NATURAL DISASTERS AND SUSTAINABLE SPATIAL DEVELOPMENT : PREVENTION OF FLOODS

LES CATASTROPHES NATURELLES ET LE DEVELOPPEMENT TERRITORIAL DURABLE : LA PREVENTION DES INONDATIONS

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Zbigniew STRZELECKI, Under Secretary of State – Vice President, Government Centre for Strategic Studies, Poland

Ladies and Gentlemen,

I have the honour to welcome you to the International Cemat Conference: "Natural Disasters and Sustainable Development – Prevention of Floods".

The problems which will be discussed today, in its essence needs the co-operation:
– between different public services;
– between different levels of public authorities;
– across many sectors of economy and social life;
– between States and nations.

So it is not surprising that this problem was taken up by the Council of Europe. Our institution – Government Centre for Strategic Studies – was also interested in this topic because we see its spatial and regional dimension, we are responsible for in the Polish government.

If it was decided to organise this conference in Poland: the obvious choice of the concrete place was Wrocław. This city is a symbol of tragedy of natural disaster especially because of the flood of 1997. Wrocław is also the symbol of success, not for the first time in its history: actually the consequent rebuilding after the flood is an example of the constructive thinking and prudent planning for the future – on the basis of negative experiences.

In this city several new ideas and concepts were successfully implemented, which concern the over-regional co-operation in the basin of a big river.

I do hope that today's meeting will contribute to better understanding the need of co-operation for reducing the risks of natural disasters. And I hope you will stress the role of good planning within this complex problem. It would give an important input into the declaration, which will be adopted in September in Ljubljana. We will sign this document on behalf of the Polish government. I'm convinced that the topic you will discuss today should be reflected in Ljubljana Declaration.

I wish you a fruitful day in Wrocław!

Margarita JANČIČ, Chair of the Committee of senior officials (CSO) of the Conference of Ministers responsible for regional planning of the Members States of the Council of Europe (Cemat)

Ladies and Gentlemen, Dear Colleagues,

I would like to welcome you on behalf of Cemat and of the Committee of Senior Officials at this International Conference on the "National disasters and sustainable spatial development: prevention of floods", organised in the framework of the activities of the European Conference of Ministers responsible for regional planning in co-operation with the Polish government's Centre for Strategic Studies and the City of Wrocław.

I would like to thank the Council of Europe – Spatial planning and landscape Division –, and particularly the Polish authorities and representatives of the City of Wrocław for all their efforts to offer us a pleasant stay in this beautiful city, and excellent conditions for our work.

In a few words I would like to introduce the Council of Europe's European Conference of Ministers responsible for Regional Planning known as Cemat. Cemat brings together the representatives of the Council's fourty-five Member States, which are responsible for spatial development and united in their pursuit of a single objective: sustainable development of the European Continent.

By implementing the principles defined in the "Guiding Principles for Sustainable Development of the European Continent", adopted in Hanover in 2000, the Member States and their Cemat Committees of seniors officials are:

- promoting the implementation of the Recommendation of the Committee of Ministers of the Council of Europe – Rec (2002) on the GP Resolutions adopted at the 12th Cemat Session in Hanover in 2000,
- contributing to the implementation of actions identified in 2002 by the World Summit on Sustainable Development held in Johannesburg,
- assisting the preparation of proposals for the 13th Cemat Session to be held in Ljubljana, Slovenia, on 16 and 17 September 2003.

After this short introduction let me introduce the today's Conference.

It was in September 2002 that the President of the Parliamentary Assembly of the Council of Europe, Mr Peter Schieder, addressed a letter to Mr Janez Kopač, the Slovenian Minister for the Environment, spatial planning and energy and the Chairman of the upcoming 13th European Conference of Ministers responsible for regional planning, concerning the tragic consequences of floods which devastated several areas in Europe in the summer and autumn of 2002.

He proposed to give priority to the issues of floods within Cemat activities. Consequently, the Committee of senior officials of Cemat expressed a wish to organise an international conference on natural disasters concerning, in particular, the prevention that will reduce damage caused by flooding.

At the very beginning I would like to stress the fact that the increasingly frequent floods in river basins cause enormous damage, and we are convinced that the spatial development approach can contribute to prevent this damage. The Conference should contribute to the definition of priorities for co-operation.

The main objectives of this Conference are:

1. To analyse the reasons and causes of major disasters:

– What is the role of the change of climate – particularly the quantities of rainfall and its seasonal distribution, and if and how can we reduce activities with impact on the global climate?
– What are the consequences of river basin engineering works undertaken in the last centuries, which resulted in the reduction of retarding basins, (catchment areas)?
– What is the role of the changed land use, for example, the increasing built-up areas or changed land cover?

2. To exchange the knowledge and experiences about the approaches and methodologies of activities in developing spatial development policies or flood prevention policies.

3. To discuss the role of spatial development and spatial planning in the policy making process, and define the priority activities we should undertake in preparing and implementing the policy decisions aiming to reduce the damage caused by flooding.

I hope you will share my conviction that the problem of floods is an outstanding transnational problem. It can be neither understood nor mastered within the borders of local or national administrative units.

The river basins include a large numbers of administrative areas, and in the case of major rivers they cross several national territories. Therefore we should ask ourselves how and on what we should extend our co-operation to constitute a response to the challenge of flooding. I am convinced that the today's Conference is the right place for that.

Now, let me wish a fruitful work to all of us at this Conference.

Thank you for your attention.

FIRST SESSION

Problems of natural disasters – Facts and background

PREMIERE SESSION

Problèmes des catastrophes naturelles – Faits et contexte

The role of river morphology and flood plains with respect to flood prevention

Jürg BLOESCH, President of the International Association for Danube Research (IAD); Swiss Federal Institute for Environmental Science and Technology (EAWAG), Switzerland

1. Introduction

Recent flood events in Europe and other continents have risen public and political awareness that humans are exposed to floods as natural disasters. They always were, but the technological development and related river corrections and constructions lulled people into security. Yet, there is not 100% security, and we still must cope with the remaining risks involved. As a social community, we have to learn from disasters, and change our philosophy and behaviour.

River basin management, flood risk and flood damage mitigation strategies must be based on the inherent properties of the riverine ecosystem and sound scientific research. There is ample evidence that improper technical measures yielded contraproductive effects, thus enhancing flood damage instead of mitigating it (Boon *et al.* 2000). Such experience and research have shown that it is necessary to consider the whole catchment, as strictly in-site measures are insufficient.

This paper briefly summarises the limnological and hydrological aspects of rivers, discusses the ecological impacts and economic aspects of floods, and develops a new perspective on flood protection strategies that can be applied in terms of sustainable spatial development. The important role of flood plains as water retention areas is emphasized. The examples of the Danube, Tisza and Rhine Rivers are representative for other large rivers in Europe and the temperate zone.

2. The hydrology, morphology and ecological function of rivers

Rivers are dynamic systems and they need space, as the range between minimum and maximum discharge normally covers 1-3 orders of magnitude in temperate zones. The "global water cycle" ultimately governs all freshwater ecosystems and includes the three spatial dimensions of streams and rivers, surface water and groundwater interactions in particular (Bloesch 2002). The "hydrological regime" is governed by the geomorphology and geology of the landscape, and climate (precipitation, storage of water by snow and glaciers, evapo-transpiration – all possibly influenced today by changes in meteorology due to global warming). Because of this overriding principle, the physical and chemical parameters (temperature, discharge, flow velocity, dissolved nutrients and sediment load, river bed morphology, instream habitats) change along the course of a river. These abiotic parameters provide the living conditions (i.e. habitat template) for aquatic and riparian flora and fauna, which are accordingly adapted to the natural disturbances of draughts and floods (Ward 1998). The "longitudinal river gradient" of biota can be illustrated by the fish zonation scheme of Huet (1949), which was later extended to biocoenotic regions (Illies and Botosaneanu 1963, see Figure 1). Similarly, large rivers cover almost all "morphological types of running waters", from steep pristine alpine headwater streams to braided or meandering flat lowland rivers, and delta branches (Calow and Petts 1994, Figure 1).

It is interesting to note that river channels are not stable and change by erosional processes over long time periods, as exemplified by the downstream migration of meanders in the Tisza River, a major tributary of the Danube River (Figure 2).

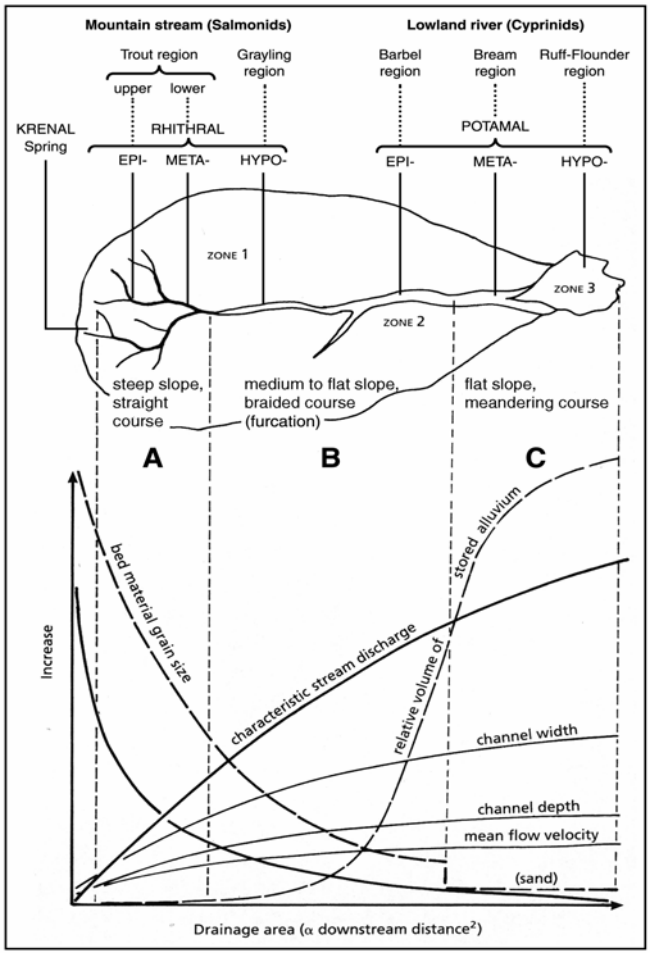

Figure 1 Scheme of channel properties, and fish and biocoenotic zonation in the longitudinal gradient of a river, according to Huet (1949) and Illies (1961).

A. Mountain headwater streams flow swiftly down steep slopes and cut a deep V-shaped valley. Rapids and waterfalls are common.

B. Low-elevation streams merge and flow down gentler slopes. The valley broadens and the river begins to meander.

C. At an even lower elevation, a river wanders and meanders slowly across a broad, nearly flat valley. At its mouth it may divide into many separate channels as it flows across a delta built up of river-born sediments and into the sea.– Modified from Calow and Petts (1994).

Running waters provide a "longitudinal continuum" that significantly affects their ecological function. Science has elucidated, amongst others, the complex nutrient and energy flux in diverse aquatic communities (Hynes 1970), the response of invertebrates to pollution (e.g., saprobity: Sládeček 1973), the river continuum concept (Vannote *et al.* 1980), the spiralling nutrient cycle (Petts and Amoros 1996), the importance of temperature (Robinson *et al.* 2002) and sediment deposition/transport (Wood and Armitage 1997), fish migration (e.g., Reinartz *et al.* 2003), the significance of ecotones such as flood plains (Ward *et al*. 1999), the river discontinuum concept (Ward and Stanford 1995), and the flood pulse concept (Junk *et al.* 1989). The "flood pulse" is especially important for tropical rivers where wet and dry seasons prevail. However, this concept also can be extrapolated to temperate zone rivers (Junk 1999; "flow pulse" versus "flood pulse": Tockner *et al.* 2000). Floods are essential for sustaining large wetlands, as plants and animals are adapted to seasonal flooding and respective changes between aquatic, semi-aquatic and terrestrial habitats (Figure 3). This is the main reason why flood plains are hot-spots of biodiversity, and therefore one of the most valuable morphological structures of rivers (Tockner and Ward 1999).

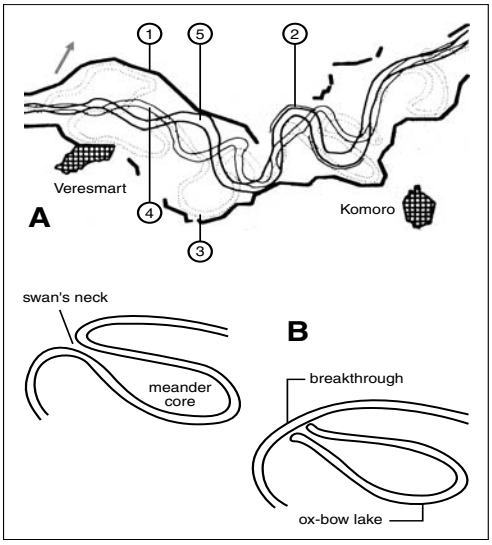

Figure 2

A. Changes in the channel of the Tisza River. Of particular interest is the migration downstream of the meander loops between Komoró and Veresmart. 1 = protective embankments adjoining the natural levees; 2 = bank safeguarded by protective constructions; 3 to 5 = photographs of river bed taken between 1830 and 1930.

B. The formation of an oxbow lake after a meander cut-off. – From Czaya (1983).

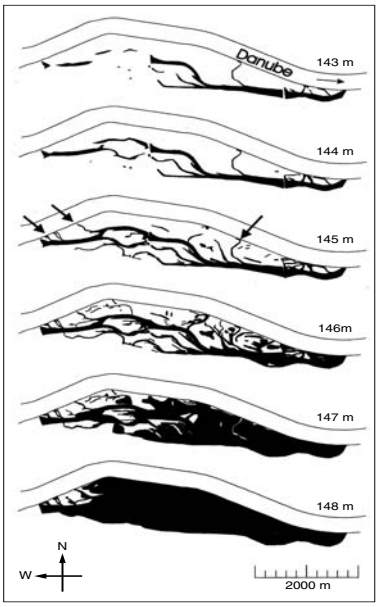

Figure 3 Inundation area (black) of the Danube floodplain (river-km 1896-1900.5) near Vienna at different water levels (m a.s.l.). – From Tockner *et al*. (2000).

The upper parts of these rivers are dominated by alpine hydrological regimes (the River Danube through alpine tributaries), while the middle and lower parts are dominated by pluvial regimes (with significantly less precipitation in the more continental Danube Basin). As a consequence, peak flow moves from summer (upstream) to winter (downstream, Figure 4 – for the River Rhine), and flow peaks are gradually flattened downstream (Figure 5 – for the River Danube). It is important to note that high flow events can be caused by several meteorological scenarios, from large scale deep pressure systems with long periods of rain to local but intensive thunderstorms (Heise 2002). In this respect, the land cover and water retention capacity of the soil is of utmost importance.

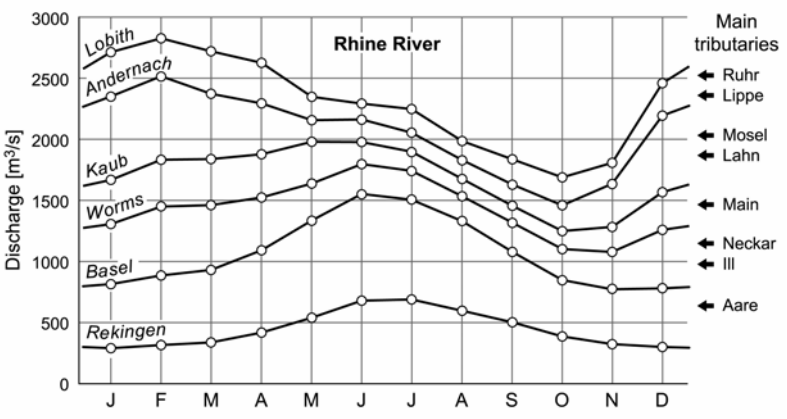

Figure 4 Monthly discharge at different stations along the Rhine River (KHR/ CHR 1977). Note the shift in peak flow from summer (Rekingen, upstream) to winter (Lobith, downstream).

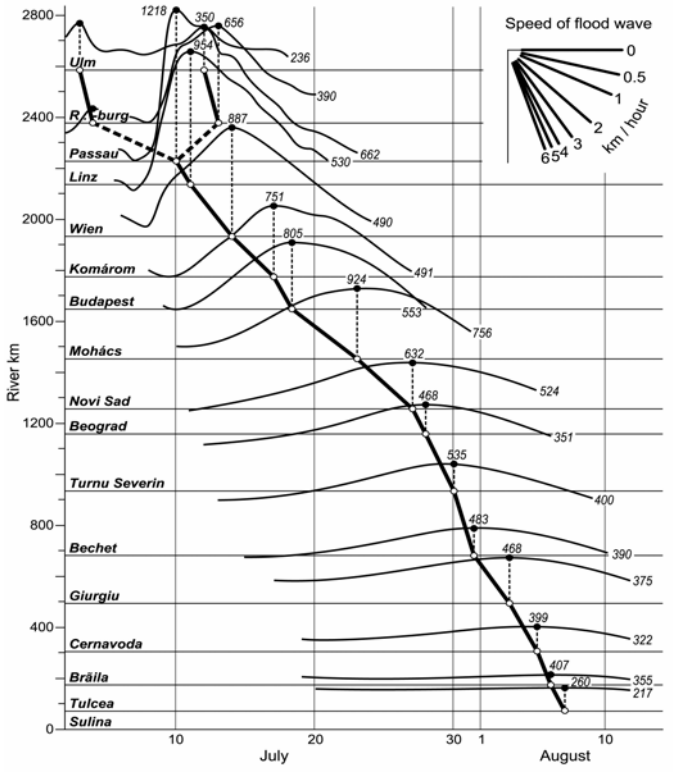

Figure 5 Course of the flood wave in the Danube River, July-August 1954. Water-level lines at the most important gauging stations (vertical height in cm). The bold line combining the time of highest water-level indicates the speed of the flood wave. – From Liepolt (1967).

Liepolt (1967) showed the lateral space needed by the River Danube during high flows (Figure 6). While this extends to several km downstream of the significant tributary River Inn, this extends up to 10-15 km downstream of the "Iron Gate" gorge. Figure 7 provides an impression of the extended areas of former flood plains in the middle Danube region, the Tisza River Basin in particular. Flood plains act as retention areas of water and nutrients, and hence play a natural role in flood mitigation (Dister 1994; Schneider 2002).

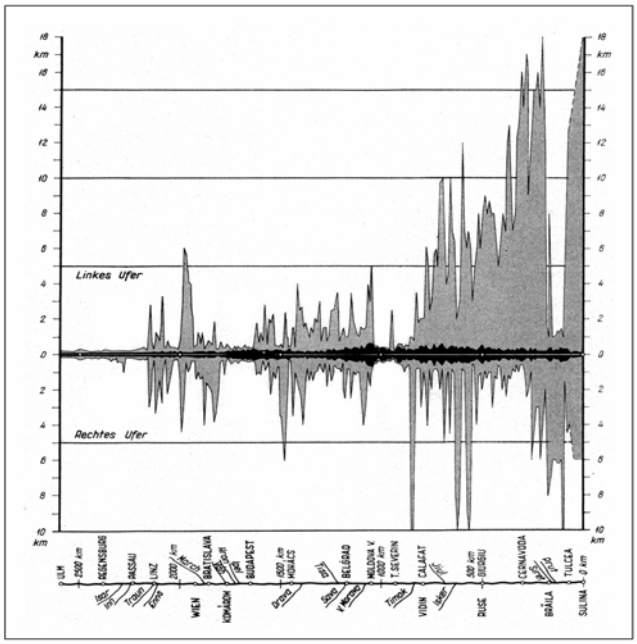

Figure 6 Lateral water extension of the River Danube during low (black area) and high (grey area) discharge. The stretches of low extension are upstream of Passau, where the river is relatively small, and in gorges in the lower part. – From Liepolt (1967).

Figure 7 Former flood-plains in the Tisza River Basin and in neighbouring stretches of the middle stretch of the Danube River. White areas are subject to flooding. – From Czaya (1983).

3. Anthropogenic impacts for flood prevention: conquering *nature sensu* Descartes

In human history, the large rivers in Europe, such as the Rhine, Rhone, Elbe and Danube, have long been used as *nuclei* of settlement and veins of transportation. As such, they also attracted trade, crafts, industries and hydropower facilities. Likewise, small to moderate human impacts on fluvial hydrosystems occurred in pre-industrial history. In the 19th century, when the industrial revolution took place, most large rivers were channelised and dammed, mostly for gaining land for development, eliminating diseases such as malaria, flood protection, and shipping (Kern 1994; Figure 8). At this time the rivers were considered as waters for unlimited human use, and this Cartesian philosophy prospered until the 1990s when artificial canals were constructed to link the large rivers to a unique European waterway system (Rhine-Main-Danube Channel, Rhine-Elbe Channel). Hence, human pressure and technical impacts in the past 160 years have drastically diminished the space needed by a natural river, and both longitudinal and lateral connectivity have been disrupted.

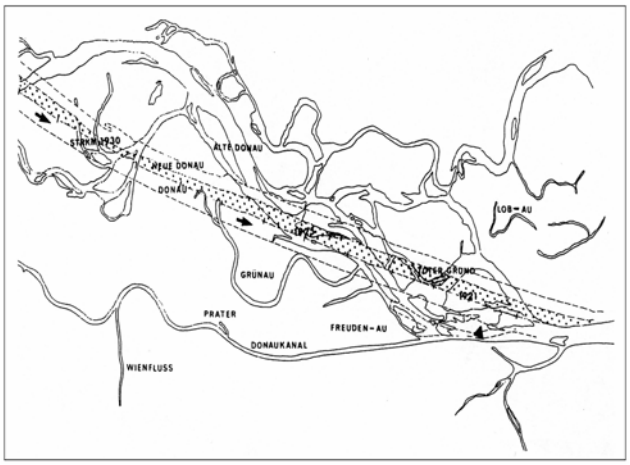

Figure 8 The channelised stretch of the River Danube near Vienna (dashed lines), and the natural braidings of 1859 (after Humpesch 1994). The lateral connectivity is almost completely disrupted, and the respective ecotones have been deteriorated. Compare to revitalisation in Figure 13. – From Bloesch (1999).

While the ecology at this time of technical development was no major issue, aquatic and riparian habitats of flora and fauna were drastically deteriorated (Tockner and Stanford 2002). More political concern arose from the fact that people (ab)using the rivers were also negatively affected by their own impacts. Nature hits back. Since flooding is a natural phenomenon it will always affect humans. Hard bank constructions, dams, dykes and artificial reservoirs could prevent many but not all floods. However, flood risk increases when people settle in flood risk zones, and the effected value of damage increased overproportionally (Röthlisberger 1998). Humans were captured in a vicious cycle, where higher floods initiated higher dams (Figure 9). The idea was to drain the excess water as fast as possible. However, we approached a point in which water engineers concluded that we cannot achieve 100% security, since floods are stochastic processes and therefore not predictible in time and size – despite sophisticated forecast-models and reservoir management. There is also the economic perspective, as (public) costs of dams and other prevention constructions were balanced with (private) costs of damage and precaution measures. The economy is particularly important with regard to hotspot pollution induced by floods (e.g., UNEP/OCHA 2000).

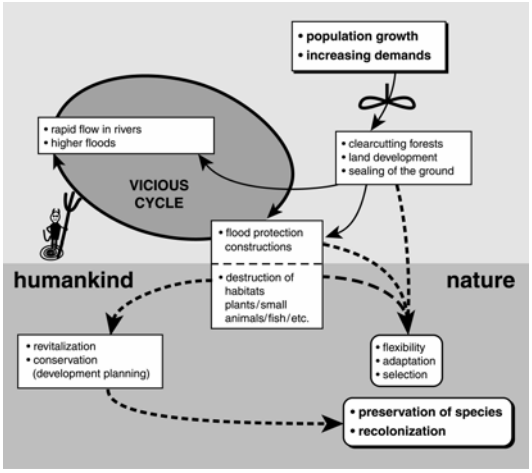

Figure 9 Causes and effects of river channelisation and constructions against floods – a vicious cycle. Driving forces (thin lines) are population growth and peoples' increasing quantitative and qualitative demands which lead to a closed circle (thick line) of cause and effect; nature cannot completely break out (dashed lines) of this vicious cycle on its own; humankind must help with appropriate measures. – From Bloesch (1996).

The morphological degradation of rivers, however, has not reached the same intensity throughout Europe. While the political and economic development in Eastern Europe prevented excessive corrections (Schneider 2002), the large rivers in Western Europe were

channelised to a greater extent (Tittizer and Krebs 1996; Figure 10). Thus, the Danube River, for example, has a large natural potential that should be used for the benefit of optimised flood control.

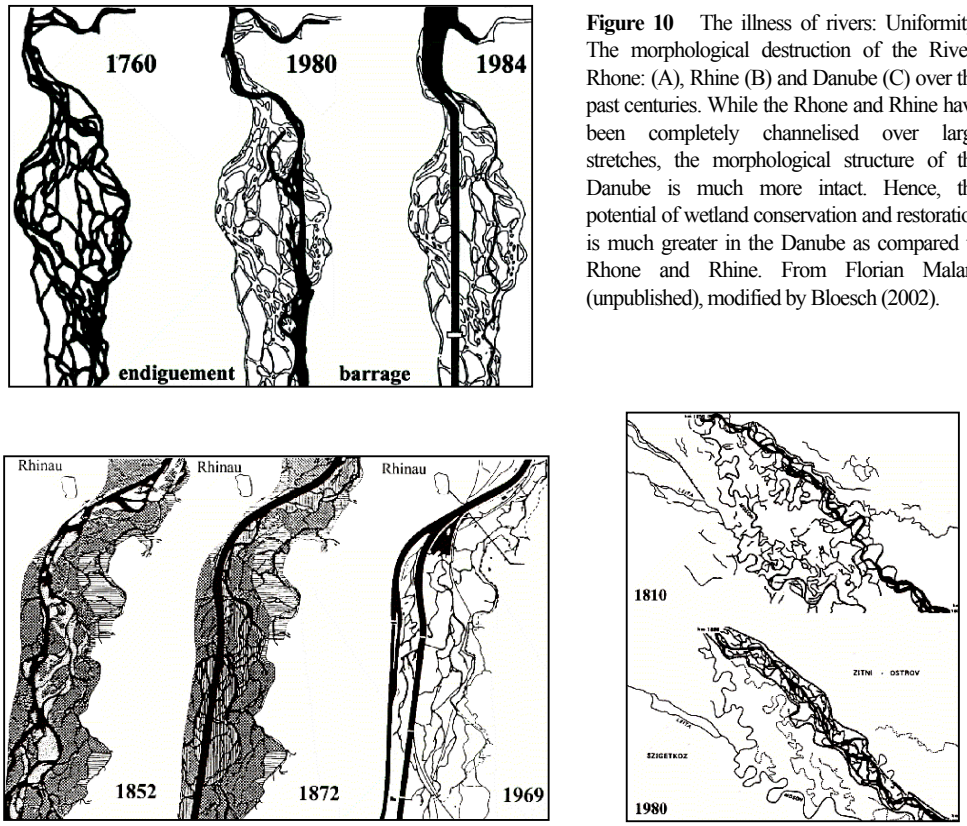

Figure 10 The illness of rivers: Uniformity. The morphological destruction of the Rivers Rhone: (A), Rhine (B) and Danube (C) over the past centuries. While the Rhone and Rhine have been completely channelised over large stretches, the morphological structure of the Danube is much more intact. Hence, the potential of wetland conservation and restoration is much greater in the Danube as compared to Rhone and Rhine. From Florian Malard (unpublished), modified by Bloesch (2002).

4. Flood risk mitigation: the new paradigm using and respecting nature

Flood risk can be mitigated but not eliminated. After the recent large floods in the 1990s, a new philosophy (paradigm) emerged in Switzerland (Willi 2001): instead of trying to achieve the impossible, namely to totally prevent all flood damage, water engineers implement a differentiated flood protection approach. The risk zones and damage potentials are investigated and mapped, and flooding is allowed more frequently in areas with less human value. For example, instead of hard bank constructions with dimensions for a 100 or 1,000 year discharge, flood protection constructions in agricultural areas are built for 20-30 year discharge, while the river morphology is restored to increase its ecological function. From an economic point of view, it is cheaper to pay the occasional (and relatively low) flood damage to farmers than build high dams.

This new approach is fully in line with the EU-Water Framework Directive (aiming at "good ecological quality" of waters) and reflects the attempts to achieve sustainable development. It also reflects the philosophical paradigm of Capra (1982) for a new concept of understanding and treating nature. In the Lower Danube there are still some large flood plains that not only act as retention areas of water and nutrients but also are hotspots of biodiversity. The examples of the rivers Rhine and Rhone have shown that total river channelisation not only destroyed much of the natural plant and animal communities, but also that it cannot prevent extreme flooding. Hence, large restoration programs are now implemented to restore some of the flood plains (Bloesch and Sieber 2003). However, many morphological structures and eco-functions are lost forever. Thus, conservation of existing flood plains has priority over flood plain destruction and subsequent restoration (Bloesch

2003). Long-term landscape planning and flood plain conservation/restoration are therefore a most crucial part of a sound river basin (catchment) management and flood protection strategy (Décamps 1996; Tockner *et al*. 1998).

5. Conclusions

The message to water managers is quite clear. Pure technical approaches are limited by costs and effectiveness. Despite considerable and still increasing human pressure, rivers need to be respected as natural features using a minimum of space. Where this fundamental request is neglected, local people will sooner or later be dramatically affected by floods. Hence, the still (partly) intact flood plains of large rivers should be considered for flood protection management as natural water and nutrient retention areas. In fact, this idea turns out to be a win-win situation, as flood plains are hotspots of biodiversity. So, the natural ecosystem can be sustained, and flood damage can be minimised. Such solutions are, in the long-term, financially cheaper than channelisation and subsequent restoration, and therefore are truly sustainable. In practice, such strategies need to be incorporated into the catchment approach and river basin management. Hence, landscape planning is a crucial measure to implement flood protection.

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Floods in Europe in the last 10-20 years

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Introduction

Floods count to the worldwide most disastrous catastrophes. 31% of the worldwide catastrophes are floods. They cause 32% of the total damages and 55% of the fatalities. Europe experienced a large number of extreme floods in the last 10-20 years. Almost all countries were hit by unusual floods causing heavy damages. Table 1 shows the statistics of selected European flood events. One can see that the number of fatalities is not extremely high due to the generally well organised rescue. On the other hand damages are extremely high often exceeding 1 billion $. This is the reason why flood protection and flood mitigation problems should be considered in regional planning.

Date	Region	Fatalities	Total loss Mio. US $	Insured loss Mio. US $
31.10.1992 - 02.11.1992	Italy: Central Tuscany, Rom, Sicily	3	712	
20.12.1993 - 31.12.1993	Benelux, Germany, Great Britain	14	1180	810
4.11.1994 - 6.11.1994	Italy: North / Piedmont, Lombardy, Liguria	64	12500	65
19.1.1995 - 5.2.1995	Benelux, France, Germany	28	3500	750
July 1997	Poland, Czech Republic, Germany, Hungary	100	3000 (Poland only)	
June 1998	Romania	23		
2.3.1999 - 14.3.1999	Hungary, Slovakia, Romania		132	
May 1999	Switzerland, Germany, Austria	13	750	300
22.6.1999 - 24.6.1999	Hungary		145	11
9.7.1999 - 14.7.1999	Hungary, Romania, Austria, Czech Republic, Slovakia, Poland	31	600	35
13.11.1999 - 14.11.1999	France: South, South-West, Tarn, Aude, Pyrenees	31	500	400
13.10.2000 - 20.10.2000	Italy, Switzerland	38	8500	470
October/ November 2000	Great Britain: North-East, West, South-East	6	1500	700
March 2001	Hungary, Romania, Ukraine	9		
24.7.2001 - 31.7.2001	Poland	26	700	30
31.3.2002 - 1.4.2002	Spain: South, Canary Islands	8	100	
4.8.2002 - 13.8.2002	Italy, Germany, Austria, Czech Republic, Russia	193	5100	
12.8.2002 - 20.8.2002	Germany, Austria, Czech Republic, Hungary	37	13500	3100
8.9.2002 - 9.9.2002	France: South, Rhone Valley, Orange, Nîmes	23	1200	700

Table 1: A list of selected European flood events and their consequences

Recent developments in flood frequencies and damages

Statistics of the insurance industry indicate a nearly exponential growth in the flood damages in the 20th century. This increase is due to different factors, partly anthropogenic partly natural. The main factors are:

1. the increase of the value of the belongings;
2. the increase of the population and industry situated in flood risk regions;
3. changes in the rainfall runoff relationship due to changes in land use and land cover;
4. changes in climate meteorology – increase of the extreme flows in many rivers.

Regional planning can contribute to reduce damages by reducing building activities in flood risk areas. Changes in climate and meteorology are not regionally solvable problems, but they should also be considered for future planning. Figure 1 shows the changes in the mean of the annual maximum discharge of the Rhine river at Worms. As one can see from the figure the maximal discharges increased in the last hundred years by more than 15%. This and similar examples show, that there is a natural increasing tendency in flood magnitudes in some regions of Europe.

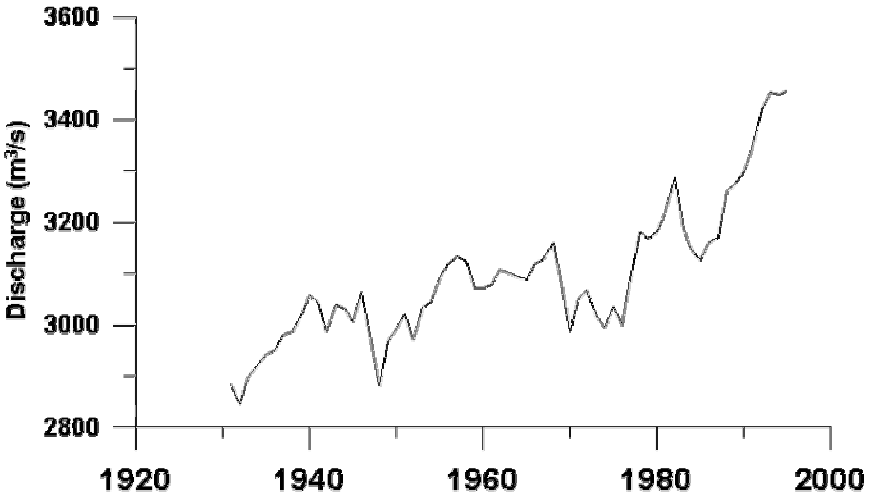

Figure 1. 30 year mean values of the annual maximum discharges of the Rhine at Worms

Causes of floods

Floods are natural phenomena which have always occurred and will also occur in the future. Their main direct cause is excess of water which cannot be retained in the catchments and flows out of it. Floods can be caused by:

1. intense and/or long lasting rainfall;
2. snowmelt;
3. obstacles on the flow path (landslides, blocked cross sections);
4. failures of natural or artificial dams;
5. a combination of some of the previous causes.

The amount of retained water and the flow velocities both depend on the catchment characteristics. In Europe landscapes are very strongly influenced by human activities. Changes in the land use and the land cover are due to urbanisation, changes in the agriculture and de/afforestation activities.

Influence of land use and land cover on floods

The increase of flood frequencies and flood magnitudes lead to discussions on the causes of the increase, and possibilities of flood risk reduction. Land use can play an important role in runoff production. The quantification of the effects of past and ongoing land use changes is an important task. In large parts of the world the landscape is already strongly influenced by human activities. Settlements and highways were built, large areas are occupied by the agriculture. Even forests are often cultivated and not in a natural state. These non natural conditions have already substantially influenced the local water cycle. For example the increase of settlement areas lead to an increase of sealed surfaces and often caused more surface runoff. Agricultural plants are often seasonal, and have a strong influence on the evapo-transpiration. The sum of all possible effects is a changed water balance. The consequences can be more frequent floods and/or water shortages too. In several parts of the world land use is changing rapidly and negative consequences were only recognised after irreversible changes occurred.

There are different possibilities to investigate the effects of land use change on flood production:

1. Physically based hydrological models use basic principles for the quantification. They have the advantage that different scenarios can be modelled, and processes are quantified to a large detail. The problems with these models are the high data need, the natural variability of soil and rainfall, the inadequate representation of the basic hydrological processes and numerical problems in the solution of the corresponding mathematical systems. These often lead to a low accuracy. These type of models should be more used for studies in small regions (a few hundred square kilometres). Niehoff (2001) used this approach to quantify the effect of land use changes in three small catchments.
2. A second possibility is the quantification of the changes based on observations corresponding to past land use changes. In this case catchment characteristics, including land use, meteorological observations and observed flood characteristics are used to find appropriate functional relationships between them. The advantage of this method is that it is based on data and not speculation. Disadvantages are the non-uniqueness of the predictions and that the range of predictions is limited to the range of observations. Samaniego (2003) developed and used such models for catchments in South-West Germany.
3. A third possibility is to use conceptual hydrological models. In these models the processes are described in a simplified manner, using system theoretical type descriptions. Parameters of these models can be coupled to catchment characteristics including soil and land use. Their advantage is that large regions can be modelled if parameter estimation is done in a uniform manner. Disadvantage is that the parameters are not physically based and can only indirectly be associated with land use. Hundecha and Bardossy (2003) applied this methodology in the German part of the Rhine catchment.

In the next part a few applications of these models are shown.

Example 1: For a small catchment (Lein) a study to investigate the effect of the location of sealed area was carried out (Niehoff 2001). A physically based hydrological model WASIM-ETH was used to simulate the hydrological response to a heavy precipitation event. Figure 2 shows 4 different land use configurations. The discharge at the outlet was calculated for each case and shown on Figure 3. One can see that for a convective summer event (28 June 1994) both timing and magnitude of the event depend strongly on the location of the sealed surfaces. For a winter event (16 February 1990) the effects are much smaller.

The other example concerns the effect of land use on the floods of the Rhine river. Here the German part of the catchment was divided into 101 subcatchments. Each of them was modelled using a conceptual hydrological model parameterised simultaneously. The output of the conceptual models was used as input for a hydraulic river flow model. The five investigated scenarios are shown in Table 2. The corresponding changes in discharges at Lobith are shown on Figure 4. One can see that on this scale for a winter event only a complete afforrestation would change maximal discharges considerably.

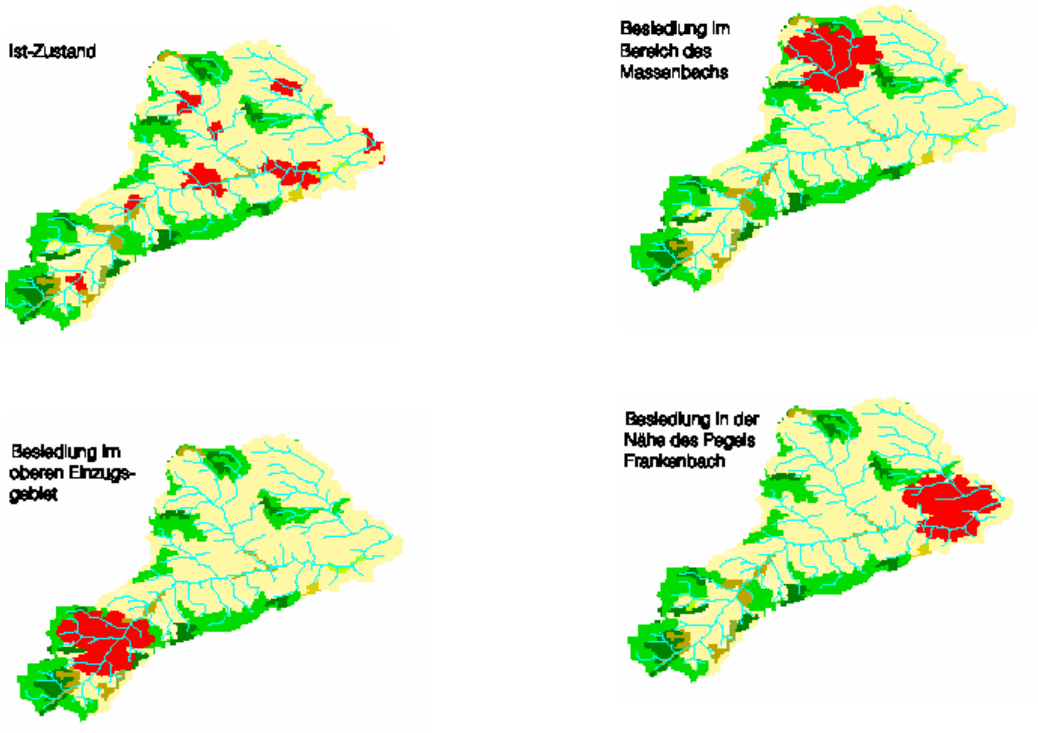

Figure 2: Different Land use scenarios

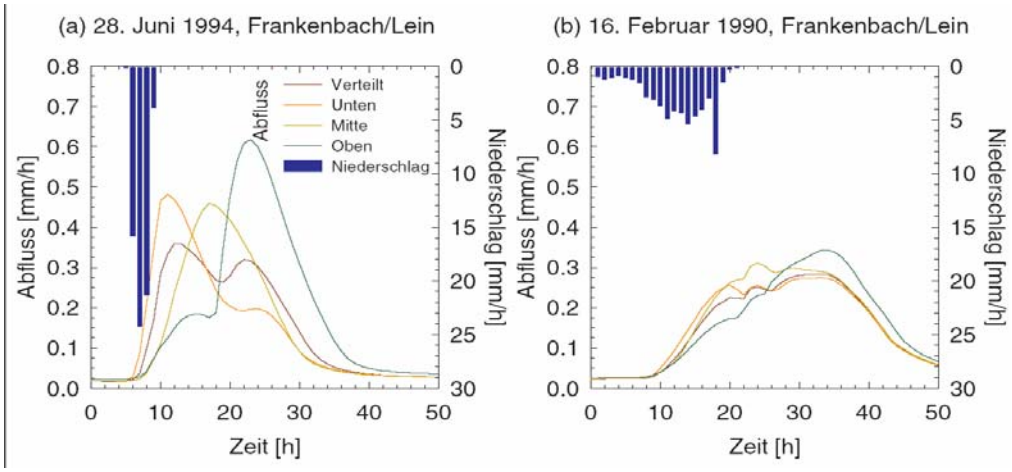

Figure 3: Effect of land use scenarios

	Forest	Urban Area	Agricultural area	Water	Sealed Area
LN1	40 %	15 %	44 %	1 %	5 %
LN2	40 %	17 %	42 %	1 %	6 %
LN3	40 %	17 %	42 %	1 %	5 %
LN4	39 %	30 %	31 %	1 %	11 %
LN5	100 %	0 %	0 %	0 %	0 %

Table 1

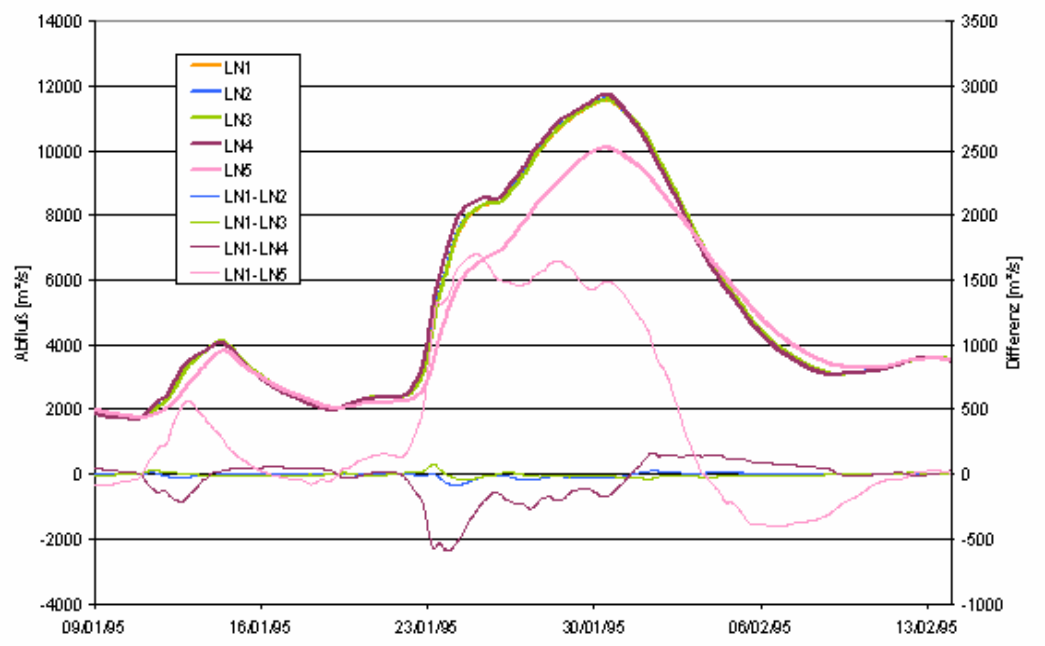

Figure 4: Changes in discharges

Conclusions and Recommendations

1. Flood catastrophes cannot be eliminated only when their consequences can be reduced by careful planning, good flood protection and flood forecasting. Society has to be prepared for future floods.
2. Land use changes have an important effect on regional hydrology including flood frequencies and magnitudes.
3. The effects depend on the scale of investigation and the exact location of the changes. Their influence can be important both in flow velocities and magnitudes.
4. There are models available to quantify effects of these changes, but there is also a need for future research in this topic.
5. Regional planning should make use of past experience and hydrological knowledge as natural trends indicate a higher flood risk for the coming years.
6. Regional planning can contribute substantially to the reduction of damages of flood catastrophes both by reducing flood probabilities and by reducing damage potential.

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Governance and floods in Europe

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The present contribution tries to look at flood event issues from a governance perspective. It undertakes to discuss the human side of spatial planning with regard to flood prevention and to remind of the necessity not to neglect humans at the moment of planning.

1. Floods in modern times

Floods are accidents. Not much can be gained in law to call them disasters, catastrophies or even natural catastrophies. Indeed, as the European landscape has for centuries been formed, shaped or influenced by human activities, as urban agglomerations have been built at shorelines or at rivers, as watercourses were forced to change their direction, the speed or the quantity of water which they carry, and as the human genius now even manages to influence the climate, differentiations between natural catastrophies and man-made catastrophies are not really relevant.

The political task consists of preventing flood accidents from occurring and of mitigating their consequences. However, it is clear from the classification of floods as accidents and the involvement of humans in accident monitoring, that all the measures taken will not be able to prevent, once and for all, the occurrence of new flood accidents. Horatius' word "*naturam expellas per furcam, tamen usque recurri"*[1] remains applicable also in this area.

The prevention of accidents and the mitigation of their consequences are frequently considered to be a problem for spatial planning (town and country planning, regional planning). An appropriate planning would, according to the defendants of this argument, make the likelihood of flood accidents smaller and thus lead to a progressive diminution of risks. However, accident prevention and management is never the task of planning authorities or engineers alone. Planning deals (also) with human beings and cannot, therefore, leave aside the desires, wishes and fears, the needs and preferences of those persons who live or want to live in areas at flood risk. The human side of flood prevention and management is all the more important as administrations depend on elections, need to take into consideration political, economic, regional, cultural and other susceptibilities, in order to avoid the reproach that the flood plan fits the planner, but not the people.

2. Governance – a fashionable notion

Structures which concern the relationship between citizens, the public and the administration, between different administrations and between administrations and other bodies – interest groups, organisations, etc. – are named, with a rather fashionable word, "governance" issues. A precise, generally recognised definition of this word which has different connotations in different legal or political cultures, does not exist. For the purposes of the present contribution, it may be sufficient to underline that governance deals with the interrelationship between humans and their organisations, bodies and institutions. Governance is broader than government which designates the (local, regional, national) public structure of a given society. While it does not make much sense to speak of company government or global government, it is possible to speak of a company's governance or of global governance.

In 2001, the European Commission published a White Paper on European Governance[2], where it identified five leading principles for good governance: openness, participation,

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[1] Rough translation: "You might chase out nature with a fork, it will return somehow".

[2] European Commission, European governance – a White Paper (COM(2001) 428 final) OJEC 2001, C 287 p.1.

accountability, effectiveness and coherence. These principles point to the fact that the underlying concept of good governance is that of an open society[3], where decisions are taken after open, transparent and, if necessary, controversial discussions; where such decisions associate the affected persons in the decision-making process and where new findings, better experience or new understandings may stir a discussion, whether the original decision should not be replaced by a better one.

3. EC water management planning

Within the European Community, this philosophical concept materialised in a number of directives which endeavour to ensure consultation, participation and, more generally, the sharing of know-how, experience and concerns in order to reduce planning errors. The most important provisions are the following :

a. As regards regional planning, the EC does not dispose of elaborate legislation[4]. Directive 96/82 on the control of major-accident hazards involving dangerous substances[5] requests Member States to take accident prevention consideration into account in their land-use policies, in particular with regard to the siting of new establishments or new developments such as transport links, residential areas or areas of public use[6]. While this Directive refers to certain industrial installations only, it is of direct interest here, because the sitting of an installation in a flood-threatened area might considerably increase the risk of humans, animals and plants, in the case of a flood. Article 12(2) of Directive 96/82 establishes the link to environmental governance by requesting that

> Member States shall ensure that all competent authorities and planning authorities responsible for decisions in this area set up appropriate consultation procedures to facilitate implementation of the policies.. The procedures shall be designed to ensure that technical advice on the risks arising from the establishment is available … when decisions are taken.

b. In the same sense Directive 2001/42 provides that plans and programmes referring to town and country planning or land use must be made available to administrations which have an interest in the planning, as well as to the public that is or is likely to be affected by or that has an interest in the decision-making concerning the plan or programme[7]. The public which includes "relevant non-governmental organisations, such as those promoting environmental protection" must be given an early and effective opportunity within appropriate time frames to express its opinion on the draft plan or programme before its adoption.

c. Finally, Directive 2000/60 on water management is to be mentioned. This Directive, adopted in 2000, will, within the next fifteenyears, strongly influence water management policies in Western, Central and Eastern Europe and is likely to have effects beyond that area. It organises water management according to river basins. As coastal waters are to be included in river basins, it can firmly be stated that the water management in Europe is to be organised according to similar structures that are relevant for flood prevention and management, as also floods develop according to river basins. The Directives requires the establishment of river basin management plans, including in those cases

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[3] The notion was coined by Karl Popper, The Open Society and its Ennemies, London 1945.

[4] Article 175(2) EC Treaty requires unanimity for EC-wide measures in the area of town and country planning. This provision thus clearly shows that the EC could legislate in this area, though subsidiarity questions may frequently suggest that measures for town and country planning are adopted at the level of Member States.

[5] Directive 96/82, OJ EC 1997, L 10, p.13.

[6] Directive 96/82 (note 5), Article 12 : "1. Member States shall ensure that the objectives of preventing major accidents and limiting the consequences of such accidents are taken into account in their land-use policies and/or other relevant policies. Member States shall ensure that their land-use and/or other relevant policies and the procedures for implementing those policies take account of the need, in the long term, to maintain appropriate distances between establishments covered by this Directive and residential areas, areas of public use and areas of particular natural sensitivity or interest ...". A very similar formula is found in Article 7 of the Convention on the transboundary effects of industrial accidents which was signed in Helsinki on 17 March 1992.

[7] Directive 2001/42 on the assessment of the effects of certain plans and programmes on the environment, OJ 2001, L 197, p.30, Article 6.

where the river basin extends beyond the territory of an individual EC Member State and even where this basin extends beyond the boundaries of the EC.

Member States must encourage "the active involvement of all interested parties in the production, review and updating of the river basin management plans". For this purpose, Member States must publish and make available for comments

- a timetable and a work programme for the production of the plan, including a statement of the consultation measures to be taken;
- an interim overview of the significant water management issues in the river basin ;
- draft copies of the plan and on request, access to background documents.

Interested persons must have at least six months to comment in writing on the draft plan and the other documents.

The objective of all three pieces of planning legislation is clear: the active involvement and participation of the public is essential for a regional planning that undertakes to include all possible considerations, including those of accident or flood prevention. A planning office, be it private or integrated in a public administration, is naturally inclined to believe that it knows best how to plan, how to find solutions to different technical and/or societal problems and how to optimise solutions. However, if considerations of an open society are taken seriously, democratic decision-making procedures will not be able to remain restricted to local, regional or national parliamentary legislation and decision-making. Rather democratic decision-making procedures will also have to be introduced into administrative and in particular planning processes. This means that what the old pattern of the administration – or, in our case, the planning office – knows best has to be overcome by processes that also involve those who will have to live with the planning decisions for years or even for decades.

4. Governance and planning

a. Citizens' participation

It is for this reason that the 1998 Aarhus Convention[8] – which gives a right to individuals and to organisations to have access to all information on the environment which is in the hands of the administration and a right to participate in decision-making on projects, plans and programmes –, does not limit itself to stipulate these rights. Rather, the Convention requests that the administrations take steps to actively disseminate information on the environment, including in electronic form. These provisions are based on the concept that the administration is not the owner of the environment and that therefore, it should share all information on the environment of which it disposes with the general public.

In the same way, the administration has to disseminate information when the permitting of a project of infrastructure is being planned or when a plan or programme "relating to the environment" is being prepared[9]. The objective is, each time, to enable the public "to prepare and participate effectively during the environmental decision making".

As these provisions refer to environmental decision-making, it is clear that they also apply, where the planned decision has a transboundary effect : the environment has no frontiers. Then it would be absurd to inform, consult and associate the public that is or is likely to be affected by a planned decision only within the boundaries of a (local, provincial, regional or)

[8] Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, Aarhus(Denmark) 1998. The Convention entered into force in 2001.
The European Community implemented the provisions of the Aarhus Convention by Directive 2003/4, OJ 2003, L 41 p.26 (access to information), Regulation 1049/2001, JO 2001, L 145 p.43 (access to documents), Directive 2001/42 (note 7 above) and Directive 2003/35, OJ 2003, L 156 p.17 (participation in decision-making).

[9] Aarhus Convention, Articles 6 and 7.

national entity. Transboundary information and participation, in particular, where it is of a transnational character, raise supplementary aspects, such as the language spoken by the public – and the planning administration ! –, different cultures and traditions, rivalries and others. Overall, however, at least in the present EC, planning co-operation beyond national frontiers in environmental matters seems to have considerably improved during the last decades, going from advertisements in local newspapers which inform of new projects (The Netherlands-Germany) to joint public hearings and consultations (Spain-Portugal, Germany-France)[10].

b. Participation of administrations

The provisions of the Aarhus Convention and of its implementing legislation examine the relations between the planning administration and the public. They do not deal with the relationship between different administrations. And yet, the principles of good governance, mentioned above, also apply to the relations between the administration, and in particular, where we have to do with river basin management and flood prevention. Both areas of activity require the active involvement of a great number of different administrations, at local, provincial, regional, national and international level, but also sector-oriented administrations such as of water management, urban development, nature conservation, on the different transport means, energy, regional development, agricultural and fishery, telecommunications, forest and tourism. All these administrations are structured at different levels, lead their independent administrative life that is hierarchically organised and do normally not have the habit of systematically consulting all other administrations which might be affected by their planning decisions. Legislation, as a rule, does not deal with the interrelationshsip and co-operation among administrations[11].

It is in this context that the principles of good governance gain all their weight. Openness and transparency require that the planning administration tries to overcome the silence among administrations that is so often met in administrative practice. And this is particularly necessary for flood prevention planning in river basins. Here, administrations of all kinds are bound to co-operate with each other in order to develop measures which reduce the risk of inondations to a reasonable degree. This means first of all that they have to share data and other information, furthermore that they mutually inform each other on all studies, plans and measures which might affect the flood prevention planning or, in the case of such flooding occurring, might influence the consequences of such flooding, finally that the flood prevention planning is elaborated jointly and adopted with the consent of everybody, rather than imposed by the more powerful administration. Openness and transparency instead of rivalry and competition, mutual co-operation instead of unilateral action, joint venture decisions instead of solitary decisions, common implementation of the common decisions instead of unilateralism – good governance aims at democratising administration and administrative decision-making processes, are required.

In the abstract, all this might sound well. Where concrete measures are to be taken, things might look quite differently, as interests of citizens, economic operators or administrations might become affected. For example, it is more and more recognised that one of the reasons for increased flood disasters is the reduction or complete disappearance of floodplains for rivers, polders or reservoirs which could, in case of need, absorb certain quantities of water. In such areas and other areas which are in danger of flooding it would be reasonable not to

[10] A study on these forms of transboundary information and participation of the public does not seem to have ever been made, and not either a study on transboundary local administrative co-operation in environmental matters.

[11] The only two provisions in EC law are Directive 85/337 on the assessment of the environmental impact of certain public and private projects, OJ 1985, L 175 p.40 which requires in Article 6 (1), that environmental administrations shall have to be consulted on any project that comes under the Directive ; and Directive 2001/42 (note 7 above) which determines in Article 6 (3) : "Member States shall designate the authorities to be consulted which, by reason of their specific environmental responsibilities, are likely to be concerned by the environmental effects of implementing plans and programmes". Specific provisions apply to international co-operation procedures.

allow the construction of houses or industrial installations – but this meets with the objections of those who look for cheap ground for building or industrial development. Controversies will be accentuated where such floodplains are opened upstream a river in order to reduce the risk for people living downstream: why should "we" make sacrifices, in order to make "their" life easier ? Similar problems surround measures such as the storage and handling of dangerous substances in areas of flood risk, the construction of fuel oil tanks, waste disposal sites and other measures.

These controversies around opposing interests which already exist between urban and rural areas, upstream and downstream residents, multiply in the transnational context. For decades, if not centuries, peoples living along the great transnational European rivers, were accustomed to organise water management – including flood prevention and mitigation measures – within national boundaries. Transnational co-operation – on Rhine, Danube, Odra, Elbe and others – took place in order to facilitate transport of goods. The co-operation beyond boundaries in order to reduce environmental impairment – in clear terms: of no longer using rivers as sewers – or to reduce the risk of floods is of relatively recent date, and is, overall, not older than thirty years. Due to political developments, such transnational co-operation was easier for the Rhine river, the basin of which is shared by nine countries, than for the Danube, the basin of which is shared by eighteen countries.

And yet, if one looks at flood prevention and mitigation measures from the point of view of democracy and of environmental protection, there is hardly any alternative to the two approaches which are pleaded for here: river basin management and good governance principles. Making the citizen understand that the environment also is his environment and that therefore he should become actively involved in river basin water management and flood protection planning, is not easy; making the administrations understand that it is at the service of the citizens, that the planning and decision power confided to it has been given to it in the interest of serving the citizens and that the differentiation of administrative services was made in order to obtain better decisions, not to make processes less transparent, less participative and less open for citizens and for other administrations, is likewise not the easiest thing. The English have a proverb that power tends to corrupt and absolute power tends to corrupt absolutely: for everybody working in an administration it is a temptation to use his power – *Wissen ist Macht* - and not to share it via democratising procedures. Henrik Mankell, the Swedish writer, recently stated that it took about hundred years, before democracy was fully established in Western societies. One may only hope that democratising administrations by sharing of information cooperating with other administrations and with citizens on decision-making in river management, will go much quicker: neither has the environment time to wait for hundred years, nor is flood prevention an issue which can be delayed.

River basin water management which includes flood protection measures and which takes places in a transboundary basin, is everything but easy. The selection of floodplains, the specific conditions for the sitting of industrial installations, for private constructions, for the placing of fuel tanks and the many other measures that might have to be taken, will take time, increase cost and meet with objections – if not hostility of those affected: in the beginning, preventive measures always are objected to. And where, for example, upstream regions accept to develop floodplains, where construction is forbidden or subjected to strong conditions, co-operation processes might in exceptional cases even have to go so far as to consider, what kind of financial – contributions to dyke constructions – or other compensation could be given to upstream regions.

c. Accountability, coherence, effectiveness

The other three principles of good governance will only be mentioned shortly. The principle of accountability means that the planning authorities should, at any moment, be able to explain and justify to the public why specific preventive measures were taken, which were the findings, underlying calculations and assessments which led to the decision. This includes the condition – never easy to respect – that the administrative decision is the best

from the point of view of flood prevention and environmental protection and is not biased by considerations of local policy, political parties, or this or that preference of a political person or institution. If, however, democracy is to make sense in administrative decision-making, also these forms of intellectual corruption of administrative minds must be reduced as far as possible. And the best way to go towards that objective is the public discussion and the public laying accounts on why certain decisions where taken. It should not be forgotten that corruption and accountability are compatible with each other as fire and water.

The coherence of flood prevention measures in a specific river basin, and even in neighbouring river basins make good sense. Diverging planning within the same basin from one area to the other, from one region to the other or even from one country to each other must be counterproductive, make it more difficult to organise, in the event of a flood, alerts, evacuation or emergency measures and rather confuse citizens than inform them properly. While the preparation of decisions should be the subject of large and democratic participation and discussions, the decision itself needs to be coherent for the river basin, integrate the individual local measures and integrate itself into the broader planning of other bodies.

It is another commonplace to require that flood prevention measures must be effective. They must allow to prevent, if any possible, inondations and limit the harm to humans and to the environment caused in the event of such accident. The famous story of 1841 when a small city near New Orleans was deliberately inundated, in order to avoid that the Mississippi inondated New Orleans itself, is just most obvious example of ineffective flood prevention management – though it is too easy to apply principles of the 21st century retroactively to an event of some 150 years ago.

In conclusion, good governance suggests that flood prevention planning

- keep the citizens that are likely to be affected by such an event, continuously informed of all studies, draft plans and measures envisaged or considered, by means of active information which is made available by the (public or private) planning administration;
- make active efforts to have the citizens participate in the plans and programmes to prevent flood events, by organising consultations, hearings, public information, co-operation with local press, radio and television media, by trying to send out clear messages, use a plain, understandable language and communicate on equal terms with citizens;
- integrate, within river basin water management structures, all other administrations which might have an interest in the flood prevention strategy, permits to share all information with them, to consult on draft plans or programmes and to ensure that the largest possible consensus is reached with regard to the planned measures.

d. Governance and monitoring of plans

Before the section of mitigating measures is addressed, there needs to be clarified that governance also requires that the flood prevention measures are effectively applied. Nothing undermines the credibility of a decision-maker – a parent, a teacher, a parliament, a government, a local council or a specialised agency – more than decisions which are taken are not complied with. Once there is a decision on the measures to be taken, planning administrations will have to take care that these measures are effectively complied with.

In the sociology of law, the formula is used that about five percent of a population never obey a legislation of a regulatory decisions, that about twenty percent of a population always obey that decision, even if it is unjust or grossly erroneous. And the remaining seventy-five percent will follow the decision, if it is perceived to be just and fair and having been made after a fair procedure, if it is properly enforced, if the decision-maker itself – in our case thus the administration itself, which recalls the observations on mental corruption, made above – observes the decision, and if the decision is seen to be effective. Good flood prevention planning should therefore include measures to monitor progress in compliance with the decision taken, regular reporting and other means to follow the evolution of measures, exchange of experience on the difficulties encountered and the solutions developed, regular information for the media on the state

of affairs, etc.

5. Governance and the flood event

Discussing how to minimize the consequences of a flood event suggests the repetition of much that was said above, as it was stated right at the beginning that the best protection against accidents is the taking of preventive measures. However, car accident prevention – driving slowly and with lights, wearing seat belts, having head rests, safety glass screens, air bags and good brakes – does not make the existence of hospitals superfluous; in the same way the planning of measures which must be taken in the case of a flood event remains necessary. Such measures constitute themselves a form of preventive measures, as they have the objective to reduce as far as possible the negative consequences of a flood event, for humans, private and public property and for the environment.

The European Community is competent to deal with water management questions and has, as indicated, comprehensively done so, by even obliging Member States to organise their water management administration according to river basins. This frame will undoubtedly allow, in due time, to discuss issues of flood prevention within a specific river bassin, and in a context that exceeds the boundaries of States and follows the river basin. However, there is at present no comparable European Community competence to organise matters, when a flood event has occurred, in order to minimise the consequences. Indeed, measures in the case of a flood event come under the heading of "civil protection" for which Member States are mainly responsible; the EC is only allowed to take "measures" in this area[12].

And all efforts in the past twenty-five years to reach intensive co-operation of Member States in the area of civil protection, have, until now, not reached very far. In military matters, European co-operation is organised, at present, via NATO. In civil protection, which is the non-military counterpart to the military side, co-operation is less intense. This is not the place to describe the history and evolution of a European co-operation in civil protection matters. For the purposes of this contribution it might be sufficient to indicate that the EC adopted, in 1999, an action programme on civil protection[13] and in 2001 a mechanism to facilitate reinforced co-operation in civil protection assistance interventions[14]. The different topics covered by the action programme – core projects to improve co-operation; training and education; pilot projects; accompanying measures; conferences and events, information; other measures – clearly show the accessory character of this European activity. The main task for organising civil protection in the case of a flood event remains with the Member States, including measures on mutual assistance.

Again, the principles of good governance – openness, participation, accountability, coherence and effectiveness – play a major role in the case of a flood event. Their impact on the different communication and organisational aspects can hardly be overestimated. Having a uniform emergency telephone number within a river basin, disposing of clear information about the different responsibilities of police, fire-brigades, armies and other bodies and organisations, making sure that everybody is informed about the decision-making person or body during the event, being able to communicate in a common language, using the same technological language, optimising the know-how of experts, organising evacuation places and means, standardising the equipment – these and many more issues rather invite to preparatory measures long before the flood event occurs. And in all that, the population needs to be informed by way of clear, simple, understandable information in order to make sure that the flood event does not cause panic.

A rather famous French book was entitled "*Le plan ou l'anti-hazard"*. Planning flood events remains a necessity, all the more as we enter into periods of climate change with uncertainties as regards weather. Governance principles are capable of ensuring that such

[12] Article 3(1.u) EC Treaty : ... "the activities shall include, as provided in this Treaty … measures in the spheres of energy, civil protection and tourism".
[13] Decision 1999/847, OJ 1999, L 327 p. 53.
[14] Decision 2001/792, OJ 2001, L 297 p. 7.

planning is acceptable by those for whom the planning is made, i.e. the citizens. Planning in respecting governance principles is likely to reach much better results in terms of flood prevention and minimisation of the consequences of a flood than the all too often encountered attitude that the planner knows everything and everything better.

Gestion intégrée des crues : le rôle des plaines alluviales dans l'aménagement du territoire

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Des catastrophes si naturelles ?

Les catastrophes naturelles font – tout le monde peut le constater – de plus en plus la une des médias et cela dans de nombreux pays. Nombre de victimes, organisation des secours, solidarité, réparation des dégâts sont largement commentés. L'élévation de la fréquence de ces phénomènes inquiète et a suscité la mise sur pied de commissions d'enquête. De leur côté, les compagnies d'assurance ont fait leurs comptes et constaté que devant l'augmentation continue des dommages, elles devront limiter les prises en charge. Mais comme l'ont déjà noté certains auteurs (Arnold, 1975 ; Tamisier, 1994) [15] le plus souvent on ne traite que des effets et les causes sont oubliées. La nature est ainsi le plus souvent seule accusée et en particulier la pluviométrie ou l'imprévisibilité des crues voire les sautes d'humeur des cours d'eau. On sait pourtant depuis longtemps[16] que l'action anthropique joue un rôle non négligeable.

Les crues sont des phénomènes naturels périodiques et dans certaines parties du monde elles sont vitales à la fois pour le volume d'eau et la fertilisation apportés. Fonte des neiges et précipitations produisent l'eau déclenchant les crues. Des sols gorgés d'eau n'épongent plus l'excès. C'est une constatation. Mais est-ce un facteur suffisant pour entraîner des dommages importants ? La pluviométrie s'est-elle considérablement aggravée au cours des dernières années ? Il semblerait que non, bien que les effets des changements climatiques laissent à craindre une telle éventualité. Pour l'heure, les cours d'eau évacuent un volume d'eau sensiblement identique aux débits habituels. Et il ne fait plus de doute que la raison des inondations dévastatrices provient essentiellement des aménagements réalisés sur les cours d'eau et de l'utilisation de plus en plus intensive du sol à l'abri (illusoire) des digues. Sur le Rhin supérieur, les aménagements ont conduit à la concomitance des crues du fleuve et de ses affluents suite à l'accélération de l'écoulement (alors qu'il était de soixante-cinq heures avant les aménagements, il met moins de trente heures entre Bâle et Karlsruhe). La disparition des zones inondables naturelles, leur transformation par la culture intensive, l'urbanisation ou les infrastructures, leur compactage et imperméabilisation, la destruction des haies et de la ripisylve, l'endiguement des berges, l'exploitation des granulats, les barrages ou encore les travaux de drainage : les facteurs qui expliquent la taille de guêpe des anciennes zones inondables sont nombreux.

Ainsi, même si historiquement des catastrophes se sont toujours produites et se produiront toujours, il est incontestable que l'action anthropique a considérablement aggravé la situation. A l'heure actuelle, on ne peut plus vraiment parler de catastrophes naturelles sauf pour déclarer une région sinistrée et indemniser les dommages.

Devant l'augmentation de la fréquence des inondations et de l'ampleur des dommages, des mesures sérieuses commencent à être prises, mettant en balance les aménagements structurels habituels et la prise en compte des conditions écologiques. L'émergence de la nouvelle culture de la gestion des inondations se fait quelquefois dans la douleur mais la nécessité de trouver un système de protection plus efficace invite à prendre des mesures hardies, quelque peu expérimentales et allant à l'encontre des pratiques habituelles. Or parmi les solutions préconisées à l'heure actuelle dans le monde industrialisé, le retour à l'espace naturel de rétention, longtemps réduit à sa plus simple expression, est celui qui offre le plus d'avantages aussi bien économiques, écologiques que sociaux.

[15] Maurice D. Arnold : *Floods as Man-made Disasters,* Environmental Conservation, Vol. 2 N°4, 1975. Alain Tamisier : *Les inondations en Camargue* in Ecologie Politique, 9 : 65 – 73, 1994.

[16] Voir par ex. Le Séminaire interrégional des Nations Unies sur les mesures de prévention des dommages des crues, 1969 ou la Commission internationale d'étude des crues du Rhin (1968-1978).

Fonctions et fonctionnement des plaines alluviales

Pour comprendre l'importance des zones inondables, il est nécessaire de connaître le fonctionnement des écosystèmes de la plaine alluviale ainsi que les divers facteurs qui entrent en jeu. Nous ferons un bref rappel de ces processus qui sont à la base d'une gestion intégrée.

Le facteur principal conditionnant les écosystèmes alluviaux est le régime hydrologique avec la fluctuation des niveaux d'eau dépendant des débits. La durée, la hauteur, la saison, la fréquence des crues déterminent les variations écologiques dans la plaine alluviale.

Le degré de pente du cours d'eau, la grosseur des alluvions, la dynamique de circulation entre l'eau de surface et l'eau souterraine, la morphologie fluviale complètent le cadre du fonctionnement de ces écosystèmes au cours d'interactions permanentes.

Les inondations pourraient être considérées comme une catastrophe pour le milieu naturel lorsqu'on observe le paysage façonné par celles-ci. Contrairement à cette impression et malgré les dégâts provoqués sur certains biotopes ou espèces, sur le plan écologique l'inondation est nécessaire pour rajeunir le milieu et en maintenir la dynamique. Elle permet de reconnecter au cours d'eau principal les eaux du réseau hydrographique secondaire, de procéder aux échanges de micro-organismes, de poissons et de ressources génétiques et en même temps de faire parvenir l'eau épurée par les bactéries dans les eaux calmes vers le lit mineur.

La liste des fonctions remplies par les plaines alluviales s'allonge au fur et à mesure de l'approfondissement des connaissances sur ces milieux. On les classe en quatre catégories : hydrologiques, biogéochimiques, écologiques et socio-économiques que l'on peut résumer comme suit :

Fonctions hydrologiques
- stockage de l'eau, rétention des crues, écrêtage des pointes de crue ;
- transport de sédiments (érosion des berges et du lit) ;
- recharge de la nappe phréatique ;
- auto-épuration de l'eau (filtrage à travers les sédiments et par les bactéries des eaux peu profondes) ;
- cycle de l'eau et effet régulateur du climat.

Fonctions biogéochimiques
- rétention et recyclage des éléments nutritifs,
- rétention de sédiments et processus de filtrage,
- transformation de polluants organiques et inorganiques (action de dénitrification par ex.)

Fonctions écologiques
- habitats pour de nombreuses espèces animales et végétales qui y trouvent des zones de reproduction, de nourrissage, de nidification, de repos, de repli, etc. ;
- réservoir de biodiversité et de ressources génétiques ;
- biocorridors ou réseaux écologiques où s'effectuent les échanges génétiques ;
- productivité biologique, chaîne alimentaire.

Fonctions socio-économiques
- pêche, chasse,
- exploitation des roselières, des forêts et autres espèces végétales,
- fertilisation régulière des terres agricoles inondées,
- transport fluvial, hydroélectricité, ressources en eau en termes de quantité et de qualité, extraction de granulats …,
- loisirs aquatiques, de plein air, écotourisme, éducation,
- paysages de qualité.

Toutes ces fonctions remplies par des écosystèmes en bonne santé montrent la richesse de ces milieux et leur exceptionnelle productivité qui en rendent encore plus nécessaire leur conservation et leur intégration dans la politique d'aménagement du territoire.

Moins de zones inondables, plus d'inondations

L'appréhension des plaines alluviales par l'aménagement du territoire prend un nouveau visage. Après avoir, pendant des siècles, considéré les vallées fluviales comme des vecteurs de développement économique considérés seulement dans les sections potentiellement productives, la planification de l'espace – et ce n'est pas la seule politique concernée – doit envisager de façon intégrée la gestion de l'eau, des cours d'eau et des inondations.

Les cours d'eau européens ont tous été – quoique à des degrés divers – aménagés depuis des siècles. Voies de communication, disponibilité en eau, fertilité de la terre, haute productivité biologique, ne pouvaient qu'attirer les humains sur leurs bords. Mais les crues les maintenaient à une distance relative et ne permettaient qu'une faible densité d'occupation du sol. Le XIXè siècle vit l'essor industriel et une occupation du sol plus intensive. Pour gagner de l'espace et faciliter les activités économiques, les cours d'eau commencèrent à être «corrigés», régularisés, aménagés, corsetés et les zones humides furent drainées («assainies!») en grande partie. Des plans ambitieux de développement des vallées fluviales virent le jour après la seconde guerre mondiale, suivant en cela d'autres plans aussi ambitieux et pas toujours suivis d'effets. Le Rhin par exemple devait devenir la Ruhr rhénane au début des années 1960 malgré de véhémentes protestations. Il devint bientôt un égout à ciel ouvert jusqu'à la catastrophe chimique de 1986[17].

L'ensemble de ces aménagements a conduit à la disparition de 70 à 95% des plaines alluviales des fleuves européens aménagés. Endigués, canalisés, barragisés et rectifiés, ils ont été séparés des zones inondables. Le Rhin supérieur a perdu jusqu'à 94% de celles-ci dont 130 km^2 uniquement suite à la construction de dix barrages entre 1955 et 1977, le Danube supérieur 95%, central 75% et inférieur 72%. Il en est de même pour l'Elbe et l'Oder, le Pô, le Rhône, le Tage, etc. Et souvent même pour les plus petits cours d'eau.

Les effets en sont multiples :
- ne pouvant plus s'étaler, les hautes eaux s'écoulent plus rapidement dans le chenal principal, surcreusant le lit, rejoignant les crues de leurs affluents qui normalement se produisent auparavant ;
- enfoncement concomitant de la nappe alluviale et absence de recharge ;
- déstabilisation des ouvrages d'art ;
- arrêt du processus d'auto-épuration ;
- assèchement progressif des forêts (ripisylve) ;
- banalisation des habitats, disparition d'espèces.

Outre l'amenuisement de l'espace inondable, d'autres facteurs entrent en ligne de compte, comme la capacité d'emmagasinement de la végétation, des sols, des terrains et du réseau hydrographique. Si celle-ci est faible, il en résultera une plus grande rapidité de l'écoulement et un risque d'inondation accru.

Les inondations catastrophiques ne se produisent que lorsque la capacité naturelle de rétention des eaux de crues est excédée.

En Allemagne, l'analyse des récentes inondations (Rhin, Oder, Elbe)[18] montre que 4/5 des anciennes surfaces inondables ont été coupés du fleuve et affectés à d'autres usages. Depuis 1990, les surfaces occupées par les lotissements et les voies de circulation ont quadruplé,

[17] Un incendie dans une usine chimique proche de la ville de Bâle a contaminé le fleuve au point de le faire déclarer biologiquement mort par les scientifiques. Il ne dut sa survie qu'à la présence de quelques rares connexions à des plaines alluviales.

[18] Lawa, 1995.

passant de 3 à 12% de la surface totale; elles ont presque doublé depuis 1950. Entre 1950 et 1980, la surface habitable disponible par habitant a doublé, passant de 15 m^2 à 31. Pour l'an 2000 il était projeté une valeur de 47m^2. Le Plan fédéral des réseaux de transports adopté en 1992 planifiait une extension de 7900 km de voies d'ici l'an 2012. A ceci s'ajoutera une extension probable due au réseau transeuropéen programmé au niveau de l'Union européenne (TEN-Transport). La forêt a augmenté de 2% et occupe 29% du territoire mais sa mauvaise santé ne lui fait plus remplir ses fonctions correctement. L'agriculture a reculé de 65 à 55% mais avec elle, ce sont des zones potentiellement inondables qui ont reculé.

La même analyse conclut qu'il n'a pas été observé d'augmentation générale des débits extrêmes en Allemagne. Par contre,

> une étude de l'université de Kaiserslautern montre que l'augmentation des surfaces occupées par les lotissements, l'industrie et les voies de circulation dans le bassin du Rhin a entraîné depuis 1950 une hausse des niveaux de hautes eaux sur le Rhin moyen de 15 à 20 cm. L'aménagement de barrages sur le Rhin supérieur entre Bâle et Baden-Baden et la perte de surfaces inondables qui en résulte font que depuis le milieu des années 1950 le niveau des crues qui s'écoulent vers l'aval dépasse le niveau normal de plusieurs décimètres dans certains cas[19].

La réponse habituelle pour la protection contre les inondations était structurelle : endiguements, barrages, murs. Presque tous les fleuves sont équipés d'un système de digues (levées en terre, double système pour les crues d'été et d'hiver ...). Ces structures étaient surélevées et consolidées après chaque épisode d'inondation importante. A l'abri derrière ces digues, zones habitées et économiques sont les plus exposées en fin de compte car aucune protection, si haute soit-elle, ne pourra garantir la sécurité totale contre une crue de période de retour de 500 voire 1000 ans. En outre, ces structures de défense nécessitent un entretien soigneux et coûteux.

> On estime, rien que pour la rénovation des digues du Rhin en Allemagne, les coûts à plus de 500 millions d'euros[20].

Les barrages hydroélectriques ou seulement de rétention peuvent stocker en amont une partie des crues, mais leur manœuvre s'avère délicate à coordonner dans le temps et l'espace, à condition encore qu'ils soient vides au moment de l'apparition des crues.

Les inondations catastrophiques des dernières années (le Rhin en 1993 et 1995 avec environ 3 000 millions de m^3 d'eau, l'Oder en 1997, l'Elbe et le Danube en 2002 ...) ont obligé à revenir sur les aménagements lourds et les réponses structurelles aux inondations.

Vers une gestion intégrée des crues

Les crues étant un phénomène parfaitement naturel, il n'y a aucun moyen d'intervenir sur la quantité d'eau qui risque d'augmenter avec les changements climatiques attendus. Mais il est possible d'intervenir sur les espaces inondables. Et il est nécessaire d'accepter l'idée que les cours d'eau et leurs vallées offrent des services socio-économiques, hydrologiques et écologiques pour le grand bien de la collectivité. Cette reconnaissance sous-tend les nouvelles mesures de gestion des crues et inondations.

Pionnier dans le domaine, le gouvernement du Bade Wurtemberg adopta en 1988 le Programme intégré du Rhin (IRP) doté d'un budget de 500 millions d'euros. Dérivant de la nécessité de prendre des mesures de prévention des inondations sur le Rhin supérieur, le programme ajouta le volet «intégration» lorsqu'il s'avéra nécessaire de prendre en compte – en plus des objectifs hydrologiques – les exigences écologiques des écosystèmes alluviaux. C'est ainsi que le programme se donna aussi pour objectifs la protection et la restauration des zones alluviales, l'objectif global étant de rétablir le degré de protection tel qu'il existait avant les aménagements du Rhin supérieur – destinés dans la première phase à protéger les riverains contre les crues.

[19] id. p. 5.
[20] id. p. 11.

Allant au-delà des mesures techniques préconisées par la Commission internationale d'étude des crues du Rhin (création de barrages de retenue appelés barrages agricoles, manœuvre des centrales hydroélectriques en cas de forte crue, création de «polders» ou zones de rétention des crues entourées de digues dans l'ancienne plaine alluviale, le IRP envisageait

> la préservation et la création d'un paysage alluvial aussi naturel que possible, constituant l'élément-clé pour une protection de l'environnement contre les crues.[21]

La réinondation écologique des zones encore ou anciennement inondables est fondée sur la connexion de ces espaces au fleuve afin de faire circuler l'eau du Rhin dès que les eaux dépassent un certain niveau, c'est-à-dire lorsqu'elles sont soumises aux crues annuelles. Cette adaptation ou réadaptation aux crues permet au milieu d'être prêt à accepter des inondations plus fortes. En outre, cet apport d'eau régulier permet de faire circuler l'eau à l'intérieur de la zone, ce qui est extrêmement profitable aux écosystèmes et aux biocénoses, spécialement lors des crues en fin de printemps, en période de végétation et de reproduction. L'élargissement de la zone inondable permet en outre de recharger la nappe souterraine en eau purifiée par les échanges microbiologiques et la filtration à travers les sédiments. Et la crue permet d'arracher aux berges les sédiments nécessaires pour stabiliser le lit mis à mal par l'extraction de granulats et la construction d'infrastructures (en aval du dernier barrage sur le Rhin, il faut verser annuellement 300.000 tonnes de sédiments).

La seule inondation périodique ne suffit pas à reconstituer la mosaïque de biotopes alluviaux et les zones encore disponibles ne peuvent pas stocker tout l'excès d'eau. Il est donc envisagé de reculer les digues afin de gagner un espace inondable plus important. Plus la zone est importante, plus le retour de l'eau dans le fleuve sera décalé. En même temps, l'onde de crue est atténuée pendant la phase ascendante. Dans un contexte général d'occupation intensive du sol, il ne sera certes pas toujours facile d'étendre les espaces de rétention, inconvénient majeur de cette solution.

Compte tenu des multiples bénéfices attendus et obtenus, l'aménagement du territoire a ici la tâche de :

- accroître au maximum possible les espaces de rétention des crues ;
- préserver ces espaces en désignant des zones spécifiques et en créant un réseau écologique fluvial ;
- prendre des mesures de gestion de ces zones pour une utilisation appropriée : extensification de l'usage agricole, conversion des peuplements forestiers non adaptés (non typiques de ces habitats) ;
- adapter les utilisations des plaines alluviales aux risques encourus et en particulier veiller à éviter ou au moins à réduire au maximum les impacts préjudiciables aux biocénoses par le biais de la pollution de l'eau et du sol ;
- faire en sorte que la circulation de l'eau à l'intérieur de ces zones ne soit pas empêchée. Il peut s'agir simplement de baisser le niveau d'une digue ou d'un chemin.

Ces mesures à objectif écologique doivent s'inscrire dans un contexte plus global à l'échelle du bassin versant en intégrant les autres politiques sectorielles. C'est ce à quoi s'emploient la Commission internationale pour la protection du Rhin et celles pour la protection de la Sarre, de la Meuse, de la Moselle, de l'Elbe, de l'Oder, du Danube ... Cette nouvelle façon de voir a été synthétisée dans un document de la Commission économique pour l'Europe des Nations Unies (CEE-NU, 2000).

En effet, il n'y aura de solution globale au problème des inondations qu'à cette échelle et qu'en intégrant les politiques et les différentes mesures de prévention des inondations.

La Directive-cadre sur l'eau pourrait servir de guide à cette politique de gestion des inondations. Mais si ce nouvel instrument communautaire, entré en vigueur en décembre 2000, évoque certes les zones humides et les crues, il ne leur consacre aucun chapitre. Cette

[21] Programme intégré Rhin, brochure grand public, 1997, p. 8.

lacune est en voie d'être corrigée grâce à l'initiative d'ONG, d'une part, et des directeurs de l'eau, d'autre part. Des réunions thématiques et des groupes de travail sont chargés de produire un document guide des meilleures pratiques. Compte tenu des objectifs de la Directive, il peut être raisonnablement envisagé que le rôle des zones humides et des plaines alluviales ainsi que des mesures structurelles existantes sera pris en compte de manière intégrée et aura également pour avantage une réduction des coûts de la gestion de l'eau. La Directive, qui devra s'appliquer aux autres politiques ayant trait au milieu fluvial (navigation, transport, développement urbain, agriculture ...), pourrait servir de plate-forme pour introduire de nouvelles formes de gestion de l'eau et de l'espace. Le guide des meilleures pratiques en préparation pourra aussi s'appuyer sur des innovations déjà mises en place par certains pays.

L'Allemagne[22], l'Autriche, la France, la Suisse travaillent à la mise en place d'un espace de liberté des fleuves après avoir testé une méthodologie[23]. La Suisse a déjà franchi un pas de plus en modifiant l'article 21 de l'Ordonnance fédérale sur l'aménagement des cours d'eau (1999). Cet article a force obligatoire et s'impose aux lois régionales :

> Article 21
>
> 1. Les cantons désignent les zones dangereuses.
> 2. Ils déterminent l'espace minimal des cours d'eau nécessaire à la protection contre les crues et à la préservation des fonctions écologiques.
> 3. Ils tiennent compte des zones dangereuses et des besoins d'espace dans leurs plans directeurs et dans leurs plans d'affectation ainsi que dans d'autres activités ayant des effets sur l'organisation du territoire.

Le but de cet article est d'obtenir que soient désignées et réservées à cet effet les surfaces nécessaires à la protection contre les crues et à la préservation des fonctions écologiques des cours d'eau.

> Les synergies qui peuvent se produire entre la protection contre les crues, l'agriculture, la sylviculture ainsi que la protection de la nature et du paysage s'inscrivent ainsi directement dans le processus de planification.

En dehors des effets bénéfiques pour la protection contre les inondations et pour les milieux naturels, la gestion du lit majeur respectueuse de la dynamique fluviale aura pour conséquence positive la préservation de la ressource en eau, sa disponibilité, son accessibilité et sa qualité (recharge de la nappe, stabilisation de l'enfoncement du lit, auto-épuration). Pour ce faire, il sera nécessaire d'éviter au maximum les protections des berges – voire leur restauration – et de prévoir le rejet de l'exploitation des granulats hors du lit mineur et majeur.

Afin de mener à bien cette entreprise, il est indispensable d'associer la population locale qui non seulement doit être impliquée dans la gestion du bassin versant mais doit pouvoir comprendre et accepter la nouvelle donne, la nouvelle culture du risque d'inondation (il ne peut pas y avoir de risque zéro), et les quelques inconvénients qui peuvent en découler (servitudes éventuelles sur leurs terrains, manque à gagner, petites crues possibles ...) dans un contexte général de solidarité à l'échelle du bassin.

Le public doit pouvoir accéder à l'information et participer à la prise de décision, ce qui aura pour bénéfice d'en faciliter l'application (voir à ce propos la Convention d'Aarhus de 1998 sur l'accès du public à l'information et à sa participation en matière de prise de décision relative à l'environnement).

Etablir et garantir un espace de liberté pour les fleuves peut devenir un objectif ambitieux pour les ministres européens de l'aménagement du territoire. Mais les fleuves et leurs plaines alluviales, avec leurs multiples fonctions bénéfiques à l'ensemble de la société à court, moyen et long terme, le méritent bien.

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[22] La loi sur l'aménagement du territoire de 1998 qui prévoit des espaces autour des cours d'eau pour retenir les crues.

[23] Cf. Suisse, Office fédéral de la coordination pour la protection de l'environnement, 2002, France, Agence de l'Eau Rhône-Méditerranée-Corse, 1998.

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How the great 2002 flood affected Czech museums

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In August 2002, the Czech Republic was affected by a flood, which was much bigger than any other flood ever recorded in historical documents. On the whole, twenty-one museum buildings were flooded, and the total damage, including both that caused to the premises and the collections and archives, is estimated at more than CZK 1 billion (this is a qualified, yet still preliminary estimate).

In spite of the enormous effort of all museum employees who risked their health to carry out the essential measures needed for reducing the extent of destruction as far as possible, the preparedness for addressing such emergency situation, including co-operation with the Integrated Rescue System (IZS), appeared to be poor, especially in the information area. This was so in spite of the fact that a significant improvement had been achieved after the year 2000 in the communication between the heritage institutions and the executive IZS units, thanks to the work done by the Czech Blue Shield Committee (committee representing the major non-governmental institutions in the heritage area, including museums, galleries, libraries and state bodies of heritage management and archives).

Extensive floods have affected the Czech Republic already twice in recent years. Taking into consideration this and the forecasts of increasing likelihood of changes in global climatic conditions, the current level of Czech museums' preparedness to face such emergencies appears to be inadequate. The same applies to readiness to face other dangers, which occur ever more frequently with the spreading of organised crime and terrorism. The damage caused to the collections also drew attention to the fact that many of the collections have been deposited and maintained under poor conditions in unsuitable spaces. It is often the case that items of key importance for collection quality are held side by side with items of marginal importance for the collections and even with items which – if the collections were appropriately reviewed – should be excluded.

The overall damages of the floods that occurred in the Czech Republic in August 2002 in a mere five days, were estimated at 70 billion CZK (ca 2 billion EUR). Cultural heritage suffered considerable damage, as the concentration of cultural monuments, historical buildings and museums along the flooded rives was quite high. Altogether twenty museums were affected, including the most important ones, such as the National Museum, the National Gallery, and the National Technical Museum. Water heavily damaged also two sites listed in the Unesco list of world cultural heritage – the town of Cesky Krumlov and the historical centre of Prague. Immediately after the floods, joint action of representatives of all the professions gathered in the Blue Shield, i.e. museums, heritage protection, libraries and archives, together with the Ministry of Culture, was launched. With substantial subsidies from the national budget and help from abroad, fundamental measures were immediately taken in order to restore the buildings and collections, damaged by the floods. Quick financial help came from ICMS members (the Committee was holding its annual conference in the Czech Republic), and flooded cultural institutions could benefit from important international help provided especially by Switzerland, The Netherlands, Germany, Liechtenstein, Norway. At present, restoration works still continue, the share of the State in the renovation of museums, cultural monuments and historical buildings consisting of ca 95% of the total costs, estimated at 7 billion CZK in the area of cultural heritage. A most pressing problem has been the drying, desinfection and restoration of some 2,000 m^3 of paper material, which is so far deep-frozen, deposited in industrial freezing boxes near Prague. Of this, more than 500 m^3 has been identified as important parts of the national cultural heritage. They are mainly historical books from chateau libraries, and the collections of architecture and history of aviation of the National Technical Museum.

The establishment of a National Conservation Centre, being a part of the Technical Museum in Brno, has been planned so that to provide for the drying and conservation of the above material. When this emergency work is finished, the Centre will be used as conservation and methodological workplace with important tasks in prevention for the museums in the whole country, and possibly also from the central European region.

SECOND SESSION

From sectoral
to integrated approach

DEUXIEME SESSION

De l'approche sectorielle
à l'approche intégrée

Part A:
Approaches and methodologies /

Partie A :
Approches et méthodologies

Typologisation of natural and technological hazards and regions in Europe

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The area of the European Union contains different types of technological and natural hazards and risks that in some way can have effects on the development of its regions. Natural hazards comprise, e.g. floods, droughts and earthquakes, etc while technological hazards concern, e.g. fallouts from nuclear power plants, oil spills and hazardous waste deposits, etc. Not all possible hazards and risks are of relevance in the context of spatial development and spatial planning. In order to facilitate risk mitigation through planning, relevant hazards have to be selected on criteria that fulfil the requirements of spatial planners.

The ESPON 2006 project 1.3.1 focuses on the typologisation of risks and hazards as well as the risk profile of regions (hazard potential and vulnerability). The aim is to better understand and manage risks and to facilitate targeted responses and policies and to point out situations that can be compared across Europe. The limitations to develop uniform criteria for the EU area for evaluating risks are the difficulties in assessing risks in complex situations, e.g. multiple hazard regions. This suggests that it is not possible to rely on European overviews only, but also need to understand specific local situations.

The starting point for the typologisation of hazards is a risk classification and characterisation scheme elaborated by the German Advisory Council on Global Change (WBGU). Six risk types were identified, following characters of the Greek mythology. Two of these WBGU risk types are relevant in the context of spatial planning: *Damocles* (Probability of occurrence is low and *E*xtent of damage is high) and *Cyclops* (*P* is unknown and *E* is high). The spatial relevance is a fundamental part of each hazard, but is not yet spatial planning relevance. Therefore, the ESPON project 1.3.1 created a so-called "spatial filter". The spatial character of a hazard can either be defined by spatial effects that might occur in case of a disaster or by the possibility of a spatial planning response.

On the basis of the selection of hazards it is possible to move towards the development of a typology of regions regarding their hazard and risk profile. Because of the different nature of hazards, such a typology will first be developed separately for each hazard. Subsequently, the separate assessments for the individual hazards will be superimposed to reveal the most threatened areas in regard to all hazards. The integration of the vulnerability of a region (damage potential, coping capacity) allows distinguishing between those regions that are only hazardous areas and those, which are risky areas. These synthetic risk profiles, which will also include data on the management of risks, will then be presented in a cartographic form – as a risk map for the European regions.

The obtained information could be of great value for spatial planning and development. An important background for the structural funds after 2006 could concern the structure of investments in risky regions. A possible prerequisite for funding could be the institutionalised preparedness to face specific hazards or the respective coping capacity. In other words: which regions need special help to improve their preparedness in order to increase the efficiency of the structural funds and their sustainability?

For more information please see:
http://www.espon.lu/online/documentation/projects/thematic/thematic_60.html
European Spatial Planning Observation Network, ESPON 2006, www.espon.lu

Project 1.3.1: The spatial effects and management of natural and technological hazards in general and in relation to climate change

Tasks

- identification and gathering of existing indicators and proposals for new indicators on natural and technological hazards;
- collection of data and development of map-making methods to measure and display state, trends and impacts;
- definition of EU wide concepts in the thematic field of indicator development on hazards;
- evaluation of effects on the European territorial structure and development;
- relationship between the European spatial system considering the other thematic fields mentioned in the ESPON 2006 programme;
- deduction of policy recommendations promoting territorial cohesion taken into account the European Spatial Development Perspective, spatially relevant policies, the role of territorial governance and the European Strategy for Sustainable Development with reference to content, instruments and institutions.

Partners of the consortium

- Geological Survey of Finland (GTK) www.gsf.fi (lead partner);
- Centre for urban and regional studies(CURS)/Unsiversity of Helsinki, www.hut.i/Yksikot/YTK/;
- Swedish Meteorological and Hydrological Institute (SMHI), www.smhi.se;
- Comissão de Coordenação da Região Centro (CCRC) www.ccr-c.pt + Instituto Geológico e Mineiro (IGM) www.igm.pt;
- Institute of ecological and regional Development – Ioer, www.ioer.de/Uk/index_e.htm;
- The Institute of spatial Planning, University of Dortmund IRPUD: www.irpud.Raumplanung.uni-dortmund.de/irpud/.

Associated partners

- Regional Ministry of the Environment of Andalusia, Spain;
- Regional Council of East Uusimaa, Finland;
- Swiss Federal Institute of Technology Lausanne (EPFL).

The development of planning guidance on flooding in England

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Introduction

The principal aim of the British Government's flood management policy is to reduce the risks to people and the natural and built environment due to flooding. This is achieved through a three-pronged strategy by:

- encouraging the provision of adequate and cost-effective flood warning systems;
- encouraging the provision of adequate and technically, environmentally and economically sound and sustainable flood defence measures; and
- discouraging inappropriate development in areas at risk of flooding.

The existing risks to the historical legacy of development in areas vulnerable to flooding are addressed by flood warning systems and flood defences under the aegis of the Department for Environment Food and Rural Affairs (Defra), with the Environment Agency as the principal operating authority. The Office of the Deputy Prime Minister (ODPM), through its planning policies, aims to reduce the build-up of risk due to new development in such areas.

The greater part of the urban fabric of Britain developed in a wholly unplanned manner in the nineteenth and early to mid-twentieth centuries. The modern planning system was introduced in 1947. It essentially requires that no development can be carried out without the benefit of planning permission. Planning decisions should take account of all material considerations, including the provisions of the development plan (the forward planning system). Since 1991 the system has been plan-led, with decisions being determined in accordance with the development plan where it is relevant, unless other material considerations indicate otherwise.

Since its introduction, guidance on the consideration of flooding in planning decisions has been issued in Government Circulars at intervals of about ten years. Department of the Environment (DOE) Circular 30/92 sought to direct development away from areas vulnerable to flooding.

The development of Planning Policy Guidance note (PPG 25)

In April 1998, there was widespread flooding in the east and west Midlands following prolonged intense rainfall. About 4,000 houses were flooded, including about 2,000 in the single town of Northampton. Interestingly, the town of Bedford, in a similar hydrological position on a different river, whose catchment was also subject to intense prolonged rainfall, suffered only fourty-four houses flooded. The principal reason for the difference was that Bedford has parkland/open space along both sides of the River Great Ouse, while Northampton has housing right alongside the river walls.

Both the popular and technical press suggested that planners were to blame for the flooding by allowing development in flood plains. A Parliamentary select committee reported in July 1998, calling for a strengthening of the planning policy against building in flood plains. Then, the Department for the Environment, Transport and the Regions (now ODPM) reviewed with the then Ministry of Agriculture (now Defra) and the Environment Agency the effectiveness of DOE Circular 30/92. It was found that the policy in DOE Circular 30/92 was working quite well, in that many development plans contained policies relating to

flooding and that most of the properties flooded were built before the advent of the planning system. However, it was agreed that there was merit in re-stating the policy in more precise terms, and particularly to strengthen the role of the Government's principal adviser on flooding, the Environment Agency.

A draft of a new PPG was published for consultation in April 2000. Review of the consultation responses indicated a mixed reception. Most local authorities considered that it represented what was already good practice among them. The environmental lobby tended to consider that it was too much in favour of development, almost suggesting that building in flood plains was acceptable if defences were provided. In contrast the development industry considered that the precautionary approach that it introduced made it far too easy for local planning authorities to refuse applications.

Revision of the PPG was almost complete when the floods of autumn 2000 arrived. These were national in their extent and over 10,000 houses were flooded. A significant proportion of the houses flooded were in small groups associated with minor watercourses, groundwater flooding, overland run-off or sewage flooding due to the drainage capacity being overwhelmed. While some of these houses were relatively recently built, most were built before the planning system came into being. A further Select Committee examined the proposals contained in the new PPG 25 and reported in December 2000.

As a result a further consultation was carried out in February-March 2001 on a revised draft PPG that introduced a specific risk-based approach that gave priority to lower-risk areas. This was revised in the light of consultation responses and PPG 25 was published by the then Department for Transport, Local government and the Regions (now ODPM) in July 2001.

Policy aims of PPG 25

PPG 25 *Development and flood risk* aims to bring about a step-change in awareness and understanding of flooding. Those proposing development, whether it is the local planning authority in its development plan or the individual developer, need to be aware of how flooding could affect their development and how their development could affect flooding elsewhere. Development proposals should be accompanied by a flood-risk and drainage assessment that is appropriate to the scale and nature of the development and the risks involved. Local authorities need then to consider flooding and any advice from the Environment Agency on flooding issues alongside other planning considerations in determining whether development should be permitted. These issues need to be considered on the wider scale of the river catchment or coastal cell.

There are large uncertainties in flood prediction and the likely effects of climate change can only increase these. Flood risk is increasing but we do not know by how much. A precautionary approach is therefore needed to deal with the uncertainties. The principles of sustainable development require that flood risk be avoided where possible and managed elsewhere. Where flooding does not present a risk to people and property, flood plains should be allowed to function naturally.

PPG 25 introduces a specific risk-based approach to flooding. While the continuum of risk is recognised, areas with an annual probability of river flooding of 1% or above or of tidal flooding or coastal flooding of 0.5% are regarded as at high risk of flooding. The lower risk level for coastal flooding reflects the more dynamic nature of coastal processes and the consequent higher risk to life. This high-risk zone is roughly consistent with the flood plain defined in DOE Circular 30/92 and shown on the Environment Agency's indicative flood plain maps. An outer zone of extreme flooding is defined by an annual probability of flooding of 0.1%. Maps of the extreme flood limit are currently being produced for the Environment Agency.

Priority for development is accorded to those areas at least risk. However, since 10% of England, by land area, by population and by housing stock, is within the indicative flood plain, it is clear that some development has to take place within higher-risk areas. Priority here is afforded to existing developed areas, which cannot simply be abandoned and where there are, in any case, more likely to be defences to an appropriate standard. This is consistent with general planning policies that favour the redevelopment of previously developed land and avoidance, where possible, of new green-field development.

Beyond the extreme flood limit, river and coastal flooding can be effectively discounted in planning decisions. Local topography and hydrogeology may, however, result in local flooding at times of intense and/or prolonged rainfall. More consideration needs to be given to local drainage provisions to ensure that they are not overwhelmed at such times. Major civil emergency infrastructure, such as hospitals, police and fire stations, should preferably be located in such areas to prevent them being out of commission at precisely the times they are needed. However, the location of existing development and the requirements for appropriate response times may lead to such infrastructure being located in areas at higher risk. If so, there need to be assurance that access will be maintained and the emergency services can operate effectively at times of flood.

Within existing developed areas in areas of high risk, most development can proceed provided that an adequate standard of defence can be maintained for the lifetime of the development. That standard is defined as protecting against a flood with an annual probability of 1% for rivers and 0.5% for coastal flooding for fifty years, taking account of climate change. Undeveloped and sparsely developed areas are generally not suitable for major new development, especially where lower-risk land may be available. However, parts of eastern England, particularly, have extensive areas within the high-risk zone and little or no land at lower risk. Development may be needed here to avoid social and economic stagnation or blight. Where defences or other mitigation are needed because of new development, the provision and future maintenance of those measures should be fully funded as part of the development. This will ensure that the true costs of a development are borne by the developer and not passed onto society as a whole as a commitment to future maintenance.

Undefended and essentially unobstructed areas that function fully as natural flood plains are to be avoided by built development. Only exceptionally should transport or other service infrastructure be allowed within these functional flood plains and they should be designed to minimise their impact on flood flows and flood storage. Opportunities should also be sought to restore flood-plain function as a part of the overall flood management strategy and development should not be allowed to prejudice areas that may be appropriate for such action.

Because defences can only reduce the risk of flooding and not eliminate it, encouragement is given to the use of construction techniques that increase the flood-resistance and resilience of buildings. Interim guidance on flood resistant construction was issued in February 2002.

Development increases run-off due to decreased permeability and water retention. It can result in local flooding due to overwhelming of inadequate or overloaded drainage/sewerage infrastructure and passes peak flows rapidly downstream, thus increasing flood risk there. PPG 25 therefore encourages the use of more sustainable drainage systems (SUDS) that retain water as near its source as possible and attenuate peak flows. The Environment Agency published in May 2003 a consultation document on a national framework for SUDS, which looks to establish design guidelines and approaches for the future ownership and maintenance of SUDS to assist in overcoming the barriers perceived to their implementation on a wider scale.

Monitoring of PPG 25

In PPG 25 the Government committed to reviewing its guidance three years after publication to take account of the developing knowledge on climate change and experience of its implementation and effectiveness. Monitoring by both the Environment Agency and ODPM includes examination of the rate of planning applications and the rate of conversion to residential use in flood-risk areas as well as the Environment Agency's response to consultation.

High-level targets (HLT) for flood and coastal defence were published by the then Ministry of Agriculture, Fisheries and Food in 1999. The Environment Agency are required to report on their responses to consultation on both development plans and applications and whether local planning authorities (and inspectors/the Secretary of State on appeal) had followed that advice. These targets provide the framework for ensuring and demonstrating delivery of the Government's stated policy aims for flood and coastal defence.

HLT 12 covers applications and appeals. Reports by the Agency cover the period from November 1999 to April 2002, i.e. from the period before the first consultation on PPG 25 to approximately nine months after its publication. The information reported has evolved over that time and it is difficult to be categorical about the impact of PPG 25. It appears, however, that PPG 25 is beginning to have an effect. Relatively few major cases have been determined contrary to the advice of the Agency and where such decisions have been reached; local planning authorities can generally justify their decisions on the grounds that other considerations outweigh the Agency's objection. In some cases, authorities proposing to over-rule the Agency's advice have re-consulted as advised in PPG 25. However, it is clear that the Environment Agency is not receiving decision notices from local planning authorities on a significant number of applications to which it has objected.

In the five years to 2000, 11% of all new dwellings (9% of the land area that changed to residential use) reported in national land-use change statistics collected by ODPM from the Ordnance Survey were in the indicative flood plain. There is significant regional variation and over one-third of the new dwellings in the indicative flood plain were in London. The number of planning applications in indicative flood plains continued to increase in 2001-02 but the value of planned development decreased by one third, consistent with the overall decline in value of planned development.

Other developments

There have been significant developments in the consideration of flooding in spatial planning. The whole of the coastline of England and Wales is covered by shoreline management plans, which establish the flood and coastal defence policies for stretches of coast on a coastal cell or sub-cell basis. These have been generated by groups of local authorities and the Environment Agency. The second generation of shoreline management plans is now getting under way.

Defra and the Environment Agency have piloted holistic assessments of river catchments as a basis for catchment flood management plans. These are to be published shortly and will in due course cover all river catchments in England and Wales. Significant activity is underway through the Interreg programme, with water management and flooding in the context of spatial development planning being considered in a number of areas in England and European partner countries. These include the Thames and Humber estuaries, the River Parrett catchment in Somerset and the fenlands of eastern England.

While the European Water Framework Directive relates primarily to the control of pollution rather than flooding there is clear scope for integration of its required River basin management plans with the catchment flood management plans.

Devolved governments in the United Kingdom are responsible for flood management and planning policies within their areas. The Welsh Assembly Government currently has planning guidance on development and flood risk based on DOE Circular 30/92. However, this is being reviewed and it is understood that it will consult shortly on new guidance that incorporates a risk-based approach similar to that in PPG 25. The Scottish Executive has consulted recently on new planning guidance on flooding that incorporates the risk-based approach, though no distinction is made between river and coastal flooding, i.e. high risk is defined as an annual probability of 0.5% or higher. The Northern Ireland Government is also reviewing its planning guidance on flooding and it is also expected to introduce the risk-based approach.

Concluding remarks

PPG 25 is intended to help local planning authorities to reduce the build-up of risk in areas vulnerable to flooding. Since it deals only with new development, its impact on total flood risk can only be marginal. It cannot significantly impact on the existing legacy already at risk.

PPG 25 aims to ensure that flooding is taken fully into account in reaching decisions on the location of new development. It does not aim to stop all development in flood plains. This is totally unrealistic since so much of our built environment is already there and is defended to an appropriate standard. Where new development, or the redevelopment of previously developed land has to take place in areas of high risk, it should be appropriately designed and defended. Thus, for example, for major new building in the proposed growth areas in SE England, flood risk and defence issues are being factored in at the outset – in full co-operation and discussion with the Environment Agency.

PPG 25 has only been in operation for just over a year and it is probably too early to determine how effective it will be. It is, however, clear that it is beginning to have an effect. Certainly there has been a step-change in awareness of flooding, though the weather has helped in this respect. The need to assess flood risk for proposed development is being increasingly recognised and it is notable that 40% of the Environment Agency's sustained objections to planning applications were on the grounds that no adequate flood-risk assessment had been submitted.

The challenge will arise when we next have a dry period with relatively few floods, since it only takes a few years to forget about the impact of the last flood and for other factors to be considered more important. Government will continue to monitor the impact and effectiveness of PPG 25 and will review it in the light of this monitoring and of developments in climate change science in 2004.

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Flood prevention policy in The Netherlands

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The Netherlands is a low situated country. Two third of the country is vulnerable for flooding. People often forgot this danger and did not reinforce the dikes in time. Disasters created moments to improve the situation. The danger of floods in The Netherlands has two sources. One is high winds and water levels from sea which attacks our coast line. The other source for danger are the high river discharges of the River Meuse and the River Rhine.

In this presentation the further focus will be on river flood management.

Along most of our rivers are dikes to prevent the land from flooding during high discharges. During the past centuries the floodplain between the dikes is silted up due to the concentration of sediment. The capacity of the rivers became insufficient to safely discharge water and ice to the sea. It resulted in dike breaches and large inundations particularly in the 18th century.

The building of our dikes started in the 18th century and since then our dikes are getting higher and more solid over the years. Nowadays, usually once in fifty years dikes are reconstructed to mitigate shrinkage of the dike's body, subsidence and sea level rise. It is the reason why the present dike reinforcement takes the observed sea level rise over fifty years into account. In 1993 and 1995 again there were high discharges in our rivers. In 1995 a whole polder was evacuated: all people and domestic animals.

River flood protection policy changed under the influence of these near-disasters. Flood protection was virtually synonymous with dike-building. Now the policy is that sustainable protection has to be based on working with and not against the natural processes. This new international agreed approach aims to reduce the flood wave by rehabilitation of the absorption capacity of the soil. The rivers will get more space to expand by making the floodplains broader and deeper. In some cases the dike will move landward.

To ensure the safety against flooding according to the present standards in future, the flood protection Act (1996) prescribes a five-yearly check of all flood defense works along the coast, main rivers and lakes. Updated hydraulic design conditions, taking into account sea level rise, higher river discharges due to climate change, subsidence, shrinkage, changes in geometry, etc. are the starting point of the check. The dike authorities (mainly water boards and Rijkswaterstaat) have to report to government and parliament about the conditions of the works. If the required safety standard is not met, they have to propose and realise plans to meet the safety standard again.

Right after the floods of 1995, the government decided to set up a plan to reinforce and higher the dikes to the legal hydraulic design level, which is fixed in the flood protection Act. This level is based on a mean exceeding in one per 1250 years. At that time not all our dikes had the right design level.

As already mentioned our flood prevention policy at the same time changed to the new approach: “Space for Rivers”. This means in fact not to higher the dikes anymore, but to create wider river beds or other additional measures in order to reach a safe transport of extreme volumes of water.

To create a wider river bed a lot of measures are needed. Measures with much diversity and with more or less consequences and impact. A complete plan is now established for the River Rhine with all the measures in it, to reach the goals for the needed water transport

capacity. To realise the measures an Act must also get into force for this purpose. Of course it's very important that the plan must be accepted by all governmental levels and stakeholders. Now the legal decision is under preparation. In the meantime we try to implement that policy as much as possible. That means that some of the measures are yet under execution.

It was already mentioned that our hydraulic design level increased due to some higher river discharges. Since 1996 the hydraulic design discharge of the River Rhine near the German border was 1500 m^3/s. In 2001 this design discharge was determined on 1600 m^3/s. This means a higher design level for the dikes. At the same time it was decided that this larger discharge may not cause a raising of the dikes, but the extra volume should be accommodated by measures in the framework of the "Space for Rivers project". Therefore measures are taken which can be carried out under the present Act.

Another subject in the framework of safety against flooding what I want to present here, but which is still in discussion in The Netherlands, is the use of "Emergency Flooding Areas". The use of these areas is focussed on situations when the river discharge is higher than the hydraulic design discharge. In such an occasion the dikes may collapse. Before this will happen, specific chosen dikes will burst through to let the water flow into a large polder area (Emergency Flooding Area) to reach lower discharges and levels downstream the Emergency Flooding Area. The idea of that policy is to prevent enormous damage to people, animals and goods in a much densely populated downstream areas. The idea is: when a flooding occurs because of high river discharges, then the government wants to decide where the flood is going to take place and not that a coincidence must determine the area.

In fact this measure is now under investigation. Several problems can be distinguished, like:
- How to find polders large enough to accommodate the needed water volume?
- What to do with the inhabitants in those areas?
- How to deal with the different safety levels which may introduced with those areas?
- When are such areas an advantage, due to costs and social impact?
- When is the right moment to open the dike?
- Who makes such a decision? Who is responsible?
- What about the costs by designating the areas and when after an operational situation?

And more problems have to be resolved before final decisions are taken. Such a measure should be implemented in the total national flood prevention policy.

Safety against flooding is an important topic in The Netherlands. The Parliament is interested in this subject. This is why a lot of work is carried out to improve our safety against flooding and to decrease the uncertainties around flooding occasions.

Not only projects focused at the accommodation of high discharges are carried out. We also are working on another approach of the legal standard for safety against flooding, taking into account the different mechanisms for a catastrophe, the level of damage after a flood, etc.

In a low situated and dense populated country like The Netherlands, the attention for safety against flooding stays important. And at the same time the whole subject is getting more and more complex to deal with. Not only on technical level, but also politically. The communication between these fields and society is extremely important. Therefore Rijkswaterstaat involves all stakeholders, in every plan and in policy making.

Safety against flooding concerns a lot of people. To take the decisions in this field, with support of a large majority of the inhabitants, is the challenge for everyone busy with flood prevention.

Flood prevention concepts for transnational river catchments - the 'INTERREG ODERREGIO' experience[24]

Jürgen NEUMÜLLER, Hans Reiner BÖHM, Ernesto RUIZ RODRIGUEZ, Peter HEILAND, Hans Jürgen GRÄFF

ODERREGIO

1. Summary

The project "Transnational Conception for Spatial Planning of Flood Prevention in the Oder Catchment Area – ODERREGIO" is funded by the Joint Initiative Interreg IIC of the European Commission. Fundamental principles and targets for preventive flood protection have been developed and agreed with the relevant actors, coming from the Republics of Poland, Czech Republic and Germany, which were integrated in a co-operative planning process. For seven specific action areas, first recommendations for necessary priority measures were given. The project will be continued within the scope of Interreg IIIB and PHARE. The goal is a concrete Action Program for preventive flood protection.

2. Initial situation

Over the past decades and centuries, extreme flood events have often occurred in the Oder valley causing considerable damage. The latest such event, the summer floods of 1997, is still fresh in our memory. The flooding and dam breaches caused enormous material damage – particularly in the Republic of Poland and the Czech Republic – and in these countries there was unfortunately loss of life as well (IKSO 1999, European Commission 1999).

This extreme event showed very clearly the risks which man undertakes when he uses flood endangered areas. At the same time, this event also provoked a new contemplation of the possibilities which are available to influence the course and the effects of flooding.

In this respect – as in other river basins – a common understanding has evolved that the tasks which have to be dealt with require an integrated approach. This means that one must view the whole river basin and also include various fields of politics in these considerations. (Heiland/DAPP 2001).

3. The ODERREGIO Project

The "ODERREGIO Project – Transnational Conception for Preventive Flood Protection in the Oder Catchment Area" has devoted itself to the task of achieving an integrated flood protection. The target of the project was to develop methods and focuses for action in spatial planning for flood prevention in the Oder catchment area (Böhm 2000, Neumüller 2000).

The necessity of taking the complete river basin area into consideration is self-evident. The extreme flooding in 1997 showed that floods do not stop at national borders and that there are very important relationships between downstream and upstream areas. Flood protection on the Oder is thus a transnational task for the countries where this river flows i.e. the Czech Republic, the Republic of Poland and the Federal Republic of Germany.

To meet this international challenge, in order to realise the ODERREGIO project, the most important water management and spatial planning actors from all three countries agreed to work together in a co-operative process. In a working group which accompanied the project,

[24] This contribution was also published in Wasser and Boden H. 3/2003 (German version).

where more than thirty actors were involved, intermediate results of fact finding and of potential and effect analysis were presented and discussed. Through the active contributory work and co-operation of the participants, the inclusion of their expertise and local knowledge provided enormous benefits for the realisation of the ODERREGIO project.

National planning was also integrated into the project (Zaleski 2000, Lua 1998). The Polish "Program for the Oder – 2006" (Odra 2001) forms the central basis here.

The result has been the successful production and transnational agreement of a "Conception for Preventive Flood Protection". In this conception, general principles and targets of preventive flood protection are formulated. Moreover, concrete action recommendations for partial areas are recommended.

For this, some preparative working steps were necessary. They are described as follows.

4. Working steps

4.1 Inventory of the current situation

At the beginning of the *ODERREGIO* project, especially for this project, a suitable digital map basis had to be created for the whole catchment area of the Oder (118,861 km²).

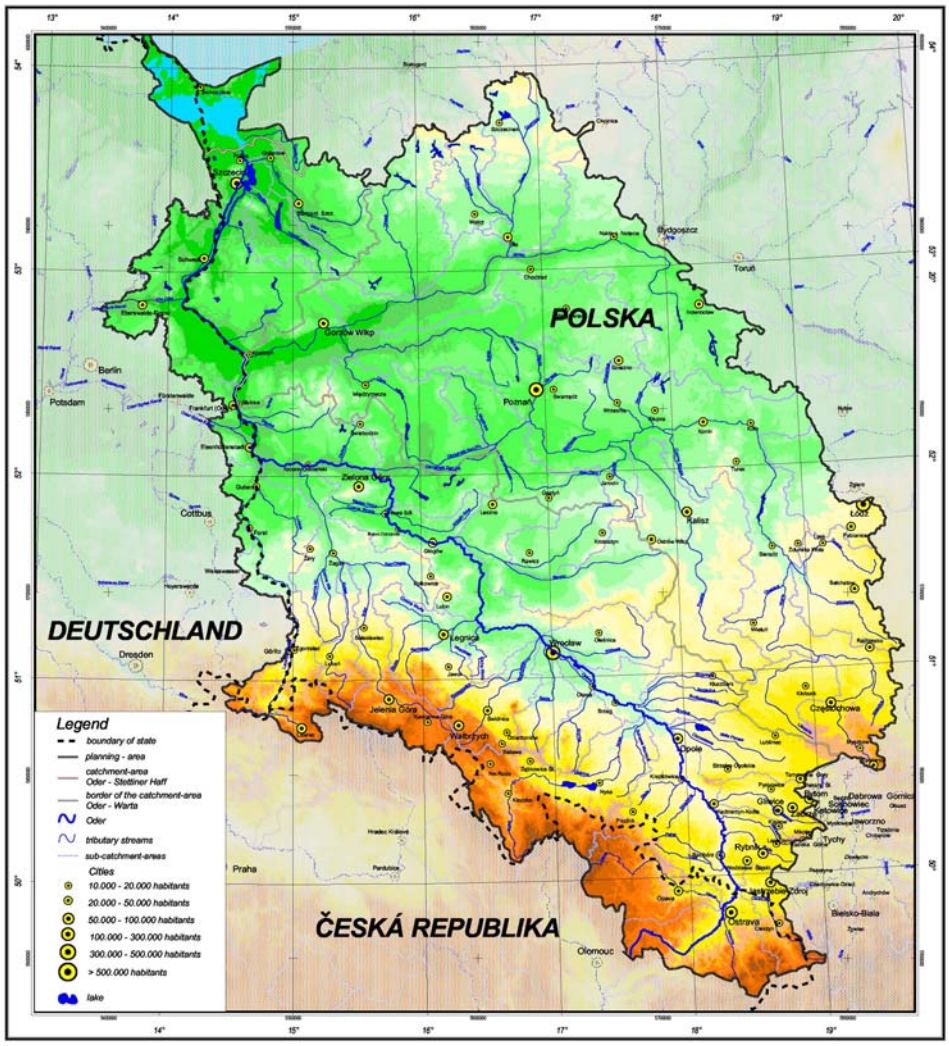


Figure 1 Planning Area – Oder Catchment Area

The difficulty in making this inventory lays in obtaining the corresponding information for such a large area. For this, as far as possible, available studies and plans were evaluated, however, partially, separate own research was carried out.

The area of the geomorphological water meadow was used in a first approach to the problem, in order to establish the borders of the areas endangered by flooding. The result obtained was a potential flooding area of a total of 6,678 km² .

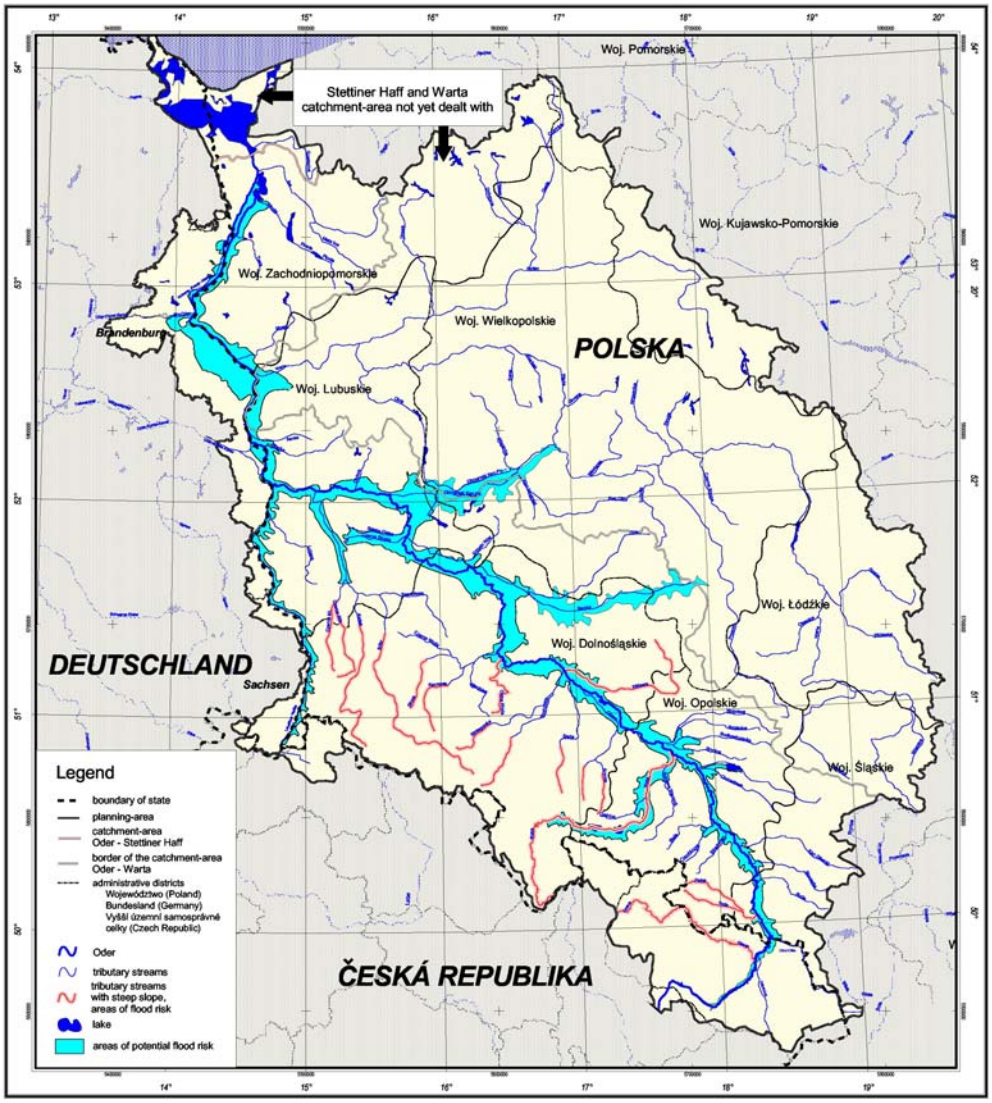


Figure 2 Potential Areas of Flood Risk

In order to establish the flooding danger potential, the real land use data – so-called CORINE land cover data – were used. The total of fourty-four established land use categories were summarised to make up six categories which provided a sufficiently differentiated picture for flooding consideration purposes. The categories are settlement areas, industrial land, infrastructure, agricultural areas, forest and nearly natural areas.

The intersection of the
– land use data (CORINE land cover), with the
– potential flooding areas
provides the possibility to estimate the flood danger potential. In this analysis, more than thirty towns were identified as particular danger points (hot spots) along the Oder and its tributaries.

4.2 Analysis

The reduction of the flooding danger must take the impact interrelations and the various action possibilities into account. Here one must differentiate between various expert disciplines and expert administrations. Particular importance lies with spatial planning and water management. The task of spatial planning is to control land use, infrastructure and settlement development in order to avoid flooding as far as possible and in case it is not avoidable to reduce the associated damage potential (compare MKRO 2000). Spatial planning can thus effectively support water management which in the past has carried the main responsibility for flood protection by providing technical flood protection measures.

Table 1 displays a total of six fields of action and their allocated measures of preventive flood protection (compare also Böhm *et al*. 1999).

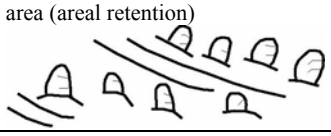
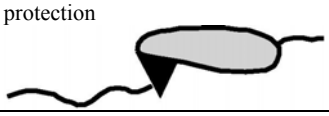
	Field of Action		Measure
1.	Retention of precipitation water in the area (areal retention) 	-	Management of rain water in settlement areas - Limitation of land sealing - Land use and cultivation which reduces flow-off - Forest management reducing flow-off - Renaturalisation of streams and ditches
2.	Retention through technical flood protection 	-	Building and management of: - reservoirs - retention basins
3.	Preservation and safeguarding of current retention areas 	-	Keeping current flooding areas free of buildings - Preservation of current polders
4.	Creation and extension of retention areas 	-	Dike relocations - Setting up polders - Renaturalisation of large waters - Keeping water meadows free - Deepening of retention areas
5.	(Object) protection by using technical flood protection measures 	-	Dikes and dams - Increasing height of dikes - Flood protection walls - Improvement of flow-off conditions - Diversion channels
6.	Minimising the damage potential 	-	Precautions in the area (control of flood sensitive land use) - Precautionary measures on buildings - Measures affecting behaviour (flood forecast and warning, public information creation of problem awareness emergency services)

Table 1: Fields of action and measures in preventive flood protection

These fields of action and the allocated measures of preventive flood protection were analysed and evaluated with regard to their realisation potential and their effects.

An evaluation of action possibilities for preventive flood protection requires a differentiated approach depending on which partial area is being considered. Therefore the planning area was subdivided up into a total of nine partial areas – so-called action areas. The subdivision was carried out in such a way to ensure that relatively homogeneous problem conditions were present for one partial area thus enabling similar action possibilities in that area.

The central results of the analysis are shown in figure 3.

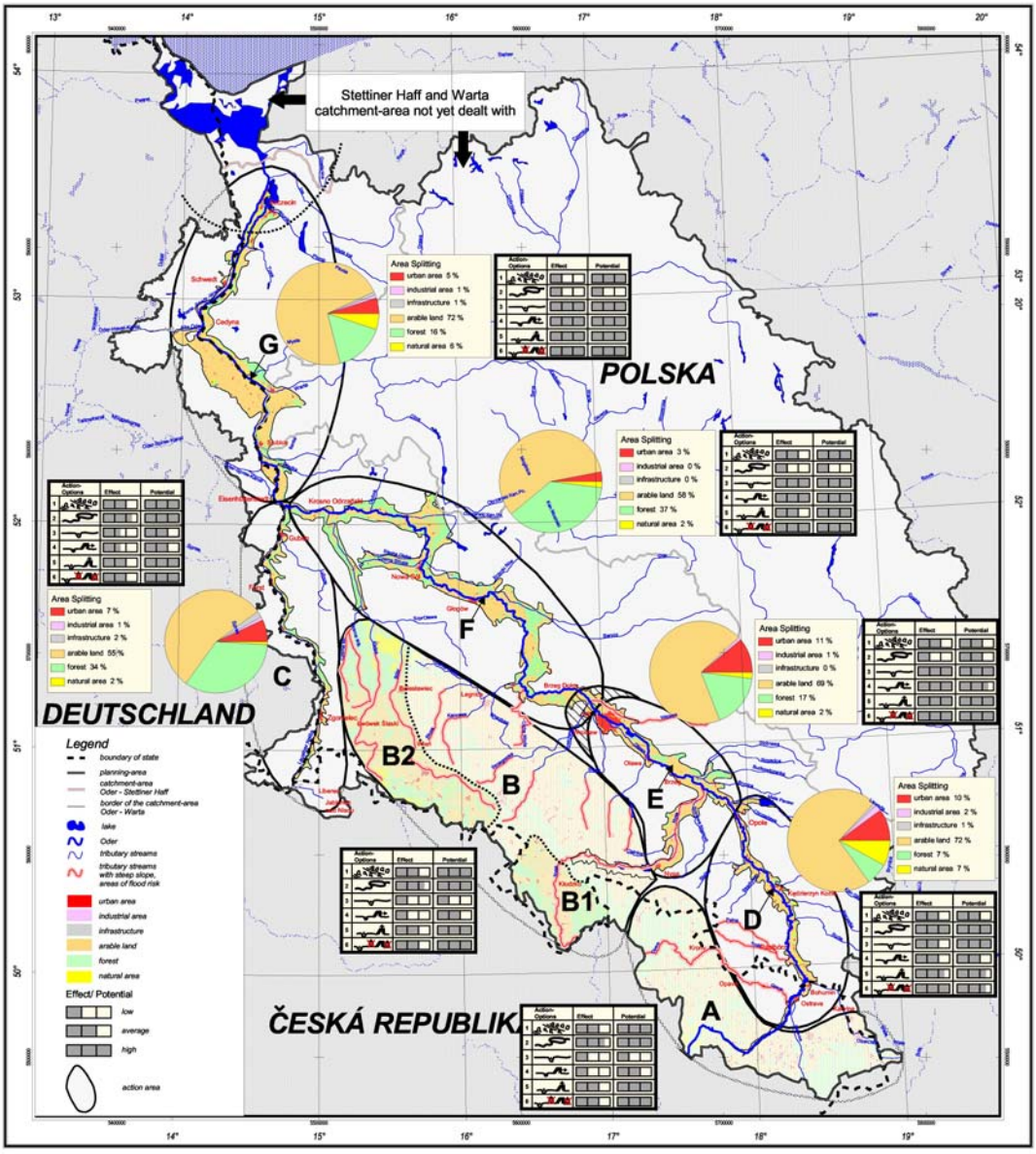


Figure 3 Action options – Analysis of potential and effects

The effectiveness of measures is highly dependent on the type of flood event under consideration. Object protection by technical measures in particular is designed to protect against flood events with a certain probability. If these measurement limits are exceeded the protection task can no longer be fulfilled and the protection measures lose their effect. Here, the analysis of effectiveness assumes medium to extreme events similar to the flooding situation in 1997.

4.3 Derivation of action recommendations for partial areas

On the basis of the analyses which were carried out, recommendations for action for each partial area were made. Here, the partial area E “Opole-Wrocław” is used to demonstrate an example for recommendations of action:

The numerous retention areas which already exist must not only be secured and preserved but also extended. Further new retention areas must also be created (e.g. Kotowice, Chrościce, żelazna II). The limitations of agricultural use must be compensated. The polders must be controllable so that a targeted cut of the peak of the floodwave is possible thus they considerably reduce the flooding threat for Wrocław. On the existing polders as well, the inflow and outflow engineering structures must be equipped to serve this purpose.

The highest priority must be given to the development of the flood reporting system and thus the improvement of the flooding forecasting.

The very great damage potential from the Wrocławski Węzeł Wodny must be clearly reduced by a special flood protection concept. A component of this concept must be a series of measures involving preventive protection with regard to the area itself, the buildings and the behaviour of those involved.

Due to the large damage potential in Wrocław, a technical flood protection level should be chosen which is particularly high (repeat interval of 200 years). This necessitates improved object protection by technical measures. In the case of negative effects for downstream areas (in particular Area "F – Wrocław-mouth of the Lusation Neisse") suitable compensation measures must be taken. (Infrastruktur und Umwelt *et al.* 2001, p. 68 f).

4.4 Summary of results

The following results have been achieved with the now completed phase of the ODERREGIO project:

a) A robust working structure has been created,
   - which is formed by representatives from administrations from Germany, Poland and the Czech Republic,
   - in which both the regional planning as well as water management is represented,
   - which guarantees agreement with the work of legitimate initiatives such as the "Stettiner Initiative" and the IKSO.

b) General fundamental principles and targets of spatial planning for preventive flood protection in the catchment area of the Oder have been defined and agreed.

c) These fundamental principles and targets were concretised for individual partial areas (areas of action) and corresponding action requirements were named.

d) The results have been included in the consultations of the "Stettiner Initiative" (signature of a declaration by the responsible ministers for spatial planning from the Czech Republic, the Republic of Poland and the Federal Republic of Germany on 29th June 2001) and in studies for the "Action Program Floods" of IKSO (compare IKSO 2001).

Thus the ODERREGIO project provides an important contribution for a trinationally agreed and integrated action program for preventive flood protection in the Oder catchment area.

5. Outlook

The "Conception for Preventive Flood Protection" which is now available is an important first step in this field in the Oder catchment area. There is an urgent need to realise the conceptual proposals which have been developed here in the three participating counties within the scope of a joint Czech-Polish-German Action program "Spatial Planning for Preventive Flood Protection in the Oder catchment Area"

This should take place as long as the catastrophic effects of the flooding events of 1997 (seventy-four deaths, estimated economic damage of 3 to 4 billion Euro) are fresh in our minds.

Concrete measures are to be defined in this action program. These measures are to be realised by national or transnational activities.

A continuation of the successful transnational and interdisciplinary discourse is decisive for the success of the action program as is a further stabilisation of the available expert and political basis. The recommendation is to use and elaborate on the robust transnational contacts and the results which have already been produced within the scope of ODERREGIO.

In view of the European extension, the financing of further work will exploit the possibilities of the promoting instrument Interreg III together with national co-financing.

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Longterm sustainable flood management in Croatia: The Central Sava Basin flood control system

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EURONATUR

Introduction

Good practice and well chosen examples are the most important tools to learn new approaches in environmental management. But where to go, if you want to demonstrate a flood control system in Europe? A system which has proved to be well designed and functioning since over thirty years and which did at the same time no destroy the ecological and cultural heritage of a region nor hinder its rural development? In 1986 my professor Gerhard Thielcke form the Max Planck Institute and one of the founders of Euronatur sent me to Croatia – during this time still a republic of former Yugoslavia – to assess the ecological value of the Sava Wetlands, and I found myself for three years in a unique floodplain – together with 700 pairs of White Stork, twenty pairs of White tailed eagles and up to 180 pairs of Spoonbills. The first European conferences on alluvial wetlands did not mention this largest riverine wetlands and still today the knowledge on the Sava in Europe is small.

During the next few minutes, you will have the chance to see a few aspects and images from this typical Central European lowlands at the Sava, which has not lost its cultural and natural heritage and serves at the same time as the most effective flood control system in Europe. The retention area of Lonjsko Polje and the Central Sava Basin should become the "Mekka" for all people, who have to deal with or are interested in flood control. At the same time, the Croatia should be assisted to develop the system according international standards as a example for best practice. The Sava Agreement developed under the Stability Pact and the conference "River Restoration 2004" in Zagreb (ECRR in preparation) are first possible steps to achieve this aim.

Croatia is a key country for the preservation of floodplains in Europe (Schneider-Jacoby 1994). Along the Rivers Sava, Drava, Mura and Danube, the country hosts the largest alluvial wetlands in the Danube Basin (DPRP 1999). The tributaries are important for the preservation of the high biodiversity and contribute to the ecological importance of the Danube river (e.g. Schneider-Jacoby 1994). This paper will focus on the Central Sava Basin (CBS), where large alluvial wetlands were preserved in the seventies as retention areas.

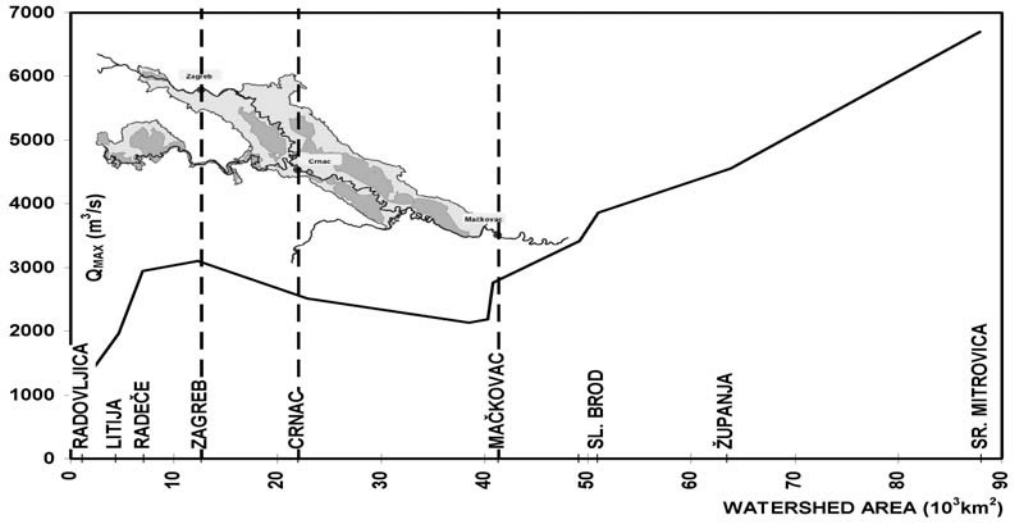
History

The flood control scheme was developed by the UN with the help of local and foreign specialist (Consortium 1972, Direkcija 1975). As the Sava 2000 programme was based from the beginning on a basin area approach, it is as far as I know the first project which did include these aspects of long-term flood management into physical planning. Although the main intention was to try up as much land as possible – the floodplain of the Sava river did cover during this times still more then 7.000 km^2 and was larger than the Danube Delta – it became obvious through the careful analysis that the destruction of all floodplains would lead to an unpredictable risk. First time floodplains were saved in a river basin to reduce floods!

The system, only partly-completed so far, has proved to be very effective in recent years, protecting important towns such as Zagreb, Karlovac and Sisak, and large agricultural areas, against flooding in the centre of Croatia. At the same time huge areas down stream also in the today neighbouring countries Bosnia and Serbia are protected by the system. About 40% of the flood-control system was built before the war began in 1990, leaving large areas of alluvial wetland unregulated. With 109 000 hectares extent, it is the largest floodplain ecosystem in the Danube River Basin (DPRP 1999) and an important nutrient-sink for the Upper and Central Sava Basin.

The study area is a key site not only for Croatia, but for the whole Sava Basin (Fig. 1). It is a unique example to show how floodplains do release the rivers from the flood waves: only floodplains can help us to avoid floods. Manipulation of the water in the Central Posavina system is carried out via three relief channels protecting the towns Zagreb (Odra Canal), Karlovac (Kupa-Kupa Canal) and Sisak (Lonja-Strug Canal), fifteen distribution facilities and the alluvial retention areas, for storage. These channels and facilities are integrated into the existing limited-flow river network. This is a system that, with the necessary retention and expansion areas in the low-lying area of Central Sava Basin, and governed by the criteria established for the manipulation of the water masses, ensures an unaltered water-regime in the Mackovac exit control profile (Fig. 1, max. = 3 000 cubic meter/sec) toward the lower Sava valley.

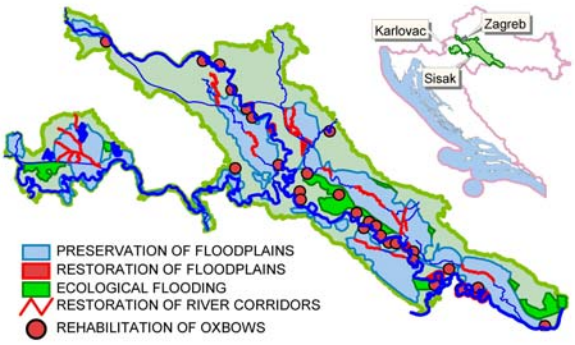
Figure 1: The effect of the floodplain in the Central Sava Basin on the peak floods in the Sava River (Brundic *et al.* 2001). Below Zagreb the quantity of water is decreasing.



The proposed CSB preservation and restoration programme

This concept has proved very effective since its design in 1972. It is an excellent model for flood-control systems: not only are retention areas preserved as safety-features, they also maintain a high biological diversity in the region. A new Environmental Assessment reviews the original concept, to include in addition to flood control, the conservation of natural and cultural heritage and the natural resources as alluvial forests in the original project design. The World Bank has given Croatia the grant to fund the preparation of this Environmental Assessment. It offered a unique opportunity to the Croatian Water Management authority, in co-operation with Euronatur, VPB and many Croatian institutions, to design a flood-control system which will provide a model for flood-control and regional development also for other countries (Brundić 2001).

Figure 2. The proposed Central Sava Basin Preservation and Restoration Programme (Brundić *et al.* 2001)



The first step in the sustainable development of the Central Sava Basin is the preservation of the existing floodplains for flood-retention (Fig. 2). This is the most important basis for preserving the traditional economic activities of the large inundation areas (e.g. pastoralism, forestry) and their valuable natural and cultural assets.

In some places the polders, which were built during the first phase of the flood-control programme (1972–1990), could be restored. In these territories, state-owned lands should be reserved for restoration and private land taken over in exchange for areas outside the floodplain during the de-nationalisation process. These restoration measures would increase the size of the floodplain and widen the Sava river corridor wherever possible. Only sites without settlements have been suggested. The area proposed for restoration extends to 1,200 hectares, with a storage capacity of 20 million m^3. The projects considered also have excellent potential for the creation of new habitats, recreation sites and nature-watching facilities, thus contributing to the development of the region.

Large and important alluvial wetlands were protected from flooding during the first phase of the project and some areas have been meliorated (e.g. Crnec Polje, large areas downstream of the study area). On the other hand some alluvial landscapes retained their character even though they were excluded from the floodplain. To maintain the alluvial landscapes, "ecological flooding" is proposed . This means that the areas cannot be restored now by re-inclusion into the flood-prone area, but their water-levels would be maintained; if necessary, water could even be introduced during floods. Through such measures, the character and value of the riverine landscape could be maintained and their ecological importance, which is of an international standard, preserved. The proposed areas extend to some 15,400 hectares and their storage capacity is about 10 million m^3.

Twenty-seven oxbow lakes and floodplain areas, which were cut off from the "live" river channel, need to be preserved in addition. The water-levels should be managed in accordance with annual flood cycles, to maintain not only the important ecological conditions, but also important socio-cultural functions, such as recreation and semi-natural landscape features.

During the first phase of the Middle Sava Flood Control Project, good opportunities for creating new habitats were missed. Nevertheless, in some areas such as along the southern dyke of Lonjsko Polje, the excavation sites evolved into very valuable habitats, with very rare, even highly endangered, assemblages of flora and fauna, typical of oxbow lakes. In future, wherever excavations are intended to take place, ecological land-use plans must be

drawn up. Thus excavation sites will become an integral part of the floodplain morphology and become incorporated into the life-cycles of the adopted fauna and flora.

A very important component of the CSB Preservation and Restoration Programme is the improved connectivity of water-bodies. The restoration of river corridors is necessary for many reasons:

1) some river-stretches were straightened during the first attempts to drain the Sava Wetlands (ie the regulation of the Lonja, Sunja and Strug inside the floodplain);
2) the building of the Lonjsko Polje retention basin interrupted partially parallel flows of the Lonja and the Strug tributaries through the floodplain and the fish migration. Mitigation is needed;
3) few roads cross the floodplain, thus there is little interruption of the wide flow of the water "front". Openings for water-access must be wide, to prevent the build-up of fast currents and high water-levels upstream;
4) the construction of forest roads, channels and drainage inside the forest has changed the water-regime inside the alluvial zone;
5) in some areas such as the Pokupsko depression, new roads (eg the highway) create a barrier between the hinterland and the floodplain.

Preserving the values

An integrated approach to the management of the Central Sava Basin is essential: this will combine the different use-values to optimum effect and improve the development of the area. The first example of such an integrated management method is the Lonjsko Polje Nature Park. Although founded only recently and with its capacity limited by lack of staff the park already co-ordinates and stimulates regional development and manages a large part of the still-existing flood plain (Lonjsko Polje, Mokro Polje). The Dutch PIN Matra Programme and Euronatur supported the establishment of the protected area.

In Croatia the category of "Nature Park" offers excellent opportunities for protecting cultural landscapes and promoting sustainable use, because it is as high ranked as a "National Park". Nature Parks such as Lonjsko Polje contain only small areas which are strictly protected, but large areas in the "protected landscape" category, where a controlled use of resources is permitted. Traditional agricultural practices and sustainable harvesting of timber is allowed, for example. For such large areas as the Central Sava Basin, comprising over 100,000 hectares of highly valuable international habitats, the Unesco Biosphere Reserve concept offers additional management strategies, such as involving local towns and stakeholders, based around the protected areas in the "Transition Zone", in the process of organising and developing the region. In such a concept the park managers take part, as well as the national and regional administrations and those enterprises which use the area (DEG 2003).

The value of the floodplain is high. Use and non-use values have to be taken into account (Schneider-Jacoby 1999). For example the alluvial forest have a direct economic values per hectares of about 20.000 € and the value of the annual harvest rate is 500 €. Further direct economic values are fishing and hunting, respectively 50-250 € and 65 € per hectare. The greatest in-direct use values beside flood control, are self-purification of water and ground water recharge. Non-use values as the preservation of biodiversity and the typical Posavina Landscape are huge. The area has great chances to become a world heritage site (continued cultural landscape).

The Croatian Master Plan for Tourism, prepared by the German DEG, describes the Sava Wetlands as the most specific tourist attraction in the Croatian inland, a real "Unique selling point", an import asset for every tourist destination on an international market.

Unique selling point

- The authentic Slavic traditional farming system
- along the historic interesting river Sava
- in the ancient alluvial landscape
- with rich flora and fauna
- and good access.

Figure 3 (left). Development of the Croatian inland tourism based on the uniqueness of Lonjsko Polje and the Posavina (DEG 2003)

The regional Tourism Master Plan proposes the Sava Wetlands as the nucleus area to develop a new kind of inland tourism in Croatia based on the natural and cultural heritage of the alluvial wetlands. This would improve the overall countries attractiveness and reputation. Thus the flood control scheme adds – if it will be developed according the environmental assessment prepared for the World Bank (Brundic 2001) – values to Croatia's future development far beyond the original aim of its design more than thirty years ago: the mitigation of flood disasters and the prevention of floods.

Table 1. Size (hectares) and storage capacities (billion cubic metres) of the different sub-units of the Central Sava Basin (recent), as planned by UN 1972 (planned) and proposed through environmental assessment for the World Bank = the Central Sava Basin Preservation and Restoration Project (CSB PRP, Brundić *et al*. 2001)

Retention area	**Recent**		**Planned**		**CSB PRP**	
	Area	Volume	Area	Volume	Area	Volume
Zutica + Lonjsko polje (*)	23.706	634	25.630	915	23.706	733
Tristika + Opeka						
Mokro Polje	22.294	611	20.510	581	22.294	611
Ribarsko Polje	16.956	175	7.400	132	16.956	175
Turopolje	15.630	316	0	0	15.630	316
Kupcina	22.242	203	5.050	150	13.599	150
Jantak	290	27	290	27	290	27
Kupa	5.899	50	0	0	5.000	50
Upper Sava	2.250	30	0	0	2.200	30
CSB Preservation and Restoration Project						
26 flooded oxbows					**500**	**2**
8 Restoration areas					**1.200**	**20**
6 Ecologically- flooded areas					**15.400**	**10**
Storage capacity	**109.267**	**2.046**	**58.880**	**1.805**	**116.775**	**2.124**
	Area (Ha)	Volume	Area (Ha)	Volume	Area (Ha)	Volume

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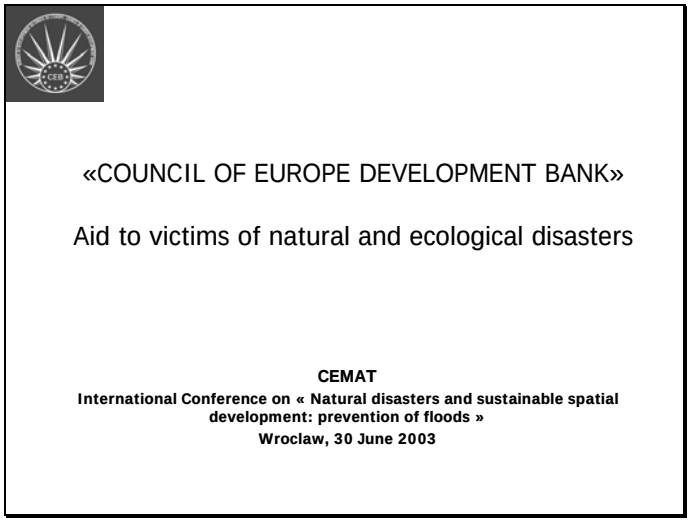
Activities of the Development Bank of the Council of Europe concerning floods

Sylvie LUDAIN, Country Manager for Poland, Hungary and Bulgaria, Council of Europe Development Bank



Figures

- Projects financed: euros 18.7 billion
- Outstanding loan portfolio: euros 8.6 billion
- Balance sheet total: euros 13.9 billion
- Own funds: euros 4 billion
- Loans disbursed : euros 1 537 million

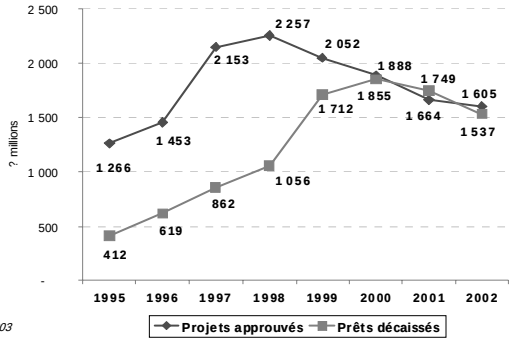
? The CEB has a long experience in aid to victims of natural and ecological disasters :

In the last 5 years, this sector represented **18% of total approved projects**, i.e. euros 1.7 billion, spread throughout Europe.

(Figures at end 2002)

Loan Activity

Projects approved / Loans disbursed per year



CEB – a development bank with a social vocation

- **Art. 2 of the Statutes :**
  - Financing of projects in favour of refugees and victims of natural and environmental disasters is the statutory priority of the CEB.
- **The CEB grants financing :**
  - To projects aimed at resolving social problems resulting from exceptional events;
  - Is increasingly concerned with prevention.
- **Means of intervention :**
  - Long term loans to governments, local authorities and banks to finance eligible social projects with attractive conditions (Selective Trust Account);
  - The CEB cooperates with other IFIs, when and where necessary.

CEB – a development bank with a social vocation

- The CEB finances emergency projects and long-term reconstruction of zones affected with disasters, in conformity with eligibility criteria:
  - **Reception centres,**
  - **Temporary and permanent social housing,**
  - **Infrastructure for health, education and professional training,**
  - **Necessary basic infrastructure**
- The CEB also finances projects aimed at preventing new disasters
  - **Implementation of follow-up and surveillance systems (for example: earthquakes, floods, fire)**
  - **Centres for civil protection, purchase of surveillance instruments**
  - **Ground conservation and protection (consolidation of river banks, development of water courses, reforestation)**

Recent projects

- **Poland**
  Floods: Renovation and prevention works in the south-west regions of Poland (Odra Basin) after the floods of July 1997 and July 1998
- **Spain**
  Environmental catastrophe in Andalousia – April 1998 :
  Failure of a tailing dam – cleaning up of the site and preventive measures aimed at restoring and protecting the ecological equilibrium in the Donana National Park
- **Hungary**
  Floods : Consolidation works in the **upper basin of the Tisza** affected by the floods of 1998 and 1999; works following the **Danube** floods in the summer of 2002
- **Romania**
  Floods : Hydraulic works for flood prevention and rehabilitation of forest roads damaged by torrential rains

International cooperation

- **A reinforcement of international cooperation is essential for**:
  - **The exchange of experience gained and of best practices,**
  - **Co-financing,**
  - **Implementation of cross-border projects (river basins).**
- **This entails not only operational coordination ...**
  - **Identification of natural and technological needs and risks, with the support of the scientific community**
  - **Support and recommendations during the preparation of national policies, intervention plans, projects**
  - **Cross-border coordination, harmonised structures and procedures**
- **... but also the coordination of financial means.**
  - **Rapid mobilisation of financial resources**
  - **Long term loans at favourable conditions**
  - **Use of specialised Trust Funds, grants**
  - **Capacity to mobilise synergies (including private sector)**

The cooperation with International Financial Institutions (IFIs) will be further reinforced

This implies :

- ✓**Policies relating to the exchange of operational and cross-border information (meteorological, hydrological and seismological data)**
- ✓**Town and country planning, ground occupation plan**
- ✓**Permanent exchanges between various actors (political, scientific, administrations, private sector (insurance and banking sector), civil society, NGO's**
- ✓**Establishing pluridisciplinary networks at international, national and local levels between groups of experts**
- ✓**Development of multirisk intervention plans and harmonisation of procedures at an international level**

Examples of international cooperation :

- **Workshop organised by the CEB in April 2001**
  CoE
  - **The Eur-OPA major risks agreement,**
  - **The World Bank,**
  - **The EIB,**
  - **The European Commission,**
  - **KfW,**
  - **Stability Pact for South-West Europe : « Disaster Prevention and Preparedness Initiative »**
- **Reinforcement of information exchange networks**
  Public sector / private sector («Provention Consortium» with the World Bank), insurance companies (CEA)
- **Regional cooperation (Stability Pact, Commission for the Danube etc.).**

Last example of coordination following the summer 2002 floods

- On the initiative of the CEB, a coordination meeting took place in Paris on 13 September 2002.

- The World Bank, the EIB, the EBRD and KfW attended the meeting

- Each institution presented the strategic orientations and operational responses to the disaster.
- The CEB**,**
  - **Allocated a € 500 million envelope to projects;**
  - **Several member states affected by the disasters requested an assistance of the CEB;**
  - **Since then, € 100 million of projects have been approved (Hungary, Germany, Romania).**

Les défis d'un aménagement transnational des bassins fluviaux

Peter TREUNER, Expert to the Council of Europe (Parliamentary Assembly)

Ce rapport présente les considérations générales et les éléments concevables d'un avis de la Commission de l'environnement, de l'agriculture et des questions territoriales de l'Assemblée Parlementaire du Conseil de l'Europe concernant une éventuelle Convention européenne de l'aménagement transnational des bassins fluviaux.

1. Introduction

(1) L'expérience d'inondations plus fréquentes et de crues désastreuses, caractérisées par des dégâts toujours plus élevés dans les bassins fluviaux, est devenue un défi politique qui résulte de plusieurs facteurs influençant les cycles hydrologiques. Selon les perspectives offertes par les experts, elle risque de grandir plutôt que de s'atténuer. Dans la plupart des cas, et par la nature du phénomène même, ce défi ne peut être compris ni maîtrisé dans le cadre des unités administratives locales ni nationales : pratiquement tous les bassins comprennent une multitude de territoires administratifs, et nombreux sont les cas de grands fleuves appartenant au territoire de plusieurs Etats. Bien que de premières approches importantes aient été entamées, par exemple concernant une concertation multinationale en vue d'un meilleur aménagement du bassin du Rhin, il convient de se demander dans quels cas, de quelle façon et dans quelle mesure une coopération transnationale ou internationale pourrait mieux répondre à ce défi. Pour s'approcher de réponses concevables il est nécessaire de se faire une idée claire des causes de l'augmentation des inondations et des crues désastreuses ainsi que des risques y associés, pour ensuite considérer l'opportunité d'une concertation transnationale d'activités d'appui et de prévention.

2. Les causes de l'augmentation de la probabilité de crues désastreuses

(2) En vue d'entamer une discussion orientée vers une politique faisable et effective, une distinction s'impose tout d'abord entre les principaux facteurs responsables de l'augmentation de la probabilité des inondations en général et des crues désastreuses en particulier, afin de saisir les champs d'actions qui s'offrent à une coopération transnationale ou internationale. En ce sens il convient de tenir compte des facteurs suivants:

- modifications des paramètres climatologiques, notamment ceux qui déterminent les intensités et distributions saisonnières des précipitations ;
- aménagements hydrauliques des bassins fluviaux réalisés durant les 19^{e} et 20^{e} siècles, qui ont eu comme conséquences des écoulements accélérés ou ralentis ainsi qu'une réduction des surfaces de rétention, et
- évolution de l'utilisation des sols, concernant l'accroissement des surfaces bâties autant que les modifications de la couverture des surfaces non-bâties.

Chacune des trois catégories principales peut mener à des décisions politiques, à concevoir dans le cadre de l'objectif général d'un développement durable. Dans le petit schéma de la page suivante les grosses flèches indiquent les phénomènes censés, de façon préliminaire, mériter un intérêt prioritaire dans une approche politique.

Schéma des principaux facteurs déterminant les cycles hydrauliques

niveau global	***méso-niveaux****	***micro-niveaux***
➔ «*global warming*»	➔ modifications des paramètres climatologiques	➔ modifications des intensités et distributions saisonnières des précipitations
	➔ aménagements hydrauliques des bassins fluviaux	➔ réduction des surfaces de rétention
➔(mondialisation)	➔ augmentation de la demande foncière en fonction de la croissance des revenus	➔ accroissement des surfaces bâties
		➔ modification de la couverture des surfaces non-bâties

* Il est à noter que la notion de «méso-niveau» comprend une grande diversité d'échelles descriptives et analytiques, de dizaines voire de milliers de km^2

(3) L'augmentation de la fréquence des inondations n'est qu'un phénomène parmi d'autres causés par l'évolution du climat global. A ce titre, il faut rappeler le recul des glaciers dans certaines régions montagneuses et la sécheresse des régions méditerranéennes. La complexité du cycle hydrologique, de son évolution en général et de ses manifestations en particulier dans des régions spécifiques, bien que mal connue, limite les possibilités de proposer des hypothèses sur les causes des phénomènes qui nous préoccupent. Dans notre contexte, la responsabilité politique justifie une première approche schématique. Toutefois, il faut souligner que toute activité concrète dans un bassin particulier nécessite une considération soigneuse des éléments spécifiques qui caractérisent le bassin examiné. Cette réflexion amènera, à terme, à la prise de conscience de l'importance d'approches décentralisées, avec un rôle particulièrement important des gouvernements et administrations locaux.

2.1 Causes générales de crues désastreuses

(4) En ce qui concerne l'évolution des phénomènes climatiques, il convient de distinguer les différents niveaux spatiaux utilisés pour décrire et analyser les faits qui constituent le point de départ d'une approche politique.

– Au niveau global, les tendances de modifications du climat sont entrées dans la conscience publique depuis deux décades au moins, corrélativement au débat sur les causes et les conséquences du *global warming*. Ce mot-clé indique aussi que toute politique de lutte contre ce phénomène qui veut être sérieuse et efficace doit être, par la nature du phénomène même, une approche internationale.
– Aux différents niveaux de l'apparition de phénomènes climatiques dans des régions délimitées, appelés ici les phénomènes des «méso-niveaux», un grand nombre d'études théoriques et empiriques est déjà disponible. Elles mettent en évidence l'importance des facteurs globaux, d'une part, et d'autre part, une influence claire des différentes formes d'utilisation des sols sur le cycle hydrologique, en connexion avec d'autres facteurs déterminants.
– Au micro-niveau de la parcelle individuelle également, un grand nombre d'études a confirmé l'influence des différentes formes du bâti et d'utilisations agricoles et forestières sur le cycle hydrologique.

2.2 Causes spécifiques de crues désastreuses

(5) Parmi les principales causes de crues désastreuses qui suscitent une approche transnationale ou internationale dans des cas concrets les faits suivants méritent une attention particulière.

Les modifications des paramètres climatologiques

(6) Les modifications des paramètres climatologiques caractérisant un bassin particulier et qui ont comme conséquences des modifications des volumes et des distributions saisonnières des précipitations et de leur écoulement, sont largement déterminées par des phénomènes globaux, mais également aussi des résultats des modifications de l'utilisation des sols initiées par la société humaine. La diminution des surfaces forestières tout d'abord, à laquelle s'ajoute aussi celle des zones humides (*wetlands*) causées par l'extension des activités agricoles, influencent les probabilités de précipitations autant que les parts de l'évapotranspiration et de l'infiltration au sous-sol, et donc les profils d'écoulement des eaux superficielles. Si l'écoulement en amont d'un bassin s'accélère en fonction d'une capacité d'évaporation et/ou d'infiltration réduite ou en fonction de surfaces de rétention diminuées, la vraisemblance de l'arrivée de crues en aval augmente. Ce phénomène seul nécessite et justifie une analyse d'ensemble des caractéristiques spécifiques de chacun des bassins où des crues désastreuses ont été observées ou sont à craindre.

Aménagements hydrauliques

(7) Les aménagements hydrauliques réalisés durant les 19è et 20è siècles dans la plupart des bassins des fleuves et des rivières majeurs, par les rectifications des cours d'eau pour faciliter la navigation ou par la construction de barrages pour générer d'électricité et/ou pour des besoins en eau potable ou d'irrigation ont eu comme conséquences des écoulements accélérés ou ralentis ainsi que, presque dans tous les cas, une réduction des surfaces de rétention. Sans sous-estimer les bénéfices de ces aménagements on constate aujourd'hui que leurs effets sur la probabilité et le volume des crues sont plus grands qu'on imaginait au moment de telles constructions. Ce fait est d'autant plus inquiétant qu'une bonne part du monde des administrations hydrologiques songe toujours à de nouveaux aménagements que leurs ingénieurs considèrent utiles.

Évolution de l'utilisation des sols

(8) L'évolution de l'utilisation des sols dans les bassins fluviaux s'est caractérisée, de façon presque générale, par un important accroissement des surfaces bâties, répondant à une demande en permanente augmentation en fonction des nouveaux besoins (infrastructures de transports, technologie de production horizontale ...) et des niveaux de revenus qui s'est traduit par une demande de plus grandes habitations, et ainsi provoquant l'extension des zones résidentielles. Simultanément, l'utilisation généralement toujours plus intense et plus sophistiquée des terres non-bâties, sur des parcelles toujours plus grandes et vidées de toute végétation «inutile» pour l'agriculture et la sylviculture autant que les modifications de la couverture des surfaces non-bâties, a eu comme conséquence une tendance vers des écoulements plus forts à l'occasion des précipitations.

3. Les risques et dangers causés par les crues

3.1 Risques pour les habitants des aires menacées

(9) Dans nos sociétés, les risques auxquels peuvent être exposés les habitants vivant dans les zones susceptibles d'être inondées doivent être considérés en premier lieu. Ces risques ne concernent pas seulement la vie, la santé et la sécurité des individus mais aussi leur domicile et leurs voisins, leur propriété personnelle et leur bien-être en général. Ce fait à lui seul justifie et nécessite des activités de prévention et la préparation d'une organisation efficace de mesures de protection, de sauvetage et de réhabilitation en cas d'événements désastreux.

3.2 Risques pour les équipements publics

(10) Les grandes crues, dont les eaux débordent des lits des fleuves et rivières et des zones de rétentions prévues, constituent aussi des risques pour tous les équipements publics (les ponts et les barrages, les routes et les chemins de fer, les hôpitaux et les écoles, les musées et les théâtres) qui peuvent être affectés. Les risques de pertes de monuments historiques et d'autres biens culturels doivent être mentionnés explicitement. Comme l'expérience l'a montré, de tels dégâts peuvent atteindre des milliards d'euros, affectant ainsi le bien-être social de façon significative par la nécessité d'allouer des fonds publics aux besoins de réparation et de reconstruction – des fonds qui, autrement, auraient été disponibles pour les besoins normaux d'investissement et de gestion. La société a donc un intérêt concret et une responsabilité générale à minimiser, en termes économiques, les pertes causées par les inondations non-contrôlées.

3.3 Risques pour l'environnement et les ressources naturelles

(11) Les grandes crues constituent aussi des risques pour l'environnement et pour les ressources naturelles en général, et ceci de façon directe et indirecte. De façon directe, les crues désastreuses peuvent affecter les populations d'animaux et de plantes, détruire leurs habitats et causer des dégâts aux ressources naturelles (pollution des réserves en eaux potables, destruction des récoltes dans les champs ...). De façon indirecte, les crues désastreuses peuvent affecter les conditions de l'utilisation ou de l'exploitation ultérieure des ressources naturelles, par exemple en détériorant leur qualité ou en augmentant les coûts d'exploitation.

4. La nécessité d'actions préventives de caractère transnational

(12) Etant donné que dans de nombreux cas, les bassins fluviaux susceptibles d'être exposés à des crues désastreuses, pour lesquelles les mesures entreprises – ou non – sur le territoire appartenant à un Etat en amont affectent les territoires d'un autre Etat en aval, il ressort que seule une approche englobant toutes les actions dans toutes les parties du bassin peut résulter dans une prévention satisfaisante. Cette réflexion amène aussi à la question de savoir si des actions préventives concernant un bassin entièrement à l'intérieur d'un territoire national ne devraient pas être incluses dans une réglementation générale, pour éviter une discrimination exclusivement causée par les frontières des Etats. Il serait en effet peu satisfaisant d'arriver à une approche constructive concernant, par exemple, les bassins transnationaux du Rhin et du Danube sans prévoir, d'autre part, des actions correspondantes pour les bassins nationaux, par exemple, de l'Adige et du Neckar.

4.1 Catégories d'actions préventives

(13) Les actions préventives à considérer doivent concerner

- tout d'abord l'organisation de la demande et de la diffusion de connaissances des faits liés à la problématique des crues,
- la diffusion des informations dans des cas d'inondations imminentes,
- la coordination transnationale de la préparation des actions en cas d'inondations,
- les aménagements hydrauliques admissibles et souhaitables, et
- la coordination transnationale de réglementations de l'utilisation des sols destinées à minimiser les conséquences négatives de crues désastreuses.

4.2 Coordination transfrontalière des informations sur les données hydrologiques et les surfaces menacées par des inondations

(14) Il est évident que toute conception d'approches préventives dépend tout d'abord de la disponibilité et de l'utilisation des meilleures informations possibles sur les phénomènes hydrologiques. En ce sens la communauté internationale se trouve devant un double défi : d'une part, il est urgent d'entreprendre le nécessaire pour appliquer et pour utiliser

continuellement, aussitôt que possible, toutes les méthodes d'analyse et de prévision de crues déjà disponibles, d'une façon entièrement compatible entre les administrations concernées ; d'autre part, il est également important d'arriver à un consensus sur la présentation et sur l'interprétation des informations obtenues à la base d'un système d'observations cohérentes et compatibles, en vue de décisions coordonnées concernant les actions préventives. Un premier pas d'importance particulière et urgente en vue de toute autre mesure de prévention serait un accord sur une présentation cartographique des zones menacées par des inondations pour l'ensemble du territoire de chacun des bassins fluviaux, et l'application coordonnée de cet accord.

(15) Les deux défis ne trouveront une réponse satisfaisante que sur le fondement de conventions qui définissent sans équivoque la terminologie, les définitions et les méthodes d'observation, d'analyse et de prévision ainsi que les présentations et interprétations des informations obtenues pour un bassin, des sources jusqu'à la mer. Bien qu'une telle uniformisation puisse être considérée et finalement adoptée pour chacun des bassins concernés, les considérations des autres éléments d'actions préventives et des aspects d'organisation présentés plus bas suggèrent la recommandation de ne pas procéder bi/ou multilatéralement dans les cas des bassins particuliers mais d'adopter une approche transnationale générale qui couvrirait tous les bassins.

(16) Malgré les progrès de la connaissance des phénomènes du cycle hydrologique en général et de ses manifestations dans des régions spécifiques en particulier, réalisés grâce à des recherches scientifiques, la complexité des systèmes n'est pas encore suffisamment bien connue. Ce constat amène à la conclusion qu'il serait dans l'intérêt de la communauté des membres du Conseil de l'Europe de coordonner et d'intensifier la recherche en ce domaine, afin de disposer des meilleures informations possibles pour concevoir et préparer des activités adéquates.

4.3 Systèmes transfrontaliers d'information et d'avertissement

(17) L'obtention et la disponibilité des informations au sein des administrations nationales et locales ne peuvent guère contribuer à une meilleure compréhension des phénomènes et à des actions préventives coordonnées si les informations ne sont pas transmises à tous les partenaires du même bassin. Ainsi un accord entre les gouvernements ou administrations concernés par un bassin particulier, portant sur le contenu, la forme et l'organisation d'un échange continuel d'un minimum d'informations défini en commun, doit être considéré comme une condition essentielle pour parvenir à l'efficacité nécessaire des approches préventives. Il serait utile d'élaborer un schéma général de tels accords qui, si besoin est, pourrait ensuite être adapté aux spécificités d'un cas concret.

4.4 Coordination transnationale de la préparation des actions en cas d'inondations

(18) Les activités fondamentales évoquées dans les deux paragraphes précédents et les coûts en résultant ne trouveront leur justification que lors de leur utilisation pour la préparation d'actions concertées en cas de crues ainsi que pour des réglementations concertées de l'utilisation des sols dans les zones susceptibles d'être inondées. Ce dernier volet sera abordé dans le paragraphe suivant.

(19) Sur la base des informations concernant les phénomènes en cause et les inondations à anticiper en cas de crues désastreuses – actuellement encore peu suffisantes mais à améliorer continuellement par une approche coordonnée comme proposé plus haut – une meilleure prévision des besoins et une meilleure organisation coordonnée d'actions concrètes est indispensable d'urgence. L'expérience a montré que la bonne volonté et l'appui spontané des voisins à l'intérieur d'un bassin ainsi que les apports de l'extérieur, pour autant que ceux-ci aient parfois été extrêmement importants et méritent un grand respect, ne répondent pas de façon assez efficace aux nécessités réelles. Cela suppose de ne pas seulement mieux organiser et coordonner les actions d'urgence des administrations locales, bien que cette

tâche, non encore achevée et méritant dans tous les cas une attention prioritaire, mais aussi de concevoir et de prévoir des actions concertées dans l'intérêt de tous les territoires impliqués et sous la responsabilité coordonnée de toutes les administrations concernées. De telles conceptions, tenant compte forcément des situations et des problèmes spécifiques prévalant dans un bassin particulier, profiteront de la disponibilité d'une «conception cadre», qui pourrait être élaborée et établie sous l'égide du Conseil de l'Europe. Elles faciliteront aussi les considérations suivantes portant sur les réglementations de l'utilisation des sols et plus tard sur les aspects d'organisation et en fin de compte d'une répartition plus «juste» des coûts d'actions préventives coordonnées et réalisées, selon les besoins établis en commun, par des administrations différentes.

4.5 Règles communes concernant les aménagements hydrauliques

(20) Etant donné qu'une catégorie des facteurs qui influencent les phénomènes de crues et des inondations dans des bassins concrets concerne les aménagements hydrauliques des fleuves et rivières et puisque les intentions des administrations responsables sont assez différenciées, en partie préparant de nouvelles mesures susceptibles de modifier encore les systèmes existants, une coordination transnationale, nécessaire au moins pour chacun des bassins majeurs, doit être envisagée et préparée aussitôt que possible. Une telle coordination devrait inclure la révision des plans d'aménagement des voies navigables à la lumière des objectifs écologiques autant qu'en fonction de l'aspect des crues. Elle pourrait aussi prévoir que les barrages existants ne devraient pas être exclusivement conçus et gérés selon les objectifs de génération de courant électrique ou de stockage d'eau potable ou d'irrigation, mais aussi en fonction de leur rôle en cas de crues exceptionnelles. Le Conseil de l'Europe pourrait initier pareille approche.

4.6 Coordination transnationale des réglementations de l'utilisation des sols

(21) Comme cela a été évoqué plus haut, l'évolution de l'utilisation des sols joue un rôle non négligeable dans l'analyse et dans les prévisions des apparitions des phénomènes hydrologiques dans un bassin particulier. D'une part, il n'y a pas de doute sur le fait que des terres agricoles soient converties en terrains à bâtir tout comme des forêts à des utilisations agricoles ou de construction ; d'autre part, certaines pratiques de production moderne dans l'agriculture et dans la sylviculture contribuent à des écoulements toujours plus forts (et aussi plus irréguliers) des eaux de superficie. En conséquence, il faut envisager d'établir dans les deux domaines des réglementations qui pourraient ralentir ou arrêter, voire inverser les tendances qui prévalent actuellement.

(22) Il serait donc souhaitable d'arriver à l'accord de tous les riverains d'un fleuve et de ses rivières, de ne pas seulement arrêter tout transfert de terres agricoles ou forestières situées dans les zones inondables, mais de reconsidérer les transferts réalisés dans le passé en vue de déterminer les possibilités de remettre des terres en service de rétention, autant que faire se peut. A cette fin on devrait considérer une règle générale selon laquelle les plans de développement régional et les plans d'occupation des sols doivent forcément inclure une documentation complète des zones inondables en cas de crues exceptionnelles, comme base de toute décision sur l'utilisation des terres aux fins de construction. Une telle politique pourrait en même temps permettre de préserver des territoires pour maintenir et protéger nos trésors de biodiversité. Une convention-cadre, établie au niveau européen, pourrait faciliter la mise en œuvre d'une telle approche.

(23) On doit toutefois tenir compte du fait que, bien qu'il soit relativement clair et simple de constater un principe selon lequel toute nouvelle construction sur des terres ayant une fonction de zone de rétention pour des crues exceptionnelles devrait être interdite, l'application de ce principe se heurte aujourd'hui encore à l'insuffisance d'informations pertinentes, assez concrètes et fiables pour l'ensemble d'un bassin – un fait qui amène facilement les gouvernements locaux à considérer leurs propres intérêts, ne sont pas limités par de telles informations insuffisantes. De même, les autorités supérieures, aux niveaux, par exemple, des régions et des Etats, ne peuvent guère procéder à l'établissement de contraintes

contre les intérêts des gouvernements locaux tant qu'ils ne peuvent pas justifier, sans doute ni équivoque, un traitement «égal» de tous les cas. A cette difficulté s'ajoute le problème de la difficulté de faire comprendre aux gouvernements locaux en amont, dont les territoires sont généralement moins ou pas du tout affectés par des crues désastreuses, qu'ils doivent se priver de possibilités d'utilisation de leurs terres exclusivement en faveur de territoires en aval, surtout dans des cas où les territoires en aval se caractérisent par des utilisations de sols de la même catégorie qui serait restreinte ou même interdite en amont.

(24) De même, on doit songer, en principe, à une réglementation coordonnée des formes souhaitables ou admissibles de l'utilisation des sols pour la production agricole et, dans un moindre degré, pour la production forestière, dans les cas où de telles surfaces jouent un rôle important en ce qui concerne l'écoulement des précipitations. Un «Code de bonne production agricole et forestière dans les zones en amont des fleuves et rivières», établi d'un commun accord entre les gouvernements concernés, peut-être dans un cadre européen, pourrait être considéré.

(25) Les difficultés s'opposant à une nouvelle orientation des réglementations de l'utilisation des sols sur l'ensemble du territoire d'un bassin concret pourront certainement être atténuées si l'on arrive à instaurer un système suffisamment acceptable d'une répartition des bénéfices et des charges d'une politique préventive, c'est-à-dire à une forme de péréquation financière quelconque. Néanmoins, il ne semble pas réaliste d'assumer qu'un accord sur un tel système puisse être finalisé dans un avenir proche. Ainsi dans l'immédiat, pour ne pas perdre de temps, une approche plus limitée, et moins satisfaisante, doit être considérée. Un grand pas serait fait si l'on pouvait préparer, discuter et enfin adopter un document général, peut-être sous la forme d'une «charte européenne», qui fixerait les objectifs et principes communs de l'aménagement du territoire transnationalement concerté dans les zones sensibles des bassins fluviaux afin d'éviter une continuation irresponsable des tendances du passé. Ce projet pourrait être préparé sous l'égide du Conseil de l'Europe soit par un groupe international d'experts indépendants, soit par un comité international de fonctionnaires, soit – et de préférence – par un groupe international composé d'experts des deux catégories.

5. La coordination d'actions d'urgence dans les bassins transnationaux

(26) Au regard des expériences des dernières grandes crues et dans la quasi-certitude que ce phénomène se répétera avant que toutes les mesures préventives nécessaires puissent être réalisées et les probabilités de cas désastreux conséquemment diminuées, la préparation d'actions d'urgence, surtout dans les bassins transnationaux mais aussi dans les bassins nationaux, et la coordination de telles actions pour l'ensemble de chaque bassin s'imposent.

(27) Dans ce contexte, il convient de mentionner aussi l'utilité de considérer les mesures suivantes : une coordination transnationale, au moins à l'intérieur de chaque bassin majeur, la formation et l'entraînement des cadres dans toutes les organisations qui auront des responsabilités en cas d'urgence, un programme d'initiation voire des exercices des états-majors qui entreraient en fonction en cas d'urgence.

5.1 Préparation de conceptions et de plans d'action pour des cas de crues désastreuses

(28) La préparation de conceptions et de plans d'action pour des cas de crues désastreuses doit tenir compte de tous éléments spécifiques d'un bassin, autant du côté des risques et des informations qu'en ce qui concerne la disponibilité de moyens d'action concrets et leur organisation. Ainsi elle ne peut être conçue sans donner un rôle-clé aux gouvernements locaux qui, seuls, ont connaissance des détails indispensables pour assurer le maximum d'efficacité et qui doivent – et généralement veulent – assumer leur responsabilité en contact direct avec leur population. Les autorités supérieures, régionales et nationales, auront toutefois à assumer leur part de responsabilité non seulement en ce qui concerne la répartition et l'organisation adéquates des compétences administratives et l'accès aux moyens nécessaires, mais aussi en vue d'assurer la coopération transfrontalière et

transnationale des gouvernements locaux. Il serait utile d'établir le prototype d'un schéma de coopération qui pourrait servir de cadre pour des solutions concrètes.

5.2 Coordination des actions dans des cas de crues désastreuses

(29) La coordination des actions concrètes dans des cas de crues désastreuses, qui ne fonctionne pas encore de façon toujours satisfaisante, concerne tout d'abord les compétences, les responsabilités en cas d'urgence et la coopération des différents agents publics à l'intérieur d'un Etat, des gouvernements locaux aux instances nationales, incluant les forces publiques. Cette coordination doit donc se fonder sur des structures gouvernementales et administratives existantes dans l'Etat. Dans le cas de bassins transnationaux, il est nécessaire aussi de disposer de règles de communication et de décisions applicables à tous les agents dans l'ensemble du bassin.

(30) La coordination devrait aussi envisager les règles gouvernant la mise en œuvre et la gestion des aides aux citoyens, aux entreprises et aux gouvernements locaux affectés par des crues désastreuses. Des règles standard pour de telles coordinations pourraient figurer dans le schéma de coopération proposé dans le paragraphe précédent.

6. Le financement d'actions préventives et d'appui en cas d'urgence dans les bassins transnationaux

6.1 Financement d'activités nationales et transnationales

(31) La réalisation d'activités nationales et transnationales, en ce qui concerne les actions préventives autant que les actions d'urgence en cas de crues, dépendra pour une bonne partie des moyens financiers nécessaires. Etant donné que les besoins d'action concernent les entités administratives de façon différente selon leur situation spécifique en amont ou en aval, exposées aux risques de dégâts ou non, il ne paraît pas «juste» de partir de l'hypothèse que le financement des activités nécessaires serait exclusivement de la responsabilité des gouvernements responsables de la réalisation d'actions préventives, d'une part ou dont des territoires sont directement affectés par des dégâts, d'autre part, et des niveaux supérieurs correspondants. En vue de parvenir à une approche globale, dont la nécessité a été soulignée plus haut, une «juste» répartition entre les bénéficiaires et ceux non exposés aux risques devrait être considérée. Une telle approche concernerait d'abord une réglementation à l'intérieur de chacun des Etats, mais dans les cas des bassins transnationaux aussi, la répartition des charges financières entre tous les Etats.

(32) Pour entamer une discussion sur un éventuel schéma général de la répartition des responsabilités financières, il serait utile d'établir un comité intergouvernemental qui commencerait par une synthèse des différentes réglementations en vigueur ou pratiquées de fait, afin de discerner d'éventuelles recommandations pour une réglementation-cadre.

6.2 Financement d'activités préventives et préparatoires

(33) Le financement d'activités préventives et préparatoires pose aux gouvernements concernés des problèmes d'ordre de grandeur différents selon la situation de leurs territoires dans l'ensemble d'un bassin et en fonction de leur capacité économique et financière. L'intérêt des «riches» à minimiser les risques généraux et les coûts causés par des dégâts en cas concrets devrait amener à une volonté d'appuyer financièrement les «pauvres» du même bassin afin de les mettre en état d'assumer entièrement leurs responsabilités, dans le cadre d'une conception pour l'ensemble d'un bassin.

6.3 Financement d'activités d'appui dans des cas concrets

(34) Le financement d'activités d'appui dans des cas d'urgence devrait, en principe, obéir à des règles similaires, basées sur une conception de solidarité couvrant l'ensemble d'un bassin particulier, tout en réservant un rôle particulier aux gouvernements nationaux auxquels les territoires affectés appartiennent.

7. Conclusions préliminaires

(35) Le rapport présenté ici aux parlementaires de l'Assemblée parlementaire du Conseil de l'Europe ne se prétend pas exhaustif ni suffisamment approfondi. Presque tout point soulevé mériterait des recherches et de considérations supplémentaires et une présentation plus détaillée et plus approfondie. Ceci s'inscrit dans la poursuite des activités du Conseil de l'Europe, de préférence dans le cadre d'un groupe international d'experts compétents dans les principaux domaines scientifiques et administratifs concernés, la présentation permet tout de même quelques conclusions préliminaires.

(36) Il ressort de cela qu'on doit concevoir différentes approches politiques pour pallier la propension au risque d'inondation d'une part, et contre les conséquences de l'apparition concrète des phénomènes de crues risquant de causer inondations et dégâts d'autre part :

a) En ce qui concerne l'évolution du climat global, le Conseil de l'Europe est appelé à s'engager dans toutes les approches et négociations internationales traitant de la réduction des effets d'activités anthropogènes sur le climat global qui déterminent, avec d'autres facteurs, les climats aux méso-niveaux et ainsi les probabilités et intensités de crues.

b) En ce qui concerne l'aménagement des bassins fluviaux et l'utilisation des sols – gouvernés par les cadres de développement en général et de l'utilisation des surfaces et de la protection des ressources naturelles en particulier, établis par les institutions responsables de l'aménagement du territoire aux différents niveaux gouvernementaux et administratifs – le Conseil de l'Europe peut contribuer à une meilleure compréhension des défis et des nécessités d'actions. Vu que, dans la plupart des cas de grands fleuves, plusieurs territoires nationaux sont impliqués, on pourrait et devrait peut-être penser à élaborer d'une part une convention européenne établissant des règles communes pour préparer des plans déterminant l'utilisation des surfaces ainsi que des règles concernant les aménagements hydrauliques réalisables. D'autre part, des plans d'action multinationaux contre l'apparition d'inondations pourraient être envisagés. La coopération dans le cadre de l'approche «IRMA» pour le bassin du Rhin – adoptée par les Etats riverains du fleuve et de ses rivières – pourrait servir de point de départ.

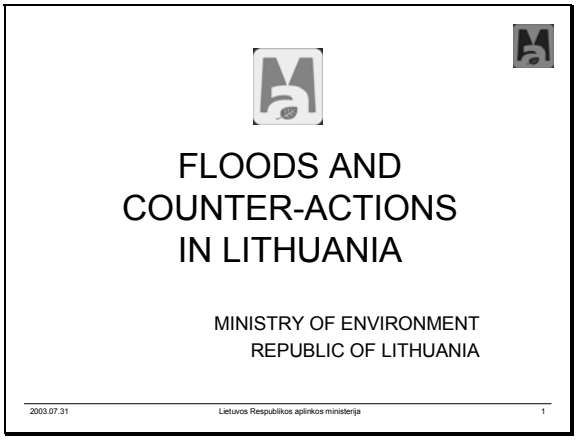
c) Le Conseil de l'Europe pourrait également s'engager au stade des règles déterminant les constructions admissibles au micro-niveau, dans les organismes locaux maîtres compétents, afin d'arriver à un minimum de concertation sur les utilisations admissibles ou à éviter.

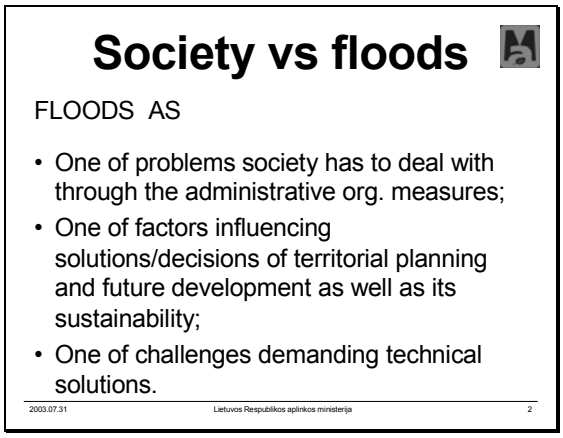
d) Finalement, le Conseil de l'Europe pourrait s'engager dans la voie du renforcement de la recherche sur les phénomènes hydrologiques afin d'améliorer les bases d'information.

(37) Vu la complexité du sujet à traiter, il serait utile, dans un premier temps, de voir le Conseil de l'Europe prendre une initiative sur un domaine prioritaire de sa compétence, et de baser ensuite les discussions à mener sur la synthèse des connaissances disponibles.

Floods and counter-actions in Lithuania

Aleksandras GORDEVIČIUS, Head of spatial planning and regional development Division, Territorial planning, urban development and architecture Department, Ministry of Environment, Lithuania





Lithuanian National flooding action plan

For more information -
to Lith.Environmental Agency at MoE and to
Dr. Violeta Vincevičienė, Water division,
Ministry of Environment, Lithuania

1. National facts on hydrographic network , dams, flooded areas (1)

- 22.2 thous. rivers and streams, total length 76.8 thous.km, 17 rivers > 100 km
- the main rivers
  - the Nemunas - Qav = 665 m^3/s, RB area 97.928km^2
  - the Neris - Qav = 189 m^3/s
- 440 dams with surface area > 5 ha,
- 25 artificial WB with surface area> 100 ha,
- 20 dams included into World Dams Register
- 50 hydroelectric power stations
- Kaunas HE power station&dam - the biggest (built in 1959):
  H=20.5m, Qav=287m^3/s,
  Qmax flood = 2810 m^3/s (once per 100 yr),
  Qmax flood = 4160 m^3/s (once per 1000 yr)

1. Flooded areas (2)

- Nemunas delta region approx. 40 000 ha (max 60 000 ha or 0.92% LT territory) flooded yearly (from Sovietsk, 57km from the mouth), approx. 4000 inhabitants (40 settlements, 700 homesteads) are in danger due to flooding. One of the main reasons of flooding - narrow Klaipeda straight
- Minija river basin and other smaller rivers (Sysa, Leite, Gege etc.)
- Some upper parts of the Nemunas river (at Birštonas, Prienai), Neris river (at Vilnius, Jonava), Nevėžis (at Kėdainiai)
- History of flooding:
  - flooding carries local character only
  - up till now - no serious accidents due to existing polder/dykes system
  - the last biggest flooding was in 1958 (1 per 100 yr), with Qmax=6580 m^3/s, and flooded area of 1300km^2

1. Flooding in LT (3)

Measures to avoid flooding

- to regulate depth of river bed/channel;
- to build polders;
- to determine / delineate dangerous zones by making maps of these zones and prepare territorial planning documents;
- to decrease / regulate economic activity;
- to deepen river stretches (of the Nemunas Delta).

2. National flood forecasting, control and prevention programmes (1)

- **Complex programme on water resources management for protection and rational use of lower-course of the Nemunas RB and Curonian lagoon (in Klaipeda and Taurage Counties), MoE No.323 of 2002-06-14**
- **Programme on measures for prevention of flooding and measures to overcome the consequences due to flooding, GR No.1485 of 2002-09-19**
- **Supplementary activities:**
  - **Master plan of the Lowland Nemunas river basin (one of 5 under ISPA) - for protection of pollutants discharges into the lowland waterbodies**
  - **Research studies:**
    - **modelling of possible flooded areas according the probability of flooding**

2. National flood forecasting, control and prevention programmes (2)

- **Complex programme on rational use and protection of water resources of the lower-course of the Nemunas RB & Curonian Lagoon (in Klaipeda & Taurage counties), MoE, No.323 of 2002-06-14**
  - The object: the large Nemunas delta (1075 km^2 incl. Curonian Lagoon, and all potentially flooded areas, polder system exists)
  - Activity programme includes:
    - characterisation of the object of study
    - measures for reduction of pollution
    - measures for problems solving caused by flooding, i.e.
      - delineation of fooded areas by making zoning scheme
      - to set up/definition of the rules for economic activity in the potential flooded zones according the zoning scheme
    - to make monitoring programme for migratory fish
    - to coordinate economic activities in potential flooded areas
    - to execute public information and awareness programmes

2. National flood forecasting, control and prevention programmes (3)

- **Programme of measures for prevention of flooding and measures to overcome the consequences due to flooding, GR No.1485 of 2002-09-19**
  - Responsible institutions - Klaipėda & Tauragė County administrators
  - The aim (plan for years 2002-2006): by using legal, technical measures (15 measures)
    - to decrease the damage and economic losses caused by flooding event
    - to preserve human health & welfare
    - to protect the environment from negative impact
  - The tasks:
    - to develop technical and legal basis for the reduction of of damage and impact from flooding
    - to overse measures to eliminate in a complex (interdisciplinary way the after-effect of flooding)

3. National action plan against flooding (1)

- National action plan against flooding, GR No.133 of 2000-02-07, i.e. “State plan for organisation of safety measures and liquidation on causes from flooding in Klaipeda County”
- National Civil safety and rescue system in case of danger of flooding in the lower course of the Nemunas, and the time schedule of actions in the case when flooding occur, O MoD No.1785 of 2002-12-17

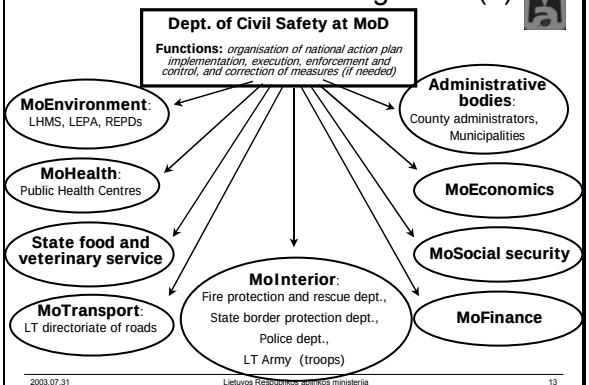
3. National action plan against flooding (2)

- **National action plan against flooding/GR No.133 of 2000-02-07 “State plan for organisation of safety measures and liquidation of causes from flooding in Klaipeda County”**
  - **The aim**
    - to foresee protection measures to prepare inhab. and institutions
    - to use rationally the resources and techniques
    - to determine functions and responsibilities of all 3 administrative levels and governmental institutions
  - **Four stages of action/reaction to flooding**:
    - preventive measures
    - readiness for flooding
    - actions during the flooding event
    - reconstructive works after the flooding event

3. National action plan against flooding (3)

- **National civil safety and rescure plan in case of danger of flooding in the lower course of the Nemunas RB, and the time schedule of actions in the case when flooding occurr, MoD No.1785 of 2002-12-17**
  - Responsible institution - Dept. of Civil Safety, Mo Defence
  - Action plan (47 detailed actions)

3. Institutions for flood management (4)



4.International agreements on flood control and forecasting

- Gov. agreement between POL & LT on collaboration and help in case of accidents, disasters and other emergency cases (*where countries collaborate in case of flooding and droughts forecasting, prevention, control and overcomming damage caused by the latter);*
- Gov. agreement between LV & LT on collaboration and help in case of natural disasters, accidents and other big emergency situations (responsible - Dept. of Civil safety);
- Institutional agreement between Rus & LT on monitoring data exchange on the state of water bodies (signed in 2002)

Territorial planning

For more information:

- to MoE/ Territorial planning, urban development and architecture dept./Lithuania

and to apskritis (county) of Klaipėda governors administration.

Territorial planning documents

- **Comprehensive plan of the territory of Klaipėda apskritis (county)** - *under preparation*;
- **Comprehensive plans of endangered municipalities** *(to be prepared)*;
- **Special (thematic) plans.**

Part B:
Practices and problems /

Partie B :
Pratiques et problèmes

Bilan et objectifs des activités de l'Accord Eur-opa Risques Majeurs

Jean-Pierre MASSUÉ, Secrétaire exécutif de l'Accord partiel ouvert «EUR-OPA Risques majeurs», Conseil de l'Europe

Présentation de l'Accord

Par la Résolution 87(2), le Comité des Ministres du Conseil de l'Europe a établi un Accord intergouvernemental partiel, ouvert appelé «Accord EUR-OPA Risques Majeurs» en mars 1987. Il est dit «partiel, ouvert» car tout Etat, membre ou non du Conseil de l'Europe, peut demander à y adhérer.

L'Accord regroupe actuellement vingt-cinq Etats membres : Albanie, Algérie, Arménie, Azerbaïdjan, Belgique, Bulgarie, Chypre, Espagne, France, Géorgie, Grèce, Italie, Liban, Luxembourg, L'ex-République yougoslave de Macédoine, Malte, Moldavie, Maroc, Monaco, Portugal, Saint-Marin, Roumanie, Russie, Turquie, Ukraine. Le Japon a le statut d'observateur auprès de cet Accord.

L'Allemagne, l'Autriche et la Suisse sont invitées régulièrement à participer aux réunions de l'Accord. La Commission européenne, l'Unesco, l'Oms et le Bureau pour la coordination des Affaires humanitaires des Nations Unies (OCHA) y participent. La Fédération internationale des sociétés de la Croix-Rouge et du Croissant-Rouge est associée à ses travaux.

Objectif principal

Resserrer et dynamiser la coopération entre les Etats membres de l'Accord EUR-OPA Risques Majeurs d'un point de vue pluridisciplinaire afin d'assurer une meilleure prévention, protection et organisation des secours en cas de catastrophes naturelles et technologiques majeures en faisant appel à toutes les ressources et connaissances actuelles pour assurer une gestion efficace et solidaire des risques majeurs.

Présidence

Depuis février 2000, la présidence de l'Accord est assurée par la France: M. le Préfet M. Sappin, Directeur de la Défense et de la Sécurité Civiles, Ministère de l'Intérieur, Paris.

La Vice-Présidence est assurée par l'Algérie : M. M. El Habiri, Directeur Général de la Protection Civile, Ministère de l'Intérieur, Alger.

Réunions ministérielles

Les dernières réunions ministérielles se sont tenues à Athènes (Grèce), les 21-22 février 2000 et à Bandol (France), les 3-4 octobre 2002.

Bilan

Politique

Les lignes directrices et les priorités dans le domaine de la gestion des risques (connaissance, prévention, alerte, gestion des situations d'urgence, analyse post-crise, réhabilitation) sont

définies par les ministres de l'Accord lors des sessions ministérielles. Par la suite, des instructions sont données par le Comité des Correspondants permanents au Secrétariat exécutif de l'Accord pour leur mise en œuvre. Les principaux résultats étant :

– l'établissement d'une plate-forme de concertation et de coopération où se retrouvent sur un pied d'égalité pays de l'Europe de l'Ouest, de nombreux pays de l'ancienne Union soviétique : Russie, Ukraine, Arménie, Géorgie, Azerbaïdjan, Moldavie et des pays du sud de la Méditerranée : Maroc, Algérie, Liban ;

– la représentation de la Région « Europe » au sein de la « Task Force de la Stratégie Internationale pour la Prévention des risques » (ISDR) des Nations Unies ;

– la mise en œuvre d'une analyse comparative des législations nationales en matière de gestion des risques dans la région euro-méditerranéenne, coordonnée par le Centre de Belgique, en coopération avec les centres européens de Kiev (Ukraine) et de Sofia (Bulgarie).

Réalisations

1. Création d'une plate-forme permanente de coopération scientifique et technique

Au travers du Réseau euro-méditerranéen de vingt-trois centres spécialisés ayant des fonctions de recherche, de formation et d'expertise, voir liste en annexe. Ces structures permettent une approche multinationale, pluridisciplinaire à la problématique des risques.

2. Activités de formation et sensibilisation

Niveau scolaire

Création d'un réseau euro-méditerranéen d'écoles à la suite d'un ensemble de conférences spécialisées sur le thème de la sensibilisation des enfants à la prévention des risques, organisées par le centre européen de Sofia (Bulgarie). Ce réseau est basé sur l'esprit du plan SESAM pour mettre en œuvre des programmes de sensibilisation à la prévention des risques adaptés à chaque établissement scolaire. Des actions spécifiques sont également entreprises concernant les groupes d'enfants à besoins spécifiques (handicap moteur, psychique, enfants en situation d'exclusion sociale).

Un secrétariat technique à été établi grâce à l'aide de la Province de Salerne auprès du Centre universitaire européen pour les biens culturels de Ravello (Italie), chargé de collecter les matériels audiovisuels adaptés aux besoins des enfants. Le Centre européen de Chypre travaille à l'utilisation d'Internet au service de ces programmes.

Proposition de création d'un réseau euro-méditerranéen d' «observatoires nationaux de la sécurité des établissements scolaires et d'enseignement supérieur», proposée lors du Séminaire de Sofia (9-10 mai 2002).

Niveau universitaire

- création de Masters européens et euro-méditerranéens ;
- Master européen de médecine des catastrophes au Centre européen de Médecine des catastrophes de San Marino depuis l'année universitaire 2000/2001 ;
- Master européen (DESS) sur la science du risque, dans une approche pluridisciplinaire à l'Université de Montpellier (Montpellier I, II, III et Ecole des Mines d'Alès, France) depuis l'année universitaire 2001/2002 ;
- constitution d'un réseau euro-méditerranéen d'universités intéressées par l'organisation de Masters et du projet de création d'un Doctorat européen ou euro-méditerranéen en science du risque.

Niveau professionnel : Kosovo

A la demande du représentant spécial du Secrétaire Général des Nations Unies à Pristina :

- réalisation de l'analyse des risques dans cette région (mars-avril 2000) ;
- participation à la création de l'Ecole de Protection civile au Kosovo, permettant de transformer l'UCK en un système de protection civile, le KPC ;
- organisation de six mois de cours pour former les cadres de cette nouvelle école ;
- production d'un *handbook* pour la formation des enseignants de l'Ecole de Protection civile ;
- participation de neuf centres européens de l'Accord EUR-OPA Risques Majeurs à cette initiative.

Information du public

Un test pour la mise en place de «radios dédiées» et/ou de banques de programmes (projet IRIS/RADRIM-Radio Risques Majeurs) est actuellement préparé, jumelant la radio avec Internet. Il a pour objectif de contribuer à une meilleure information et sensibilisation à la connaissance et à la prévention des risques naturels, technologiques, de santé, sociaux, etc. Ces radios regrouperaient quatre niveaux de programme : européen et international, national, régional, local. Pour l'instant, un test est prévu dans quelques communes en France : Bordeaux, Nîmes, Amiens et le réseau des radios associatives regroupées au sein de l'EPRA (Echange et production radiophoniques), ainsi que la préparation d'un projet pilote à Casablanca (Maroc) ayant pour cible la sensibilisation des enfants à la prévention des risques.

3. Activités scientifiques et techniques

– Programme Strim (*Space Technologies for Risk management*)

  Sensibilisation des responsables de la gestion des risques à l'utilisation des technologies spatiales au service de la gestion des risques sur le plan des télécommunications, de l'utilisation de l'imagerie spatiale, du positionnement.

– Programme EDRIM (*Electronic Discussion Group for Risk Management*) Intranet sécurisé

  Mise en place d'un réseau expérimental de télécommunications hybrides (spatiales et classiques) entre des responsables de la gestion des risques pour faciliter l'échange d'informations, la discussion et la coopération. Ce programme a été mis en œuvre à partir du projet RIMS (*Risk management Services*) soutenu par la Commission européenne (DG Société de l'Information).

Quatre simulations ont été réalisées :
- Draguignan : simulation d'un accident de transport de produits toxiques ;
- gestion d'un feu de forêt entre l'Espagne et le Portugal ;
- gestion d'un inondation dans le bassin de la Meuse ;
- gestion d'un tremblement de terre en Grèce.

4. Programme d'aide à la décision dans la gestion du risque : contribution de la communauté scientifique

Avec le soutien de la Commission européenne (DG Recherche-coopération internationale), un programme visant à mobiliser la communauté scientifique pour contribuer à améliorer l'aide à la décision dans la gestion des risques a été mis en place. Le principe de base repose sur l'idée qu'il convient à la demande des décideurs de leur fournir au moment voulu, sous une forme adéquate, la connaissance structurée voulue, dans un souci d'aide à la décision.

A la suite du séminaire de synthèse organisé à Montpellier (12- 14 décembre 2001), un ensemble de propositions ont été dégagées et soumises à différents appels d'offres, par exemple :

– *Water models development and decision support system for integrated management of water resources in Euromed countries,*
– *International conference on environmental security in the Danube river basin,*

– gestion intégrée du risque d'inondation et de la ressource en eau pour des territoires soumis aux crues éclair,
– *Chernobyl public awareness and scientific co-operation,*
– *information and prevention of major industrial hazards in Europe and Mediterranean partner countries.*

De même, un test d'aide à la décision a été organisé du 1er au 31 mars 2002 pour le bénéfice de la Direction ECHO de la Commission européenne : il consistait à fournir dans les quarante-huit heures une évaluation des dommages causés par un tremblement de terre, quelle que soit sa localisation dans le monde.

5. Activités développées suite à la 9e session ministérielle (3-4 octobre 2002, Bandol, France)

a) En coopération avec l'Office de coordination humanitaire des Nations Unies (OCHA), un cours de formation d'opérateurs de protection civile a été organisé en mai et juin 2003 à Goma (République démocratique du Congo). Cette formation a jeté les bases d'une structure de protection civile dans la Province du Nord Kivu.

b) Parmi les activités du Programme FORM-OSE niveau universitaire, il est intéressant de noter la préparation d'un Master européen sur le thème «Collectivités locales et risques».

c) Une priorité a été donnée au Programme de mise en sécurité des établissements scolaires à partir d'un projet de cartes de vulnérabilité des bâtiments scolaires par rapport aux risques sismiques, des inondations et glissements de terrain. Dans ce sens, des modèles de plans de mise en sécurité des établissements scolaires ont été établis ainsi que des programmes de sensibilisation des enfants à la prévention des risques.

6. Publications en 2002

– Ethique et médecine des catastrophes – Editions du Conseil de l'Europe, ISBN 92-871-4863-5 ;
– *Handbook* pour la formation des formateurs des Ecoles de protection civile – Editions du Conseil de l'Europe/IOM) ;
– *Ancient buildings and earthquakes: reducing vulnerability of historical built-up by recovering the local seismic culture: principles, methods, potentialities* – Editions du Conseil de l'Europe ;
– Rapport Final : Mobilisation de la communauté Scientifique au service de l'amélioration de la gestion des risques – Editions du Conseil de l'Europe.

Réalisation audiovisuelles
– Gestion concertée de feux de forêts : EDRIM / RIMS ;
– Actions de l'Accord au Kosovo : sur le chemin de la paix au Kosovo ;
– Aide à la décision : nouvelles technologies.

ANNEXE

Réseau des Centres euro-méditerranéens spécialisés de l'Accord EUR-OPA Risques Majeurs

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PAYS	CENTRE	DIRECTEUR	e-mail
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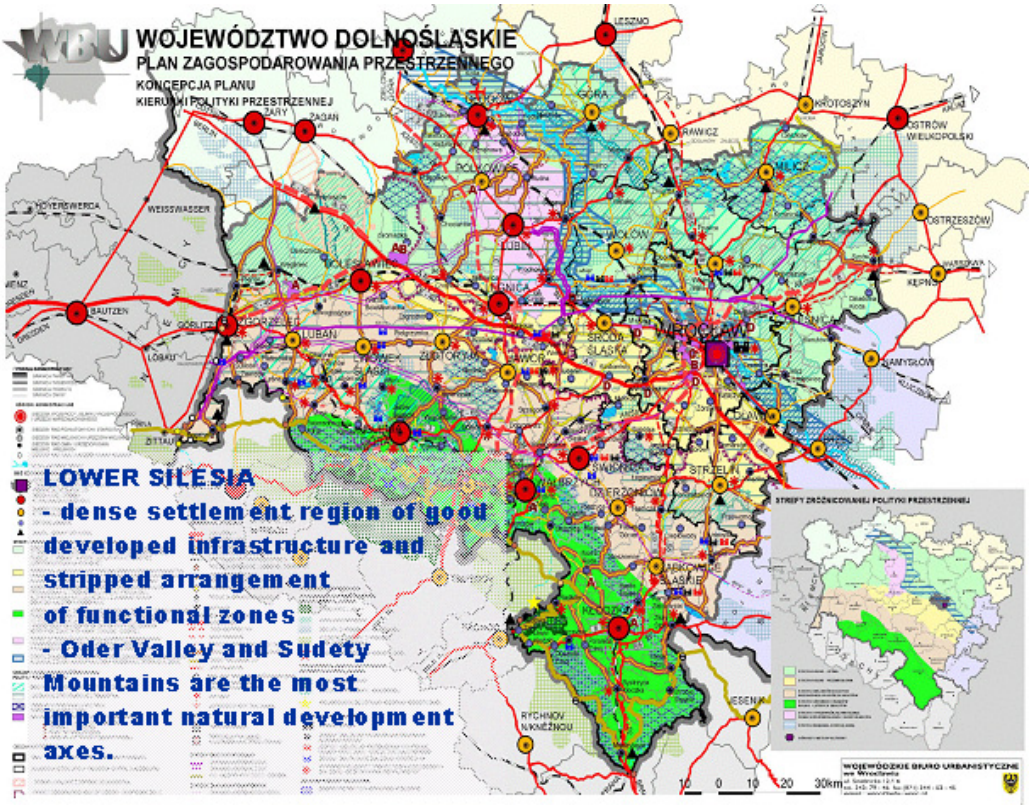
Changes in the spatial policy after the great flood in Odra river basin in 1997

Janusz ZALESKI, President of the Wrocław Development Agency, Poland
Stanisław DENDEWICZ, Technical University Wrocław, Poland

1. Introduction

1.1 Lower Silesia – basic spatial characteristics

Lower Silesia is one of Poland's most beautiful regions. Within the country's administrative structure, divided into sixteen voivodships (provinces), it is approximately covered by the Dolnośląskie voivodship, with nearly 20,000 kilometers^2 in area. Civilisational progress in this land has covered its space with a dense road and railway network. Over 70% of the region's population, numbering three million, live in eighty-nine cities, with Wrocław as the region's main city inhabited by 1/3 of the voivodship's urban population. Apart from Wrocław, the most important cities include Legnica, Jelenia Góra and Wałbrzych, which are subregional service centers. In terms of economy, Lower Silesia ranks high in the country, generating over 8% of GDP. The space marked by the axes of the Oder Valley and Europe's oldest mountains – the Sudety range – forms its natural landscape. Those axes impose striped arrangement of areas with different characteristics of spatial conditions.

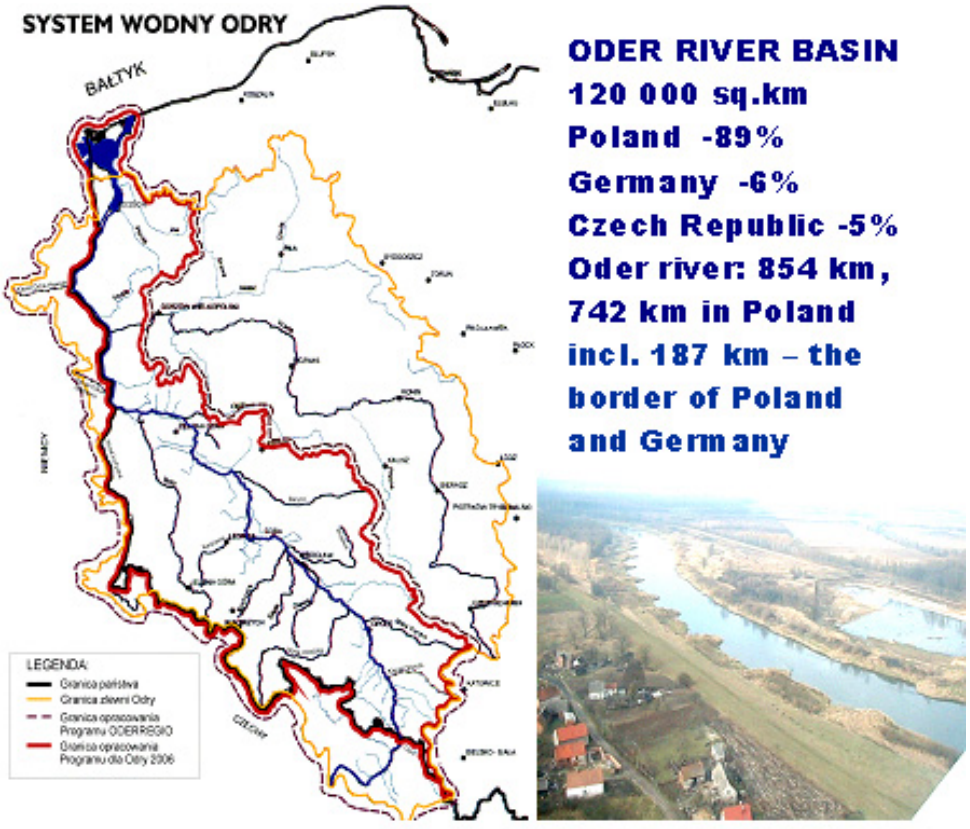


Pic.1 Spatial development plan of Lower Silesia – WBU Wrocław.

Lowland agricultural and forest areas, as well as a copper basin – the region's largest economic potential – are situated along the Oder valley. The foreland and foothills of the Sudety Mountains are one of Poland's richest areas in natural resources, with an intensive settlement network composed of picturesque little towns, the majority of which have cultural heritage of town-planning and architectural interest. Between the Oder Valley and the Sudety mountain range, a third Pan-European transportation corridor runs, leading to the west via Dresden to Brussels, and to the east via Kraków and Lvov to Kiev. Nearly 100% of Lower Silesia's area is located in the basin of the Oder, Poland's second largest river. The entire area of the Oder basin amounts to ca. 120,000 km^2, including 106,000 km^2 in the territory of Poland. The length of the Oder river – 854 km, in Poland – 724 km, including 187 km of the river section forming the border with Germany. Average flow – 573 m^3/s.

1.2 History of floods in Lower Silesia – a catastrophic flood in 1997 and its effects.

Historically, Lower Silesia, as most European regions geographically associated with valleys of big rivers, has been devastated by great floods many times. The first historic records speak of 2000 flood victims in Kotlina Kłodzka in 1310. Subsequent great floods were recorded every several dozen of years. The floods in 1501, in 1736 and in 1785, when Wrocław was flooded from the side of all the city's entry points, and in 1854 – deemed to be the largest flood in the 19th century – should be acknowledged as the largest floods. It was as early as 1903 that another flood of catastrophic magnitude took place. The flood in 1997 surpassed all the previous ones in terms of its parameters. With average flows on the Oder below 600m^3/s, the maximum flow in 1854 on the Oder in Wrocław was 2450m^3/s, in 1903 2200m^3/s, in 1997 as much as 3640m^3/s.



Pic.2 Characteristic of Odra basin

Two waves of heavy rainfalls, which followed each other in close succession, were a decisive factor for the occurrence of high waters on the Oder in July 1997. The first period abounding in rainfalls began in the Oder basin around July 4, 1997. A low pressure area forming on the V b track over the Balkans and further smaller low pressure areas over the Carpathian Mountains caused transport of humid, warm air masses from the eastern part of the Mediterranean Sea and the Black Sea to the north, where they met cold air from over the Baltic Sea. Extremely large temperature differences of air masses which met, coupled with vertical movements caused by the upper low, brought heavy rainfalls, in particular, over the Carpathian Mountains and the Karkonosze Mountains. Precipitation maps for the period 4-8 July, 1997, show maximum precipitation between Wrocław, Katowice and Brno, thus, in the Sudety Mountains and the Beskidy Mountains. By morning on July 9, 1997, precipitation reached the level above 200 mm in those regions, and even above 300 mm in a large part of the area. The highest values were recorded on the Pradziad peak (in Czech: Preded) – 455 mm, and at the Polish station, Racibórz – 244 mm. The Czech station, Lysa hora, in the Beskidy Morawsko – Śląskie, recorded 586 mm precipitation over five days in the period 4-8 July, 1997, including 510 mm over 72 hours. The remaining part of the basin in the upper Oder course also received large amounts of rainfall. The flood situation deteriorated when nearly two weeks later another low pressure area reached the Czech Republic from the centre over Italy. Coupled with an upper low in the period 18-22 July, 1997, weather conditions that formed were similar to the first period which had brought heavy rainfalls. The low again caused – this time slightly further to the west, primarily over the Izerskie Mountains and the Karkonosze Mountains – long lasting and extensive rainfalls over already flood-hit areas. Over four days from 17 to 21 July, 1997, measurements again showed precipitation exceeding 100 mm (Praded 139 mm, Lysa hora – 167 mm, Wieluń – 116 mm, Częstochowa – 115 mm). Thus, the amount of rainfall over only four days was the same as the long-term mean precipitation for the whole July. That period of rainfall resulted in the second flood wave and the long duration of the flood. Over the whole of July, precipitation was a multiple of the long-term mean precipitation for July: in southern Poland and in the east of the Czech Republic, precipitation was three times higher, and in mountainous areas it was even four or five times higher than usual. The 1997 flood caused enormous losses in Poland: 54 death casualties, about 1400 localities inundated, areas in 26 out of 49 then existing voivodships were underwater (652 municipalities), 6 700 km^2 were flooded (2% of Poland's area), 680 thousand residents were affected by the flood, including 50,000 whose homes were entirely flooded (over 106,000 were evacuated from flooded or threatened areas), 9,000 entities with over five employees were flooded, as many as 145,000 small enterprises and 4000 research, culture and health care institutions. The value of losses is estimated at PLN 14 billion, including costs of rescue operations. The total estimate of flood losses does not include lost profits caused by restricted activities of businesses in 1998, extraordinary costs associated with flood control operations and flood recovery, losses of religious organisations.

Pic.3 Flood in Wrocław in 1997- Świebodzki railway station

Lower Silesia was the hardest-hit region, as losses within the new administrative area accounted for nearly 45% of the entire country's losses, and losses within the Wrocław metropolitan area accounted for nearly 30%. The City of Wrocław, the capital of the region and a 670,000 metropolis, was underwater in 30%; for twenty-one days, it was devoid of electricity, water (some areas of the city even longer), a functioning sewerage system, what presented an epidemiological threat. In Lower Silesia, the number of death casualties was the highest – in Kotlina Kłodzka, a mountain flood occurred in its classic devastating form. In many rural areas, e.g., in the area of Wołów, Oława, the water inundated a number of rural settlements and often remained there for three weeks.

Pic.4 Flood 1997-KlodzkaValley-phot. L.Pikuła

2. Directions of the Government's policy after the flood – the Oder 2006 Program.

Violent floods of 1997, 1998 and 2001 imposed on government administration and 700 local governments particularly difficult tasks associated with the reconstruction of completely destroyed or severely damaged technical infrastructure and public facilities owned by local governments. Those tasks significantly exceeded financial capabilities of local governments and the existing system of financing flood protection. Under those circumstances, in 1997 the Council of Ministers adopted the National Reconstruction and Modernisation Program; its priority task was, in the first place, reconstruction and modernisation of flood-affected municipal infrastructure and flood control infrastructure. A total of over PLN 10 billion has been released for the implementation of tasks relating to flood recovery and the construction of the flood protection system. In the reconstruction and modernisation plan adopted by the government, the following tasks were deemed to be of priority nature: in the first place, restoration of normal living conditions for the population in flood affected areas, the carrying out of the most urgent renovations, as well as reconstruction of dikes and hydrotechnical and land amelioration facilities of essential importance for flood safety, reconstruction of technical infrastructure in flood affected regions, construction of the country's modern flood protection system, the creation of a regulatory framework for efficient crisis management. The second part of the program envisaged medium- and long-term measures, which were passed by the Parliament in 2001 in the form of the Act on establishment of the Oder 2006 Program.

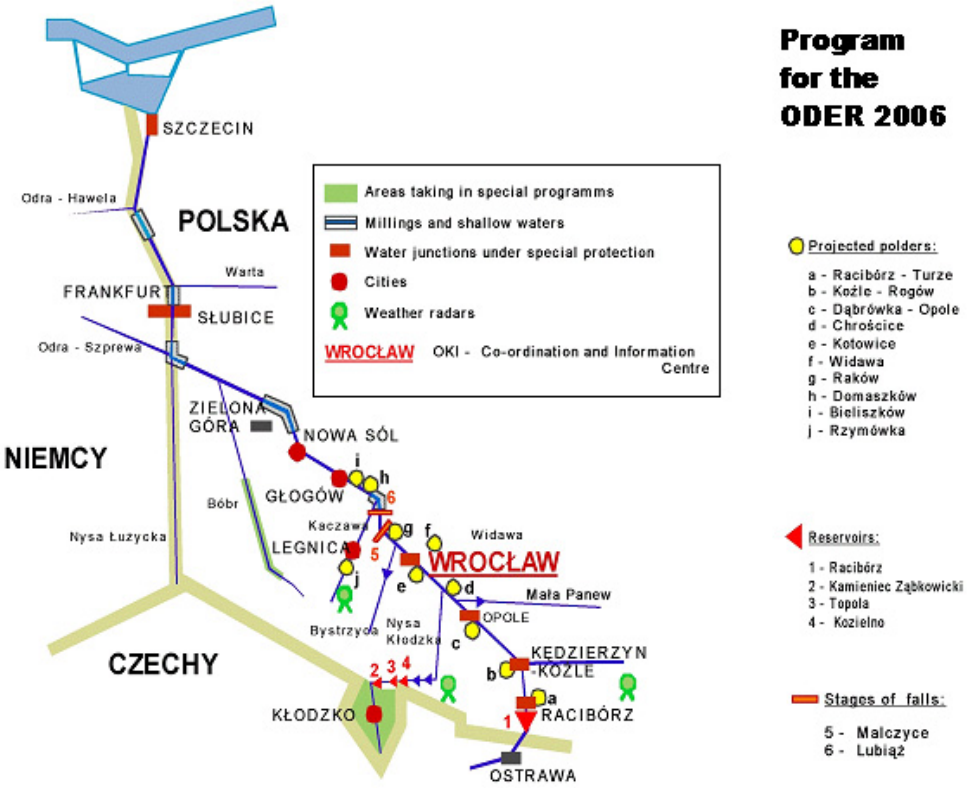
The Oder 2006 Program, by laying down a strategy of modernisation of the Oder Water System, proposes a vision for the Oder, and regions situated on the Oder, as a modernly developed ecological corridor in this part of Europe; the Program also defines, in keeping with sustainable development principles, specific tasks:

– increase in water retention related to flood protection (polders and reservoirs);
– modernisation and extension of the existing flood protection system under the so-called Component B of the World Bank loan – monitoring and warning system;
– water cleanliness protection;

– restoration and maintenance of inland navigation;
– utilisation of water force for renewable energy generation;
– maintenance and renaturation of ecosystems of rivers and their valleys;
– preventive land development by cities and municipalities situated on the Oder.

Taking into account the experiences of 1997, the Program pays special attention to flood protection of large concentrations of the population, including Racibórz, Kędzierzyn-Koźle, Opole, Wrocław and Słubice, but also of areas where floods are frequent and violent – Kotlina Klodzka and left-bank tributaries of the Oder, in particular, the Bóbr valley. It is envisaged that, among others, reservoir retention capacity in the Oder basin will be increased by about 250 mln m³ and polder retention capacity by 100 mln m³, and a modern hydrological monitoring system for the upper and middle Oder catchment and an efficient flood warning system will be constructed.

Of course, it is difficult to speak of a comprehensive program without implementing an adequate spatial development policy. The assumption is that the Oder 2006 Program will form a basis for preparation of initial working materials for voivodship parliaments and management boards of municipalities and cities located in the Oder valley, which will allow spatial governance to be introduced along the entire Oder valley, paying attention to preventive flood protection, the continuity of ecological corridors, improvements to the landscape of river banks, protection of essential values of civilisational heritage, and bringing the economic and social development in line with possibilities of the natural and cultural environment.



Rys.5 Program dla Odry 2006 – schemat rozmieszczenia zadań- Program for the Oder River 2006- diagram of issues arrangement.

Improvement in navigation conditions on the Oder Waterway will create a chance for increase of cargo carriage in international transport of bulk goods, such as hard coal, aggregates, cement, fertilisers, and others, first of all, over-dimension cargo and container carriage. It will enable effective utilisation of the connection of the Oder with the West European system of waterways through the Oder-Szprewa canal and the Oder-Hawela canal. It will also form a basis for international reciprocity in the use of waterways. The Program envisages measures aimed to bring the Oder Waterway in line with three class parameters, however, paying attention to regional needs and capabilities, and also seeking to earlier achieve, in selected river sections, higher parameters which meet international requirements.

Pic.6 Reservoirs „Topola" i „Kozielno" on Nysa Kłodzka river – total cost 180 mln zł (November 2002)

The value of projects implemented under the Program scheduled for the years 2002-2016 is estimated at PLN 10 billion in 2001 prices. It is envisaged that the Program will be funded from Polish public funds (central government budget and local government budgets, environmental protection and water management funds) supported with EU structural funds and cohesion funds, as well as loans of international financial institutions (World Bank, European Investment Bank, Development Bank of the Council of Europe).

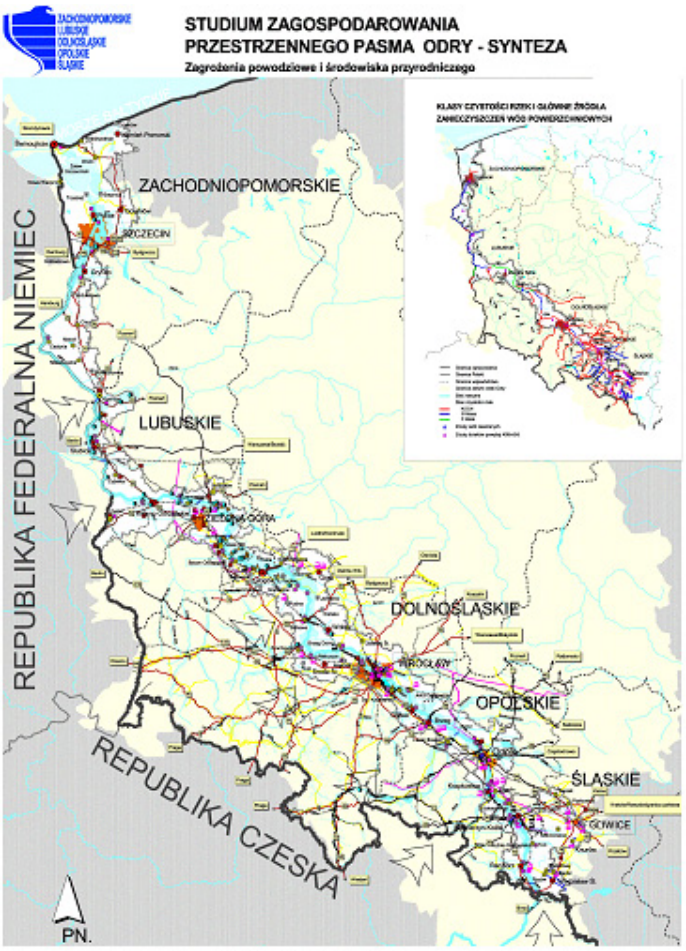
3. Spatial policy in the Oder basin after the 1997 great flood.

After the 1997 great flood, another two years passed until the second phase of the government reform was implemented, i.e., voivodship and poviat local governments were established. In 1999 Poland was divided into sixteen local-government-operated voivodships, which were obliged, among other things, to devise spatial development plans for their areas. It was a favorable situation which introduced a regulatory framework for spatial planning at a regional level. On account of map scales applied in regional spatial planning and political links with local governments – it was possible to incorporate (implement) the government's program assumptions in spatial policy at the local and regional levels. In Poland only spatial development plans adopted by municipalities have the force of local law. The Act on spatial development, passed by the Polish Seym (Parliament) in 2002, allows government administration (at the voivodship level – the voivode) to interfere with the local spatial planning process in order to incorporate public investment projects, including flood control projects. Flood hazard areas, among others, are identified in the regional spatial development plan, and spatial policy is determined for such areas.

Upon embarking on the work on spatial development plans for voivodships, on the initiative of Prof. Janusz Zaleski – the then government plenipotentiary for the Oder matters – and Jan Waszkiewicz – Marshal of the Dolnośląskie voivodship, efforts were made in voivodships situated on the Oder to concurrently carry out special planning studies which would lay down the spatial policy in the Oder valley. In 2003 the voivodships situated on the Oder:

Śląskie, Opolskie, Dolnośląskie, Lubuskie and Zachodnio-Pomorskie, and a government office for development of cities, signed a memorandum of understanding for coordination of that work. In June 2002 those voivodships finished the planning work and carried out a joint presentation of its results during an international conference.

A synthesis of the spatial development status in the area marked by boundaries of the municipalities situated on the Oder river was carried out in aggregated natural and anthropogenic spheres. The Study on Spatial Development in the Oder Region enables harmonised implementation of the spatial policy resulting from the government's Oder 2006 Program at the regional level, and indirectly – at the local level. Synthetic graphic and textual information on threats to the cultural environment was prepared. This information enables rational and coordinated transregional spatial policy aimed at reducing effects of these threats, including floods.



Pic.7 Map from prepared study of the Oder strip concerning flood and natural environment

Efforts aimed to integrate the spatial planning process in the Polish part of the Oder basin allowed Polish partners to join in the project named ODERREGIO which was implemented under the INTERREG II C initiative. The ODERREGIO project was devised in the years 1999-2001 as part of co-operation between Germany, Poland and the Czech Republic, with EU financial support under the INTERREG II C initiative. Priorities concerning flood prevention within the whole Oder basin in the sphere of land management were defined. The basin's area covers ca. 119 thousand square km, of which 90% belong to Poland (5% to Germany, 5% to the Czech Republic). The project's partners included, on the German side, Saxony,

Brandenburg and Berlin; on the Polish side: Śląskie, Opolskie, Dolnosląskie, Lubuskie and Zachodnio-pomorskie voivodships, and relevant water management boards, on the Czech side: central level ministerial agencies. The leaders of the project were Prof. Hans Reiner Boehm from Darmstadt, Prof. Janusz Zaleski and Stanisław Dendewicz from Wrocław, and Eng. Karel Havlicek from Prague. The work resulted in the creation of a body of technologically homogenous electronic cartographic materials for the entire Oder basin region, including identification of the basin's floodplain area (ca. 7,000 m^2), the structure of land use, and assessment of potential flood hazards, with identification of hot spots. Effectiveness of standard measures aimed at flood loss prevention was assessed separately for nine specific basin areas. Benefits of the ODERREGIO project are the following:

- integration of the transnational and regional community of spatial planners with regard to exchange of experiences;
- creation of the Oder basin electronic maps of transnational coverage and making them available for potential use by the countries participating in the project for the development of GIS applications in transregional spatial planning;
- creation of substantive bases for improvement and integration of central, regional and local spatial policies with respect to flood prevention,
- enabling rational and harmonised planning of programs, ventures and projects at different levels and in water management areas, including flood loss prevention.

4. Conclusions

In the Oder basin countries, which will join the EU in 2004, there are conditions for the integration of strategic economic and spatial planning. However, it is necessary to create such organisational and regulatory frameworks in countries situated within one basin of big rivers, such as the Oder or the Elbe, which will enable the following objectives to be pursued:

- laying down rules of spatial policy formation for disaster-prone areas in documents formulating directions of spatial planning across whole Europe (e.g. ESDP) – so that possibly accurate information on European preferences in approach to spatial policies formulated in that aspect at a national level, e.g. "space for the river", results from them;
- introduction of a hierarchy in spatial planning in flood-prone areas – there is a need to impose a legal obligation to incorporate in local (municipal) spatial planning solutions which result from spatial policy formulated at the regional and national levels of planning;
- determination of transnational recording standards for spatial development plans in this field – in particular countries, there are essential differences in the law which defines standards of recording spatial planning arrangements, at the same time, the process of spatial planning integration is technologically determined by applying common GIS tools.

Les inondations en Languedoc Roussillon – La gestion du risque inondation et la politique d'information préventive sur les risques naturels et technologiques en France

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1. Le risque d'inondation est important en Languedoc-Roussillon

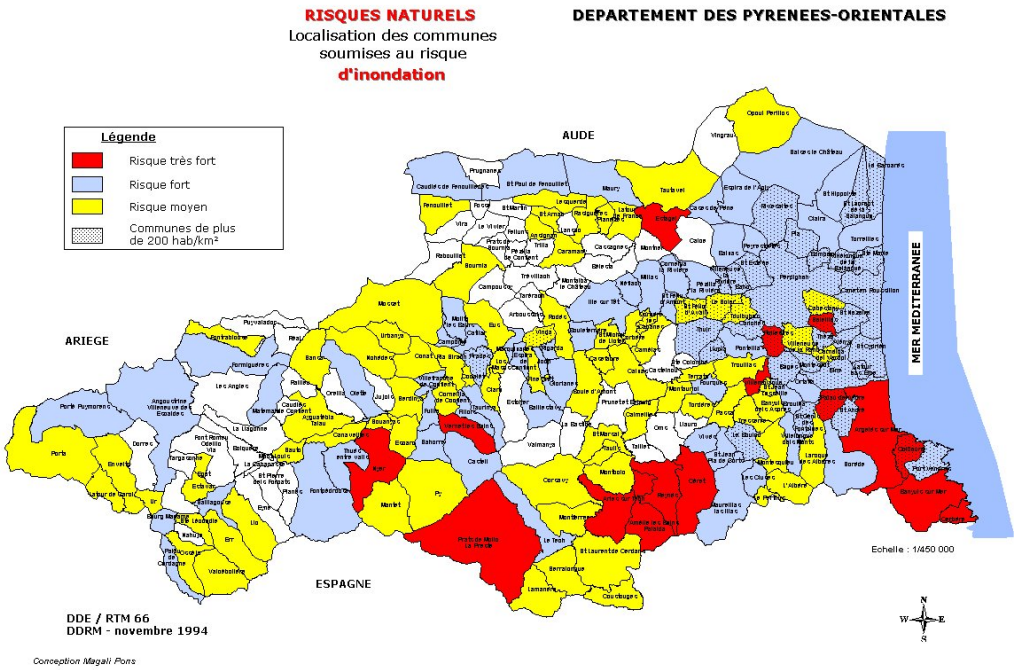
384 100 personnes habitent dans des zones inondables des quatre départements de l'Aude, du Gard, de l'Hérault et des Pyrénées-Orientales.

321 000 personnes habitent dans des zones inondables à risque élevé (fort ou très fort).

Les Pyrénées-Orientales

178 communes sur 222 sont concernées par le risque d'inondation, ce qui représente 138 300 habitants

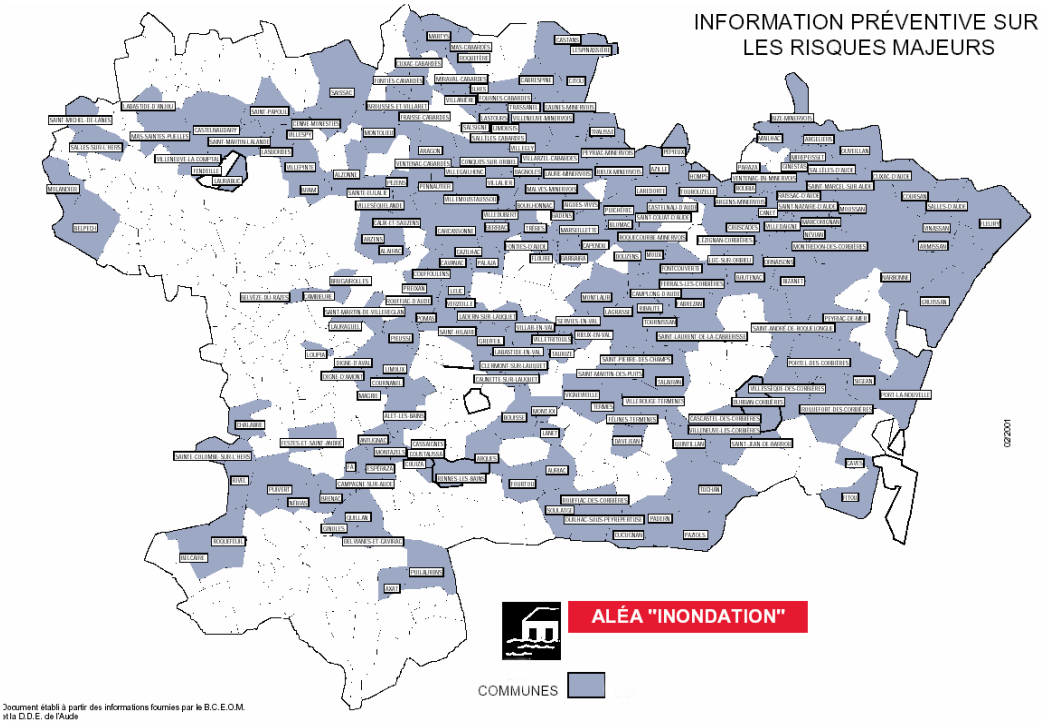
124 000 habitants, soit 32 % de la population du département, sont soumis à un risque élevé, fort ou très fort.



L'Aude

223 communes sur 364 sont concernées par le risque d'inondation, ce qui représente 42 800 habitants.

36 900 habitants, soit 12 % de la population du département, sont soumis à un risque élevé, fort ou très fort.



2. Caractéristiques des inondations en Languedoc-Roussillon

Les précipitations sont rares mais intenses avec des records de 900 mm en 24 heures comme en 1940 sur le Canigou dans les Pyrénées-Orientales.

Le Languedoc-Roussillon est une région d'extrêmes, il ne pleut pas durant plusieurs mois, ce qui provoque des sécheresses importantes, puis de très fortes précipitations s'abattent sur des temps très courts, elles provoquent alors des inondations.

Le terme «Aiguat» est utilisé ; il signifie un «abat d'eau» ainsi que l'inondation elle même ; dans les Pyrénées-Orientales, on ne dit pas l'inondation de 1940 mais «l'Aiguat de 40». Avec un climat méditerranéen, les inondations sont d'autant plus fortes :

– après une longue période de sécheresse ; les précipitations ne pourront pas s'infiltrer dans les sols secs, qu'elles ravineront ;
– après plusieurs jours de pluie, ce qui est plus rare ; les sols n'absorberont plus car ils seront gorgés d'eau.

De nombreux fleuves et ravins sont souvent à sec une grande partie de l'année et ils se transforment lors des précipitations intenses en torrents. Ces cours d'eau sont de véritables «oueds».

La montée des eaux est très rapide, pouvant passer à cinq mètres en une demi-heure ; la décrue est très rapide également ; on parlera d'«inondations éclair», mais les dégâts seront importants. En plaine la durée de submersion est plus longue, de l'ordre de un à trois jours, elle dépend des vents : si les vents soufflent du sud, la mer «grossit» et retient les fleuves, elle empêche les écoulements ; par contre, par vent du nord, la décrue est très rapide.

Il existe plusieurs types d'inondations : des inondations de plaines, des crues torrentielles avec des transports solides, des inondations pluviales liées à l'imperméabilisation des sols.

Les inondations sont des phénomènes naturels. Elles ont contribué à la richesse des plaines des Pyrénées-Orientales et de l'Aude grâce aux apports d'alluvions. Les Templiers au 12è siècle avaient même dévié le fleuve Agly pour favoriser les inondations afin de fertiliser les sols. Dans une région sujette à la sécheresse, les précipitations et les inondations alimentent les nappes phréatiques.

Les inondations ont toujours existé. Il n'y a pas plus d'inondations aujourd'hui que dans le passé, contrairement à ce que pensent de nombreuses personnes. Des récits anciens dans les archives, des repères de crues scellés ou gravés dans la pierre représentent de très nombreux témoignages sur les inondations historiques. De nombreuses dates peuvent être mentionnées, nous n'en citons que quelques-unes unes parmi les plus fortes. Le fleuve Aude change de lit et prend une nouvelle direction : en 1320, les 16 et 17 octobre 1763, le 6 octobre 1820, le 24 août 1842, en 1843, en 1856, le 1er août 1872, le 25 octobre 1891, en 1907, les 2 et 3 mars 1930, les 17 et 19 octobre 1940, les 7 et 8 novembre 1962, le 13 septembre 1963, en 1965 (cinq crues en trois mois), en 1986, le 26 septembre 1992, les 12 et 13 novembre 1999.


3. Les inondations : risque majeur

A partir de quand le risque d'inondation devient-il un risque majeur ? Un événement potentiellement dangereux – l'aléa – (Fig. 1) n'est un risque majeur (Fig. 3) que s'il s'applique à une zone comportant des enjeux humains, économiques ou environnementaux (Fig. 2).

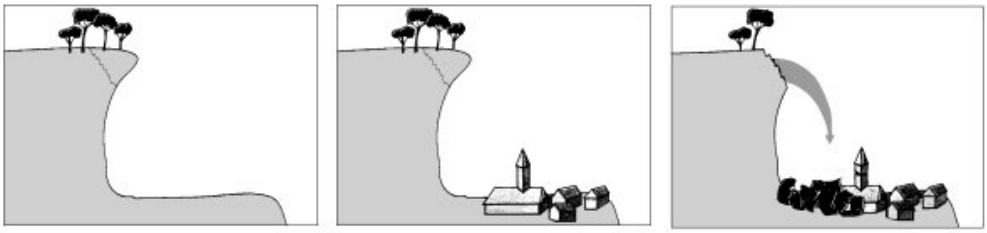


Fig. 1 : l'aléa → Fig. 2 : les enjeux → Fig. 3 : le risque majeur

Le risque majeur est la confrontation d'un aléa avec des enjeux :
– un aléa sismique en plein désert n'est pas un risque majeur ;
– un séisme à San Francisco : voilà le risque majeur.

Le risque majeur se caractérise par de nombreuses victimes, un coût important de dégâts matériels, des impacts sur l'environnement. La vulnérabilité mesure les conséquences.

> La définition que je donne du risque majeur, c'est la menace sur l'homme et son environnement direct, sur ses installations, la menace dont la gravité est telle que la société se trouve absolument dépassée par l'immensité du désastre. (Haroun Tazieff)

Ainsi la société comme l'individu doivent s'organiser pour y faire face.

Face au risque d'inondation il existe deux écueils :

- la présomption : certains pensent que l'on peut supprimer les inondations en faisant des travaux d'aménagement ;
- la résignation ou le fatalisme : d'autres pensent que l'on ne peut rien faire et qu'il faut accepter la nature telle qu'elle est.

Entre ces deux attitudes, il en existe une troisième, celle qui consiste à rester humble face à un phénomène naturel (il ne faut pas l'oublier), tout en sachant vivre avec ce risque en en diminuant la vulnérabilité. Il est nécessaire de savoir diminuer la vulnérabilité comme le faisaient les civilisations anciennes et les Anciens il y a encore pas si longtemps.

Citons quelques exemples d'adaptation aux inondations.

- Certains ponts romains ont de nombreuses arches dans le lit majeur, prévues pour laisser le libre écoulement des eaux : bien souvent, les arches ont été utilisées et intégrées à des constructions aux belles pièces voûtées … Lors des inondations, ces maisons sont les premières inondées.
- Certains ponts ne sont pas symétriques, ils descendent plus bas sur une rive, ce qui permettait aux eaux de passer en temps de crue d'un côté sur le pont ; ce dernier ne créant pas obstacle, il se trouvait ainsi protégé.
- Les lits des cours d'eau et leurs berges étaient régulièrement entretenus de même que les fossés ; des chemins creux étaient réservés et entretenus ; les cultures respectaient certaines pentes pour lutter contre l'érosion.
- Le rez-de-chaussée des bâtiments servait de remise, les riverains habitaient au premier étage, des «tancs», planches ou martellières étaient placées devant les portes et fenêtres avant la crue pour empêcher l'eau d'entrer dans les bâtiments.
- Les marches de certains domaines étaient basses et très larges pour faire monter les troupeaux à l'étage.

Les inondations certes n'étaient pas supprimées, mais les dégâts se trouvaient réduits.

4. La gestion du risque inondation

De nombreux bourgs, villes et villages existent en zones inondables, parfois même ils se sont retrouvés au fil des siècles en zone inondable en raison de l'alluvionnement ayant entraîné un exhaussement des terres. Les basses plaines de l'Aude en sont un exemple : il peut y avoir par endroits six mètres d'alluvions. Parfois certains bâtiments sont passés d'une rive à l'autre après une crue, le lit de la rivière ayant changé son cours.

Il ne serait pas raisonnable de geler une grande partie du territoire du Languedoc-Roussillon, il faut vivre avec le risque ; il est par contre possible de se protéger et de réduire la vulnérabilité aussi bien pour les hommes que pour les biens socio-économiques.

4.1. La connaissance du risque

Cette connaissance consiste à évaluer :

- les aléas : avec une connaissance de l'historique des crues, les fréquences, les intensités ;
- les enjeux humains : les personnes mises en danger ;
- les enjeux socio-économiques : l'inventaire des structures et infrastructures exposées.

4.2. La sauvegarde des personnes et des biens

a) La prévention

- Les aménagements et entretiens préventifs au niveau du bassin versant : il s'agit de préserver les capacités d'écoulement sur l'ensemble du bassin versant, avant l'événement, pour en minimiser les conséquences en aval.

- l'entretien doit être régulier avec le nettoyage des lits des cours d'eau, des berges, l'enlèvement des bois morts, etc. susceptibles de faire des embâcles ;
- la restauration et l'entretien des ripisylves ;
- la préservation et la restauration de zones naturelles d'expansion des crues, la création de bassins d'orages.

– La réglementation

L'information préventive **Loi du 22 juillet 1987** **et** **Décret d'application du 11 octobre 1990** ↓	**La prévention** **Loi du 2 février 1995, dite Loi Barnier** **et** **Décret d'application du 5 octobre 1995** ↓
Dossier départemental des risques majeurs (DDRM) réalisé par les Services de l'Etat Il recense au niveau du département les risques naturels et technologiques encourus sur chaque commune (inondation, feu de forêt, mouvement de terrain, séisme et rupture de barrage, accident de transport de matières dangereuses, industriel). ↓ **Dossier communal synthétique (DCS)** réalisé par les services de l'Etat après consultation des maires Il décrit les risques encourus au niveau communal, à quoi ils sont dus, un rappel de l'historique, la cartographie avec le zonage pour chaque risque, les populations qui doivent être informées, une synthèse pour rappeler les mesures de prévention, de protection, de prévision, d'alerte, de secours, les gestes qui sauvent, les contacts et numéros de téléphone utiles. ↓ **Document d'information communal sur les risques majeurs (DICRIM)** réalisé par le maire. Il s'accompagne d'une campagne d'affichage dans les lieux publics. Il informe la population des risques qu'elle encourt sur la commune, il est associé à la réalisation d'un plan de secours, il se veut pratique pour agir rapidement en situation de crise.	**Plan de prévention des risques (PPR)** (Cartographie) Ses principes sont : – d'interdire les implantations humaines dans les zones les plus dangereuses et de les limiter dans les autres zones inondables ; – de préserver les capacités d'écoulement et les zones d'expansion des crues pour ne pas aggraver les risques dans les zones situées en amont et en aval ; – de sauvegarder l'équilibre des milieux dépendants des petites crues et la qualité des paysages. Le PPR a pour objet : – l'identification du zonage exposé au risque sous forme cartographique ; – la réglementation attachée à la zone inondable qui s'impose au PLU (ancien POS). Le plan de prévention des risques ne supprime pas le risque d'inondation.

b) La protection

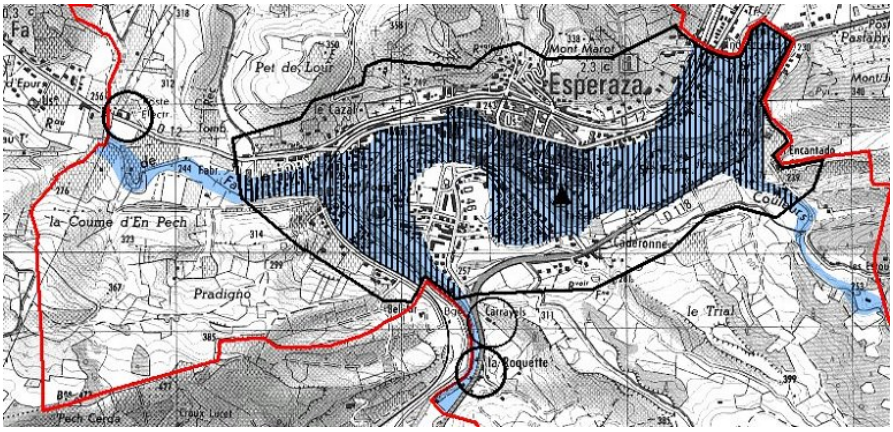
– les travaux lourds tels que des endiguements, la création de barrages ; ces divers aménagements ne sont plus prioritaires ; les aménagements légers sont favorisés ;
– les expropriations pour cause de risque majeur sont possibles.

c) la prévision

– les alertes de Météo-France avec les cartes de vigilance qui, aux niveaux orange et rouge, sont diffusées aux maires par le préfet ;
– l'annonce des crues grâce au système de mesures hydrométéorologiques de la Direction départementale de l'équipement (limnimètres et pluviomètres) ;
– l'organisation d'actions de sécurité civile sur la commune.

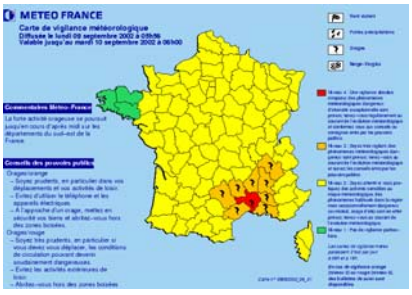
4.3. La maîtrise de la situation de crise lors de l'événement

- l'alerte des maires par le préfet et l'alerte de la population par le maire ;
- la mise en place par le maire du Plan de secours communal et par l'Etat de plans d'urgence et du Plan ORSEC (Organisation des secours) (le suivi de la crue, les évacuations) ;
- le suivi de la crise, déclaration de commune sinistrée … (arrêté de catastrophe naturelle, déclaration de calamité agricole).



Commune d'Esperaza dans l'Aude : carte du croisement de la zone inondable en bleu et de la zone hachurée où l'information préventive doit être faite (carte du DCS)

13 personnes sur 26 sont mortes par imprudence, dans leur voiture lors des inondations de novembre 1999 dans l'Aude.



Carte de vigilance Météo-France

Destructions lors des crues de l'Aude en 1992 et 1999.

Regional water resource treatment and accompanied disasters prevention as core elements for sustainable spatial development in the pilot euroregion "Upper Prut"

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Nowadays the concept on the regional sustainable spatial development can be considered as a composition of the Technology Foresight approach (1), modern understanding of the equilibrium between economical and environmental aspects of mankind activity (2-3) as well as new hierarchical vision of safety as a multivariate process (4).

Last time these issues became very actual for the surroundings of the widening European Union and NATO under the new ideas of neighbourhood (5).

Along the new EU and NATO borders Euroregions becomes "points of growth" for new European policy. And through them can be co-ordinated (and concentrated) the efforts of the local, regional, national authorities and international organisations, aimed to find systems/solutions for the above mentioned problems.

Even the enumeration of the Euroregions in these area: "Neman", "Bug", Danube-Kris-Mures-Tisa", "Neisse", "Elbe/Laba", "Danube-Drava-Sava", "Upper Prut", "Lower Danube" etc. allows to judge, which role water resources and associated security issues play today for the further regional development.

Therefore in the system of four four Euroregions ("Lower Danube" "Upper Prut", "Carpathian" and "Bug"), which covers entirely the western border between Ukraine and CEE-candidate countries: Poland, Slovakia, Hungary and Romania – Ukrainian-Romanian-Moldovian "Upper Prut" was constructed from the very beginning as a new EcoEuroRegion model (6-14) to implement step by step the new principles of sustainable development and safety into the regional economy, social, educational, safety and other spheres.

The Government of Ukraine, in its Order dated 14.02.2002 Nr. 59-*p* had foreseen

> experimental elaboration of transfrontier co-operation mechanisms as the elements of the process of European integration and development of the regional policy within the frames of the above-mentioned Euroregion.

One of the main features, which stimulated such decision, is that this Euroregion includes the significant part of the Danube basin in Ukraine, Romania and Moldova (Upper Prut and Upper Siret), a large part of Dnestr basin (see Fig.1) as well as a number of complex hydro-engineering works (Bucecea on Siret, Stynka on Prut and, especially, Novodnestrovsk hydro-accumulated power station on Dnestr).

In comparison with the Trans-Carpathian Region of Ukraine, the frequency of natural floods here is some lower, but the complexity of their emergencies even higher.

As it was already shown on the Conferences (12-13) the main issue is due to the crucial destroy of former economical, legal and social systems in the rivers basins. The real potential of technogenic disasters was shown already in 1983 by the Stebnik catastrophe on Dnestr. And the last years' disasters in Romania (on Tisza and Siret) demonstrated, that prompt turn to the market economy don't give any adequate improvement for the technogenic and environmental safety, but sometimes even makes it worse.

First of all the spatial development approach needs both a new comprehension and a well co-ordinated activity of all authorities and international organisations, together with more efficient application of transfrontier collaboration between the neighbouring territories, foreseen by the international conventions.

Properly speaking floods in the region has two natural causes: *a)* seasonal freshets (territorial pool-type) and *b)* local showers, which mainly lead to the disasters in certain cities/settlements. Phenomenon of the first type have taken place during the aqueous cycles and the last catastrophic disasters which took place in Chernivtsi in 1969 and 1974, when the level of water in Prut was around seven meters higher than the ordinary level. The natural occurrences of the second type are more frequent and their character widely depends on the local activity and response.

For the last decades of XX century a set of measures has been implemented, which allows better monitoring and forecasts such floods, to act efficiently and to mitigate their consequences.

But for the above-mentioned change of the economical core, more and more important legal and social issues become other components of the water management system and technogenic sphere as a whole, for which floods and accompanied disasters may play a role of "trigger".

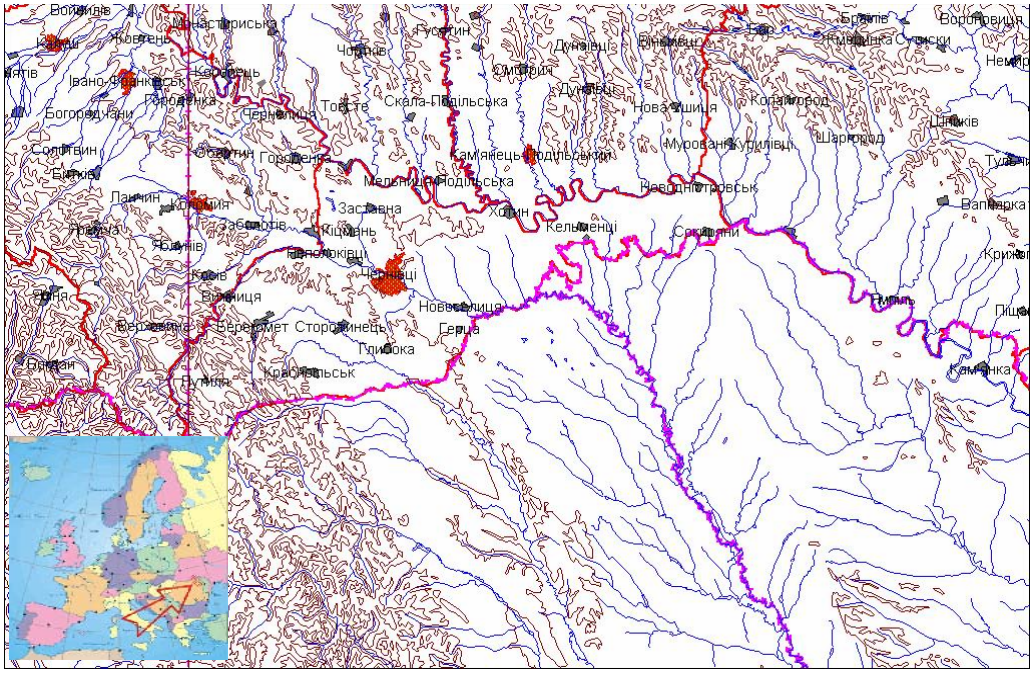

Fig. 1 Rivers system in the Euroregion "Upper Prut"

This effect of floods can also appear in two ways (separately or jointly):

a) when the already existent individual factors become "summarised" by the flood and then give the synergistic consequences;

b) when the flood provokes a previously imperceptible phenomenon, which further starts to develop and/or becomes a new factor of danger.

The geolandscape construction of Chernivtsi Region (Fig. 2), for instance, stimulates the erosive processes for the right tributaries of main rivers, which are iteratively intensified by floods. Besides the economical damage, these consequences bring political problems, because the appreciable territories from the banks of border rivers are shifted by floods to the neighbour countries.

The environmental impacts are also multiplied by the excavation and dredging technologies and their product dumping, for example taking sand and gravel from the river banks. Additionally some disordered silt deposits on the river's banks from water cleaning plants (10) should be noted here. This group of technogenic factors has very obvious "bias" to be integrated into destructive effects of floods.

The second joint natural and technogenic aggravation aspect for all types of floods is also specified by the geolanscape peculiarities of the region. The Chernivtsi Oblast is the smallest one in Ukraine, but it contains more than 1400 landslide-dangerous sites, 70 mudflow inclinable areas and 8% of its territory is liable to attack karst phenomena. Situation is worsening by the fact that part of this geological peculiarities are directly situated in the urban areas, along the main transit ways, near large plants, etc.

Fig. 2 Geolandscape system of Chernivtsi Region

For instance, in Chernivtsi city, some settlements for the last decades were few landslip disasters, due to the structure of soils as well as to such technogenic factors as leakages from water supply and canalisation systems. At the same time, the accumulation of their consequences (cavities, gullies, obsolete storm run-off canalisation, etc.) do create very specific conditions for synergetic effect of floods of type *b)*.

In collaboration with Austrian Partners of the Euroregion, a developed pilot project had been elaborated (15), which should be supported by the Austrian Government. It aimed to demonstrate the complex solution existing for the water supply improvement, disasters prevention as well as the change of mentality both for population and the authorities. Finally, this project was rejected by the Program TACIS-Bistro.

The most significant cumulative effects of natural floods are also due to the technogenic activity in the region. The above-mentioned large hydro-engineering works in Prut, Siret and Dnestr basins have changed essentially both in the river beds and on the hydrological regime of the subterranean waters. As a result for the last decades, many landslide and karst

processes became very active in the watershed areas of the Ukrainian, Romanian and Moldovian parts of Euroregion "Upper Prut". But the rise of the water level in large reservoirs also changed the natural processes in underground layers. These negative processes are additionally stimulated by the current human activities, for instance, by pumping out mining water into Prut river from Moldovian pit near settlement Kriva.

For the last decade, a drastic acceleration of the karst processes is being observed, especially in the most narrow part of watershed area between Dnestr and Prut. The rise of the water level in the reservoir of the Dnestr Hydro-complex is near six meters. Additional rise through floods *a)* and/or intake of water in case of *b)* are combined with other negative factors and can initiate, as a final result, a systems' disaster, such as break of the watershed (see Fig. 3).

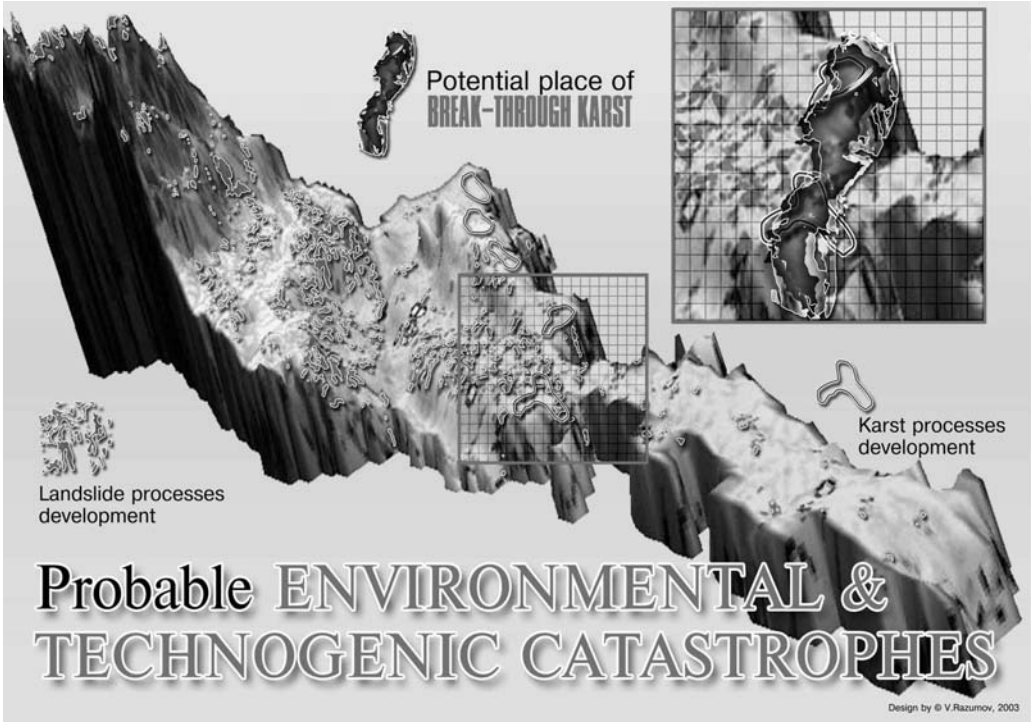

Fig. 3 Probable disasters, additionally stimulated by floods.

The general approach to solve such problems in Carpathian-Danube region was formulated by the sixteen countries Summit (2). It summarised the intention to encourage and support

> new ways and means of integrated and participatory approaches to sustainable development in the Carpathian region by addressing the specific issues of industry, agriculture, forestry, rural development, ... energy, mining and transport at the regional level, in co-operation with national stakeholders, private sector and international organisations … the creation of a favourable climate for enhanced co-operation in technology-transfer, environmental science and technology, in particular for the development and dissemination of innovative energy-efficient and environmental friendly technologies, the mobilisation of financial resources for environment and sustainable development projects and programmes in Carpathian and Danube region and to use the existent mechanisms for the purpose in particular EU funds and the Global Environment Facility (GEF).

Prognosis for further spatial sustainable development in this region (4, 10, 12-13, 16) shows that the continuation of the anthropogenic impacts needs to begin with an adequate evaluation system. In (17) the way was shown for further harmonisation of such global approaches as "Life Cycle Assessment" (ISO 14000) and the specific peculiarities of productions, services and other activities in post-communist Economy.

One of the challenges for the creation of EcoEuroRegion was the principal difference in main features of further development and upsurge both for the single enterprises and sub-regional structures (counties, cities) in the States of Eastern Europe and former USSR versus developed countries of Western type.

There already worked out the nowadays facility and algorithm for balances evaluation of natural and antropogenic factors in each kind of activity: forecasting detection, preliminary accounting, identification, classification characterisation and finding the best technology. Nowadays, this approach receives a wide support (14) both in the EU and the NIS.

All over last years, representative fora have completely supported such collaboration (18-20). A real interest has been shown towards the implementation of such and approach from the World Bank, UNIDO and other authoritative international organisations.

Therefore the next task consists in using new opportunities for this area to be closer incorporated into INTERREG III, ISPA and other powerful European structures under the CADSES initiative and neighbourhood approaches (5) to solve together step by step the foregoing problems.

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The experience of a town in the Czech Republic

Tomas JIRSA, Mayor of Hluboka nad Vltavou, Czech Republic

In August 2002 two waves of destructive floods hit the whole South Bohemia as a result of unexpected torrential rains. After that, during the night of the 1st September new torrential rains brought new floods for the districts of České Budějovice and Český Krumlov. The first wave, which came on 7 August, caused the swelling of some rivers in South Bohemia, namely of all Malše, Vltava, Stropnice and Blanice. It was a case of emergency, which had to be tackled by regional and district flood committees in co-operation with Integrated Rescue System as well as other partners according to the integrated flood emergency plan for the whole river-basin of Upper Vltava and the flood emergency plans of districts and municipalities.

The state of emergency in the district of České Budějovice and Český Krumlov was declared on 8 August 2002 and progressively the flooded municipalities and cities were evacuated. Because of the new predicted torrential precipitations the Governor of the Region has called the special flood committee on 11 August 2002. The next evacuation started on 12 August 2002.

The crisis management team of South Bohemia region was mobilised at the same time and the Governor of the Region declared the state of emergency for the whole South Bohemian Region at 1.30 p.m. Subsequently the emergency actions were in progress within the whole South Bohemian region from 10 to 16 August 2002, in order to avoid loss of human lives and to prevent the possible extension of existing damages with the participation of the Czech army, police, fire brigade, rescue service as well as other bodies and volunteers.

The alleviation of flood effects began with remedial measures straight after the water fell in order to ward off the immediate threat of any emergency case. The costs of both the immediate rescue of human lives and the preventive measures focused on avoiding further damages to property in South Bohemia were pre-calculated to 271 million CZK. During and immediately after the floods, providing subsistence for the worst struck people became the overriding priority.

In summary we can note that during the floods of August, 333 municipalities and towns in South Bohemia were flooded, 17 500 inhabitants were evacuated and six people lost their lives. Damages to property were reported in all from 11,711 natural persons and legal entities.

The restoration of basic functions within the South Bohemian region were estimated at 15,5 billion CZK. About thirty houses tumbled down, dozens of houses are to be demolished immediately and hundreds of them need to go through a static assessment.

Within the recently flooded houses the walls must be dried, which supposes to provide electric and gas dryers and humidity-separators as well. Thirty-six bridges were destroyed and large damages suffered also on roads of the first, second and third categories.

Based on this, the costs for redevelopment of roads and bridges of the second and the third category are estimated at 915 million CZK to date. The same amount was estimated for damages on water storage reservoirs and waterways. A lot of sewages plants were destroyed and silted, the public water supply and wastewater disposal systems in majority of affected towns and villages were damaged. More than 350 million CZK are estimated to be necessary for their renovation and reconstruction.

Nothing but damages on organisations founded by South Bohemian Regional Authority are estimated at around 11 millions CZK. For example the Library collection of 20th century was completely flooded and destroyed, also a help in purchasing new books for the Scientific library would be appreciated. Losses for entrepreneurs within the South Bohemian Region are appraised with 3,1 billion CZK.

The emphasis at present is on any form of help in building alternative housing for those inhabitants, who lost all their property during the floods in August.

Floods in Bulgaria

Kapka PANTCHEVA, Representative of Bulgaria to the Cemat Committee of senior officials

STATE AGENCY
FOR CIVIL PROTECTION

FLOOD
PRE-EVENT
ENGINEERING ACTIVITIES

CHARACTERISTICS OF THE RIVER FLOW IN BULGARIA

- *Variable*

a) Srping-autumn high

б) Summer low

- *Climate change*

TYPES OF FLOODS IN BULGARIA

- Natural
- Man made

PROTECTION AGAINST THE HARMFUL IMPACT OF WATER

- Standing measures for protection
  - а) Dykes and other HTI
  - б) Maintaining a monitoring system
  - в) Fighting erosion in the catchment areas of rivers
  - г) Cleaning river beds
- Protection in emergencies

STANDING MEASURES FOR PROTECTION

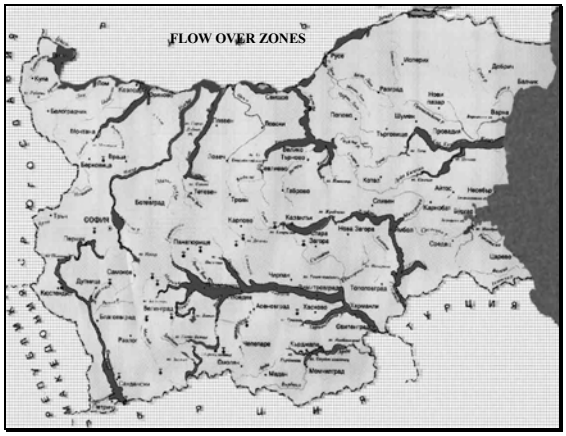
- Dykes
  - а) along the Danube- 260 km approx.
  - б) internal rivers - 3200 km approx.
- Dams
  - а) 2690 in total
  - б) 51 complex and important dams

PROTECTION IN EMERGENCIES

- Emergency plans for all water installations and systems
- Periodical checks of technical and operational state of the installations
- Timely forecast of the size and consequences of a flood

VULNERABLE AREAS ALONG THE BULGARIAN SECTION OF THE DANUBE

km 671.000	Isle of Lyaskovets	0.50 m
km 646.000	Bryag	0.11 m
km 478.000	Isle of Aleko	0.37 m
km 470.000	Tail of Isle of Aleko	0.20 m
km 459.000	Isle of Mishka	0.36 m
km 450.000	Isle of Gr. Brashlyan	0.44 m
km 434.000	Isle of Radetski	0.41 m
km 427.000	Isle of Kosui	0.00 m



PROTECTION IN EMERGENCIES

- Determining the way of protecting the regions of flooding (locations, infrastructure, communications)
- Organization of timely notification
- Organization of evacuation from the flooded areas and shelter in the areas of dislocation

CLOSING SESSION

SESSION DE CLÔTURE

Sławomir NAJNIGIER, Deputy Mayor of Wrocław

Ladies and Gentlemen,

Please allow me, instead of recapitulating the discussion, to share with you a few reflections. I have as a resident of Wrocław, a city located on five rivers, as its deputy mayor in charge of the flood defence effort during the thousand-year flood in 1997, and as a former minister responsible for physical planning at the national level.

My main points are simple:

1. There is no single method of preventing natural disasters (including floods) or mitigating their consequences. The policy of sustainable spatial development is important but it is not the only way to improve the situation, whether locally or at a regional level.
2. The policy of sustainable spatial development must be shaped into a practical legal framework and become a genuine tool at the local and regional levels. Otherwise it will remain an academic dream.
3. The policy of sustainable spatial development may help to mitigate the consequences of floods but only if it is consistently followed over a longer timeframe, for several decades. In the short term, classical flood prevention methods will tend to be more effective.

My realistic pessimism stems from a few observations.

1. When our ancestors, centuries ago, decided where to locate towns and villages, they were guided by criteria different from those applied today and they did not adhere to the principles of sustainable development. However, the consequences of their decisions are felt to this day. In historical towns, situated on rivers, floods have always occurred and have been the price of those historical decisions. Let me reinforce this. We are dealing with a paradox here. From a practical point of view, those historical planning decisions continue to have a greater impact today than the good intentions of present-day planners.

Wrocław, which like many European cities was founded more than a thousand years ago on an island, is a good example. On the one hand, the river has provided water, food, and military protection; on the other, it has put the city at a constant risk of flooding. Today, in a seminar setting, it is easy to say our ancestors made a mistake. In accordance with modern, environmentally sound, scientific principles of urban planning, Wrocław would probably not be granted permission for development on what is known as the Cathedral Island.

2. In countries that respect private ownership it is impossible to move an entire city to a different location or to shape it from a position of a central planner. It is impossible to halt the development of a city. It is impossible to effectively implement a policy of demolishing whole districts that are threatened by flooding. The European culture is not a nomad culture. In historical cities we are forced to coexist with rivers and with floods. The Yangtze dam project in China shows that it is possible over a ten-year period to physically destroy hundreds of towns and villages and displace the entire population using totalitarian methods, but that is not a good example for Europe. Today's presidents, governors, or prime ministers are not emperors, pharaohs, or dictators.

3. It is small wonder that the authorities usually choose classical flood prevention methods, oriented towards quick results. Physical planning plays only an auxiliary role in the context of such measures as it does not produce quick results and is extremely costly in urban conditions. Public authorities have at their disposal a limited set of measures with which to

prevent floods or mitigate the consequences of flooding in cities located on rivers. The authorities make decisions in real-life situations, under financial, social, and legal constraints. Any public authority (whether local, regional, or central) can at best strive to improve, in good faith, on the condition that already existed.

Sometimes the decisions made are far-sighted. I would like to cite an example of a good initiative which we must continue a hundred years later. Following a big flood that hit Wrocław in 1903, the Prussian government spent huge amounts of money to create flood defences for the city. The construction works continued until the mid-1920s. The system that had been built allowed to channel flows of the scale experienced in 1903, i.e. 2400 m^3/s. For several decades the people of Wrocław could forget what a flood was.

During the Thousand-Year Flood in 1997 it turned out, however, that the river could carry as much as 3600 m^3 of water per second. The public authorities have no choice: they must upgrade the old system of flood defences (see Appendix).

4. The adoption of the principles of sustainable spatial development will require time and money. Today we know much more about the adverse effects of human activities that were *bona fide* efforts to prevent floods. Bad river canalisation, instead of preventing floods increases the intensity of flooding. But we will need years to renaturalise rivers.

5. It is easier to talk about sustainable spatial development than to apply its principles in political practice. In Poland, despite a fair degree of understanding among specialists, no success has been achieved in implementing the concept of a "compact city" or preventing development on rural land, often in flood-prone areas. For economic reasons farmland owners as a group are not interested in any urban planning controls. Municipal authorities, even those that are highly conscious of the principles of sustainable development, are forced to issue building permits for projects to be constructed in areas that should never be built up.

This realistic assessment does not mean that we are doomed to defeat in the struggle to promote the ideas of sustainable spatial development.

1. Climate change forces us to co-operate at all levels: global, European, national, regional, and local. We are ever more conscious of the interconnections between various phenomena. We are not surprised that deforestation in one country increases the threat of flooding in another country. One of the forms of co-operation may be the coordination and standardisation of physical planning in flood-prone areas.

2. During the next 15-20 years the concept of sustainable spatial development will become obvious and is likely to be applied in practice. Space is becoming a scarce resource. Following the stage of setting common standards for the protection of nature and the environment against man's activities, there will probably come a phase of developing European urban planning standards.

3. It is possible, especially within the European Union, to develop common regulations aimed at protecting flood-prone areas against excessive and chaotic urban development. Flood prevention standards should be applicable at local and regional levels. Specialists usually see the problem of floods as a small part of the global issue of improving land use and universal adoption of urban planning. For tactical reasons, politicians should start from standards that are likely to gain political acceptance in national parliaments. Flood safety is an issue that has a strong appeal.

4. It will be much easier to implement development bans or restrictions than to undertake construction or rehabilitation projects.

5. We need to be patient. The policy of sustainable spatial development may be helpful in controlling floods and their impact but only if it is consistently followed over a longer timeframe, for several decades and across large geographical areas. I hope this is what is going to happen.

Thank you for your attention.

Appendix

Activities of the public authorities in Wrocław in the wake of the 1997 flood

The goal of designers and scientists is to prepare Wrocław for flows whose probability of occurrence in any given year is 0.1% (thousand-year flood), which for Wrocław is 3300 m^3/s.

So far the following measures have been undertaken:

1. Most hydroengineering facilities and levees of the River Odra have been upgraded, using up-to date methods, to increase their water-tightness. Wherever possible the height of the embankments has been increased and their tops have been adapted for use as recreational footpaths.
2. A network of flood emergency storage sites stocked with necessary supplies (300,000 sand bags) has been established.
3. Recreational hills have been built for sand storage (they hold about 20,000 cubic metres of soil).
4. Flood emergency plans have been prepared for different flood alert levels. The plans are updated annually.
5. The crisis management system has been changed.

The following measures are planned for the coming years:

1. Increase the capacity of the Odra's right-bank tributary, Widawa, to take over a part of the peak flows. It is proposed to modernize the embankments of the river, the bridges, and a canal between the Odra and the Widawa to enable the latter to take over 300 m^3/s of the Odra's waters.
2. Build a new polder, called "Kotowice", upstream of Wrocław with a maximum capacity of 41 million cubic metres. This would make it possible to reduce flows equal to or exceeding the thousand-year flow by 300 m^3/s.
3. Build a new one-kilometre-long flood-control levee protecting the housing district of Kozanów, one of the worst hit by the 1997 flood. At present preparations for the project are in progress.
4. Increase the capacity of the existing Odra channels and the Flood Canal by, among other things, modernizing the locks, as well as deepening and widening the river channels.
5. Purchase transportable flood defences that could be used to provide additional protection for the most valuable parts of the city, such as the Cathedral Island (the original seat of the Wrocław dukes).
6. Increase expenditure on the upkeep of the existing flood protections, including such simple but important measures as mowing the levees several times a year.
7. Construct water storage reservoirs on the upper Odra, the Nysa Kłodzka, and their tributaries. The most important of those is the Racibórz reservoir which has been in the pipeline for many years.
8. Build a network of radar stations forming an early warning system about existing threats. This project is the responsibility of the Institute of Meteorology and Water Management.

Maguelonne DÉJEANT-PONS, Chef de la Division de l'aménagement du territoire et du paysage, Conseil de l'Europe

A l'issue de cette Conférence internationale consacrée au thème des catastrophes naturelles et du développement territorial durable : la prévention des inondations, je souhaiterais remercier tout d'abord, bien vivement, au nom de tous les participants, M. Marciej Borsa, Directeur du Département pour la stratégie territoriale et régionale et représentant de la Pologne auprès du Comité des hauts fonctionnaires pour la Cemat, pour l'organisation parfaite de cette Conférence.

Je remercie également tout particulièrement les autorités de la ville de Wrocław et notamment M. Sławomir Najnigier, Maire adjoint de Wrocław, Ancien Président du Comité des régions inondées de Wrocław et ancien ministre responsable du développement urbain de la Pologne pour leur appui essentiel au déroulement des travaux.

La Conférence qui nous réunit aujourd'hui est la sixième d'une série de séminaires et de conférences qui se sont tenus pendant ces trois dernières années afin de préparer la prochaine Conférence européenne des ministres responsables de l'aménagement du territoire (Cemat). Chacun de ces séminaires ou conférences a tenté de préciser les dispositions des Principes directeurs pour le développement territorial durable du continent européen énoncés dans la Recommandation Rec (2002) 1 du Comité des Ministres du Conseil de l'Europe aux Etats membres afin d'examiner quels sont les meilleurs moyens de les mettre en œuvre.

Les Principes directeurs consacrent ainsi une section aux catastrophes naturelles. Le Principe directeur n° 10 traite de la « Limitation préventive des effets des catastrophes naturelles ». Il considère que

> les catastrophes naturelles telles que les tremblements de terre, les ouragans, les inondations, les avalanches, les incendies de forêts, les glissements de terrain, etc. sont la cause, chaque année en Europe, de dommages considérables avec de graves conséquences pour la vie et la santé des personnes, pour l'économie, pour les structures urbaines et pour les paysages.

Les Principes directeurs considèrent donc que

> des mesures préventives devraient être prises dans le cadre de l'aménagement du territoire visant à limiter l'ampleur des dommages et à rendre l'armature urbaine moins vulnérable.

Il est précisé que de telles mesures concernent, par exemple, l'affectation des sols et la construction.

La question des inondations est un thème grave également examiné au niveau mondial. Lors du Sommet mondial pour le développement durable (Johannesburg, 26 août-4 septembre 2002), l'Organisation météorologique mondiale (OMM) a relevé qu'en l'an 2002 plus de 17 millions de personnes avaient souffert des inondations dans plus de quatre-vingts pays. On a déploré près de trois mille victimes et des dégâts matériels de plus de trente milliards de dollars US. Au total plus de huit millions de km ont ainsi été ensevelis sous les eaux.

J'espère que les résultats de notre Conférence serviront à mieux appliquer les Principes directeurs. Un projet de résolution devant être soumis pour adoption à la 13e Session de la Cemat sur la présentation des inondations sera en effet préparé sur la base des travaux menés par l'Assemblée parlementaire et le Congrès des pouvoirs locaux et régionaux de l'Europe ainsi que sur la base des conclusions de cette Conférence. Les travaux de la Cemat tentent ainsi de mettre en œuvre la dimension territoriale du développement durable préconisé au niveau mondial dans le cadre des Conférences de Rio et de Johannesburg.

Je vous remercie à nouveau pour votre participation active aux discussions de cette Conférence.

CONCLUSIONS

Rapporteur

Dusan BLAGANJE
Council of Europe Expert / Expert du Conseil de l'Europe

The International Cemat Conference on "Natural Disasters and Sustainable Spatial Development: Prevention of Floods" was organised in co-operation with the Polish Government Centre for Strategic Studies and the City of Wrocław in the Old Town Hall of Wrocław on 30 June 2003 as the sixth in the series of events leading to the 13th Cemat session which will take place in Ljubljana, on 16-17 September 2003.

The aims of the Conference were to analyse the reasons for major disasters and the possibilities of the prevention of floods, to promote the implementation of the Recommendation of the Committee of Ministers of the Council of Europe Rec (2002) 1 on the Guiding Principles for Sustainable Spatial Development of the European Continent (GPSSDEC-Cemat) and Resolutions adopted at the 12th Cemat Session in Hanover in 2000, to assist the preparation of proposals for the 13th Cemat Session, to contribute to the implementation of actions identified in 2002 by the World Summit on Sustainable Development held in Johannesburg and to enhance the integrated approach of spatial development planning and good governance.

The Conference should lead to the adoption of a joint Cemat position on the prevention of floods in view of the implementation of the Cemat Guiding Principles for Sustainable Spatial Development of the European Continent (Recommendation Rec (2002) 1 of the Committee of Ministers of the Council of Europe).

Although the Conference did not leave the other natural disasters aside, it concentrated mainly on the problem of floods. Floods are a natural phenomenon imposing a risk to people which is greater in the areas where the flood zones are settled. They are rare events, limited to restricted areas, and this fact has often led to the loss of awareness of the risk and damage which they cause. But recent flood events have raised public and political awareness to the fact that Europe is exposed to floods as natural disasters, that there is no absolute safety from floods, and that technical measures, however sophisticated and extensive they might be, do not at all grant complete safety.

In history the rivers attracted human settlement, mainly as resources of water and food and as axes of transport. Therefore considerable cultural heritage is concentrated along the rivers which is particularly sensitive to floods and thus requires special protection. In the 19th century most large rivers of Europe and many smaller ones were channelized for gaining development land, flood protection, shipping and reduction of wetlands and diseases related to them. Extensive construction works of this kind were carried out throughout Europe until the 1990's and they have significantly reduced the natural river space and the areas for their harmless inundation in flooding conditions.

People have been building channels, dikes and dams and regulating the natural river flow to prevent floods, following a much too simple idea of washing the flood waves downstream from the protected areas as swiftly as possible. This in turn caused accelerated river flow and higher floods with much greater damages, particularly in the unprotected areas, both up- and downstream from such works. But still this led to the construction of even higher dikes and dams and not to sustainable river and flood risk management.

The main causes of floods are natural water cycle, hydrological regime, topographical and geological conditions influencing river morphology, nowadays possibly influenced by changes in meteorology due to global warming. Rivers are dynamic systems and above all they need sufficient space to flow away all the water they catch from their basins, not only in normal hydrological conditions, but at times of extreme precipitations as well, when the order of magnitude of their discharge multiplies.

La Conférence internationale Cemat ayant pour thème « Catastrophes naturelles et développement territorial durable : prévention des inondations » a été organisée en coopération avec le Centre d'études stratégiques du gouvernement polonais et la ville de Wrocław dans l'ancien hôtel de ville de Wrocław, le 30 juin 2003 ; elle était la sixième d'une série d'événements qui aboutiront à la 13e Session de la Cemat, prévue pour se tenir à Ljubljana les 16 et 17 septembre 2003.

La Conférence avait pour buts d'analyser les causes des grandes catastrophes et les possibilités de prévention des inondations, de promouvoir l'application, d'une part de la Recommandation Rec (2002) 1 du Comité des Ministres du Conseil de l'Europe sur les Principes directeurs pour le développement territorial durable du continent européen (PDDTDCE-Cemat), d'autre part des résolutions adoptées à la 12e Session de la Cemat, à Hanovre en 2000, de contribuer à la formation de propositions pour la 13è Session de la Cemat, de contribuer à la mise en œuvre des actions définies par le Sommet mondial pour le développement durable qui s'est tenu en 2002 à Johannesburg, ainsi que de mettre l'accent sur une approche intégrée de la planification du développement territorial et de la bonne gouvernance.

La Conférence devrait conduire à l'adoption d'une position commune de la Cemat sur la prévention des inondations, aux fins d'application des Principes directeurs de la Cemat pour le développement territorial durable du continent européen (Recommandation Rec (2002) 1 du Comité des Ministres du Conseil de l'Europe).

Sans laisser de côté les autres catastrophes naturelles, la Conférence s'est intéressée surtout au problème des inondations. Les inondations correspondent à un phénomène naturel dangereux pour les personnes et sensible surtout dans ce que l'on appelle les zones inondables. Ces événements rares sont limités à des périmètres bien circonscrits, ce qui fait souvent perdre de vue les risques qu'ils créent et les dégâts qu'ils provoquent. Mais les inondations récentes ont sensibilisé l'opinion publique au fait que l'Europe est exposée à des inondations qui sont des catastrophes naturelles, qu'il n'existe pas de sécurité absolue contre elles et que les précautions techniques – toutes vastes et perfectionnées qu'elles puissent être – n'offrent pas la garantie d'une totale sécurité.

Les hommes se sont toujours installés à proximité des fleuves et rivières, principalement pour les ressources en eau, la nourriture et le moyen de transport qu'ils y trouvaient. C'est pourquoi une partie considérable du patrimoine culturel est concentrée le long des cours d'eau, ce qui la rend vulnérable aux inondations et appelle donc sur elle une protection spéciale. Au dix-neuvième siècle, on a canalisé la plupart des fleuves d'Europe et de nombreuses rivières pour gagner des terres, se garantir des inondations, faciliter la navigation fluviale et réduire les zones humides à cause des maladies qui s'y contractaient. Ces vastes travaux d'aménagement, qui se sont poursuivis dans toute l'Europe jusqu'aux années quatre-vingt dix, ont considérablement réduit l'espace fluvial naturel et les zones soumises à des inondations occasionnelles sans conséquences.

On construisit des canaux, des digues et des barrages, et l'on régularisa le débit naturel des cours d'eau pour prévenir les inondations, selon l'idée beaucoup trop simpliste qu'il suffisait de chasser les vagues d'inondation en aval pour les écarter le plus vite possible des zones protégées. Ces aménagements provoquèrent une accélération des débits fluviaux et des inondations beaucoup plus fortes entraînant des dégâts bien plus importants, surtout dans les zones non protégées, tant en amont qu'en aval des ouvrages en question. Or, face à cela, on construisit des digues et barrages encore plus élevés, et l'on omit de gérer les risques fluviaux dans l'optique de la durabilité.

Les inondations tiennent principalement au cycle naturel de l'eau, au régime hydrologique et aux conditions topographiques et géologiques influençant la morphologie des cours d'eau ; peut-être aussi sont-elles liées de nos jours à des changements météorologiques dus au réchauffement de la planète. Les rivières sont des systèmes dynamiques, et surtout, elles ont besoin d'assez d'espace pour charrier au loin toutes les eaux qu'elles captent à partir de leur bassin, non seulement dans des conditions hydrologiques normales, mais aussi à des

moments de précipitations extrêmes, lorsque leur débit se multiplie.

Alluvial plains have primary importance in river management and flood prevention. They are large areas where permeability of soil and retaining capacity of land profile significantly reduce the height and velocity of flood waves. But at the same time, as various examples in Europe show, they are enabling economically sustainable forestry, pasturing, tourism and some other compatible activities.

Development has significantly reduced natural flood plains and on the other hand it has increased water run-off due to decreased permeability and water retention which enhances the flood risk. But local flooding can appear well before the peak flow of rivers are reached, due to inadequate drainage infrastructure. Increased run-off of surface water at times of the extensive precipitations further increase the peak flow of rivers which are rapidly flowing downstream, increasing flood risk at unprotected areas.

Flood risk is inevitable but it can be managed and reduced. It has been widely agreed that flood prevention requires integrated approach. In an integrated approach not only the areas directly affected by floods, but also the entire river basins must be considered.

River basin and flood risk management, and flood damage mitigation strategies must be based on serious scientific research. The properties of entire ecosystems of rivers, alluvial plains and the remaining river catchment areas must be analysed. The relations between the natural and man-caused processes in areas adjacent to the rivers, and the peripheral ones, those upstream and the ones downstream should be investigated in depth. And not least the knowledge of meteorological and climatic patterns must be studied in-depth. Scientific approach requires observation, quantification, forecasting and modelling, essentially on the basis of the natural science, which should be undertaken at an adequate scale. Important tasks are open in the field of information and data management. A standardised information system for these purposes is needed most of all.

As it is impossible to eliminate floods it is also impossible to fully avoid damages caused by them. Thus new approaches in river and flood risk management tend to allow more frequent flooding in the areas where they cause least damages. This is economically sustainable as it is less costly to pay occasional damages – predominantly on agricultural land or forest – than to invest into extensive water construction works or to cover much higher damages in the built environment.

This approach can be implemented either through the preservation and the enlargement of the existing natural water retention areas or through the restoration of natural river morphology and opening new retention areas. Both are ecologically sustainable. Rivers must get much larger space to expand, which can be achieved, through making the floodplains broader and if possible deeper. Working with and not against the natural processes should also include measures for the rehabilitation of the absorption capacity of the soil. But it should be remembered that such measures require a lot of time once they are agreed and adopted.

Spatial planning, including both of its more detailed executive components, i.e. landscape- and urban planning, has a crucial role in sustainable river basin management and flood prevention. The primary task of spatial planning is to direct human settlement and sensitive land uses away from natural retention areas and zones with enhanced flood risk, and thus prevent greatest damages when flood occurs. This strategy should be applied wherever it is possible through historic settlement patterns which could not be changed or improved with reasonable cost.

Les plaines alluviales présentent une importance primordiale pour la gestion des cours d'eau et la prévention des inondations. Ce sont de vastes zones où un sol perméable et une certaine configuration du terrain peuvent retenir l'eau, réduisant en grande partie la hauteur et la rapidité des vagues d'inondation. En outre, comme le montrent plusieurs exemples européens, ces plaines se prêtent à divers usages économiquement durables : exploitation forestière, pâturage, tourisme et autres activités.

Le développement a beaucoup réduit les plaines naturellement inondables, et il a accru le ruissellement à cause d'une diminution de leur perméabilité comme de leur capacité de rétention de l'eau, qui accroît les risques d'inondation. Mais des inondations locales peuvent apparaître bien avant que les cours d'eau ne soient en crue, à cause de l'insuffisance des infrastructures de drainage. L'augmentation du ruissellement des eaux de surface en cas de fortes précipitations ne fait qu'accroître le débit maximum des cours d'eau, qui s'écoulent rapidement, aggravant les risques d'inondation des zones non protégées.

Le risque d'inondation est inévitable, mais peut être géré et réduit. Chacun s'accorde à dire que la prévention des inondations doit passer par une approche intégrée dans le cadre de laquelle il faut tenir compte non seulement des zones directement affectées par les inondations, mais aussi de tout le bassin fluvial concerné.

La gestion des bassins fluviaux et des risques d'inondation, ainsi que les méthodes de réduction des dégâts causés par les inondations doivent reposer sur des recherches scientifiques sérieuses. Il faut analyser les propriétés d'écosystèmes entiers, avec leurs cours d'eau, leurs plaines alluviales et leurs bassins hydrographiques. Il faut aussi examiner d'une manière approfondie les relations entre processus naturels et processus dus à l'action humaine dans les zones avoisinantes des cours d'eau ou périphériques à ceux-ci, en amont comme en aval. Non moins nécessaire, enfin, est l'étude attentive des problèmes météorologiques et climatiques. L'approche scientifique passe par l'observation, la quantification, la prévision et la modélisation, principalement sur la base des sciences naturelles et à une échelle appropriée. Des tâches importantes sont à accomplir dans le domaine de l'information et de la gestion des données. Ce qui s'impose le plus à ces fins, c'est un système d'information normalisé.

De même qu'on ne peut éliminer les inondations, il est impossible d'éviter tous les dégâts qu'elles causent. C'est pourquoi les nouvelles approches de la gestion des cours d'eau et des risques d'inondation tendent à laisser se produire des inondations plus fréquentes dans les zones où celles-ci causent le moins de dégâts. C'est économiquement soutenable, car cela coûte moins cher de payer pour des dégâts occasionnels, surtout ceux subis par les terres agricoles ou les zones forestières, que d'investir dans de vastes ouvrages ou d'avoir à supporter les conséquences financières des dégâts causés au cadre bâti.

On peut adopter cette approche soit en préservant et en élargissant les zones existantes de rétention naturelle des eaux, soit en restaurant la morphologie naturelle des cours d'eau et en créant de nouvelles zones de rétention. Ces deux démarches sont écologiquement viables. Les cours d'eau doivent disposer d'un espace bien plus vaste pour s'épandre, ce qui peut s'obtenir par un élargissement et, si possible, un abaissement du niveau des plaines inondables. Si l'on veut œuvrer avec et non pas contre les processus naturels, il faudra prendre des mesures pour restaurer la capacité d'absorption des sols. Mais on ne devra pas perdre de vue que ces mesures exigent beaucoup de temps une fois définies et adoptées.

L'aménagement du territoire – y compris ses deux composantes spécialisées que sont la gestion des paysages et l'urbanisme – joue un rôle crucial dans la gestion durable des bassins fluviaux et la prévention des inondations. Sa fonction essentielle est d'éloigner les établissements humains et les utilisations sensibles des sols des zones de rétention naturelle des eaux et des secteurs où existent des risques d'inondation accrus, empêchant ainsi des dommages plus grands lorsqu'une inondation se produit. Cette stratégie doit s'appliquer chaque fois que cela est possible dans les zones de peuplement historique qui ne peuvent être modifiées ou améliorées moyennant un coût raisonnable.

Landscape planning should allow for preservation and restoration of natural river beds and water retention areas – wet and dry. It should also prevent the reduction of water absorption capacity throughout river catchments, regardless of whether it is caused by human activity or through natural change, for example by the use of sustainable drainage systems that control water as near to its source as possible. Urban planning should allow for sufficient space for rivers in the cities, enabling the compensation of flood waves in enlarged river beds, and should provide safe design of coastlines in the cities at the seaside. The priority for urban development should be given to areas with the least risk. These too are not short-term measures and therefore other actions are equally important.

It has been suggested that development proposals should be accompanied by a flood-risk and drainage assessment, appropriate to the scale and nature of the development and the risks involved. The largely uncertain and possibly increasing flood risk requires a precautionary approach. The principles of sustainable development require that flood risk be avoided where possible and managed elsewhere.

The role of environmental-, planning-, water- and construction law cannot be overestimated. It must provide legal instruments at European, national, regional and local level which will facilitate the management of natural disasters and effectively enforce the agreed and adopted measures. The sustainability of spatial development cannot be achieved without mitigation and management of risk, caused by floods and other natural disasters.

The regional and local authorities have a crucial role and primary responsibility for flood management and spatial planning policy within their areas and the respective planning authorities under assistance from central governments should steer the development in such a way that the risk in areas vulnerable to flooding will be reduced.

That does not mean that we should stop all development on flood plains. This would be an unrealistic aspiration and unsustainable in every aspect too. Equally unrealistic would be the expectations that we could relocate flood-endangered development. Too much has been already constructed there and lot of it is reasonably flood-protected. But wherever new development, or redevelopment is to take place in areas of high risk, it should be managed appropriately, which should not only be the case for flood protection but as well for prevention of hazards caused by other natural disasters, particularly earthquakes, eruptions, landslides, avalanches and fires.

River basins and floods, when they happen, extend beyond any administrative borders. Flood prevention and protection thus require interregional, transborder and international co-operation in order to be efficient and sustainable. The recent floods in Europe have broadened this awareness under which new structures of successful co-operations have been set up, noting that some of them already existed before.

The major issues of European co-operation in the field of flood prevention and protection are the questions of solidarity and sustainability which cannot be separated. Solidarity of people in the river basin means that everybody must be aware that one's flood protection should not be at the expense of the other's flood risk. Sustainability of flood protection should not at all be seen only in terms of environmental sustainability. More than in many other instances it has stressed components of social and economic sustainability due to the fact that it is very expensive and not easily a win-win activity with all benefits for everybody and no cost for anybody.

La gestion des paysages doit faire une place à la préservation et à la restauration du lit naturel des rivières comme des zones de rétention de l'eau, humides ou non. Il faut aussi qu'elle empêche la réduction de la capacité d'absorption de l'eau dans la totalité des bassins fluviaux, que cette réduction soit due à l'activité humaine ou à une évolution naturelle, par exemple en recourant à des systèmes de drainage durables permettant de régulariser le débit des rivières au plus près possible de leur source. L'urbanisme doit laisser à celles-ci assez d'espace à l'intérieur des villes, en permettant à leurs eaux en crue de s'écouler dans un lit élargi, et il doit offrir une ligne de côte sûre aux villes du littoral. Enfin, il lui faut accorder la priorité aux zones de moindre risque. Ces mesures ne sont pas à court terme, elles non plus, et doivent donc aller de pair avec d'autres actions également importantes.

On a laissé entendre que les propositions d'aménagement devaient s'accompagner d'une évaluation des risques d'inondation et des possibilités de drainage qui corresponde à l'ampleur et à la nature des aménagements envisagés, ainsi qu'aux risques inhérents à ceux-ci. Le risque d'inondation, qui est très incertain et peut s'accroître, demande à être abordé avec le souci de prendre des précautions. Les principes du développement durable imposent d'éviter autant que possible les risques d'inondation et de gérer ceux-ci ailleurs.

On ne saurait trop insister sur le rôle joué par le droit relatif à l'environnement, à l'aménagement du territoire, à l'eau et au bâtiment. Il doit fournir aux niveaux européen, national, régional et local les instruments juridiques qui faciliteront la gestion des catastrophes naturelles et permettront de prendre effectivement les mesures élaborées et adoptées. La durabilité du développement territorial ne saurait être assurée sans une réduction et une gestion des risques causés par les inondations et autres catastrophes naturelles.

Les autorités régionales et locales ont, sur place, un rôle crucial à jouer et une responsabilité primordiale à assumer dans la politique de gestion des inondations et d'aménagement du territoire, et les autorités compétentes – appuyées par l'Etat central – doivent diriger le développement de manière à réduire les risques dans les zones exposées aux inondations.

Cela ne signifie pas que nous devions mettre fin à tout aménagement dans les plaines inondables. Ce serait là une politique irréaliste et insoutenable à tous égards. Egalement irréaliste serait l'idée de délocaliser des constructions menacées par les inondations. On a déjà trop construit dans ces endroits, et une grande partie des bâtiments y sont assez bien protégés contre les inondations. Mais chaque fois que des opérations de construction ou de reconstruction sont engagées dans des zones à haut risque, il faut les gérer de façon appropriée, ce qui devrait être le cas non seulement pour la protection contre les inondations, mais aussi pour la prévention des dangers inhérents à d'autres catastrophes naturelles, notamment les tremblements de terre, les éruptions volcaniques, les glissements de terrain, les avalanches et les incendies de forêts.

Les bassins fluviaux et les crues – lorsqu'elles se produisent – font fi des frontières administratives. Pour être efficaces et durables, la prévention des inondations et la protection contre elles exigent donc une coopération interrégionale, transfrontalière et internationale. Les inondations qui se sont produites récemment en Europe ont accentué une certaine prise de conscience de ce fait, grâce à quoi de nouvelles structures de coopération ont été mises en place avec succès, quand bien même d'autres existaient déjà.

Les principaux aspects de la coopération européenne dans le domaine de la prévention des inondations et de la protection contre elles sont la solidarité et la durabilité, qu'on ne saurait séparer l'une de l'autre. En vertu de la solidarité entre habitants d'un même bassin fluvial, chacun doit être conscient que sa propre protection contre les inondations ne saurait être assurée au prix d'une négligence des risques d'autrui. Quant à la durabilité de la protection contre les inondations, elle ne peut en aucun cas se percevoir seulement en termes de durabilité environnementale. Plus que dans bien d'autres cas, en effet, la durabilité a manifestement ici des composantes sociales et économiques dues à ce qu'on est en présence d'une activité très coûteuse, à l'issue de laquelle chacun n'est pas forcément gagnant sur toute la ligne.

But there is another, extremely important aspect of solidarity and social sustainability of flood protection and particularly of flood damage relief, which must absolutely not be left out of sight – what could quite easily happen in the conditions of strongly expressed paradigm of ecological sustainability. The damages suffered by the less developed regions of Europe and the poorer inhabitants of our Continent when struck by floods, are much more difficult to mend than in the developed parts, due to lack of financial, material and human resources. Natural disasters in such areas as a rule increase, not decrease the development disparities. In such cases the solidarity of the well off Europeans with their less fortunate fellows is crucial. The social aspect should therefore be at the forefront of integral flood management, along with the primary concern of protecting human lives.

From various points of view – the social one not excluded – considerable attention in the flood management should be given to the basins of border rivers, particularly those connecting regions with considerable development imbalances, whereby three types of European borders should be specially mentioned: the outer borders of the peripheral member states of the Council of Europe, the new outer borders of the enlarged European Union and the borders between the old and the new members of the European Union.

The Wrocław Conference called for a consistent pan-European action in the field of integrated flood management. Because of the role of spatial development policy in this respect, Cemat is the most appropriate framework to set up such action. Therefore the Ministers at their 13th Session should consider taking the appropriate initiative.

Mais la solidarité et la durabilité sociale qui doivent caractériser la protection contre les inondations, en particulier l'aide aux sinistrés, présentent un autre aspect, qui est des plus importants et qu'il est interdit de perdre de vue, ce qui pourrait aisément se produire dans la mesure où l'on insiste tant par ailleurs sur le paradigme de durabilité écologique. Les dégâts que subissent en cas d'inondation les régions peu développées et les habitants pauvres d'Europe sont beaucoup plus difficiles à réparer que dans les parties développées de notre continent, à cause de la pénurie locale de ressources humaines, financières et matérielles. Les catastrophes naturelles qui affectent ces régions accroissent généralement les disparités en matière de développement, et dans de tels cas, il est crucial que les Européens les mieux lotis se montrent solidaires des plus mal lotis. L'aspect social des choses doit donc figurer en première ligne dans la gestion intégrale des inondations, au même titre que le souci majeur de préserver des vies humaines.

A plusieurs points de vue, dont le point de vue social n'est pas exclu, il faut prêter une grande attention – dans la gestion des inondations – aux bassins des cours d'eau frontaliers, notamment ceux qui relient des régions entre lesquelles existe un déséquilibre considérable en matière de développement ; on mentionnera à cet égard trois types de frontières européennes : les frontières extérieures des Etats membres périphériques du Conseil de l'Europe, les nouvelles frontières extérieures de l'Union européenne élargie et les frontières entre anciens et nouveaux Etats membres de l'Union européenne.

La Conférence de Wrocław a préconisé une action paneuropéenne cohérente pour la gestion intégrée des inondations. Or, compte tenu du rôle que joue à cet égard la politique de développement territorial, la Cemat est le cadre qui se prête le mieux au lancement d'une telle action. C'est pourquoi les ministres devraient envisager à leur 13e Session de prendre une initiative appropriée.

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