natural disaster and different study have been made. New text of law should be proposed in 2008. It will allow to implement a better incitation. The insurance sector is already reacting and preparing the direct effect of the new law.

Recommendation of the Inter-ministerial mission

The inter-ministerial mission was constituted in 2005 with the objective to make a diagnostic and to propose reforms of the system that should be voted in 2008. The mission proposed several recommendations and the following part will focus on proposition concerning directly flood events. The mission recommends reinforcing the financial stability of the CCR by excluding temporally the participation of the State on the total or on the partial cash dividend provided to the CCR. The mission would like to institute compulsory withholding taxes on the premium by a rate of 1/12 (1% on the 12% of the premium). The mission also propose to suppress the natural disaster decree or to remove its content: the mission would like the creation of an independent administrative authority or a council that will be responsible of the

decree publication. The actual decree could be replaced by decisions. The zones under natural disaster could be infra-communal, and the nature of the damages covered by the compensation should be more precise.

Reactions of the insurance companies

The reform (loi n°45, enregistrée à la Présidence de l'Assemblée nationale le 4 juillet 2007) proposed by the State generate emulsions within the insurance sphere, and the propositions are not completely approved. The FFSA (The FFSA, Féderation Française des Sociétés d'Assurance is an association representing 90% of the French insurance system and regroups anonym societies, mutual insurance society and reinsurance.) approve some of the reform proposed by the mission, such as the suppress of the natural disaster decree because the objective of this reform is to make more transparent the definition of the insurance cover. The FFSA would like to proceed step by step in order to define criterion objective for each type of events, then by testing its application on the coming disaster events. The final step will concern the preparation of the legal framework and its integration in the natural disaster contract. In order to avoid each insurance company to define their own natural disaster criterion, the project of the Law-maker propose to define the list of the events that could be defined as natural disaster. The list and the criterion will be implemented through a decree included in the legal regime with a State guaranty. The GEMA see in this part of the reform that the State wants to withdraw its responsibilities that will limit public help for expensive natural disaster. The money invested for the Catnat system is important and the State sees the insurance company as generator of incomes1.

The FFSA doubts about the replacement of the rate increase of 12% applied on the premium by a rate determined by the insurer in function of the risk exposition. Indeed, the FFSA indicates that the free price application may compromise the actual system based on national solidarity and mutualisation, it could destabilise the financial equilibrium of the system (Direction des affaires publiques, Dossier de presse du 30 janvier 2007).

The insurance system is difficult to change, it is a heavy administrative mechanic, however the insurance companies are interested in new approaches for understanding the risks by using new tools and the documents elaborated by the public services. The MRN (Mission Risques Naturels) regroup and propose tools and educational documents for improving the decision making when elaborating insurance contract and control of the prescription. (Cf Les outils d'aide à l'analyse de l'exposition aux aléas inondations pour les assureurs, les actes de colloques, 2èmes rencontre géographes et assureurs ».

4.4.2 The Netherlands

Compensation for damage due to flooding

This article will address the historical development of (political) decision-making and underlying legal principles regarding the issue of compensation for flooding damage in The Netherlands.

The survey will show that catastrophic events drive the political and legal process.

Recent floods

In 1993, the river Meuse had risen to dangerously high water levels. As a result, part of the southern Dutch province Limburg, approximately 21.000 hectare, had been flooded. Around

12.000 people were evacuated, 2.500 companies suffered major damages and 7.000 houses were flooded. The total damage amounted to a sum in between 100 and 150 million euro.

In 1995, The Netherlands, again, were affected by flooding. This time, the water of the rivers Meuse, Waal and Rhine had risen to the extent that dike breaches were threatening. About 250.000 people had to be evacuated. The government compensated the damages of people and companies to the sum of 180 million euro. The National Disaster Fund contributed another 40 million euro.

Taking into account the total amount of damage, it is clear that many people, (agricultural) companies and also infrastructure suffered severely from those events. The major question arising from this: is there a legal obligation to compensate water damage and how should compensation be regulated in The Netherlands?

Insurance

Basic principle in Dutch civil law is that every person has to carry his own damage. Compensating damage for other parties is only possible if a good reason exists to do so. One such reason can be an agreement between two parties, for instance by means of an insurance policy.

In 1953 the province Zeeland suffered from a flooding disaster. Almost 2.000 people died and many thousands had to be evacuated from their lands. Insurance companies then were only obliged to make minor payments, because damage due to flooding was not covered by the insurance policies. After this national catastrophe, the insurance companies became aware of the fact that in case of major flooding, their financial resources could not in any way cover the total costs of the damages. This awareness led shortly thereafter to a decision of the association of insurance companies not to insure flood damage. Not only the enormous amount of damage, but also the lack of statistical information (in order to calculate the premium) and the fact that only a small group of citizens in The Netherlands would benefit from a flood insurance, were mentioned for the unwillingness of insurance companies. Under pressure of the European Union Commission, the association of insurance companies had to withdraw its own members' scheme on the basis of making prohibited trust agreements. The situation in The Netherlands regarding flood insurance however did not change and as a consequence until this day no insurance company in The Netherlands has offered any flood insurance.

Wrongful Act by government

Dutch civil law stipulates that in case someone or some party can be held responsible for causing damage unlawfully, the victim must be compensated. In case of a flood, as in all natural events, it might seem impossible to pin responsibility on another party. This could be the case if, for instance, mistakes were made that resulted in flood damage. Many questions can arise from such a situation. For example: is government responsible because it did not take the required measures to avoid the high waters? And: can government be held responsible for damage to buildings in designated flood prone areas?

In addition to this, the national government has to deal with various other interests, quite apart from safety. For instance, the protection of nature and landscape or pressure to keep building targets for local government might compromise safety aspects. Besides this, and on a very practical level, government has only limited financial recourses to take protective measures, a

factor also bound to affect the decision-making process. Government is obliged to balance possible conflicting interests and this is one of the reasons why it is so difficult to hold it legally responsible for damages as a result of natural events. In the aftermath of the 1993 and 1995 floods, the victims were also confronted with this legal obstacle in their attempt to uphold their case in court against the government.

In general there was no legal obligation for either insurance companies nor government to compensate damage caused by the high waters. We will examine the question who paid for the damage in 1993 and 1995 and how the damage compensation at present is regulated here below.

System of compensation

A closer look at the situation in 1993 and 1995 shows that a huge amount of money was paid by 'Het Nationaal Rampenfonds' (The National Disaster Fund). In the end, this fund compensated damage for, in particular, private persons. In order to compensate (agricultural) companies, the national government initiated emergency regulations. The main reason was to avoid bankruptcy and loss of employment due to the flooding. Moreover, minor contributions were made by the European Union and local government. As one can learn from the government response to the 1993 and 1995 flooding, The Netherlands do not have a structural system for compensation due to flooding. The national government relied on ad hoc policies and (private) incidental funding. In order to improve legal certainty for potential victims, assure equal treatment of the victims of disasters and reduce political intervention in ad hoc policies, it became evident that a more structural system was necessary.

In order to address the issue, the national government initiated a bill in which every citizen effecting an insurance of goods or a building insurance would have to pay a compulsory contribution to a flood and earthquake fund. The fund's resources would be used to compensate the damages. This proposal for compulsory contributions is very similar to the French system of damage compensation. However, the proposal never became law because the Council of State advised negatively on it. The lack of a provision for financial contribution of the government was the main argument in the rejection of the bill. According to the Dutch Constitution, the government is responsible for the habitability of the country and therefore obliged to contribute in some way.

Scope of the Law Damage Compensation

In 1998, the national government introduced the 'Wet tegemoetkoming schade bij rampen en zware ongevallen' (Law Damage Compensation). This law, based on the Belgian compensation system, provides damage compensation in case of natural disasters and defines the claims and procedures in general. In this scenario the compensation will be paid from general means, i.e. tax income of the government.

Definition

The law, mentioned above, is enforced when a fresh water flood or earthquake occurs. It defines floods as: a) high waters, caused by the part of the Meuse which is not embanked and has a flood risk less than 1/50, b) flooding of a river which is not embanked, and c) the collapse or overflow of dikes. Besides this, the fresh water flood has to be qualified as a 'disaster' or 'serious accident': the event must cause a serious threat to public safety, material

damage occurs, and the deployment of various help and rescue services, e.g. fire brigade and police, are involved.

For the part of the Meuse where the high water protection is not yet completed, high waters can be defined as: high water levels caused by the part of the Meuse which is not embanked and has a flood risk less than 1/10. In this situation the 'disaster' criteria is not applicable. This 'temporary' exception is made because the Law Damage Compensation should protect solitaire building locations in the winter bed until the high water protection is completed.

Salt water disasters are excluded from the definitions in the law. With the construction of the Delta works after the 1953 catastrophe, a salt water flood is not likely to occur. For disasters other than floods and earthquakes this law could also be relevant, however in those cases a separate government decision is needed to enforce the law for those disasters.

Damage categories

In general, damage to houses, household effects, public infrastructure, assets, costs of evacuation and rescue is compensated. The law does not contain a limitative list of damage categories, which means that other damage can be compensated, requiring a separate government decision.

Restrictions

It should be noticed that the Law Damage Compensation contains some important restrictions. Firstly, damage will not be compensated if it is possible to insure the damage and/or if the damage can be transferred to others. Damage to for example ships and motor vehicles will not be compensated because these are insurable. Secondly, if the damage can be contributed to the victim's own fault or the victim did not take enough measures to avoid or reduce the damage, the law is not applicable either.

Another restriction is that the law compensates only part of the damage. The government justifies this in pointing out that it has no legal duty to compensate and moreover it is not possible to make use of the general means unlimitedly. In this argumentation the victims of a disaster also have their own responsibility.

Finally, after the high waters in 1993 and 1995 the government introduced the Beleidslijn Ruimte voor de Rivier (Policy Line Space for the River). The policy substantially restricted building in the riverbed. For buildings, which were built in the riverbed after the introduction of the policy, and changes to already existing buildings, the Law Damage Compensation is not applicable.

In 2006, this policy was replaced by the Beleidslijn Grote Rivieren (Policy Line Large Rivers). The new policy maintains the basic assumptions of its predecessor and emphasizes that the initiator of activities taking place in the riverbed, is in principle responsible for the damage, since high waters in the riverbed can not be qualified as a disaster.

Compensation

The Law Damage Compensation does not regulate the exact amount of compensation for the various categories of damage in advance. After each disastrous event the government will regulate the level of compensation by separate arrangement, depending on the overall amount of damage and costs involved. Under the terms of the arrangement a citizen's or company's

own risk can be taken into account, as well as a minimum and maximum amount of damage compensation for the various damage categories.

Execution of the Law Damage Compensation

Since its introduction, the Law Damage Compensation has been enforced four times. Twice in 1998 after heavy rainfalls, then in 2001 after the failure of a dike caused by drought and finally in 2003 after the flooding of the Meuse in Limburg. Only in the latter instance, the law was enforced automatically, in the other three cases a separate decision of the government was needed to activate the law.

In 2003 a large part of the province of Limburg, the area along the Meuse between Eijsden and Gennep, was inundated. For this part of the Meuse, the flood protection had not been completed, and therefore to be classified as: high water levels caused by the part of the Meuse which is not embanked and has a flood risk less than 1/10. This event was directly covered by the Law Damage Compensation.

In another part of Limburg, near the area of Tegelen, a broken dam caused flooding. In this occasion the law was also enforced: the government applied the criteria 'disaster' to the unforeseeable failure of the dam causing a huge amount of material damage. The government compensated various damage categories to citizens and companies in the flooded areas.

The table below shows an example of the compensatory regulation for damage to household effects of citizens in 2003. In this regulation both a maximum amount of damage compensation and an amount of own risk are taken into account.

Table 12 : Compensatory regulation for damage to household Source: Ministry of Internal Affairs, EB2003/50646, 2003

Damage to household effects (in euro)	Compensation
0 – 9.100	90%
9.100 – 13.600	75%
13.600 – 27.200	50%
> 27.200	0%

Since the introduction of the Law Damage Compensation in 1998, a number of changes have taken place in the area of insurability. Certain categories of damage have become insurable, like damage due to heavy rainfall. As a consequence the law is not relevant any longer for such an event. Up to the present a flood insurance for people living in 'risky' areas is non-existent although at times such a possibility is mentioned in the debate.

For damages due to flooding, which are not insurable or transferable to others, the Law Damage Compensation in The Netherlands is still the only option for compensation claims.

5 Synthesis and perspectives (J. Spits, M. Fournier, J. Serrano)

In this chapter we will analyse the main differences and similarities between the Middle Loire River in France and the Sandy Meuse in the Netherlands. First we will focus on the definition of flood prone areas. Secondly, we will have a closer look on the urban developments in the field and discuss the policy evolution. We conclude with explaining the attitudes of authorities regarding building in riverbeds in France and The Netherlands.

The Middle Loire River in France has specific characteristics. Therefore, the Loire River cannot unconditionally be generalized towards a country scale. The same counts for the Sandy Meuse River in the Netherlands. Therefore, the comparison in this chapter will merely focus on the scale of the rivers Middle Loire and Sandy Meuse and less on a comparison on country scale.

However, the rules and regulations of the Middle Loire are generic at country level. The same counts for the Sandy Meuse regulations. This means that a comparison on the rules can be done towards a country scale to a large extend.

5.1 Riverbeds and flood prone areas

The riverbed characteristics of the Middle Loire River in France and the Sandy Meuse River in the Netherlands are very comparable. The hydro-geomorphological history of development of both rivers is similar. Both riverbeds are located in a wide river valley which is the result of a long-term vertical incision of the river in the underlying soil. The riverbed in the natural valley is bounded by vales and higher grounds. The water level of the river can easily fluctuate due to rainfall and the river will frequently flood the vales. The higher grounds are the boundary of the flood prone areas in the natural riverbed.

However, in the course of time man has occupied the riverbed started to use and build in the flood prone areas. To protect the issues like houses and agriculture, people started to build canalizations, dikes and dams. The process of urban development in riverbeds appears to be a long term and ongoing process till today. Nowadays, many people are actually living and working in these flood prone areas or are economically involved in stakes in these areas. In response to this development, the rivers have been more and more regulated by dikes, quays and dams. On the Loire River, the protection system has been grounded mainly on dikes and some spillways. Lately (1980s), dams have been added in the upper part of the river basin. Villeret which is the most important dam built for flood control on the Loire River can lower a flood about 40 cm. This process of urban development and the accompanying river regulations have changed the riverbed characteristics.

The Loire has become more and more an embanked river, especially the Middle Loire: from Bec d'Allier to Saumur, the Loire is nearly totally embanked (with dikes which are about 8m high). Houses are directly built behind (and sometimes on) the dike. The protection of the floodplains has resulted in a narrowed and embanked riverbed. The main land use of the floodplains is housing, agriculture and industry. On the Loire River, the level of protection is about 1:100.

The Sandy Meuse River in the Netherlands is situated in a valley comparable to the Loire. The Sandy Meuse River also has become more and more embanked especially at the cities and villages. The main land use along the Sandy Meuse is agriculture (grassland and arable land), water and buildings. The level of protection differs between 1:50 years to 1:250 years..

The actual protection level depends on the progress of the so called project Meuse Works. These are room for river measures (river bed widening and deepening) and flood protection measures along the upstream part of the Meuse River in the Netherlands. After the realisation of the project Meuse Works in 2015, the level of protection along the Meuse is 1:250 years for 70% of the residents

Due to its riverbed characteristics, the Sandy Meuse River has the highest rate of building of all Dutch rivers. However, the Sandy Meuse river situation is an exception and is not representative for the general Dutch river system which is dominated by the Dutch delta system.

The Dutch delta

Mostly all major river sections in the Netherlands like the Rhine River, The Scheldt, IJssel River and the downstream part of the Meuse River are situated in the Dutch river delta (the Sandy Meuse River, upstream from Arcen near Nijmegen to Eijsden at the Belgium border, is the only Dutch river located in a valley, similar to the Loire). The Dutch river delta is below sea level and covers largely the western-northern part of the country. This low part of the country has been reclaimed on the sea and rivers by building dikes and dams. Without flood defenses, this low part of the country (about 65% of the total surface) would be flooded. Since this flood prone area is lower than sea level, the effects of a flooding would be severe. The flood depth and flow velocity will be very high and will cause an immense damage behind the dikes and probably many loss of life. Therefore, the protection level against flooding is very high with high and strong dikes. All rivers in the delta are completely embanked systems with a strict flood protection level of 1/1250.

The water discharge is strongly regulated by dikes. The so called winterbed of the river (main channel and floodplain) is strictly bounded by the high dikes. The land use planning of the winterbed is strongly dominated by its water discharge function and hardly tolerates buildings for housing or land uses that could be an obstruction for the water discharge.

5.2 Definition of floodplains

For all rivers in France, the demarcation line of the floodplain is drawn at the higher ground, representing the highest known flood level. This level is determined by a combination of hydro-geomorphological methods, historical studies and local constraints (i.e. agreements with local actors). No actual flood defenses like dikes are taken into account for the drawing of the demarcation line. The definition of floodplains is similar for all river systems in France.

In the Netherlands, the drawing of the demarcation line of floodplains depends on the river system. The floodplains of the Sandy Meuse are defined quite similar to the French floodplains. The demarcation line is drawn at the higher grounds, representing a standard risk level of 1/1250. In practice, this border is a combination of historical studies to the (highest) known flood levels at higher grounds. If no historical data are available, then hydro-geomorphological methods are used to estimate 1/1250 flood level. Finally, local constraints can be applied such as agreements with local actors (like ‘article 2a areas wbr’).

However, most of the Dutch floodplains are along the rivers in the lower part of the country (below sea level) and are drawn by taking into account the flood defenses. In this Dutch delta, the demarcation line of floodplains is drawn at the top of the dikes. The demarcation line is exactly covering the standard flood risk area of 1:1250. This means that the floodplains here are not representing the highest known flood level.

Since the number and length of rivers stretches in the Dutch delta are by far predominant, their characteristics and definitions are fairly dominant in the national debates and policies about rivers.

5.3 Policy evolution

The policy evolution in France and Netherlands does show strong parallels and some remarkable differences.

After World War Two

Urban expansion in riverbeds

Parallel policy evolutions appear in France and Netherlands from Second World War to the midst of the nineties. The urban development in riverbeds had a similar growth than in areas that are not flood prone. Due to the strong demographic growth and economic development after the Second World War, many houses and factories were built. The riverbeds appeared to be attractive sites for building mainly because of their vicinity to the center of historic riverine cities and villages. In the former, historical times, people mainly built on the natural higher grounds and hills because of the flood risk. In the period of urban expansion after the Second World War, this flood awareness appeared to have been neglected and abandoned.

In the Netherlands the general flood strategy was strongly focused on flood protection. The general aim has been to keep the water away from the people and the stakes. The flood strategy in the Dutch delta consisted mainly of always raising the dikes. This had been resulting in rivers and streams in a tight and narrowing corset. Since long times, the general attitude has been fighting with the water which turned out to be very successful.

In addition to this general flood strategy focused on protection against flooding, the building of houses and industries behind these dikes continued as well. Especially along the Sandy Meuse River in the Netherlands, the urban growth appeared to be strong compared to the other Dutch rivers. The wide extended vales of the Sandy Meuse appeared feasible for building, whether or not in combination with flood protection like dikes and quays. Especially the villages and cities were likely to protect.

The French general flood strategy is similar to the Dutch strategy: the ambition was to totally protect the vales with dikes, dams and sometimes spillways when they were already built. The aim was to keep the building in the vales in combination with protection against flooding. Along the Middle Loire, centuries ago, the flood protection has sometimes been weak and very old houses were built taking into account the flood risk. But along the second part of the 20th century, this awareness of flood risk declined. In fact, all along the 20th century until the 1990s roughly on the Loire, there was a belief works would be sufficient to prevent any flooding in the vales. The programs of reinforcement of dikes on the Loire have been launched both in the 19th century and in the 20th century (1970s and is still going on). More recently, the abandonment of some dam projects, new floods events in France and in Europe, as well as new hydraulic models revealed that the dike system was quite weak in some places and that there was a major risk remaining.

The recent past

Shock events

In 1993 and 1995 high waters and flooding have been a shock event in North West Europe, resulting in a clear shift in policy. Due to extensive rainfall, most cities and villages along the upstream river Meuse in the Netherlands were flooded. The Rhine branches in Germany and Netherlands were all facing very high waters. In the Netherlands many people were forced to evacuate extended areas prone to flooding. France also was dealing with high waters and severe flood damages during winter 1993.

In the Netherlands it became very clear that the flood strategy at that time was no longer sustainable. Along the Sandy Meuse the flooding caused severe damage. Here the water flooded the vales and their urban settlements. The Dutch rivers in the lower delta were facing a maximum water level raised to the top of the dikes. Eventually no dike breached or has been overtopped. By way of precaution, many people have been evacuated from the flood prone areas. During these floods, no people have died.

Along the Middle Loire, the new flood events as well as new hydraulic models revealed that the dike system was quite weak in some places and that there was a major risk for flooding. However, because the last flood dated from about 150 years ago, the flood awareness of inhabitants and policymakers had reduced.

Protecting the existing riverbed

Both France and the Netherlands responded in the same general way to these flood emergencies: a strong protection of the riverbed and remaining expansion areas against new urban settlements. The long time urban sprawl in the riverbed had turned out as a main factor for the reduction of the riverbed. The urban development in the past is regarded as one of the main causes for the current high water and flooding. At the same time it appeared that many high economic stakes like cities and working areas were at flood risk.

As a result, the protection of the existing riverbed had become strictly regulated in France as well as in the Netherlands in 1997. In both countries in principle no new building in the floodplain was allowed. Only enlargement of existing buildings to some extend has been allowed.

More room for river

In the Netherlands, creating more room for river has been introduced beside the above mentioned protection of the existing riverbed. Making new room for river is an even more drastic approach beyond protection of the existing riverbed. In 2000 the Netherlands took a national decision ‘room for river’ including river widening and deepening. “Room for river” measures are widespread along the Dutch river systems. The general aim for the Rhine branches is to raise the total discharge capacity from 15.000 m3/s in 2000 to 16.000 m3/s in 2015. Examples are the dike relocations in Nijmegen and lowering of groynes on 70 km Waal river stretch from Nijmegen downstream to Zaltbommel. Along the Upper Meuse a similar room-for-river project will increase the discharge capacity in 2015. Here also dike relocations and lowering of floodplains are planned and executed. The discussion about the possible necessary discharge capacity for the year 2050 has already started. For the Rhine branches 18.000 m3/s might be necessary taking into account effects of climate change.

On the Middle Loire, new room-for-river projects are less common and very local. Room for river is not applied in a structural way. Only local pilot room-for-river projects have been planned or initiated. In the city of Blois along the Middle Loire River, a project is running to maintain the discharge channel of La Bouillie. Due to the fact that the last use of the spillway dated back from 1907, the memory of the risk has been decreasing. During the last century, the city of Blois has been expanding with new urban settlements located in this spillway. The aim of the running project is to remove the buildings located in the discharge channel and give more room for high waters. Because of local settings, this spillway is necessary for the water discharge capacity when the Loire reaches a maximum water level.

In France, the future strategy will be a combination of structural and unstructural measures. The example of La Bouillie is firstly a failure because the discharge channel has been partially occupied by houses. Now, authorities have to deal with the destroying these houses. The State has planed to realize 40 spillways along the Loire River. But this objective is strongly linked to the will of decrease the vulnerability of the activities and to the need to associate local people.

Economic stand still and decline

It appears that the policies for protecting the existing riverbed and creating more room for river in France and Netherlands are very efficient to guarantee or increase the flood safety of the river system.

Within the Dutch context, the strict ban for new building in flood plains is often related with strong negative side effects. Especially the decline in economic development of the floodplain areas is often mentioned. However the precise numbers are unknown, this economic decline was directly related to lack of development of new buildings and activities. Moreover, also the existing activities and stakes came more under economic pressure. In the end, activities were marginalized, closed or relocated elsewhere. People like employees and inhabitants moved away in the course of time or are in a difficult position at the moment. A good example of this last argument are greenhouse entrepreneurs in the riverbed near Venlo. A rule of thumb is that a healthy greenhouse company has to double in area every ten years to maintain economically healthy.

This process of economic decline contributed to a general deterioration of the floodplain areas. This process strongly affects the attractiveness and functionality of these areas. Also along the Sandy Meuse River, several hotspots of economical decline in the floodplains can be identified. The floodplain areas which are primarily used for recreation and industries are most vulnerable for economic decline. Here the urban expansion appears to be crucial for a sustainable development of the area.

In France the ban on building did not lead to an economic decline in municipalities as it did in the Netherlands. Maybe the reason is economic development has been severely controlled but not completely forbidden. We can distinguish a first stage during which the State administration has been really tough on regulation and tried to implement it as strictly as possible (beginning of 2000s). But then, taking into account reality of many municipalities along the Middle Loire, negotiation started and development opportunities remained, for instance in municipalities which were totally located in the riverbed. These opportunities are clearly identified and delimited in the regulation documents. Municipalities, in most cases,

can still develop in already urbanized areas (so, in all areas that are already built, activities can still develop, as long as constructions are adapted to the flood risk). But, municipalities cannot expand the urban pattern anymore in the flood-prone area: all natural or agricultural lands located next to the city and in the flood prone area must remain “empty”. It corresponds to all Red (or A) zones. There is an exception where development is forbidden in an already urbanized area. Any new development is forbidden in all urbanized areas located in a high risk zone (level 4).

Current urban developments

In the Netherlands building in riverbeds is allowed again under strict conditions after a ban on building of circa 10 years. In France the urban development actually still continues although the strict regulations of the PPRi to limit the urbanization in flood prone areas. However, as well in the Netherlands as in France, the new buildings in floodplains are merely on a low profile and small scale.

In the Netherlands the economic situation in the river areas worsens after a ban on building for 10 years. Without any success local entrepreneurs and developers continuously had been requesting and claiming for new building permissions widespread in the riverbed. None of these project proposals had ever been honored because of strict river safety policy. However, from an economic point of view, most of these project proposals would be desirable.

In the Netherlands recently a new policy became effective to regulate building in riverbeds. Most striking and new is the fact that from now on building is only allowed in combination with creating more room for the river. In 2005, the Ministry of Public Works, Transport and Water Management jointly with the Ministry of Spatial Planning and Environmental Issues appointed 15 locations for experimental building in the riverbed. These small scale experiments are a first step to a new approach for urban development in riverbeds. The building takes place under strict conditions:

- The building has to be a flood adapted construction, like floating or on pillars

- All the projects have to create more room for river in the vicinity of the building plot.

- The building works in combination with the room-for-river measures are privately funded.

The selected locations were mainly hotspot areas because of their drive for investment. Initiators have been submitting several requests for building in the recent past. At some locations, matters appeared very difficult and complex and had been taken to the highest court.

This completes the policy shift in the Netherlands from solely flood protection by dikes towards more a more balanced approach of flood protection in combination with flood damage reduction. The latter mainly explained as flood adapted building like floating houses or on pillars.

In line with and following these experiments, the new national policy Large Rivers in 2006 generally allowed building in riverbeds. The conditions to meet are:

- All the projects have to create more room for river in the vicinity of the building plot.

- The building works in combination with the room-for-river measures are privately funded.

In France, maintenance and realization of the system of protection against floods on one hand and development of zones liable to flooding on the other hand are managed at two different levels. The State takes maintenance, strengthening of dikes, realization of spillways. It tries to favour a quick evacuation of waters by restricting impediments to water flows. In regulations of PPRi, he can forbid the erection of fences around gardens and impose a coefficient of building lower than 10 %. It is also his services which draw the maps of risk. Inside these frames (see above) municipalities have freedom to decide their own development.

However, today the discourse from the State administration and decision-makers is that the risk of flooding is never null and that all those houses, enterprises, infrastructures should be adapted to the flood risk. In Orleans along the Middle Loire, a pilot project has been started to reduce the flood vulnerability of existing houses. The aim is to reduce the potential flood damage of these houses. Houses are made more wet-proofed by realising measures like a separated electric circuit between the first and second floor and putting tiles on the first floor and stairs. This project focused on the reduction of potential flood damage by adapting the existing houses will be evaluated and might lead to a more substantial element in the flood strategy along the Middle Loire.

The Netherlands are more focus on water proof settlements than France. “Innovative houses” compensation measures are few developed in France where as it is the heart of the Dutch development policy in flood areas.

5.4 Practices of municipalities

Generally, the local municipalities in France as well as in the Netherlands are favoring urban development. The main idea is that urban development is beneficial for economic development and will enhance the prosperity of the community as a whole. Restrictions on building because of river safety are not always agreed on by municipalities. Mostly municipalities intend to emphasize urban development over river safety issues. They admit the risk and they try to benefit as much as possible of the possibilities that the PPRi regulation is implementing and therefore keep developing in the areas where it is granted.

Along the Middle Loire the position of a municipality towards building in flood prone areas seems to depend on its location towards the river and the availability of alternative building areas. Along the Sandy Meuse River the attitude of municipalities seems to be merely defined by the capacity of administration and knowledge and experience with building in flood prone areas.

Along the Middle Loire there are many communes that are located in a floodplain area. We can roughly distinguish communes that are completely in a floodplain area and communes that are partially in a floodplain area. The communes who are partially under flood risk tend to plan new urban developments mostly in the areas outside the floodplain. Main reason is the flood risk. The communes which are entirely under flood risk are facing a possible land lock. The planning of new urban developments can be more difficult. The possible solution for these municipalities is the spreading ‘in’ of urban development within their current urbanized area. This means the use of open spaces inside the urbanized areas for the realization of new buildings. Contrary to this process of spreading in, municipalities that are not facing any flood risk usually tend to spread out their new buildings in the open space outside their existing urbanized area (i.e. to ‘inpand’ instead of to expand).

Along the Sandy Meuse River a similar situation of municipalities under flood risk exists. However, the average area-size of Municipalities in the Netherlands tends to be generally larger than in France. The relatively larger area-size of Dutch municipalities is a result of the merge-process of municipalities to enhance scale efficiencies. For the Sandy Meuse River this means that most municipalities are only partly under flood risk. A few municipalities are entirely under flood risk. The response of municipalities that are completely or partially in the floodplain is similar to the municipalities along the Loire. The municipalities completely under flood risk tend to realize new urbanization by spreading in.

Additionally, the recent regulations in the Netherlands allow again the building in floodplains under strict conditions. This set of rules opens new opportunities for municipalities for urban developments in the floodplains. Although the option for building is quite recent and therefore difficult to evaluate, it is already clear that municipalities respond in different ways to these opportunities. Along the Sandy Meuse River the larger riverine municipalities like Venlo (housing projects) tend to be far more pro-active to develop new urbanization in flood plains. Also municipalities with extensive water recreational areas that are bound to the Meuse river such as the municipality Bergen (recreation area ‘t Leuken) and municipality of Roermond (Meuse lakes) are pro-active with new urban developments. The smaller municipalities tend to be more neutral when it comes to new urban developments in floodplains. Part of the explanation could be that the river management in combination with land use planning is getting more and more complex. The realization of new urbanization requests much expertise and knowledge. Probably is this high level of expertise and knowledge a barrier for a small municipality with a limited capacity for new developments. Finally, it is also to be expected that some municipalities are reluctant towards new urban developments in floodplains because of other arguments like nature conservation or bad experiences with urban developments in the past.

5.5 Future expectations

In the Netherlands the new set rules which allows building in floodplains has been launched In the Netherlands the new set rules which allows building in floodplains has been launched in 2006. This makes it difficult to draw conclusions for the future. The conditions for building seem important for the future urban developments in riverbeds in the Netherlands. Especially the condition that building of houses is allowed only in combination with creating more room for river might play a crucial role in the future river development. Besides this, the European Flood Directive could have an effect on the way planning in the Delta is arranged.

Looking at the future challenges for the river we are facing such as climate change and multifunctional land use, it is expected that the water levels will rise further and peak discharges become more frequent. This means that, on the long term, we will need substantially more room for river in the future to handle these higher water discharges. This more room for river could now be realized in combination with new urban development. The idea is that urban development might become the main economic driver for realization of more room for river in the future. This means that the future developments of the riverbed and urbanization will become more integrated in the (multifunctional) land use planning and financing mechanisms for these developments. In this way the budget for more room for river will (partially) be funded by private funding.

In France the future expectations for urban development in riverbeds are less clear. It is expected that the set of rules will not change on the very short term. Maybe the next European

Flood Directive will make French State strategy evolve. For the moment, this means that new urban developments are not combined with creating more room for river. This means that the budget for creating more room for river in the future will be paid by merely public funding. It is not clear if France is tending towards a similar policy evolution as the Netherlands.

The process of urban spreading in will continue in the municipalities that are completely in the floodplains.

Along the Middle Loire, some pilot projects are running and aim to make existing houses more flood proof (in the val d'Orléans for instance). This project for the reduction of the potential flood damage of houses might be successful. In the case that this flood damage reduction is evaluated positively, it might be applied on a larger scale.

However, the role of the French insurance companies seems also important when it comes to reduction of potential flood damage. So far the insurance continue to compensate flood damages. As long as the compensation of the flood damage is covered by the insurances, there will be no real economical incentive for property owners to make their house more flood damage resistant.

In some way, we can say that the principle of solidarity is favoured to the principle of responsibility.

5.6 Concluding remarks

The following concluding remarks regarding the research can be made.

- Both the Middle Loire and the Sandy Meuse river originated in a natural river valley. However, in the course of time and the land use planning by man, we now can consider the Middle Loire and the Sandy Meuse as merely embanked rivers. The dikes on the Loire constitute a real channel.

- So far, sea level rising is not a big concern in the Loire River flood planning. The threat of sea level rising is less important in the Middle part of the Loire valley.

- High consideration for technical solution to build in flood plain is common in France and the Netherlands. It is evolving in France since dikes could still break.

- The lesson learnt from the shock event has been that the urban development and land use planning in the past appeared to be a main factor in reduction of the riverbed.

- There seems to be a difference in planning culture between France and the Netherlands when it comes to urban development in riverbeds. In the Netherlands the approach seems to be more opportunistic while in France the strategy and policy appears more restrictive.

- In the Netherlands, there is an innovative policy, trying to experiment new types of building philosophy. In France, the philosophy is much more about avoiding building in flood plains. The idea is based on the fact that most cities can expand further (on the plateau). The only case study where experiments might be starting is in the city of Nevers. The city is very much inspired by the Dutch case and intends to build adapted houses once a new discharge channel is built.

- Environmental concerns are differently taken into account in French policies. Between the dikes, in the embanked river bed, it is important to control expansion of alluvial forests as they are obstacles to the water flow. Those forests reveal that traditional uses of those areas have disappeared (grazing) and they have led to a closing of landscapes. In the floodplain, behind the dikes, natural areas are still plenty and little by little there is a rising awareness that some trees are more interesting for biodiversity or ecosystems than others. This is why, in some places, poplar trees are cut and replaced by some other species. Eventually, one should highlight that the State Services are now very concerned about environmental issues. For instance, there used to be hard works (with caterpillars) in the embanked river. Now, the strategy is more to cut the forest little by little in smaller patches and then let the water continue the work. So, in that perspective, environmental concerns are existing. But obviously, within the embanked river bed, safety is the main issue. The Plan Loire Grandeur Nature intends to take it into consideration, but the main topics of municipalities are building in flood plain, developing economic assets and revising the PPRi.

- The Dutch government has initiated a national flood program, with the purpose to maintain the flood protection norms on river basin level taking expected changes in the river discharge characteristics into account. Financial resources are prearranged. The emphasis is on the improvement of discharge capacity without reinforcing the dikes.

- In France the flood risk approach is mainly on local level, with the purpose to reduce the flood damage on local level. There are no structural large scale projects aimed on the improvement of the discharge capacity.

- Considering damage compensations the following conclusions can be draw. The main difference between the legal systems of flood damage compensation is the possibility to assure flood damage. In France, a law based on the hybrid system of collaboration between the State and the insurance companies was introduced in 1987. The idea was to make a justified insurance system by collecting money from every French citizen to compensate natural disaster damage. This means, in France, annual damages costs are shared between a great numbers of insured people. In the Netherlands, however, insurance companies do not offer insurances which cover flood damage because of the enormous amount of damage, the lack of statistical information (in order to calculate the premium) and the fact that only a small group of citizens in the Netherlands would benefit from a flood Insurance. In the past damage compensation due to flooding was based on ad hoc policies in case of disasters. In order to improve legal certainty for potential victims, assure equal treatment of the victims of disasters and reduce political intervention in ad hoc policies, the national government introduced the ‘Wet tegemoetkoming schade bij rampen en zware ongevallen’ (Law Damage Compensation)..

List of figures

List of tables

Table of contents

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