POLICY BRIEFING

Living with floods: Achieving ecologically sustainable flood management in Europe

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Morava river near confluence with Danube river
Credit: Daphne Institute for Applied Ecology, Slovakia

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Floods in Europe: Setting the scene – Why this paper?

During the last ten years or so, many European countries have repeatedly suffered tragic loss of life and massive economic damage due to catastrophic flooding. In 2003, floods occurred in Southern France in the Rhone and Loire rivers. In August 2002, scenes of devastated cities, towns and villages in Austria, the Czech Republic, Germany and Russia were flashed around the world, with economic costs estimated in the hundreds of billions of Euro (3,5). Almost immediately, questions began to be asked. Why has this happened? What can be done to prevent such losses occurring repeatedly in the future? Coming just five years after the floods that wrought havoc across Central Europe in the summer of 1997, and less than a decade since dramatic floods along the lower and middle courses of the river Rhine, many people were also asking why such events seem to be happening more often and causing more damage than in the past.

A deadly cocktail

The answers to the question 'why?' are quite clear. The floods of recent years have become disasters because of human mismanagement of rivers, their floodplains and catchments. Virtually throughout Europe, river courses have been straightened – often to assist navigation – and constricted into artificially narrow channels by the construction of dikes to enable former floodplains to be used for farming, urban development and transport links (see Annex I for more detail). The result of all this straightening and narrowing is that rivers are flowing faster and over a much smaller area than they would under natural conditions. Floodwaters have nowhere to go, since the floodplains that would normally store the excess flow quite safely have been cut off from their rivers. Inevitably, even though dikes are built higher and higher and constantly reinforced – at a massive economic cost – the waters will continue to break through, catastrophically reclaiming their original course.

At the same time, land-use practices in many river basins (or catchments) are increasing the threat of flooding downstream. The way in which land is farmed or developed can have a dramatic impact on the amount and speed of surface water entering streams and rivers. Overgrazing, land compaction, deforestation and an increase in the area of impermeable surface, such as tarmac and concrete, can all dramatically increase the flood risk (see Annex I for more detail). Throw in the predicted greater regularity of extreme weather events in Europe as a consequence of climate change, and you have a deadly cocktail set to bring further human suffering and financial loss to millions of people and companies and across the region.

Rivers – The dynamic lifeblood of Europe

Rivers have always played a vital role in European civilisation and development. They provide water for drinking, farming, and industry; yield rich fish harvests; act as transport corridors; and have thus supported the growth of most of Europe's major cities – among them Budapest, London, Paris and Vienna. A river is also a dynamic ecosystem that constantly changes – from source to sea, from season to season – with characteristics that are influenced by a wide range of natural factors, including local climate and geology.

Rivers shape the land they flow through, but are also products of the land, taking with them the sediment and dissolved substances that enter watercourses. Land and water are ecologically linked in a natural system known as a river basin (often also called a catchment or watershed). This is a complex system including the river course, its network of tributaries, wetlands and groundwater, together with all the land that they drain. The floodplains and wetlands within a river basin

are particularly important in maintaining its proper functioning – the natural water cycle – and hold the key to reducing the impacts of flooding on human life and property. These places are also among Europe's most productive wildlife habitats.

Flooding: A natural phenomenon

Floods occur naturally every year, usually in winter or spring, but sometimes also in autumn, depending on the hydrological regime governing a given river (e.g. Alpine, Mediterranean, Atlantic). Frequency also depends on the amount of rain, especially when the soil is already wet and cannot store any more moisture. When special conditions are met, which, according to statistics, happens every 50, 100, 200 or 500 years, floods can be of exceptional height and have thus catastrophic effects on riverine inhabitants and their properties, especially when they/these are too close to the river and/or on its floodplain.

Floods play an important ecological role and this is crucial for society. They sustain and renew ecological functions that are important for our economy (*see also below*). In linking the river and its floodplains, the floodwaters transport nutrients, organisms and genes that are important for fish fauna and waterfowl populations (food supply); biodiversity (genetic exchange); agriculture – since land is fertilised regularly and free of charge; and sediments – helping to compensate for loss of land elsewhere due to coastal erosion. Floods are also crucial for the replenishment of groundwater from which we obtain drinking water. In addition, water purification takes place when floodplains are inundated because biochemical processes 'filter' water, recycle nutrients, transform organic pollutants and fix inorganic ones. Furthermore, floods regenerate habitats through changes in water levels and physical force, which together cause erosion and deposition of river-bank sediments, islands and softwood forests, resulting in a mosaic of biotopes supporting high biodiversity. All these functions have positive socio-economic impacts, including support for fisheries, 'free' fertilisation of land, groundwater recharge, and others (*see also below*).

Floodplain loss – The squandering of a precious asset

Floodplains – the low-lying areas of land adjacent to rivers, lakes and coasts that are periodically inundated with water – are among the most valuable, but also the most degraded, ecosystems in Europe. The wetlands that occur in these areas, such as marshes, wet meadows and seasonally flooded forests, are exceptionally productive and of great ecological and socio-economic importance.

Since the arrival of the first inhabitants, floodplains have been used for fishing, hunting, supplying drinking water and harvesting. However, as technology has advanced, they have been progressively cut off from the rivers themselves, as part of well-intentioned efforts to boost agricultural production, to increase the area of easily developed flat land, to promote river transport and to increase energy production (*see Annex I for more detail*). Reduction of flooding and the eradication of malaria have also been important driving forces of historical floodplain loss in many parts of the region. Whatever the underlying causes, only a fraction of Europe's floodplains continue to fulfil their natural functions. For example, studies conducted by WWF show that more than 80% of the original floodplain along the Danube river and 90% of the Rhine have been destroyed.

During the last twenty years, however, it has been realised that naturally functioning floodplains provide an astonishing array of environmental and socio-economic services[1]

[1] For a overview of the economic values of wetlands world-wide please see: WWF Living Waters Programme; 2004; *The Economic Values of the World's Wetlands*, available at http://www.panda.org/downloads/freshwater/wetlandsbrochurefinal.pdf

completely free of charge (see below), including floodwater storage and mitigation of floodpeaks. Surges of floodwater spread out over a floodplain, which acts as a natural storage reservoir, releasing the water slowly afterwards.

In addition to flood control, the other 'free' floodplain services include[2]:

- Nutrient retention – when water slows down as it spreads across a floodplain, its sediment load settles out, providing the natural fertiliser that has benefited farmers for millennia. Nowadays, however, many European rivers contain unnaturally high levels of nutrients due, for example, to the runoff of chemical fertilisers from farmland. Where floodplains still function normally, the deposition of sediment onto the floodplain and riverbanks removes some of the nutrients from the river. Consequently, wetland vegetation converts most of the deposited nutrient load into lush new growth. This helps maintain river water quality and prevents the build-up of pollution from substances such as nitrates and phosphates. Importantly, the nutrients contribute to the lower end of the food chain. This can bring benefits to the organisms that rely on bank-side vegetation.

- Rich biodiversity – floodplains provide important habitats for a wide range of fauna and flora, including many rare and endangered species. They are spawning grounds for fish and act as important migration corridors, especially for water birds.

- Support for sustainable agriculture, forestry and fisheries – the high productivity of floodplains and their wetlands provides many opportunities for sustainable agriculture and use of natural resources.

- Groundwater recharge – when a floodplain is still connected to its river, the periodic covering of land by floodwater enables aquifers to be replenished, thereby helping to secure supplies of water for human use.

- Recreation and tourism – the natural diversity and beauty of functioning floodplains can be a valuable socio-economic asset, offering many opportunities for the development of sustainable tourism and recreation, including hiking, camping, home-stays, cycling, fishing, birdwatching, swimming and painting.

A better future?

Floods are among the events widely regarded by people as 'natural hazards'. They are a part of nature; they have always existed and will continue to exist. However, in nature, floods are less about 'threat', 'hazard' and 'damage' and more about periodic renewal of vital ecological processes. These should be taken in consideration when humans develop flood management strategies aimed at preventing or limiting the detrimental effects of floods on their lives and property.

Nevertheless, human interference with natural processes has led to radical alteration of river basins and exacerbation of flood risks and damage to property and livelihoods. As a result, severe flood events in Europe have worsened in recent years, and the traditional response to this flooding – building higher and higher flood 'defences' such as dikes – has only seen flood waters getting deeper and more and more constrained, further increasing their destructive potential. Now is the time for constructive scrutiny of our past actions and of the current situation across Europe and. Governments and other decision-makers must begin to work with nature and not against it.

[2] Jones, T.; 2000; WWF Life Environment Project. *Wise Use of Floodplains: Policy and Economic Analysis of Floodplain Restoration in Europe-Opportunities and Obstacle* available at http://www.floodplains.org.uk/pdf/other_reports/Policy%20and%20Economic%20Analysis%20-%20Tim%20Jones.pdf

There is a compelling case to be made that the only sustainable way forward – both economically and ecologically – is to restore natural flood management systems by reconnecting rivers with their floodplains. This is an easy solution at face value, but there are huge pressures for maintaining the status quo. These range from policy instruments, such as the European Union (EU) Common Agricultural Policy that encourages intensive farming of floodplains, to the substantial short-term profits available from developing land for industry or housing. With enlargement of the EU, there have come pressures for a new wave of major transport development schemes seeking to use floodplains because of the relatively low costs of building in flat, open areas.

At the same time, there have been attempts made, most notably by river Commissions[3], to draw up and implement plans to manage rivers and floods in an integrated manner. However, these good examples do not seem to have been widely used elsewhere. Now, the EU Water Framework Directive (WFD), adopted in 2000, sets the scene – across the EU and beyond – for a completely new approach to managing water, based on integrated river basin management (*see Chapters 3 and 4*) as a tool for achieving "good ecological and chemical status". Though not specifically drawn up as a mechanism to tackle flooding, by promoting a river basin approach and requiring public participation and full stakeholder consultation, the WFD offers unprecedented opportunities. Full implementation of the WFD should, in particular, take into account the vital role of floodplains and other wetland areas in ecologically sustainable flood management. In this sense, the WFD offers opportunities for enhancing safeguards for populated areas, which Member States, public authorities and other stakeholders cannot afford to miss.

[3] The Rhine agreement to manage floods at trans-national scale dates back 1982. The Integrated Rhine programme of the Land Baden-Wurtemberg dates back to 1988 and incorporates integration of flood retention areas, restoration of floodplains and enhancement of biodiversity. The Loire Integrated Programme also pre-dates the EU's Water Framework Directive.

Aims and structure of this paper

This paper aims to demonstrate that:

1) Nature has a valuable role to play in flood management via, for example, the functions carried out by wetlands and floodplains in the hydrological cycle at the river basin level. The paper calls this 'ecologically sustainable flood management'. However, that this role has been largely disregarded by public authorities in their flood management policies and strategies. Furthermore, that in many cases, the destruction of nature and changes in land-use patterns have contributed to a dramatic worsening of the extent and impacts of flooding, as seen recently in Europe.

2) Water and water-related policy tools to develop such a new 'ecologically sustainable' approach to flood management in Europe already exist. That the main policy tool is Integrated River Basin Management (IRBM), as introduced by the EU Water Framework Directive (WFD), which requires the development of River Basin Management Plans (RBMPs) for delivering 'good ecological and chemical status'. That the European Commission and Member States should focus on preparing these RBMPs and work towards enhancing the opportunities they offer for 'ecologically sustainable flood management', which can best be achieved by integrating additional flood management measures into them. Thus, that there is no need to develop parallel planning processes and/or additional laws to deal specifically with flooding.

3) EU financial mechanisms, such as the Common Agricultural and Regional/Cohesion Funds, can work to the

benefit of ecologically sustainable flood management if they are further integrated and aligned with the WFD.

The paper briefly explores the trends and impacts of floods in Europe in the recent past, and tries to quantify their direct and indirect (longer term) impacts. It then highlights some of the root causes for such events by analysing factors such as changes in land-use patterns, river regulation and the effects of climate change. A third section is dedicated to explaining IRBM and the benefits it brings to flood management. European case studies of ecologically sustainable flood management in the context of IRBM are also included in this section.

Subsequent chapters focus on the EU policy and funding tools that WWF argues are already available for supporting a shift from discredited 'traditional' flood management to a new approach that works with nature to prevent severe flooding, such as occurred across central Europe in the summer of 2002.

Each chapter contains a 'Conclusions' section summarising its main points. **An overview of the policy recommendations for 'ecologically sustainable flood management' that can be extracted from the paper is given in the final chapter.**

WWF is well aware of the need to consider other aspects of flood-damage prevention, protection and mitigation when devising flood management policies/strategies. These include, among others, risk analysis, risk-zone mapping, emergency planning for rescue and relief, and communicating flood risk information to human populations. We are also aware that these aspects have to be developed as part of an interactive process with the strictly 'water management' components of flood prevention, protection and mitigation.

Similarly, WWF does not underestimate the often devastating social impacts of flooding or the urgent need for better means of describing, assessing and promoting the economic values of ecologically sustainable flood management over hard engineering.

Nevertheless, this paper concentrates mostly on the ecological dimension of sustainable flood management, in particular on water retention and other non-structural measures. In this context, it highlights the existing policy and funding opportunities within the EU that can be used to support such an approach across Europe.

WWF offers this paper as a contribution to the current EU-wide debate on policy and legislation concerning flood-damage prevention, protection and mitigation.

1. Floods in Europe: Trends and impacts

Flooding is the leading cause of damage to people and the environment due to natural hazards. Globally, flood damage has been particularly severe in recent years and it is evident that both the frequency and intensity of floods are increasing[4].

A ten-year comparative study of the world's great flood disasters from 1950 to 1998, showed that the number of flood events increased nearly threefold. During the period 1950 to 1979, only 7-9 major flood events took place per decade. However, between 1980 and 1989, and from 1990 to 1998, 20 and 34 major flood disasters occurred, respectively[5]. This greater frequency has been matched by an increase in the severity of flood impacts, both in Europe and globally.

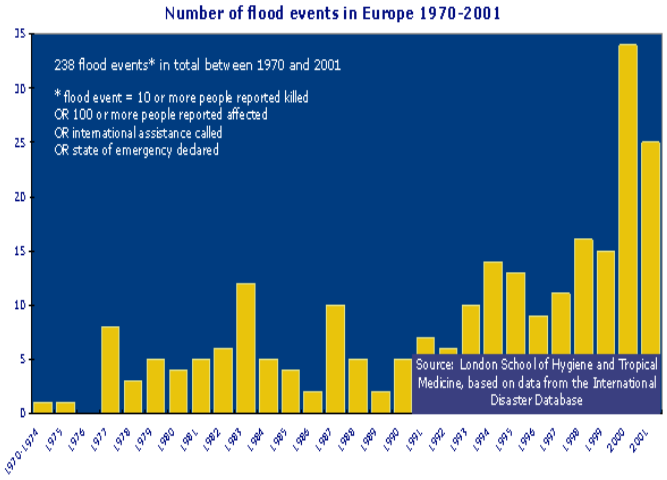
The International Disaster Database (see graphic below) recorded 238 flood events in Europe between 1975 and 2001, with the largest concentration in the last decade. As discussed in Chapter 2 of this paper, the direct effects of human interventions in river basins (e.g. floodplain destruction) together with the indirect consequences of global warming have been largely responsible for this increase.

Any attempt to assess the human, economic, environmental and cultural losses due to flooding can never come up with wholly accurate figures. This Chapter provides an outline based on official statistics, which, though providing only a partial view of the true consequences of floods, demonstrates the gravity of the changes to rivers and floodplains brought about by our own actions.

[4] Loster, T.; 1999; *Flood Trends and Global Change*. Geoscience Research Group, Munich Reinsurance Company. http://www.iiasa.ac.at/Research/RMS/june99/papers/loster.pdf

[5] Loster, T.; 1999; *Flood Trends and Global Change*. Geoscience Research Group, Munich Reinsurance Company. http://www.iiasa.ac.at/Research/RMS/june99/papers/loster.pdf

Graph 1- Overview of flood events in Europe 1970 – 2001[6]



1.1- Impacts of floods

In general, the deeper the water and the faster the flow the greater the damage caused by a flood. The speed at flood onset and the duration of a flooding event are critically important factors. Flood damage is often greatest along river tributaries, where small streams can become raging torrents in a very short time[7]. For example, in the case of the 2002 flooding of the Elbe, only a small proportion of losses were actually incurred in the main river valley itself.

The consequences of flooding can be divided into direct and indirect losses. The former can be defined as losses occurring during or immediately after the flood event, such as loss of life and damage to property. The latter may include disruption to transport and trade, environmental damage, greater vulnerability of certain areas to the next flood event, and reduced public confidence[8]. Direct losses have traditionally received more attention

[6] World Health Organisation (WHO) information sources: http://www.euro.who.int/eprise/main/WHO/Progs/CASH/Extreme/20020610_1

[7] Munchener Ruck, Munich Re Group; Annual Review (2003): *Natural Catastrophes 2002*. http://www.munichre.com/pdf/topics_2002_e.pdf

[8] Estrela,T; Menendez, M; Dimas, M. et al.; 2001; *Sustainable Water Use in Europe: Part 3 Extreme Hydrological Events Floods and Droughts,* Environmental issue report No 21, European Environment Agency.

because they are easier to quantify. Indeed, existing databases provide information mainly on the locations and dates of floods, the number of people killed or injured and the estimated economic costs. However, it is also important to highlight indirect losses, as these usually have longer-term consequences of considerable extent; for example, pollution of the environment.

1.1.1- Direct losses

Loss of human life

The most tragic and sudden impact of flooding is always the loss of human lives and homes. Clearly, such losses cannot be expressed in purely monetary terms. The World Health Organisation (WHO) provides information on direct flood impacts on human life and health. During the ten-year period 1990-2000, about 2,000 people died as a result of floods worldwide and some 400,000 became homeless. From January to July 2002, Europe suffered eight major flood events resulting in 93 deaths, with 336,000 people affected (note: these figure exclude the floods of August 2002). WHO figures indicate that during the catastrophic floods of August and September 2002, more than 100 people were killed in nine countries (Albania, Austria, the Czech Republic, France, Germany, Romania, the Russian Federation, Switzerland and Tajikistan)[9]. The table in section 2.2 summarises some of these events.

Economic losses

The most immediate and evident effect of flooding is damage to public infrastructure such as roads, electricity and energy supply systems, buildings, industrial facilities and private properties. Everything damaged is evaluated in economic terms and reported by national governments. Considering the economic costs, natural catastrophes have a direct impact on production potential and on gross domestic product (GDP). For example, GDP in Germany declined in 2002 on account of floods by a little less than €1 billion and, for 2003-2004, the investments in repairs and reconstruction as result of flooding will far exceed € 10 billion[10].

The European Environment Agency has reported the direct losses from significant flood events in Europe (France, Italy, The Netherlands, Romania, and United Kingdom) between 1992 and 1998 at 877 lives and more than €19 billion[11].

The August 2002 floods perhaps provide the clearest example of direct flood impacts. Across Europe, various information resources indicated that floods in Austria, the Czech Republic, Germany, Hungary and the Russian Federation caused massive damage to roads, railways, electricity and water supplies and sewage disposal systems. Extensive infrastructure losses included approximately 740 km of streets that were destroyed and 180 bridges and 94 railway bridges that needed to be re-built. The floods of 2002 were also unprecedented because they wrecked many centuries-old historical and cultural buildings. Prague faced its worst ever flooding, which considerably affected the historical centre with a number of museums, theatres, galleries and medieval quarters[12] flooded out.

According to the *Munich Re*, the floods of 2002 in Europe were among the top ten natural disasters in the world in terms of economic and insurance losses. Total economic losses across the affected region were estimated at € 15.2 billion, while insured losses were € 3.1 billion. In spite of the magnitude of the sums involved, this is in one sense also a typical

[9] WHO information sources: http://www.euro.who.int/eprise/main/WHO/Progs/CASH/Extreme/20020610_1

[10] Loster, T.; 1999; *Flood Trends and Global Change*. Geoscience Research Group, Munich Reinsurance Company. http://www.iiasa.ac.at/Research/RMS/june99/papers/loster.pdf

[11] World Health Organisation (WHO) information sources: http://www.euro.who.int/eprise/main/WHO/Progs/CASH/Extreme/20020610_1

[12] World Health Organisation, Europe; September 2002; *Flooding: Health Effects and Preventative Measures*. Copenhagen and Rome. http://www.who.dk/document/mediacentre/fs0502e.pdf

example, in that the proportion of flood losses insured is usually relatively low[13].

Table 1- Estimated economic costs in countries most affected by floods in summer 2002[14]

Costs of floods in 2002 (in Euro)	Economic	Insured
Germany	€ 9.2 billion	€ 1.8 billion
Czech Republic	€ 3.0 billion	€ 0.9 billion
Austria	€ 3.0 billion	€ 0.4 billion

The direct economic costs noted above will also leave their mark on the affected countries' economies for some time to come. This is particularly relevant for new EU Member States and EU Accession Countries (prospective Member States) whose economies are still in some form of transition after decades of communism.

1.1.2- Indirect (longer term) impacts

Besides the immediate, direct effects of floods such as loss of life, livelihoods, property and infrastructure, much greater attention needs to be paid to the indirect effects that are traditionally underestimated when assessing the consequences of flooding. People may suffer both physically and psychologically, while wider environmental effects may include pollution. A recent report on flood risks issued by the UK Office of Science and Technology[15] and considered probably the most comprehensive study of its kind anywhere in the world, confirms that the human cost of flooding cannot be measured by statistics alone. However, the consequences are often significant and long lasting. Dealing with them may require substantial financial resources[16].

The most obvious negative environmental impact of flooding is pollution of soil and water – especially from sewage, given the very specific vulnerability the physical infrastructure necessary for sanitation. In flood-prone areas, preventive measures should be taken to reduce possible adverse effects of floods on aquatic and terrestrial ecosystems, i.e. minimising diffuse pollution from surface-water runoff, minimising the amount of surface water runoff and infiltration entering foul and surface water sewerage systems, and maintaining recharge to groundwater (subject to minimising the risk of pollution to groundwater)[17].

Pollution during flooding incidents can also result from spillage of stock-piled goods in industrial areas; from oil and other hazardous products stored in residential areas; from agricultural pesticides and fertilisers; and from acid water and heavy metals when mining waste dams fail. The best precautionary measure is either to store hazardous substances outside areas at risk of flooding, or to elevate storage areas[18].

Recent flooding in Central and Eastern Europe demonstrated vividly how direct damage to industrial and urban infrastructure, including sewage and wastewater systems, had indirect

[13] Loster, T.; 1999; *Flood Trends and Global Change*. Geoscience Research Group, Munich Reinsurance Company. http://www.iiasa.ac.at/Research/RMS/june99/papers/loster.pdf

[14] Munchener Ruck, Munich Re Group; Annual Review (2003): *Natural Catastrophes 2002*. http://www.munichre.com/pdf/topics_2002_e.pdf

[15] Guardian Unlimited; April 22nd, 2004; *Global warming floods threaten 4m Britons*. http://www.guardian.co.uk/climatechange/0,12374,782494,00.html

[16] Loster, T.; 1999; *Flood Trends and Global Change*. Geoscience Research Group, Munich Reinsurance Company. http://www.iiasa.ac.at/Research/RMS/june99/papers/loster.pdf

[17] As reported in *Best practices on flood prevention, protection and mitigation*, November 2003, EU Water Directors in the framework of the WFD Common Implementation Strategy. For specific impacts on water quality deterioration see Estrela T.; Menendez, M.; Dimas, M. *et al*; 2001; *Sustainable Water Use in Europe: Part 3 Extreme Hydrological Events Floods and Droughts,* Environmental issue report No 21, European Environment Agency

[18] As reported in *Best practices on flood prevention, protection and mitigation*, November 2003, EU Water Directors in the framework of the WFD Common Implementation strategy. For specific impacts on water quality deterioration see Estrela T.; Menendez, M.; Dimas, M. *et al*; 2001; *Sustainable Water Use in Europe: Part 3 Extreme Hydrological Events Floods and Droughts,* Environmental issue report No 21, European Environment Agency

impacts such as outbreaks of infectious disease, pollution, poisoning and post-traumatic stress disorder. Thus, in the summer of 2002, as the floodwaters receded, new threats began to emerge – disease, illness and exposure to chemical pollution. People returned home to find decaying garbage and debris. In the Czech Republic, sewage treatment plants were forced to shut down because of the floodwaters. The Spolana chemical plant in Neratovice, about 20 km north of Prague, leaked poisonous chlorine gas, endangering human health, while contaminating the natural environment. Following the floods in Poland in 1997, the effects on human mental health in the community were reported to include increases in suicide, alcoholism, and psychological and behavioural disorders, particularly among children[19].

1.2- Recent flood events

The most recent severe flood events across Europe include those of March 2004 in Southern Spain, December 2003 in the Rhone and Loire rivers, and summer 2002 across Central and Eastern Europe.

Other catastrophic floods during the past ten years include:

- The Tisza river (a major tributary of the Danube), between 1998-2001
- The Sarno (Italy) in 1998
- The 1997 floods of the Odra, Morava and Danube rivers
- The flooding of the Rhine and Meuse rivers in 1993 and again in 1995.

These occurred because of extensive urbanisation, loss of vegetation cover, and other human-induced changes to river basins, combined with persistent high precipitation[20] – all of these factors are discussed in more detail in Chapter 2. The impacts from these and earlier flooding events have all been very serious, including loss of human life.

A number of European countries suffered from damaging flood events during the winter of 1993-1994. Across the southeast of the United Kingdom, eastern France, Belgium, Luxembourg, the Netherlands, Germany and Poland, precipitation was more than double the long-term average. As a result, a number of rivers overflowed their banks. Ten people died in affected countries and costs reached approximately € 290 billion. Less than a year after this event, in January 1995, the Rhine and Meuse rivers flooded once again due to intense rainfall; however damage was considerably less in this case. Why was the damage less in 1995? Had lessons be learnt and effective protection measures put into place? Or was it more due to good luck?[21].

The 1997 floods of the Odra, Morava, and Danube in Poland, the Czech Republic and Germany were shocking in their severity. These had severe repercussions for humans and the environment. The flooding affected a quarter of Poland, including 1,400 towns and 400,000 hectares of agricultural land. It destroyed 50,000 homes, 162,000 people were evacuated and 55 people died. Assessed costs reached €4 billion, including damage to 480 bridges, 3,177 km of road and 200 km of railway. Ecological consequences for the Odra river included heavy metal and mineral oil pollution carried by the floodwaters, while nitrogen concentrations increased between six and eight times their 1996 levels, and phosphate levels rose to over 16 times 1996 levels. In the Czech Republic alone, damage

[19] World Health Organisation, Europe; September 2002; *Flooding: Health Effects and Preventative Measures*. Copenhagen and Rome. http://www.who.dk/document/mediacentre/fs0502e.pdf

[20] World Health Organisation (WHO) information sources: http://www.euro.who.int/eprise/main/WHO/Progs/CASH/Extreme/20020610_1

[21] World Health Organisation (WHO) information sources: http://www.euro.who.int/eprise/main/WHO/Progs/CASH/Extreme/20020610_1

was estimated at €2.1 billion and 40 people lost their lives[22].

The flood at Sarno in Italy in 1998 was rapid and devastating. 147 people died when a river of mud burst through a densely populated urban area[23].

[22] World Health Organisation (WHO) information sources: http://www.euro.who.int/eprise/main/WHO/Progs/CASH/Extreme/20020610_1

[23] World Health Organisation (WHO) information sources: http://www.euro.who.int/eprise/main/WHO/Progs/CASH/Extreme/20020610_1

Table 2- Summary table of selected major European flood events in 2002[24]

Month	Country(ies) affected	Impacts
January	eastern France	180 people affected; 60 families evacuated; several highways and secondary roads closed
January	Belgium	600 people affected. Flooding following heavy rain affected more than 200 houses
May/June	Moldova	One person killed; 500 people affected; 27 houses destroyed and 139 damaged; 44 bridges damaged; 1 dike damaged; 87 wells destroyed; over 4,700 hectares of agricultural land flooded
June	northern Italy	No people affected. Heavy storms flooded roads, brought down bridges and raised the water in Venice to record levels
July/August	Russian Federation	The city of Novorossiisk was without electricity and more than 3,000 people were stranded in the city's train station. The rains also caused a 400m^2 retaining wall to collapse over the railroad tracks blocking 10 trains from leaving the city. In southern Russia, rains in July left more than a 100 people dead and forced hundreds of thousands to evacuate their homes.
August	Czech Republic	15 people killed; 15 000 people evacuated; 220,000 people affected. An unfavourable meteorological situation beginning in the middle of July resulted in a state of emergency being declared. Several historical buildings in Prague were damaged, and damage was caused to agriculture and industry. Two accidents associated with leakage of chlorine at the Spolana Neratovive chemical plant were tackled without affecting the local inhabitants.
August	Austria	Flooding along the Danube affected some 60,000 people.
August	Germany	The Elbe region was most badly affected during floods in Central Europe. Costs of the flooding in parts of Germany estimated at €9.2 billion; 21 deaths reported.
August	Romania	Flooding damaged large sections of eastern, southern and western parts of the country. Some 450,000 people affected, particularly in rural areas, through destruction of homes, infrastructure and crops.
August	Tajikistan	A flash flood struck the village of Dasht in Gorno-Badakhshan Autonomous Province. The overall number of deaths was reported at 24
September	Albania	Floods inundated hundreds of homes and prompted the government to declare a disaster emergency for four districts. Thousands of acres of farmland were also reportedly flooded, and power to many homes was also lost.
September	Switzerland	Flooding resulted in landslides that killed three people.
September	United Kingdom	Heavy rain caused extensive flooding of London's underground and train system. Several stations were closed and services were curtailed.

[24] World Health Organisation, Europe; September 2002; *Flooding Health Effects and Preventative Measures*. Copenhagen and Rome. http://www.who.dk/document/mediacentre/fs0502e.pdf

1.3- Conclusions

Flooding is the most common 'natural' disaster in Europe and, in addition to loss of life, can result in major direct and indirect losses, involving economic, social, ecological and cultural impacts. The financial costs may run into hundreds of billions of Euro. As discussed above and in Chapter 2, the incidence of flood events is on the rise in European river basins, due in large part to mismanagement of both land and water, and other anthropogenic factors. In many cases, European taxpayers are being forced unwittingly into paying several times over for flood-related costs. For example, national and EU agriculture policies have provided subsidies, funded by taxes, for the conversion of active floodplains to farmland. Taxpayers are then also asked to foot the bill for damage from multiple flood events, exacerbated by the conversion of floodplains. The same European citizens are then faced with paying yet again – either for building higher and higher dikes (which may only provide a temporary and false sense of security), or for correcting the original mistake by rehabilitating degraded floodplains.

Statistics from the last decade demonstrate that flood-damage protection, prevention and mitigation efforts to date have generally been unsuccessful as the trend is for increasingly frequent and more damaging flood events. It is plainly evident that new approaches and solutions are needed to guarantee the safety of people, property and goods in an economically and ecologically sustainable manner. For this reason, it is important to take appropriate steps without delay.

The policy, technical and administrative (legal/financial) measures required for effective flood management are well known, and often presented by environmental NGOs and progressive institutions such as the International Commission for the Protection of the Rhine. The basic building block is Integrated River Basin Management (IRBM), which is now enshrined in EU legislation through the Water Framework Directive (see Chapters 3 and 4). Suitable mechanisms and tools already exist at EU level (*see Chapter 5*). There is no need to 'reinvent the wheel'. The big challenge is to ensure that the **opportunities already available** for ecologically sustainable flood management are used to their full potential by national, regional and local governments, and other relevant authorities across the region.

2. The causes of increasingly severe flooding

Under natural conditions, river flooding can be caused by continuous heavy precipitation for several days or by very intense rainfall over a much shorter period of time. Rainwater reaches watercourses both by direct surface inflow and via infiltration into soil and groundwater. During brief but very intense rainfall events, the infiltration capacity of soil may be exceeded, leading to increased surface run-off and a correspondingly rapid rise in river levels and an elevated risk of flooding. Snowmelt or frozen soil can exacerbate this risk[25], and the extent and frequency of floods are generally influenced by a number of natural factors including:

- Climatic conditions
- Soil and vegetation cover (stable soil and vegetation cover generally help to reduce flooding)
- Rock type (e.g. permeability) and landscape form (e.g. presence of steep slopes)

Nevertheless, flooding is increasingly also a consequence of human mismanagement of the environment. This Chapter investigates four main factors – all human-caused – that contribute to the increasing incidence of severe flooding in Europe, namely:

- Changes in river-basin land use
- River regulation
- Floodplain loss (resulting also from a combination of the above-mentioned factors is illustrated with examples from major European river basins)
- Climate change

[25] Estrela T.; Menendez,M.; Dimas, M. *et al*; 2001; *Sustainable Water Use in Europe: Part 3 Extreme Hydrological Events Floods and Droughts,* Environmental issue report No 21, European Environment Agency

2.1- Changes in river-basin land use

Any land-use change within a river basin will have an effect on the quantity and speed of water running off into watercourses. Depending on the type and scale of a given land-use change, the hydrological effects may be relatively minor and localised, or they may be significant at a basin-wide level, with implications for the frequency and intensity of flood peaks. Some of the most important categories of change are summarised below.

Agricultural intensification

The EU's Common Agricultural Policy (CAP) has led a post-World War Two drive to intensify agriculture. This has resulted in radical land-use changes throughout all Member States. Marginal land has been brought into cultivation, wetlands and woodland have been drained and cleared, and there has been a massive expansion in the use of irrigation. One impact of these changes has been to simplify landscape structures, with large tracts of land often dedicated to a narrow range of products (such as cereal cultivation in eastern England, or livestock rearing in northwest Germany). The simultaneous expansion and intensification of farming in the EU has had a range of consequences in terms of flood risk. Large areas of floodplain have been diked and drained, while the removal of natural vegetation cover, compaction by farm machinery and simplification of landscapes have tended to increase surface-water flow and sedimentation of watercourses.

Urban development

Many towns and cities are located in or close to floodplains. Expansion of these settlements implies further reduction in floodplain area – either directly through construction on floodplains themselves, or indirectly, due to the building of dikes ironically intended to protect new building from floodwater. The growing numbers of Europeans living in or close to floodplains also increases pressure for the development of new transport links (see

below). And it is not only urbanisation of floodplain areas that raises the risk of flooding. Urban growth anywhere within a river basin will also have a tendency to increase both the volume and rate of runoff, due to the greater area of hard, impermeable surfaces that prevent water from percolating into the ground. Storm-water drains frequently channel the excess flow directly into streams and rivers, raising the risk of downstream flooding unless special measures are taken to slow down the flow. Figures from the European Environment Agency show that areas with the highest rate of urbanisation are also those which are more prone to floods, e.g. the Mediterranean and the river Rhine[26].

For example, in the Mediterranean, urban developments are quite often placed on floodplains due to a combination of a high rate of urbanisation, inadequate planning control and enforcement for urban development, and the visual absence of water courses as a consequence of severe droughts and over-abstraction.

Transport development

The mobility of Europeans has increased dramatically in recent decades, in parallel with rapid expansion of transport by air, rail, road and sea, which has had an important influence on river-basin land-use. For reasons of convenience and relatively low cost, roads and railways are often constructed in river valleys and lake basins because of their flatness. As discussed above, these are also the places where a significant number of large settlements are concentrated, adding another construction imperative. However, as with urbanisation, construction of transport infrastructure contributes to constriction of floodplains and an increase in the area of impermeable (or 'sealed') surfaces. Linear features, such as roads and railway lines, which do not have sufficient or adequate drainage works, may divert flows to other areas or increase water levels upstream. Hence, the construction of road and rail networks can intensify floods and their catastrophic effects[27]. Airports and shipping facilities are also frequently built in floodplains, exacerbating the flood-risk factors already mentioned. Enlargement of the EU has brought with it plans for the development of new Trans-European Transport Networks (TENs-T), such as the 'Via Baltica' linking Germany, Poland and the Baltic States, which are liable to lead to further floodplain loss and – in any case – increased surface runoff. Other recent proposals (though not specifically part of the TENs-T) include a canal linking the Danube to the Elbe and Odra rivers, and a new canal through the Ukrainian portion of the Danube Delta.

Deforestation

Forests play an important role within river basins by slowing down the flow of surface water and increasing percolation into the ground. Deforestation and other loss of vegetation cover in the headwaters of river basins increase surface run off[28]. Localised damage to vegetation cover can be crucial to water-retention capacity in the area concerned. Forests are also extremely beneficial in reducing erosion and, therefore, the level of sediment entering watercourses. Forest cover mitigates the impact of small and medium-sized floods, and this is particularly important in southern Europe[29]. However, floodplain forests have suffered the largest decline of any forest type, particularly in southern, central and Eastern Europe, due to the intensification

[26] Estrela T.; Menendez,M.; Dimas, M. *et al*; 2001; *Sustainable Water Use in Europe: Part 3 Extreme Hydrological Events Floods and Droughts,* Environmental issue report No 21, European Environment Agency

[27] Estrela T.; Menendez,M.; Dimas, M. *et al*; 2001; *Sustainable Water Use in Europe: Part 3 Extreme Hydrological Events Floods and Droughts,* Environmental issue report No 21, European Environment Agency

[28] Estrela T.; Menendez,M.; Dimas, M. *et al*; 2001; *Sustainable Water Use in Europe: Part 3 Extreme Hydrological Events Floods and Droughts,* Environmental issue report No 21, European Environment Agency

[29] Estrela T.; Menendez,M.; Dimas, M. *et al*; 2001; *Sustainable Water Use in Europe: Part 3 Extreme Hydrological Events Floods and Droughts,* Environmental issue report No 21, European Environment Agency

of forestry[30]. Clearing forests has, unfortunately, been a common practice for centuries in Europe and, consequently, extensive areas of forest are becoming increasingly rare.

The removal of trees from catchments reduces the absorption capacity of the land and causes erosion. Water rushes down hillsides, turning what otherwise would be fast-flowing streams into raging torrents. Flash floods, which have claimed the lives of at least two people in Romania, and dozens more in Slovakia and the Czech Republic in recent years, are one result. Extensive logging in Ukrainian and Romanian forests, perched along the rim of the Tisza and Danube river basins, together with melting snow and heavy rainfall, have been blamed as one of the chief causes of the flooding in 2001[31]. WWF has also pointed out that deforestation was a major cause of the flood events in Hungary in 2002.

2.2- River regulation

River regulation, a widely used term, *"comprises of the physical changes that people impose on watercourses, such as land drainage, water abstraction, flood protection, inter-basin water transfers, reservoirs, wastewater discharge, weirs, dredging, channelization and navigation"*[32]. Such modifications to a river's natural course can have far-reaching consequences, including an increase in the risk of flooding upstream or downstream of the location of a given intervention. A large proportion of European rivers has been affected by regulation; to take just one example, it is estimated that 30,000 km of Austria's total river network of 100,000 km are regulated.[33]

Flood protection dikes

Europe has an extensive system of dikes, separating rivers and seas from their natural floodplains. Historically, dikes have been built in order to protect communities from flooding and often to make former wetlands available for human use, especially agriculture. Although dikes are one of the oldest forms of flood protection in Europe, ironically, they can also exacerbate flooding under certain circumstances. For example, more than 60% of the Netherlands would be inundated if it were not for that country's extensive dike systems[34]. However, at the same time, the building of dikes constricts river courses, preventing water from entering the floodplain during times of high flow. Water can only rise within the dike structure, potentially leading to catastrophic breakthrough or overtopping of the dike walls. The higher the dike is built, the greater the volume of water held back and the greater the level of risk to human life and property in the event of a dike failure. Following the severe flooding of 1993 and 1995, the Dutch government instituted a major land-use policy reform aimed at making 'Room for the rivers'. This involved a range of tough new planning controls combined with physical measures to increase water storage capacity through floodplain rehabilitation and removal of many artificial obstacles.

Dams

Dams are the most common forms of direct infrastructure on rivers. The World Commission on Dams states that *"large dams have fragmented and transformed the world's rivers, modifying 46% of primary*

[30] Estrela T.; Menendez,M.; Dimas, M. *et al*; 2001; *Sustainable Water Use in Europe: Part 3 Extreme Hydrological Events Floods and Droughts,* Environmental issue report No 21, European Environment Agency

[31] Beckmann, A.; 2002; *Mopping up after the floods,* CER review.

[32] Estrela T.; Menendez,M.; Dimas, M. *et al*; 2001; *Sustainable Water Use in Europe: Part 3 Extreme Hydrological Events Floods and Droughts,* Environmental issue report No 21, European Environment Agency

[33] WWF European Living Waters Programme website, Austria country profile. http://www.panda.org/about_wwf/what_we_do/freshwater/index.cfm

[34] Estrela T.; Menendez,M.; Dimas, M. *et al*; 2001; *Sustainable Water Use in Europe: Part 3 Extreme Hydrological Events Floods and Droughts,* Environmental issue report No 21, European Environment Agency

watersheds". Within the EU, around two-thirds of rivers – and virtually all larger rivers – have been dammed. Many dams are built primarily for the generation of hydroelectric power and/or for the storage of water for supplying urban centres and irrigated agriculture. However, the construction of many dams in Europe has also been wholly or partly justified in terms of flood-risk reduction, with large storage reservoirs intended to slow down, capture and retain peak river flows, enabling water levels to be controlled downstream. Such an approach has proved simplistic, since dams fragment river systems, radically altering their hydrological and ecological functioning, and potentially leading to elevated flood risks. In Southern Europe, for example, dams are multipurpose – for water provision, flood prevention and energy production – and water users put political pressure on public authorities to increase the storage rate of dams in order to enter the summer dry season with dams that are as full as possible. This notably reduces the flood mitigation capacity of dams.

Thus, in the first place, the construction of dams often involves the permanent inundation of floodplains upstream, leading to a loss of natural flood retention capacity. Furthermore, unless operated under very strict conditions, releases from dams can actually worsen downstream flooding[35]. Additionally, due to the trapping of sediment behind dams, downstream floodplains and deltas are starved of replenishing material, leading to an increase in erosion and a reduction in the flood mitigation capacity of these areas.

These river regulation works are another means whereby the river continuum is damaged and rivers are separated from their floodplains and side arms.

[35] WWF; 2001; *Conserving the Source of Life - Background and Focus of WWF's Living Waters Target-Driven Programme*.

River channelization

River channelization (or 'canalisation'), alongside the construction of dams and dikes, has been a common form of flood protection in many countries. The aim is to transport peak flows as rapidly as possible from A to B, frequently incorporating a bypass of 'at risk' areas such as towns and villages. In some cases, a completely new artificial channel is created. Elsewhere, a natural river course is greatly simplified by the cutting through of meanders and side branches, and the re-profiling of the riverbed by deepening and grading. Through this process, a heterogeneous meandering river is changed into a homogeneous, straight channel with a more steeply sloping bed, uniform flow conditions and lower habitat diversity[36]. Ox-bow lakes, side arms and other floodplain features become isolated from river flows, again contributing to a reduction in space for the river and an increase in the likelihood of damaging floods in the event that banks and dikes are overtopped. The emphasis on moving water downstream as quickly as possible is also a high-risk strategy, increasing vulnerability to flood disaster should the flood prevention infrastructure be unable to cope with the flow volume. The more rapid downstream progression of a flood peak means that communities in flood-prone areas may have less warning and, therefore, less preparation time to implement flood response and mitigation measures.

Alterations to a river channel and bed in a given area can have significant effects on natural erosion and sedimentation processes elsewhere. This leads to raised riverbeds, which push water levels higher (and during flooding events contribute to the high water levels) and the need for even higher levels of protection[37].

[36] Estrela T.; Menendez,M.; Dimas, M. *et al*; 2001; *Sustainable Water Use in Europe: Part 3 Extreme Hydrological Events Floods and Droughts,* Environmental issue report No 21, European Environment Agency

[37] World Commission on Dams; 2000; *Dams and Development: A New Framework for Decision Making- The Report of the World Commission on Dams*. Earthscan, London

2.3- Floodplain loss

Floodplains – the periodically inundated low-lying areas adjacent to rivers, lakes and coasts – are nature's answer to flood control. They have long provided the space that rivers have needed during times of high water, both in terms of increasing the natural flood storage area and by acting as natural sponges – absorbing the water and releasing it slowly later on. Yet this vital role is still overlooked and – as shown above – floodplains and their associated wetlands continue to be lost as a result of human interventions. In turn, not only is natural flood mitigation diminished, but also changes occur to the natural hydrological functioning of river basins. Some examples are given below for three large European rivers. Annex I contains a table summarising the causes of floodplain degradation, together with remarks on the situation in Europe. Overall, it is estimated that only 20% of Europe's floodplains remain functional[38].

Example 1: **River Rhine**

During a period of just 200 years, the Rhine river lost more than 85% of its floodplain due to dam and dike construction and other human interventions. This resulted in a dramatic decrease in the river's natural flood retention and control functions, as witnessed by the exceptional – and very nearly catastrophic – flood events of 1993 and 1995. In 1998, Ministers from the Rhine river basin countries adopted a twenty-year 'Action Plan on Flood Defence', which recognised that mismanagement of the river and its basin had contributed to elevated flood risks. Restoring and rehabilitating floodplains to increase flood storage capacity is a key element of this Action Plan. Whilst full implementation of the plan is forecast to cost upwards of 12 billion Euro, this figure pales into insignificance against the estimated value of economic assets in areas currently at risk of flooding, which stands at some 1,500 billion Euro[39].

Example 2: **River Elbe**

One of the largest rivers in Central Europe, the Elbe has suffered from poor water quality and more than 80% of the original floodplain has been lost due to dike construction[40]. The Stepenitz river basin, a medium-sized (575 km^2) tributary basin of the Elbe basin, situated in the German State of Brandenburg, is characterised by a series of complex hydrological and ecological problems. These result mainly from the current intensive agricultural practices in almost 80% of the total basin area and past measures such as land 'improvement' for agriculture, river-channel straightening, and drainage of natural wetlands, all of which resulted in considerable loss of natural flood-retention areas[41].

Example 3: **River Danube**

In 1999, in the framework of the UNDP/GEF Danube Pollution Reduction Programme, WWF carried out an assessment of floodplain loss along the Danube and five of its major tributaries (the Morava, Drava, Sava, Tisza and Prut rivers). This showed a decline from the original ('historical') floodplain area of 41,600 km^2 to approximately 7,850 km^2 – representing an overall loss in excess of

[38] Hygum, B.; 2001; *Water and Wetland Index: Assessment of 16 European Countries- Phase 1 Results*. WWF European Freshwater Programme available at http://www.panda.org/about_wwf/where_we_work/europe/what_we_do/freshwater/initiatives/wwi/index.cfm.
WWF-Germany's Auen Institute has also published a vast bibliography on floodplains functions and loss on various rivers. See: http://www.wwf.de/naturschutz/lebensraeume/fluesse-auen/

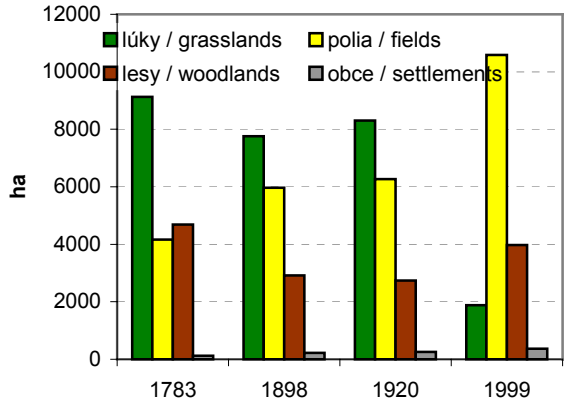
[39] Source: http://www.iksr.org/icpr.

[40] *Economic valuation of measures towards sustainable development in the Elbe River Basin*. Research project within the programme Elbe-Ecology funded by Bundesministerium fürBildung und Forschung, Germany (Ministry of Education & Research E&R). ESEE, Newsletter of the European Society for Ecological Economics, 11/2000

[41] The Elbe-Ecology project funded by Bundesministerium fürBildung und Forschung, Germany (Ministry of Education & Research E&R. http://www.pik-potsdam.de/cp/ragtime/hydro/projects/elbe-ecology/elbe-ecology.html#elbe-ecology

80%[42]. Historical analyses of changes of the spatial structure in lower part of the Morava river basin – a sub-basin of the Danube – show drastic land structural changes (see graphic below). The ratio of 2:1 natural versus man-made areas prior to river regulation, has been reversed over the last 50 years so that there are now twice as many man-made areas as natural ones. The area of grassland, which covered 8,000 ha during the 18th and 19th centuries, had decreased to 1,913 ha (12% of the total area) by 1999.[43]

Graph 2- Development of main landscape structures in lower part of the Morava river basin since the 18th century[44]



2.4- Climate change

Many flood events have been associated with unusually high precipitation. Such exceptional rainfall events may already be a result of global warming and are certainly indicative of the types of effects that many parts of the world will be seeing more frequently as our climate continues to change. Global warming is caused by an increase in greenhouse gases (such as carbon dioxide, methane and nitrous oxides) resulting from human activities, primarily the burning of fossil fuels. These gases act as a giant blanket, trapping heat energy in the earth's atmosphere, thereby progressively warming the planet. According to the European Environment Agency *"climate change alters precipitation patterns resulting in changes in the distribution, intensity and duration of extreme rainfall events and a higher frequency of heavy precipitation."*[45]. Under natural conditions, river basins are able to cope with higher than normal amounts of rainfall, but the combined impact of human and climate change patterns, means that they can no longer cope. For example, during the floods of summer 2002, Germany's weather service reported that 317 litres of rain had fallen in 24 hours at a monitoring station in hills near the Czech border – the highest reading since records began in 1870[46].

Current situation

Over the past 130 years the mean temperature of the earth has risen about 0.6 ^{o} C[47]; whereas average land temperatures increased by 1.2^{o} C since about 100 years[48]. Further research has revealed that the average global temperature is rising 0.2^{o}C per decade[49]. At first, such figures may not seem significant, but careful investigation reveals more clearly the link between human-induced temperature increases and flooding. Over the last 120 years, the ten

[42] WWF Danube-Carpathian Programme and WWF-Germany Auen Institute; 1999; *Evaluation of Wetlands and Floodplain Areas in the Danube River Basin. Final Report*. WWF Danube-Carpathian Programme, Vienna.
[43] Seffer, J.& Stanova, V. (eds.); 1999; *Morava River Floodplain Meadows – Importance, Restoration and Management*. DAPHNE – Centre for Applied Ecology, Bratislava
[44] Seffer, J.& Stanova, V. (eds.); 1999; *Morava River Floodplain Meadows – Importance, Restoration and Management*. DAPHNE – Centre for Applied Ecology, Bratislava
[45] Estrela T.; Menendez,M.; Dimas, M. *et al*; 2001; *Sustainable Water Use in Europe: Part 3 Extreme Hydrological Events Floods and Droughts,* Environmental issue report No 21, European Environment Agency
[46] Guardian International; August 14th, 2002; *Tides of misery Flood Europe*. http://www.guardian.co.uk/international/story/0,3604,774124,00.html
[47] Intergovernmental Panel on Climate Change, Third Assessment Report, 2001
[48] DEFRA & Hadley Centre, UK, 2003, *Climate Change – Observations and Predictions*
[49] P. Vellinga and W.J van Verseveld; 2000; *Climate Change and Extreme Weather Events,* University of Amsterdam-Institute for Environmental Studies and WWF

warmest years have all occurred since 1987, with nine of these occurring after 1990[50]. The four warmest years were all very recent - in 1998, 2001, 2002 and 2003[51].

In recent decades, most of Europe has experienced temperature increases larger than the global average, with enhanced precipitation in the northern part of the region and reductions in the south. Analysis indicates that rainstorm intensity has increased, and areas where increased amounts of precipitation have been observed also show increased heavy precipitation events[52].

For example, in February 2004, the Scottish Executive Environment Group produced a report reviewing the levels of protection offered by flood prevention schemes in relation to predicted climate change scenarios. The report states that climate change will affect the weather patterns differently in the east of Scotland than in the west. It also argues that any flood engineering works would need to be raised by between 5 cm and 18 cm if the same level of protection as provided in 1990 was to be re-established in 2050[53].

Future scenarios

The average global temperature is expected to rise between 1.4 and 5.8 ^{o}C from 1990 to 2100[54]. In general terms, an increase in temperature will lead to higher evaporation and more moisture in the air. When the air becomes saturated, precipitation forms. However, increasing global temperatures do not necessarily mean more frequent precipitation events, but rather an increase in the amount of precipitation per event[55]. Scientific research demonstrates that precipitation patterns will continue to shift towards heavier rainstorms, which will be accompanied by an increase in the number of dry days. All scientific models for Europe predict increased precipitation during the winter, with Northern Europe also predicted to become wetter during the summer[56]. Furthermore, climate change may also lead to long-term changes in vegetation cover and structure, with possible knock-on effects on soil properties, e.g. water retention capacity, surface-water run off[57], and hence the volume of water entering rivers.

Mountain ranges – in particular the Alps, Carpathians, Balkans and Fennoscandian mountains – are the source of most of Europe's major rivers, with the timing and amount of flow in rivers such as the Rhine, the Rhone, and the Danube being strongly dependent on the seasonal accumulation and melting of snow and, during the summer and early autumn, on meltwater from mountain glaciers. There is increasing evidence (e.g. in the Swiss Alps) that rising temperatures are already leading to reduced snow and ice cover and increased rainfall, which could lead to long-term changes in the hydrological regime of mountain streams and rivers. Such changes would especially affect downstream areas along rivers such as the Rhine and the Danube, where river management, settlement patterns and land use are adapted to a long-term pattern of regular seasonal variations in flow. As the extensive flooding in Poland, Germany, and the Czech Republic in 1997 and 2002 have demonstrated, many flood-defence systems have a limited capacity to cope with irregular flows and any changes in hydrological regimes could have major impacts in floodplain

[50] World Meteorology Organisation 2002, *WMO Statement on the Status of the Global Climate in 2002*
[51] DEFRA & Hadley Centre, UK, 2003, *Climate Change – Observations and Predictions*
[52] Guardian International; August 14th, 2002; *Tides of misery Flood Europe*. http://www.guardian.co.uk/international/story/0,3604,774124,00.html
[53] UK CIP02 Update, 2003; *Climate Change: Review of levels of protection offered by flood prevention schemes*
[54] Intergovernmental Panel on Climate Change, Third Assessment Report, 2001
[55] Guardian International; August 14th, 2002; *Tides of misery Flood Europe*. http://www.guardian.co.uk/international/story/0,3604,774124,00.html
[56] Intergovernmental Panel on Climate Change, Third Assessment Report, 2001
[57] World Commission on Dams; 2000; *Dams and Development: A New Framework for Decision Making - The Report of the World Commission on Dams*. Earthscan, London.

areas[58]. Following the floods of 2002, the German Environment Minister said: "*If we don't want this development to get worse, then we must continue with the consistent reduction of environmentally harmful greenhouse gases.*"[59] The evidence is clear: climate change and the resulting effects upon air temperature, and in turn precipitation, are very likely one cause of recent floods in Europe.

In Mediterranean countries, extreme flood events are expected to occur in combination with extreme drought events. The negative synergies thus generated will severely affect the health of ecosystems and the services they provide for all of us, as well as human land and water uses.

2.5- Conclusions

Europeans currently face a turning point in the way in which land and water, including floodplains – and hence flooding – are managed. Recent studies have shown that our 'natural sponges' for storing water during flooding episodes are disappearing. Thus, for example, approximately 80% of Europe's floodplains have been lost; almost three-quarters of river stretches analysed have poor ecological quality; and the river systems of over half of the countries in Europe are severely fragmented[60]. This is due to the mismanagement of various human activities, including agriculture, forestry, transport, urbanisation, industrial development, mining and quarrying, and tourism.

When viewed in the context of increasingly extreme weather events due to global warming, statistics such as these take on a special significance. There is no question that these factors have led to incidents of severe flooding in Europe becoming more frequent and the impacts of such events becoming ever more costly and disruptive. In preparing policy and practical responses, it will be essential for planners and decision-makers to keep in mind that:

- Flooding is a natural – and in many ways beneficial – process that will continue to occur;
- Increasingly negative impacts of flooding on human life, property and livelihoods are largely a consequence of our own actions;
- We therefore need to address the root-causes of damaging floods and not just the symptoms;
- In managing flood risk, governments need to work with nature and not against it.

These points must be understood – and acted on – at all levels (international/EU, national, regional and local) throughout the European region if further devastating and unnecessary losses are to be avoided in the future.

[58] WWF Poland, *Flood damages will increase in the future, if we do not reserve areas prepared for flooding - warned WWF*. Press release

[59] Guardian International; August 14th, 2002; *Tides of misery Flood Europe*. http://www.guardian.co.uk/international/story/0,3604,774124,00.html

[60] Hygum, B.; 2001; *Water and Wetland Index: Assessment of 16 European Countries- Phase 1 Results*. WWF European Freshwater Programme

3. Integrated River Basin Management and ecologically sustainable flood management

3.1- What is Integrated River Basin Management?

Integrated River Basin Management (IRBM) is now widely recognised as the most appropriate approach for delivering sustainable use of the world's limited freshwater resources. It has been endorsed by international organisations, such as the Global Water Partnership and the 'Ramsar' Convention on Wetlands, and is enshrined in the EU's Water Framework Directive.

"IRBM is the process of coordinating conservation, management, development and use of water, land and related resources across sectors within a given river basin, in order to maximise the economic and social benefits derived from water resources in an equitable manner while maintaining and, where necessary, restoring freshwater ecosystems" (based on a definition adopted by the Global Water Partnership).

In short, IRBM provides a basin-wide framework for making strategic decisions about water management – including flood management – that are economically, socially and environmentally sustainable.

IRBM rests on the principle that naturally functioning river basin ecosystems, including wetlands and groundwater, are the source of freshwater on which people everywhere depend. Therefore, management of river basins must include maintenance of ecosystem functioning as a paramount goal. IRBM also assumes that the needs and expectations of all 'water stakeholders' must be assessed jointly at a basin-wide level, and that final decisions have to be based on the best possible information.

3.1.1- IRBM: Why do we need it and how to do it?

The interconnectedness of different water and land uses within a river basin, and their impacts on one another, are well documented[61]. Most visibly, changes in land uses in upstream areas, such as dam building, urban development or cultivation of previously un-farmed land, can lead to a host of interrelated impacts downstream. These might be increased pollution loads, greater soil erosion, and limited flood storage capacity due to development of former floodplains. However, while most European river basins are subject to such multiple impacts, few as yet enjoy the integrated basin-wide approach to planning and management that is required to resolve them.

The IRBM approach recognises that there are many different tools for managing freshwater resources. These may include the designation of protected areas to safeguard headwaters and wetlands that contribute to maintaining water quality and quantity; forestry practices that are compatible with conservation of freshwater resources; sustainable agricultural practices that are adapted to local conditions, use less water and are less dependent on chemical inputs; the use of more efficient technologies by water-intensive industries; dam and reservoir management that mimics natural flow regimes; innovations in the design of shipping so that fewer alterations to natural river channels are required for commercial navigation; and restoration techniques to re-establish valuable natural functions in heavily degraded freshwater systems.

Nevertheless, none of these tools will be effective if used in isolation. Indeed, if one solution is pursued while other issues or sectors are ignored, the effects are at best strictly localised and temporary, and at worst

[61] WWF Living Waters Programme, 2003, *Managing rivers wisely: Lessons from WWF's work for integrated river basin management* available at http://www.panda.org/downloads/freshwater/managingriversintroeng.pdf

ultimately futile. IRBM provides a structure within which the full range of tools and approaches can come into play, with multiple sectors working together, rather than at cross-purposes, in order to manage and conserve freshwater resources sustainably and equitably.

3.1.2- WWF's seven guiding principles for effective IRBM

WWF has established a set of seven key elements or 'guiding principles' that should be in place for an IRBM initiative to succeed[62]. These are:

- A long-term **vision** for the river basin, agreed to by all the major stakeholders
- A solid foundation of **knowledge** of the river basin and the natural and socio-economic forces that influence it
- **Integration** of policies, decisions and costs across sectoral interests such as industry, agriculture, urban development, navigation, fisheries management and conservation
- Strategic decision-making made at the river basin **scale**, which guides actions at sub-basin or local levels
- Effective **timing**, taking advantage of opportunities as they arise while working within a strategic framework
- Active **participation** by all relevant stakeholders in well-informed and transparent planning and decision-making
- Adequate investment by governments, the private sector, and civil society in **capacity** for river basin planning and participation processes

3.1.3- The EU Water Framework Directive and IRBM

For decades, interest groups and academia have demanded that environmental policies and objectives are oriented towards the environment's 'carrying capacity', the proper and long-term functioning of ecosystems and maintenance of biodiversity. In the case of water, this should be achieved via Integrated River Basin Management (IRBM). Decision-makers finally recognised this demand and have enshrined it in EU law via the WFD.

The WFD is the implementation tool for IRBM in the EU because it makes integrated river basin planning and management compulsory for Member States as well as for Accession Countries (from the date of their accession to the EU). Governments are required to establish River Basin Districts as the fundamental unit for applying and coordinating the Directive's provisions at both national and transboundary levels, and to prepare River Basin Management Plans for delivering 'good status' in all European waters within a 15-year time frame. A stated goal of the Directive is to contribute to mitigate the effects of floods, though precautionary flood protection measures are not specifically prescribed. In any event, the Directive requires the protection, restoration and enhancement of wetlands, which is key for the development of ecologically sustainable flood management measures.

References throughout this paper, but in particular in Chapter 4, explain why the WFD is therefore the right tool for implementing ecologically sustainable flood management in Europe and why there is no need to develop parallel planning processes[63] and/or additional legislation to deal with flooding.

3.2- Benefits of an IRBM approach to flood management

In June 2003 the European Conference of Ministers responsible for Physical Planning recognised that "The tragic consequences of the floods which devastated several parts of Europe in 2002 made it necessary to give

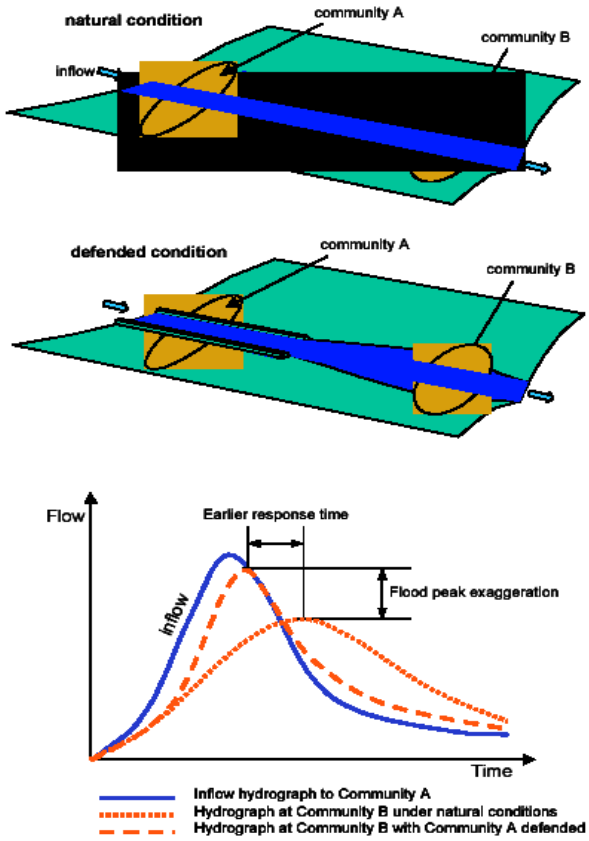
[62] WWF Living Waters Programme, 2000, *Managing water wisely: Promoting sustainable development trough integrated river basin management* available at http://www.panda.org/downloads/freshwater/managingwaterwiselyeng2.pdf

[63] As seems to be suggested by the European Commission services developing the Communication and Action Programme on "Flood prevention, protection and mitigation"

priority to the question of floods within the activities of the European Conference of Ministers responsible for Physical Planning". They also "stressed the fact that technical measures do not grant complete safety. If flood risk is therefore inevitable it can be managed and reduced. It has been widely agreed that flood prevention requires an integrated approach where not only the areas directly affected by floods but also the entire river basins must be considered."[64]

WWF firmly believes that a truly integrated approach to river basin management would in many cases prevent the accumulation of separate peak water flows coming together to constitute a 'flood'. Once a flood occurs, however, there are two main ways of managing the water: move it, or store it. Both responses have parallels in natural systems, depending on local conditions (e.g. floodwaters flow quickly through narrow gorges, but spread out over floodplains). As river basins become more and more urbanised and the imperative to protect human communities from flood risk increases, the traditional approach has been to concentrate on moving the water through and away from inhabited areas as quickly as possible. Too often the 'bigger picture' has not been examined, and defending one area has led to increased flooding elsewhere.

In the graphic below, community A experiences natural flooding, whereas community B does not. However, when traditional flood 'defences' (e.g. floodwater retention dikes) are provided for community A, the hydrograph shows that the flood peak at community B is increased and occurs more quickly than before. Effective flood management must look at the 'bigger picture' and aim to ensure that where increased flooding does occur, it happens in areas specifically designated and prepared for flooding.



Indeed, experience has shown that effective measures for flood prevention and protection have to be taken at the river basin level, so that the interaction and cumulative effects of individual measures implemented along watercourses can be taken into account. Therefore, it is essential that water management systems, improved flood forecasting, flood defence measures and emergency response measures are all coordinated and planned at a river basin level – cutting across regional boundaries and country borders. This should be done in cooperation with the relevant organisations in the fields of hydrology and meteorology, mitigation planning, river control, civil protection and crisis management.

In this context, WWF strongly believes that the WFD has a crucial role to play. The River

[64] Guiding Principles for Sustainable Spatial Development of the European Continent (Recommendation Rec (2002) 1 of the Committee of Ministers of the Council of Europe) available at http://www.coe.int/T/E/Cultural_Co-operation/Environment/CEMAT/List_of_Conferences/CEMAT13_report.asp#P656_78009

Basin Management Plans (RBMP) that are to be set up according to the Directive by 2009, and which define the measures necessary for achieving the 'good ecological and chemical status' objectives by 2015, should include any water and water-management related measures for flood-damage protection, prevention and mitigation developed by River Basin Authorities and stakeholders (*see Chapter 4*). Article 13.5 of the Directive, allowing the general RBMP to be supplemented by another plan/programme dealing in more detail with a specific water issue, supports this. Furthermore, this would prevent the need for duplicating human resources for the development of a separate river basin planning process for flood management[65], which would anyway need to be integrated into the RBMP to prevent jeopardising the WFD objective of 'good ecological and chemical status'. Any measures or mechanisms developed purely for managing flood risk, and that could have a negative effect on the achievement of this objective, must be subject to WFD requirements, including derogation tests.

3.2.1- Measures for ecologically sustainable flood management in river basin planning

Traditionally flood-damage prevention and protection has relied on 'structural' measures, such as building dikes, dams and embankments. As shown elsewhere in this paper, this approach alone does not work. However, some sort of 'structural' approach to flood management is still needed.

Examples of useful **structural measures** are:

- Building/construction codes and legislation to relocate houses and other infrastructure away from flood-prone areas;
- Planning of appropriate land-use types and practices;
- Adjusted planning and design for physical flood-control structures (and for mitigation of their adverse effects on the environment and others).

As we have learnt more about flooding, we have come to realise that other types of measures and approaches are needed to ensure effectiveness and sustainability of flood management, by using complementary **preventive measures**, for example:

- Making an inventory of flood-prone areas
- Implementing early-warning systems
- Communicating the flood risk accurately and quickly to stakeholders
- Preparing communities to respond effectively to flood events

Any measures will only deliver long-term benefits when their planning and implementation are integrated at the **correct scale**, i.e. river basin level. This requires interdisciplinary cooperation, especially:

- At all levels of government (national, regional, local)
- Across all sectoral policies (especially environmental protection, physical planning, land-use planning, agriculture, transport and urban development)
- During all phases of risk management: risk assessment, mitigation planning and implementation of measures
- With all concerned stakeholders (e.g. farmers, industries, local communities, NGOs)

In addition to structural and preventive measures, '**non-structural measures'** are crucial for ensuring a sustainable approach to flood-damage protection, prevention and mitigation at the river basin level. 'Non-structural' measures include giving back room to rivers so they can flood naturally, and creating more natural retention areas to absorb the water.

Indeed, every cubic metre of water that does not drain immediately into the closest water body increases the risk of flooding, in particular downstream. Water storage by

[65] As seems to be suggested by the European Commission services developing the Communication and Action Programme on *Flood prevention, protection and mitigation*

vegetation, soil, aquifers and wetlands therefore has an important flood mitigation effect, particularly for small to medium-scale floods. A large natural storage capacity favours slow rises in water levels, leading to comparatively minor flooding. Erosion and sediment loads are also reduced. Maximising natural water retention should, therefore, be a key element of river basin planning for ecologically sustainable flood management. Specific options for achieving this include:

- Implementing better land-use planning and better land management practices: prevent rapid run-off both in rural and urban areas (e.g. by limiting the expansion of 'sealed' – concrete or tarmac – surfaces), and prevent construction in floodplains. Consider all floodplain and wetland drainage proposals as being contrary to the objective of ecologically sustainable flood management. Avoid excessive soil compaction and erosion, employ only contour tillage, leave vegetated strips along watercourses, convert arable land to pasture, etc.

- Maximising natural vegetation cover: maintain and, where possible, restore the existing vegetation and forest cover, particularly in mountainous areas, riparian woodland and floodplain meadows.

- Restoring floodplains and wetlands[66]: maintain, protect effectively and, where possible, restore degraded wetlands and floodplains, including river meanders, oxbows, and – in particular – reconnect rivers with their floodplains; for example, by relocating dikes, opening natural levees. Reduce the intensity of landscape drainage, reverse the straightening of watercourses and bank reinforcement – make room for the river to flow naturally. This is as true in upland or 'headwater' catchments as it is for downstream lowlands. By creating more space for rivers and water, floodplain and wetland restoration is a major contribution to flood prevention and protection. It helps to decrease the level and intensity of peak flows while restoring ecosystems, increasing biodiversity, and helping to improve water quantity and quality as well as groundwater discharge.

- Creating low-risk flood storage areas: use former floodplains to create designated floodwater storage zones with extensive grassland and/or alluvial forest cover. For major cities, a specific risk-assessment study might be needed for establishing a level of protection for sewage and other wastewater systems that uses environmentally appropriate and cost-effective methods

- Developing strong legislation: in case incentive-led voluntary approaches to flood-risk reduction are unsuccessful, develop and/or strengthen a programme of measures that is backed by rigorous and enforceable legal tools.

3.2.3- Strategic planning of flood management at the river basin level

All types of measures for flood (damage) prevention and protection – as highlighted above – should be taken into account in the preparation of a strategy covering the whole river basin. This should have a:

- Long-term strategic approach. Drawing long-term conclusions (perhaps applying a time scale of several decades) concerning the actions required in terms of water management, land-use planning policy, climate change and finance.

- Interdisciplinary approach. Developing an integrated approach covering all relevant aspects of water management, physical planning, land use, agriculture, transport and urban development, nature conservation, at all levels (national,

[66] This measure is already part of some European governments' plans to tackle floods (e.g. Czech Republic, France, Germany and The Netherlands) and should be taken up as a key action by others, given that it is central to ecologically sustainable flood management

regional and local). Defining and allocating responsibilities of governments/local administrations, businesses, community groups and individuals.

- Safety consideration. The strategy must be pro-active and preventative as well as allow for early warning, for providing aid the case of a flooding emergency, and for learning the lessons from its implementation.

Such a strategy would help to ensure continuity and integration of river basin planning, and can be used to set out principles for organising and coordinating activities, including financial investment.

It is WWF's strong belief that the WFD River Basin Management Plans (RBMPs) are the most suitable vehicle for implementing such a strategic approach. Therefore, RBMPs should include the water management and water-management related measures for flood (damage), protection, prevention and mitigation developed by the designated River Basin Authorities and all other stakeholders. WWF believes equally strongly that there should not be separate river basin management planning processes for flood management[67] (*see also Chapter 4*). This is supported by Article 13.5 of the Directive, which allows for more detailed planning on specific water issues (in this case, flood damage) to be included as a supplement to general RBMPs. The alternative is that the benefits of IRBM for flood management will probably be lost in the confusion of two different sets of water management measures being developed and implemented separately at river-basin level.

3.2.4- International and transboundary cooperation for flood management

In the case of international river basins, transboundary cooperation is a prerequisite for effective river basin management. In terms of flooding, this might include *inter alia* joint preparation of risk analyses and flood forecasts, and improved coordination of emergency assistance provision and preventive measures. Existing river basin organisations in Europe, such as the International Commissions for the Danube and Rhine Rivers, have already built up a wealth of experience in preparation of transboundary strategies and should be, as far as possible, the implementation bodies for these strategies, including flood protection, prevention and mitigation measures.

The WFD River Basin Management Plans (RBMPs) are also the right vehicle for implementing **transboundary cooperation** for flood protection, prevention and mitigation measures. Indeed, virtue of Article 13, the WFD requires the setting up of International River Basin Districts and of single International River Basin Management Plans. This challenge has already been taken up by International Commissions, such as that for the protection of the Danube River (ICPDR). Thus, the Danube River Basin countries have endeavoured to produce a single international RBMP, which is coordinated by the ICPDR acting as the international platform for cooperation.

3.2.5- Financial instruments for IRBM

While national and regional funding sources will normally bear the largest part of the costs of integrated river basin management, there are several EU mechanisms that can be harnessed for additional support. These include the Common Agricultural Policy (CAP), PHARE Cross Border Co-operation, INTERREG, European Regional Development Fund, Special Action Programme for Agriculture and Rural Development (SAPARD), EU Solidarity Fund, LIFE and the Structural Funds (as follows from the revised Indicative Guidelines published in 2003). For further details see Chapter 5.

[67] As seems to be suggested by the European Commission services developing the Communication and Action Programme on *Flood prevention, protection and mitigation*

Note that flood insurance can both reduce the financial risk for individuals, communities and companies and increase the level of risk awareness. Yet according to the insurance industry, in spite of these apparent advantages, cover for flooding is not yet widely taken up[68]. The establishment of a national, regional or river basin 'flood fund' might also be considered as a means of supporting flood-prevention measures in an IRBM context.

3.3- Case studies of ecologically sustainable flood management

Ecologically sustainable flood management, in contrast to traditional hard engineering, aims to tackle flooding by considering a whole river basin as a complex system and working with nature rather than against it. Only by looking at the natural functioning of catchments as a whole – rather than at disconnected hot spots – can reductions be achieved in overall pressures on the river basin from infrastructure, settlements, farming, or climate change. For example, preserving or re-instating natural floodplains upstream by setting back dikes can help absorb floodwater before it reaches urban areas.

The following case studies illustrate approaches to river basin management from different parts of Europe, which either take – or could take – this direction in order to tackle the causes of flooding. The first example demonstrates concrete achievements in terms of applying ecologically sustainable flood management measures in an IRBM context to secure reductions in flood risk. The other two assess existing approaches and put forward alternative solutions, also using ecologically sustainable flood management measures in an IRBM context, to achieve such reductions

Case study I: Morava river, Slovakia[69]

Characteristics of the river

The Morava is a middle-European river basin and one of the Danube's largest tributaries, with a length of 328 km. The lower reaches of the river form the border between Slovakia and Austria, while its middle section separates Slovakia and the Czech Republic. Discharge normally reaches a maximum in March and April due to mountain snowmelt, though floods may also occur due to heavy summer rainfall and high flows in the Danube.

Biodiversity values

The Morava supports diverse well-developed wetlands – mostly wet grasslands – with fragments of original floodplain forest occurring in protected areas. Due to its high natural values, the lower Morava river was designated as a Ramsar site in 1993.

Human interventions

The first river regulation measures were implemented by the beginning of the 19th century. These projects were mostly concerned with enabling navigation via the Morava river to the Danube. However, most flood protection measures were implemented from 1935 onwards. Since then, more than 90 % of the river's course has been regulated through dike construction, canalisation, and removal of all large meanders. Significantly altered hydrological conditions on the upper part of the Morava river, such as straightening of the river and construction of reservoirs in the Dyje river basin (the Morava's main tributary), have influenced the discharge regime in the lower Morava.
The course of the lower Morava was artificially shortened from 97 km to 79 km and 23 meanders were cut through and isolated from the main river bed, supposedly to enhance flood protection. However, as a result

[68] Swiss Reinsurance Company (Swiss Re); 1998 *Floods – an insurable risk?*, 51pp. Report available at http://www.swissre.com

[69] Information provided by Jan Sěffer, DAPHNE – Center for Applied Ecology, Bratislava, Slovakia. Phone +421-2-65412162, e-mail: daphne@changenet.sk

of this regulation, the floodplain was reduced to just 24% of its former area. Secondary causes of wetland loss include conversion of floodplain meadows to arable land by ploughing of 493 ha of meadow between the 1960s and 1980s. Nevertheless, the Morava retains a floodplain more than 3 km wide along its lower reaches, an exceptional feature in Central Europe, due largely to the fact that this was part of the 'iron curtain' border zone during the Cold War.

The role of the Morava floodplains in preventing flood damage

In early July 1997, exceptionally heavy rainfall occurred in Central Europe and affected the upper part of the Morava river. This situation resulted in the worst-ever recorded flooding of the Czech region of Moravia, with damage to buildings, roads, bridges, railway lines and water and sewerage networks. Inundated areas were typically up to 5 km wide (13 km in extreme cases) and up to 2.5 m deep. However, in the lower Morava, the floodplains were – just – sufficient to protect human life and property.

During the regionally catastrophic flooding of summer 2002, the lower 30 km of the Morava became a 5,000 ha lake. This was thanks to the retention capacity of the Morava floodplains, which is more than 100 million m^3 on the Slovak side alone (this compares with the volume of Gabcikovo – the largest dam in Central and Eastern Europe – which is 'only' 35 million m^3). The floodplain and its wetlands were able to absorb surges of Danube floodwater, thus slowing down the flood peak. The captured water was then slowly released. Compared with the situation in Austria and Germany, the consequences of the Danube floods were minimal, with only a few houses flooded at the confluence of the Morava and the Danube.

Common approach for river basin restoration

As mentioned earlier, significant floodplain areas remained along the Morava in spite of the river regulation works of the 19th and 20th centuries. Moreover, during the last decade, water management authorities, environmental non-governmental organisations (NGOs), stakeholders and state nature conservation authorities have been working together in different parts of the basin to maintain, restore and enhance the river's natural functions. This cooperation has resulted in a number of projects that are focused on re-opening meanders, restoring floodplains, improving forest management and increasing public awareness of floodplain values. Project implementation is based on strong participation of all local stakeholders and mutual agreement with land owners/users. All measures are in line with the principles of ecologically sustainable flood management combined with nature conservation interests. This approach is also among the main principles for the trilateral management plan for the lower part of the Morava river that is now being prepared by the ministries of environment from all three countries, with assistance from NGOs and individual experts.

Reopening of meanders

Water management bodies, working with the assistance of nature conservation authorities and NGOs, have so far removed structural regulation of the river bed, limited gravel mining, and reopened four meanders on the Slovakian side of the channel. However, the varied success of the measures implemented for each meander clearly indicates the complexity of the river system dynamics, and demonstrates that successful large-scale restoration throughout the basin will require much more detailed knowledge.

Restoration of meadows

To improve water quality in the Morava river and increase the retention capacity of floodplains, various restoration projects and programmes (including agri-environmental schemes) are being implemented in both the Slovakian and Austrian parts of the basin. These have focused on restoration and

management of more than 1,000 ha of floodplain meadows, including the successful conversion of 140 ha of arable or abandoned land to species-rich meadows on the Slovakian side and 74 ha on the Austrian side of the river.

In this context, a cost-benefit analysis of the environmental services provided by floodplains in Slovakia, taking into account the benefits from grassland management compared to arable land, and estimations of their value as a nitrogen sink was carried out[70].

This study, based on economic data provided by farmers and scientific information on the removal of nitrogen by wetlands, came up with very encouraging results. The cumulative net benefit to society from environmental services provided by the Morava floodplain wetlands (*see Graph 3*) was calculated to be in the range of 300 to 489 Euro/ha/year. Other economic valuation studies for floodplains in the Danube basin, including forest, grassland and wetland habitats, have produced similar results of around 383 Euro/ha/year[71].

Financing

The restoration activities have been supported by national, EU and international funding, invested mainly in hydrological and nature conservation research, implementation and monitoring of restoration measures on the ground, and public awareness activities. For example, a 1993-1997 UNDP/Global Environmental Facility project enabled ecosystem restoration techniques to be developed and refined at a series of demonstration sites. These projects have been followed up by a number of initiatives focusing on a sustainable future for the floodplains.

Lessons learnt

- The relatively large extent of the Morava river's remaining floodplains contributed significantly to reducing the Danube flood wave and mitigating the impact of flood events in August 2002

- The success of ecologically sustainable flood management based on basin-wide river restoration is dependent on the involvement of all relevant sectors (e.g. agriculture, forestry) during the planning process, and on developing detailed knowledge of the ecosystem

- The joint efforts of water management authorities, environmentalists, scientists, farmers and NGOs in the Lower Morava river represent a unique example of interdisciplinary cooperation and public participation in river basin management

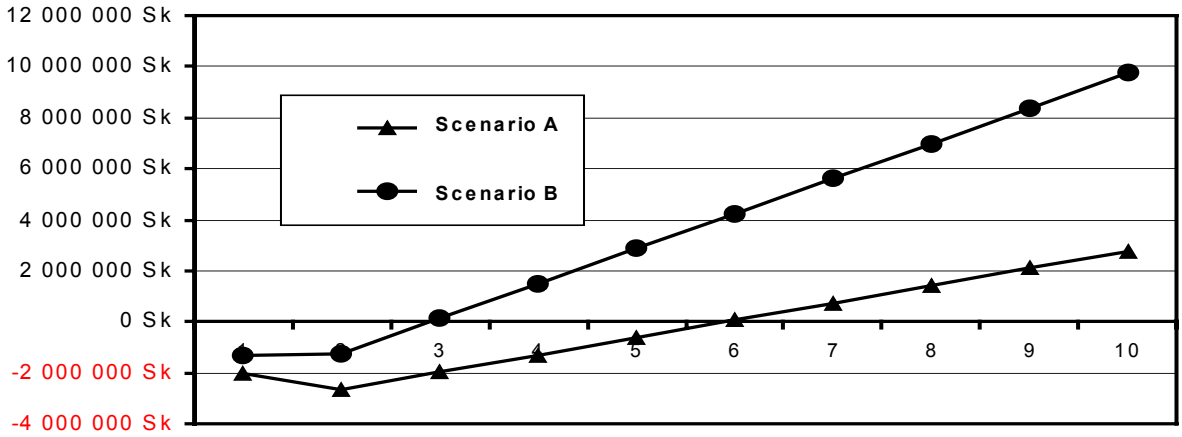
- Trilateral management plan priorities being prepared for the Lower Morava river take into account the legislative and financial opportunities provided by implementation of the EU Habitats and Birds Directives, Common Agriculture Policy, Rural Development Regulation and Water Framework Directive (see Chapters 4 and 5).

- The restoration and maintenance of the Morava river floodplains significantly increased the biodiversity value of the river's ecosystems, particularly wet meadows

[70] Sěffer, J. & Stanová V. (eds), 1999, *Aluviálne lúli rieki Moravy – význam, obnova a manazment.* DAPHNE – Centre for Applied Ecology, Bratislava

[71] Andréasson-Gren, I-M. & Groth, K-H.; 1995; *Economic Evaluation of Danube Floodplains*. Gland, Switzerland: WWF International

Graph 3- The cumulative cost/benefit of 10 years' restoration and the post-restoration period in the Morava floodplains for two scenarios (A = minimum number of flood days and B = maximum number of flood days). These depict two curves representing the limits of minimal and maximal estimates of the net social benefit of the restoration of degraded and converted meadows over a ten-year period. In all probability, a real net social benefit lies between these two curves. Moreover, it should be noted that probability of scenario A is around 20 – 30 per cent and probability of scenario B is between 70 – 80 per cent



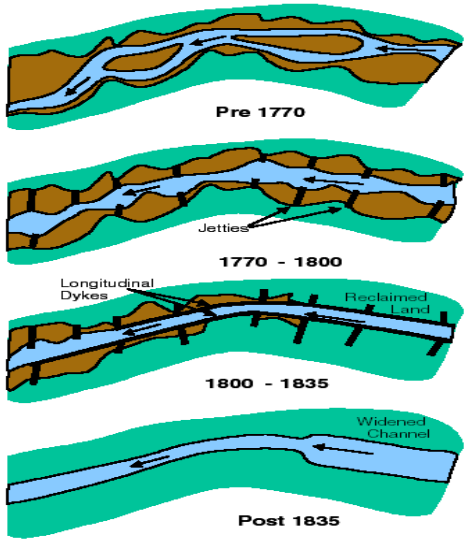
Case study II: The river Clyde, Scotland, UK[72]

Characteristics of the river

The river Clyde flows for around 100 miles from its source in the Southern Uplands of Scotland, down through the country's former industrial heartland to Glasgow and out into the Firth of Clyde (the estuary of the Clyde). On its journey from the hills to the sea the river flows across many local authority boundaries and receives water draining a large geographical area.

Causes of flooding

Under natural conditions the Clyde was a shallow river with shoals, which posed a problem for trade as ships were unable to navigate the river channel up to Glasgow. Once ports were developed in the lower estuary it was not long before efforts were being made to deepen the river, achieved by narrowing the channel, building quay walls and by dredging. These alterations have changed, and will continue to affect, how the river responds to flood events.



Development of the lower Clyde for navigation
(adapted from 'Clyde Navigation', J. F. Riddell (1979))

The key factors in flooding are intensity and duration of rainfall and initial catchment conditions. A wet catchment has no extra capacity to store water and thus river flows

[72] Information provided by Mike Donaghy, WWF Scotland. Phone : +44 1887 820 449 or email : mdonaghy@wwfscotland.org.uk

peak faster. Coastal/tidal flooding can occur during exceptionally high tides or during storm events when low pressure systems result in storm surges that funnel water up the estuary. Wind action causes increased wave heights which also contribute to coastal flooding. Drainage networks in urban areas have been developed to take away surface runoff and sewage. These are sometimes old, with insufficient capacity if they have not been upgraded to reflect increased development. They are generally designed to carry runoff from a storm event with a 1 in 5 probability, i.e. with a 20% chance of occurring in any given year. During more intense storm events urban drainage networks can be overwhelmed, leading to flooding. More severe floods are predicted to occur more frequently in the future as a result of climatic changes. A medium climate-change scenario predicts that the odds of a currently '1 in 100 years' flood event are expected to narrow to 1 in 65-70 years by the 2020s and to 1 in 40-60 years by the 2080s.

Main flooding issues for the Clyde catchment:

- The Clyde is Scotland's largest populated catchment
- Flooding from tributaries of the Clyde often occurs in urban areas
- Tidal flooding occurs in the Firth of Clyde
- Glasgow experiences the interaction of both extreme river flows and extreme tides
- Urban drainage networks (especially older infrastructure) may be overwhelmed
- Siltation has reduced channel capacity and changed the flow regime
- The river basin covers an extensive geographic area, so solutions may not be within the jurisdiction of any one local authority

Flood history

The threat of flooding from the Clyde is not a new phenomenon but something that generations of Clydesiders have had to face. In recent decades, major floods occurred in 1977, 1985 and 1994. Climate change scenarios predict an increase in the frequency of flooding in the future.

The catchment of the river Clyde is home to more than a third of Scotland's 5 million inhabitants, with over 600,000 living in Glasgow. Glasgow ranks 4th among UK cities at risk from flooding. Recent research for the Scottish Executive showed that around 23,000 properties are at risk from a one-in-100 years flood of the Clyde and its tributaries, with a further 23,000 properties at risk from tidal flooding in the Clyde estuary, out of a total number of around 780,000 properties.

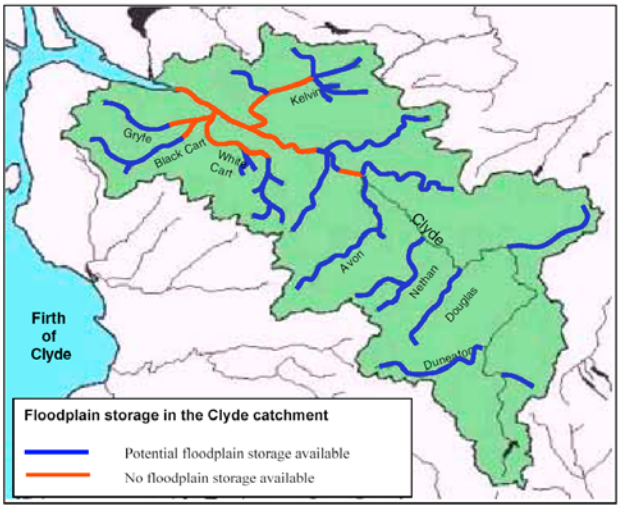
Scotland has not experienced a flood of this magnitude in recent years but has been hard hit by devastating regional flooding. The Association of British Insurers estimates that, in the last decade, the three largest floods in Scotland cost the insurance industry £170m. The Scottish Executive has reported that around 170,000 properties in Scotland are threatened by flooding. Given that the average insurance claim for a flooded residential property is £28,000 (EUR 41,000), the potential flood risk for this sector alone can be valued at close to £50m (EUR 73 million).

Working with rivers – ecologically sustainable flood management

There are two options available for dealing with floodwaters: either move them or store them. In natural, unaltered river systems, both these processes take place. Wetlands and washlands provide areas of flood storage, while water moves quickly through steep-sided valleys and gorges.

The Clyde has a variety of engineered flood defences, the vast majority of which involve encouraging the movement of water. These are typified by floodbanks and floodwalls where rivers pass through built-up areas. These areas no longer have any real potential for storage, and are highlighted in red (black on a grey-scale printout) on the adjacent map. The surviving floodplain could be managed much more sustainably to reduce the impact of

flood events. As experts predict larger, more frequent flooding in future, the additional protection required could be gained – at least in part – by new approaches to flood management.



Floodplains as storage

Much of the Upper Clyde catchment has a floodplain, which has been developed for agricultural use rather than housing or industry. There is potential to make better use of these areas – highlighted in blue in the map above (dark grey on a greyscale printout) – for flood storage in order to limit the overall effects of catchment flooding.

What does the future hold?

(a) **2050: Traditional approach only**. Given the predicted rise in the frequency and magnitude of both river and tidal flooding, the traditional hard engineering flood protection route will involve increasing the height of existing defences and building new defences to protect areas that are likely to be affected by flooding in the future.

Using estimated costs for Glasgow, it would cost approximately £2,000 (almost EUR 3,000) per property for tidal flood prevention. Given that around 93,000 properties in Scotland are estimated to be at risk of tidal flooding, it would cost in the region of £186 million (EUR 273 million) to protect these properties with hard defences. A similar financial investment is likely to be required to provide river flood defence walls for the further 77,000 properties at risk from river flooding.

Hard flood defences are a static approach to flood risk management, with a nominal design life of 50 years, a fixed level of protection and further investment required for their maintenance. The flood risk, changing climate and land use are all dynamic, and the design parameters are constantly moving. Increasingly high floodwalls are not an environmentally or economically sustainable option, isolating communities from the river, resulting in losses in amenity value, habitats and species, as well as natural flood alleviation potential.

(b) **2050: Ecologically sustainable flood risk management across basin**. River flows during the 1994 floods on the lower Clyde overtopped the artificial banks for more than 48 hours. A floodplain of 182 km^2 filled with water to a depth 0.3 m – equating to approximately 10% of the total Clyde catchment area – would have been required to store this water until the danger of flooding had passed. However, a much smaller area could make a significant difference to the volume and timing of the flood peak in the lower river if upstream floodplain storage along the Clyde and its tributaries was increased. While such floodplain storage measures will not directly help to solve Glasgow's tidal flooding problems, they can attenuate the effects of high river flows coinciding with extreme tidal events. However, this demands a strategic approach across land uses, all tributaries and the estuary, something that is not in place at present.

It is difficult to quantify the cost of using floodplains instead of providing hard defences. Under the 2001 Rural Stewardship Scheme, 5.5 km^2 of floodplain are managed on the basis of an agreement that flooding will not be prevented. Landowners receive an annual payment of GBP 25 per hectare under this

agreement. Given that Scotland's total inland floodplain, not allowing for flood defences, covers 2,950 km^2, there is plenty of potential for use of environmentally sensitive flood alleviation options. A catchment-wide approach to flooding should ensure that flood risk can be managed strategically and proactively, allowing for the best option and the most sustainable balance to be reached.

Conclusions/Lessons learnt

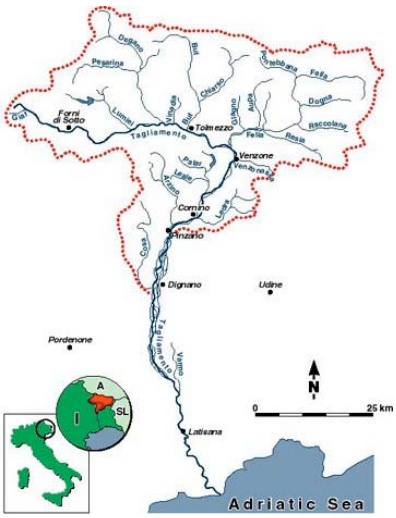
- The example of the Clyde river basin illustrates that the emphasis should not be on *preventing* flooding but on *better management* of floods. The impacts of flooding can be significantly reduced by ecologically sustainable flood management, using information on the whole catchment to design appropriate flood protection measures for the whole river.

- WWF believes that Scotland is at a crossroads in how flood risks are managed. We have the opportunity to deal with the problem at source, tackling flood risk alongside other water issues, such as water quality, land use, biodiversity and recreation. Alternatively, we can continue with the present fragmented approach, protecting one stretch of river at the expense of downstream inhabitants because no one stands back to look at the bigger picture.

Case Study III: Tagliamento river, Italy[73]

Characteristics of the river

The Tagliamento river is located in the Southern Alps of northeast Italy. It originates at 1,195 m above sea level and flows for 178 km to the northern Adriatic Sea, thereby forming a linking corridor between Alpine and Mediterranean zones. Its drainage basin covers 2,871 km^2. Dikes have constrained the lower 30km of the river, so that it is now little more than an artificial channel, about 175m wide. However, the upper reaches of the river are more or less intact, so that basic river processes – such as flooding, or the erosion and accumulation of sediment – take place under natural conditions.



Map and picture of the Tagliamento river catchment

Causes of flooding

The basins of the main tributaries of the upper Tagliamento catchment lie in one of the wettest regions of Europe, where annual precipitation can reach 3,000 mm. The catchment is mainly mountainous and the slopes are very steep, leading to high peak flows and sediment loads in the central and lower part of the basin. The flood peak moves downstream so fast that it can reach the town of Latisana (on the regulated lower part of the river) in just 12 hours. Upstream, where the floodplain still functions naturally, the height

[73] Information provided by Nicoletta Toniutti, WWF Italy, European Alpine Programme +39 0432502275 or e-mail n.toniutti@wwf.it

of the river rises and falls by only 2m. Close to Latisana, though, the river is squeezed into such a narrow channel that its level may fluctuate by as much as 7m. The dikes were originally built during the second half of the 19th century to protect the main population centres and farmland. However, their effect has been to increase the risk of severe flooding. On 4-5 November 1966, breaching of the dikes caused the deaths of 14 people, more than 5,000 others lost their homes entirely, while 24,000 suffered serious damage. Latisana was the most severely affected area.

Following the 1966 disaster, the regional and national authorities began discussing how to protect people from flooding. However, wetland drainage, dike construction, urbanisation, industrial development and intensive cultivation continued apace in former floodplain areas along the middle and lower Tagliamento, further increasing the threat of catastrophic flooding. In 1996, water levels in Latisana were close to overtopping the dikes and hydrologists predict that it is only a matter of time before even the 1966 flood level is exceeded.

New plans, old solutions

It is only now, after almost 40 years, that a 'solution' has been put forward by the local water authority in the form of a flood protection plan for the middle and lower Tagliamento. However, this involves the construction of artificial floodwater retention basins and additional regulation of the river's course, which, as discussed below, is far from a sustainable option. Shortcomings in the process of developing the plan include lack of understanding about the underlying causes of flooding in Latisana, while the involvement of local communities, other stakeholders and scientists has not yet really been implemented.

The plan envisages the construction of flood retention basins along the middle course of the river. These would cover 14 km^2 and be capable of storing up to 30 million cubic metres of water for at least 10 hours. This would reduce the peak discharge at Latisana from up to 5,000 m^3 per second to 4,000 m^3 per second. The proponents of the scheme claim this is sufficient to prevent damage from most flood peaks – except those so severe that they are expected to occur, on average, less than once in one hundred years. However, recent experience across Europe suggests that the frequency of unusually high flooding is increasing and that the low mathematical probability offers little comfort when an exceptional event does occur. Furthermore, the retention basins along the Tagliamento would be built on intact floodplains and destroy one of the ecologically most important areas along the entire river (including a proposed Natura 2000 site). New dikes would be built, further constricting the river's course and significantly reducing recharge of the area's important groundwater aquifer. Narrowing of the riverbed would also accelerate the water flow, thereby increasing erosion.

A new process for a more sustainable approach to flood alleviation in the Tagliamento

WWF's European Alpine Programme has financed a preliminary feasibility study, taking into account hydrological, socio-economic and ecological issues. This study showed that although there are flood management options that would provide both better protection for human communities and maintenance of the river's ecosystem, international experience shows that successful design and implementation requires in-depth understanding of the hydrological, geomorphological and ecological features of the entire watershed. In order to achieve this for the Tagliamento, it is a matter of urgency to acquire additional information and knowledge; not only from multidisciplinary, scientific studies, but also from active engagement with the people living and working in the basin.

In fact, the WWF study highlights serious data deficiencies concerning many features of the Tagliamento watershed. The safety of the basin's population and the future of a significant part of Friulia depend on rectifying these shortcomings. A multidisciplinary team of specialists, working in cooperation with the basin authority, should carry out not only research along the river corridor itself, but also studies to enable integrated catchment management, thereby safeguarding the hydrological and ecological functioning of the river. This would be achieved by protecting and enhancing the values of remaining natural areas and taking into account all the problems that affect the fluvial corridor, as well as by identifying appropriate actions that are in line with the principles of the EU Water Framework Directive.

By following this approach, it would be quite possible to make the Tagliamento river a focus of international interest, thereby generating long-term advantages with regard to both socio-economic and environmental aspects. Technically, there are no real limitations. It is clear that the safety of human populations can guaranteed by promoting restoration of a hydro-geological and ecological equilibrium. What is lacking is the political will to pursue this course. The planning and decision-making context must enable sustainable management options to be identified and selected.

3.4 – Conclusions

It is abundantly clear that water-related issues cut across sectors (e.g. agriculture, industry), political and administrative borders (e.g. regional, national and international boundaries), interest groups (e.g. public, private, NGO, recreational, industrial), environmental requirements of different species groups (e.g. people, animals, plants) and can be found in different ecological systems or 'compartments' (e.g. rivers, lakes, wetlands, above ground, below ground, soil). It is therefore necessary that any water-management policy takes these crosscutting elements into account and defines ways in which to address them fully. Policies should be oriented towards ensuring the proper and long-term functioning of ecosystems and maintenance of biodiversity. This requires assessing the needs and expectations of all 'water stakeholders' at a basin-wide level and the basing of final decisions on the best possible information. Integrated River Basin Management (IRBM) is internationally recognised as the best mechanism for accomplishing these objectives.

IRBM means addressing at river basin level all activities, interests, impacts and effects relating to the water environment, understanding the relationships between them and defining measures to tackle existing problems (e.g. pollution, over abstraction, floods, droughts) in an integrated manner. In this way, sustainable solutions – that respond to the needs of people, economy and the environment – are generated, instead of repeating the failed and fragmented approaches of the past that deal with problems on a local, and usually temporary, basis.

It follows that, in order to be successful, flood (damage) prevention, protection and management strategies need to take into account the entire river basin (its characteristics, inhabitants, uses, ecosystems, etc.) in order to generate a positive cumulative outcome from the individual measures implemented along a watercourse. Such strategies should ensure flood management measures that are ecologically sustainable in addition to delivering increased security for people and property. A fundamental requirement of such an approach is cooperation between sectors and stakeholders dealing with different aspects of flooding (e.g. weather forecasting and risk planning). The culmination should be the definition of a long-term, interdisciplinary strategy, with a strong safety component, based on a combination of structural, preventive and non-structural measures to be applied at the basin level, and across boundaries where necessary.

Experiences from Europe confirm that:

- Ecologically sustainable flood management can be successful in achieving the objectives of safety for people as well as preservation of the river ecosystem if based on basin-wide river restoration/conservation; if all relevant sectors (e.g. agriculture, forestry, NGOs) are involved during the planning process; and if detailed knowledge of the hydrological, geomorphological and ecological features of the entire watershed ecosystem is developed – not only from multidisciplinary scientific studies, but also from the participation of those who live and carry out their activities along the river by actively involving the basin communities.

- A certain flood risk will always exist. Ecologically sustainable flood management works by shifting the emphasis from *preventing* flooding to *better management* of floods. The impacts of flooding can be significantly reduced by using information from, and designing appropriate flood management measures for, the whole river basin taking into account its ecology (e.g. setting aside floodplain areas for flood storage in order to limit the overall effects of flooding in the basin).

- Many countries are now at a crossroads in how they manage flood risk. They have the opportunity to deal with the problem at source, tackling flood risk alongside other water issues, like water quality, land use, biodiversity and recreation, in an IRBM context. Alternatively, they can continue with the present fragmented approach, protecting one stretch of river at the expense of downstream inhabitants because no one stands back to look at the bigger picture.

The WFD requires the establishment of IRBM across Europe via the development of River Basin Management Plans (RBMPs) in a participatory manner and is, therefore, the right vehicle to provide an IRBM context to flood management. It follows that water management and water-management related measures to prevent, protect and mitigate flood damage required at national or international (transboundary) levels **must** be included in the WFD's RBMP planning process; a conclusion supported by Article 13.5 of the Directive. Thus, IRBM requires – and the WFD allows – that for each River Basin District, there should be a single RBMP governing overall spatial integration of measures for sustainable water management, including those for flood (damage) protection, prevention and mitigation.

Indeed, if flood risk is to be managed via **Integrated** River Basin Management – a point that is universally agreed[74] – there should be no separate planning process at the river basin level to deal specifically with flooding and running in parallel with the WFD RBMP [75]. This would be liable to result in proposals that are less effective and less sustainable, making no sense economically, environmentally or administratively (the latter bearing in mind that the same over-stretched, under-resourced public administration body is liable to end up with responsibility for developing and implementing two overlapping plans). Worse still, measures proposed under a separate 'flood plan' might even become an obstacle for achieving the legally biding objective of under the WFD's RBMP. Indeed, to avoid such a situation, any measures developed for managing flood risks, and that might have a negative effect on the achievement of 'good ecological and chemical status', must go through the requirements of the WFD RBMP planning process, including derogation tests.

[74] As stated in the conclusions of several international conferences on flooding, detailed in Chapter 4 and elsewhere in this paper, as well as the EU's *Best practices for flood protection, prevention and mitigation* paper *(see also Chapter 4)*

[75] As seems to be suggested by the European Commission services developing the Communication and Action Programme on *Flood prevention, protection and mitigation*

4. Policy tools in Europe for ecologically sustainable flood management

The recent flood events in Europe in the summer of 2002 were considered by many as one of the worst natural disasters in living memory. The resulting devastation required rapid and effective measures to minimise loss of life and property, and to prevent additional risks to human health and the environment. However, it was also clear that radical changes were needed to policies and practices governing planning and management of land and water if such catastrophes were to be prevented in the future.

As a consequence, a range of actions and initiatives were stimulated at European and national levels, especially with regard to policy and financial measures. The latter were aimed mainly at paying for immediate clean-up and risk reduction activities, while policy initiatives have taken a longer-term perspective and have begun to address the driving forces behind the increasing regularity and severity of flood events in Europe.

The policy and legal framework for ecologically sustainable flood management in Europe already exists

WWF believes that the existing international legal framework – at both European and global levels – provides a sound basis for ecologically and economically sustainable approaches to flood management and risk reduction[76]. Key instruments include the EU Water Framework Directive (WFD) and other EU water-related Directives, EU nature conservation legislation, the WFD Common Implementation Strategy process and global treaties such as the 'Ramsar' Convention on Wetlands and the Convention on Biological Diversity.

4.1- EU policy tools

4.1.1- The Water Framework Directive: The right tool for ecologically sustainable flood management in Europe

The Water Framework Directive[77] (WFD) offers an extraordinary opportunity to manage all land and waters at a river basin and sub-basin level in a way that protects the environment and people from the damaging effects of flooding. It represents a significant change to the traditional water management policies in Europe because integrated basin-wide management is its fundamental building block.

Integration – in order to deliver the Directive's objectives – is required not only geographically, but also across policy sectors, recognising that policies impacting on freshwater ecosystems must not be developed and implemented in isolation from one another.

The WFD also provides for international/transboundary cooperation and planning, and has a strong emphasis on public participation. It further allows for working with nature, rather than against it, through the restoration and conservation of wetlands and floodplains, which are not only central to the delivery of 'good water status' – the overall aim of the Directive – but also help to reduce the likelihood of catastrophic flood impacts.

Although the specific role that the WFD may play in precautionary flood (damage)

[76] Cf. Background briefing paper *Managing Floods in Europe: The answers already exist – More intelligent river basin management using wetlands can alleviate future flooding events* available at http://www.panda.org/downloads/europe/managingfloodingbriefingpaper.pdf

[77] The WFD text can be downloaded from the EU's 'Eur-Lex' legislation database: http://europa.eu.int/eurlex/en/lif/reg/en_300L0060.html and from the WWF website: http://www.panda.org/about_wwf/where_we_work/europe/what_we_do/freshwater/initiatives/policy.cfm

protection is not explicit in the text of the Directive, the issue is addressed indirectly via the obligation for 'no further deterioration' of aquatic systems. Nonetheless, it clearly sets as one of its purposes "*to mitigate the effects of floods and drought*" (Article 1 e). In addition, the obligation, set out in Article 4, to achieve 'good ecological and chemical status' in all waters by 2015 provides the context for identifying ecological solutions for problems, including flooding, in a freshwater ecosystem. The Directive's specific requirement *"to protect, restore and enhance wetlands"* will be key for the development of ecologically sustainable flood management measures.

River Basin Management Plans (RBMPs) are the framework within which the measures for achieving 'good status' are to be defined, and provide the appropriate mechanism for spatial integration of measures for sustainable water management, i.e. for the implementation of Integrated River Basin Management (IRBM). In the case of transboundary basins, the WFD requires RMBPs to be prepared jointly by two or more Member States (and in conjunction with non-EU countries where applicable).

By making public participation mandatory in the development of RBMPs, the WFD provides a unique opportunity for cooperation and involvement of stakeholders. These range from the water management sector, to major users such as agriculture and industry, secondary users such as water supply companies, NGOs, the general public and authorities involved in regional planning at local, national, and international levels. This participatory approach should facilitate the development of solutions based on more complete knowledge of the effects of flooding on a broad range of stakeholders.

Indeed, because a RMBP is the primary vehicle for defining and implementing all the measures necessary for achieving 'good status' in a participatory manner for a given river basin district, WWF is convinced that the RBMP planning process **must** include any water management and water—management related measures for flood risk management required at national or international levels. This is supported by Article 13.5 of the Directive allowing the RBMP to be supplemented by another plan dealing with a specific water issue. Thus, IRBM requires and the WFD allows that, for each River Basin District, there should be a single RBMP governing overall spatial integration of measures for sustainable water management, including those for flood (damage) protection, prevention and mitigation.

It would make no sense at all – economically, environmentally or even administratively, as the same administration might be in charge of both – to develop and implement a separate planning process for flood management[78] and outcomes are likely to be less effective and less sustainable. Worse still, measures under a separate 'flood plan' might even become obstacles for achieving the legally biding objective of 'good ecological and chemical status' under the WFD's RBMP. Indeed, to avoid this, any measures developed to manage the flood risk that could have a negative effect on the achievement of the 'good status' objective must go through the WFD RBMP planning process requirements, including derogation tests.

4.1.2- The WFD Common Implementation Strategy guidance documents and flood management

In order to assist the achievement of the demanding objectives of the WFD on the ground, the EU Member States and European Commission agreed in May 2001 to develop a Water Framework Directive 'Common Implementation Strategy' (WFD CIS). This is a platform bringing together the European Commission, Member States, Candidate Countries and stakeholders, for the purpose of sharing information, experience and expertise to develop guidance documents on several of

[78] As seems to be suggested by the European Commission services developing the Communication and Action Programme on *Flood prevention, protection and mitigation*.

the complex technical issues covered by the WFD.

Thirteen Working Groups, each under the leadership of one or more countries, were established mainly to identify and select 'best practice' approaches to river basin management planning and to generate guidance that is technically feasible and ecologically and economically sound. The guidance documents[79] are now subject to testing and validation in 'pilot' river basins, prior to production of a Manual on Integrated River Basin Management to assist regional, local and national authorities with WFD implementation and compliance.

At first, flood management issues were not covered explicitly by the WFD CIS process. However, the summer 2002 floods pushed the EU Member State Water Directors to introduce, in all WFD CIS guidance documents, a paragraph stressing the need to manage floods as part of integrated river basin management (IRBM). This called for the *"Integration of all significant management and ecological aspects relevant to sustainable river basin planning including those that are beyond the scope of the Water Framework Directive such as flood protection and prevention"*. The fact that this text was introduced in the Foreword of all guidance documents reflects the political importance floods had gained in the WFD CIS agenda by then and emphasises the cross-cutting nature of flood management. Moreover, it also underlines the need for Member States to use the WFD's full potential by making flood management an integral part of their RBMPs.

[79] Guidance on: Analysis of pressures and impacts; Identification of water bodies; Public participation in relation to the WFD; Typology, reference conditions and classification systems for transitional and coastal waters; Identification and designation of heavily modified and artificial water bodies; Economics and the environment; Monitoring; Reference conditions and ecological status class boundaries for inland surface waters; Intercalibration; the Planning process; GIS; Wetlands; and Ecological classification all available at http://forum.europa.eu.int/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents&vm=detailed&sb=Title

Indeed, the WFD CIS did finally become the context for a *European initiative on flood prevention, protection and mitigation*, which has led to the drafting of a *Best practices paper on flood prevention, protection and mitigation* and will further lead to the adoption of a European Commission Communication and Action Programme on the issue (see 4.1.3 below).

4.1.2.1- The WFD CIS horizontal guidance document on "The role of wetlands in the Water Framework Directiv"

In Article 1(a) the WFD clearly identifies part of its purpose as being to protect, restore and enhance wetlands. However, it does not define what a wetland is, nor does it explain to what extent wetlands should be used to achieve the WFD's environmental objectives, such as "mitigating the effects of floods". Because of these ambiguities, the EEB and WWF persuaded the European Commission, EU Member States and Candidate Countries and other stakeholders that, in the context of the WFD CIS, the role the wetlands play in implementing the WFD should be explored and clarified.

The Water Directors meeting in November 2002 provided a common 'Wetlands' text to be inserted in all WFD CIS guidance documents. In this text the Directors acknowledged that wetlands are coming under increasing pressure and highlighted their potentially important role in river basin management and in helping to achieve WFD environmental objectives. It is important to note that this text states that: "*Wetland creation and enhancement can in appropriate circumstances offer sustainable, cost-effective and socially acceptable mechanisms for helping to achieve the environmental objectives of the Directive. In particular, wetlands can help to: abate pollution impacts,* ***contribute to mitigating the effects of droughts and floods****, help to achieve sustainable coastal management and to promote groundwater re-charge. The relevance of wetlands within programmes of*

measures is examined in the horizontal guidance paper on wetlands".

The Water Directors also recommended that a WFD CIS horizontal guidance document on wetlands should be prepared to realise the principles mentioned in the 'common text on wetlands'. This horizontal guidance is now available. Although the document does not define wetlands, it provides a description of what wetlands are and explains the relationship between ground- and surface-water bodies (the 'units' to which the environmental objectives of the WFD are to be applied, and monitored) and wetlands. It also explains how to include wetlands within the river basin planning cycle[80]. The central chapters in the horizontal guidance document on wetlands are:

- **The specific role wetlands play in achieving WFD environmental objectives**. This is illustrated by specifying minimum requirements, the relationship between wetlands and WFD objectives for surface water, and the relationship between wetlands systems and Heavily Modified and Artificial Water bodies. It also explains the relevance of wetlands in achieving environmental objectives for groundwater, transitional and coastal waters, and protected areas.

- **The role of wetlands in 'basic' and 'supplementary' measures.** This chapter pays particular attention to wetland restoration and recreation as possible 'measures' within the RBMP's programme of measures, also taking into account economic tests, as necessary, to prevent further deterioration and to achieve 'good ecological status'.

It also pays special consideration to how wetlands can be used to manage floods and droughts in a manner compatible with WFD objectives including through case studies. It stresses that such consideration "*could greatly assist Member States with (WFD) implementation, and in integrating flood management strategies with River Basin Management Plans. It is highly likely that a mixed range of flood management options will be part of sustainable flood management in the future*".

4.1.3- European initiative on flood prevention, protection and mitigation

Another important reaction to the floods in Central and Eastern Europe during the summer of 2002 was the clear perception by the authorities at national, regional and local level – as well as the EU institutions, insurance companies and others – that traditional policies and practices for flood prevention and protection, based on infrastructure development, had failed significantly. Policy decisions and instruments for the future had, therefore, to go beyond the existing perceptions and 'beliefs' and really address the root-causes behind floods, not just the symptoms.

At European level, the EU Environment Council meeting in October 2002 sent a very clear signal of this change of perception by mandating the European Commission to begin elaboration of a Europe-wide instrument that would assist Member States and Candidate countries in defining and implementing new and more effective flood prevention measures. These could also constitute a paradigm shift towards ecologically sustainable flood management, and some Member States (e.g. Germany) have already started moving in this direction.

In November 2002, the European Commission supported and took forward a proposal made by the Netherlands to the other EU Member State and Accession Country Water Directors that an 'Initiative on flood prevention, protection and mitigation' in the context of the WFD CIS process be developed. This

[80] In these cases, a clear distinction is made between legal obligations and 'best practice' recommendations. Note that EU Member States and Candidate Countries always have the flexibility to establish stricter environmental protection according to their particular national concerns

initiative, co-led by the Netherlands and France, was aimed at sharing experiences and compiling 'best practice' examples, and other relevant information, for sustainable flood management. Key concepts for its development would be policy integration at EU and national levels, use of existing legislation and instruments, and strengthening of international cooperation.

This meeting was followed in December 2002 by a High Level International Conference on 'Prevention of flood hazards by integrating socio-economic and environmental considerations' in Budapest[81] (in December 2002), which took forward this concept and began defining what such a pan-European initiative should encompass. The final Joint Statement from the conference called for a *"new comprehensive approach to flood management at an international level, implying better harmonisation of water policies and land use practices, as well as environmental protection and nature conservation"*. IRBM was recognised as the core element for flood prevention, protection and mitigation, and the RBMPs under the WFD as the fundamental tool to achieve these objectives.

A further International Conference on 'Precautionary Flood Protection in Europe' took place in Bonn in February 2003, and emphasised the need for integrating the European initiative on flood protection into other policy areas, such as transport, shipping, urban development, emergency management, and especially nature conservation.

Subsequently, during their June 2003 meeting in Athens, Water Directors achieved agreement on, *inter alia:*

- The need for reinforced political commitment to flood prevention and flood protection.
- Integrated river basin management being the tool of choice to address flood prevention and flood protection, with experiences and achievements by International River Conventions (Danube, Rhine, Elbe, Oder, Moselle/Mosel, Schelde/Escaut and Meuse/Maas) being highly relevant.
- EU funding mechanisms being very powerful and effective instruments for promoting investments in flood prevention and protection schemes, with funding conditional upon the existence of integrated flood prevention plans at the level of the river basin.

Some of these meetings were developed in parallel with the WFD CIS process and were not formally part of it, whereas others were. In all cases, however, the main conclusions provided significant inputs to the formulation of the document 'Best practices on flood prevention, protection and mitigation' developed in the context of the WFD CIS as a result of the above-mentioned Water Director's agreement. A Working Group charged specifically with the task of preparing this document was established under the joint leadership of the Netherlands and France with participation from most of the EU Member States and Accession Countries as well as some stakeholders, including WWF. The Water Directors at their meeting in Rome in November 2003 endorsed the final version of this paper[82]. Its various components will later be integrated into the WFD CIS 'Manual', due for publication in 2006.

The 'Best practices on flood prevention, protection and mitigation' document includes an exhaustive analysis of the root causes of increased flood impacts in Europe. It also

[81] *Budapest Initiative on strengthening International Cooperation on Sustainable Flood Management, Joint Statement by the Heads of Delegations, International Conference on Prevention of Flood Hazards,* Budapest, 30 November – 1 December 2002. Available at http://www.kancellaria.gov.hu/tevekenyseg/esemeny/2002/12/1201_e_5.htm

[82] The paper is available at http://forum.europa.eu.int/Public/irc/env/wfd/library?l=/framework_directive/ksdocumentssonsfloodspre&vm=detailed&sb=Title

identifies what needs to change in terms of existing practices and 'mentalities' in order to tackle flooding more successfully and sustainably at all levels, and makes recommendations on how to deal with the previously identified root-causes. The document also constitutes an inventory of 'best practice' in flood-risk reduction, based on experience across Europe with regard to:

- Integrated river basin approach
- Public awareness, public participation and insurance
- Research, education and exchange of knowledge
- Retention of water and non-structural measures
- Land use, zoning and risk assessment
- Structural measures and their impact
- Flood emergency
- Prevention of pollution

Furthermore, at the Rome Water Directors meeting, "*the Commission (DG Environment) presented a position paper on the preparation of a European initiative on flood prevention and protection. The Commission envisages preparing a package on flood prevention and flood protection including a Communication on ongoing flood-related EU activities (including funding aspects) and a legislative proposal focusing on flood prevention and protection plans at river basin level, closely linked to the Water Framework Directive. The proposals of the Commission will make best use of the (...) finalised document on "Best Practices"*. The above-mentioned Communication – bringing together all the flood-related activities at the EU level as well as an Action Programme on Flood prevention, protection and mitigation are expected in June 2004.

In addition, Germany will host an international conference on the issue of floods under the umbrella of the United Nations Economic Commission for Europe (UNECE) in June 2004. The Dutch Presidency of the EU, during the second half of 2004, also intends to hold a political debate on flood prevention and protection at an informal Environment Council. All these events should contribute to further promoting the subject of flood management in the EU's agenda and to generating more ideas for addressing flooding in an ecologically sustainable way.

4.1.4- EU civil protection initiative[83].

As a further response to the flood disaster of 2002, the Commission starting working on the adoption of an 'Integrated EU strategy on prevention, preparedness and response to natural, man-made and other risks'. Preparatory work for this strategy has taken a civil protection angle and has been led by DG Environment. The strategy is supposed to cover a whole range of issues from forest fires to technological disasters (e.g. spills from industrial plants), including a strong component on flooding. The goal is to protect citizens and the environment by identifying risks, raising public awareness, adopting preventive measures and identifying necessary actions. This requires integrating relevant instruments and initiatives under several policy areas at EU level.

Taking into account that the protection of people and environment is a complex issue; the 'environmental component' of civil protection policy should have full regard for existing environmental legislation instruments. It is important for any new strategy to recognise that the WFD already provides for the integration of sectoral planning, international cooperation and 'good status' of waters through IRBM, including issues and measures related to flooding. Furthermore, it is vital that links should be established with the above-mentioned initiative on 'Flood prevention, protection and mitigation', as well as with the future European Commission Communication and Action Programme on the topic planned for the summer of 2004. It is also important that, in the context of civil protection planning policies, Member States

[83] More information available at http://www.europa.eu.int/comm/environment/civil/prote/integrated_strategy_en.htm

and public authorities realise and tackle the limitations inherent to flood prediction/modelling methods.

WWF has recently become aware that the flooding component of the civil protection initiative could be integrated into the European Commission's forthcoming *Communication and Action Programme on Flood prevention, protection and mitigation*. We support this move and hope that these initiatives will finally open the way for ecological approaches to sustainable flood management and change the reluctant, sceptical or just overly cautious attitude of many governments.

4.2- Other European initiatives

As shown in previous sections and chapters, the increasing social and economic impacts of natural hazards, especially flooding, has raised awareness at the pan-European level and mobilised transboundary actions, including those led by international river commissions.

In 2000, at the Second Meeting of the Parties to the United Nations/Economic Commission for Europe (UN/ECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes, guidelines for sustainable flood prevention[84] were adopted. This is an instrument aiming to reduce the impact of flood disasters in Europe and was developed by a Task Force on flood prevention and protection, which included national experts from European countries led by Germany, together with experts from the World Health Organisation, the World Meteorological Organisation, the International Decade for Natural Disaster Reduction, the ECE Secretariat and the International Commissions for the Protection of the Rivers Rhine and Elbe.

The adoption of the guidelines was an important stepping stone towards a more integrated and well-established flood prevention policy in the European region. The document emphasises the need to implement existing preventive measures such as: building (construction) codes, legislation to relocate infrastructure away from flood-prone areas, appropriate land-use planning, and adequately designed floodplains and flood control structures. Priority is given to integrated water management measures for the whole river basin rather than to the management of floods as such. This includes integration of the requirements of flood prevention and reduction, including the provision of retention areas, into physical planning as well as urban and rural development. Cooperation within each riparian country as well as effective cross-border collaboration and strong involvement of the public are highlighted as crucial elements that governments should consider when setting up joint management bodies.

Both the Rhine and Danube rivers – two of the most important in Europe – have well-established river basin organisations in the form of International Commissions, which coordinate policy and technical work at a whole-basin level. Significant work on ecologically sustainable flood management has been carried out in both basins; for further information see: http://www.iksr.org/hw/icpr/ and www.icpdr.org

4.3- National policy initiatives

One good example, among many in Europe, is Belgium. Others include Scotland, Hungary, Germany and Poland, but for the purposes of this document the Belgian case has been elaborated.

4.3.1- Belgium

Environmental issues, including flooding, come under the responsibility of Belgium's regional governments. This means that Flanders, Wallonia and the Brussels Region have all developed different strategies.

[84] For more information http://www.unece.org/env/water/publications/documents/guidelinesfloode.pdf

Nevertheless, as part of the International Commission for the Scheldt and the Meuse, all three regions attempt to work together.

Tidal flooding – Flemish flood policy and the Scheldt river basin

With a population density of 434 inhabitants per square kilometre, the Flemish region is one of the most densely populated areas in Europe. In addition, a majority of the region lies in the Scheldt river basin – the most industrialised in Europe with large urban conglomerations and Europe's highest population density. The length of the main river is 355 km, of which 160 km are tidal. Storm tides and heavy rainfall can cause flooding due to erosion, and runoff from drained agricultural areas and 'sealed' urban surfaces. Part of the main river and some of its tributaries have been canalised in the past and the whole system is heavily regulated by weirs and sluices.

The approach followed by water managers has evolved greatly during the last decade. After serious flooding in 1976, a flood-protection programme was developed. This programme, called the Sigma-Plan, has been revised recently.

The most remarkable action from this plan is providing "room for the river" via the creation of new floodplains using the original concept of 'controlled floodplains' and 'controlled reduced tide plains'.

Twelve controlled flood areas, together covering some 550 ha, have been constructed in Flanders along the Scheldt and its tributaries. The largest area, the polders of Kruibeke, Bazel and Rupelmonde, totalling some 600 ha near Antwerp, is now being constructed. The concept is to make this polder into a nature area with only a slight tide. By letting a limited volume of water into the polder when the water level is normal, the lowest parts will change into a freshwater tidal area. The higher parts of the polder, which flood only rarely, will be grazed by herds of horses and cattle living under natural conditions. Freshwater tides, grazing and local seepage of fresh spring water will make the polder a very attractive nature and recreation area.

Such freshwater tidal areas have become rare along West European estuaries, but in this case, an enormous area is being restored. Through the revised Sigma-Plan, the government has decided to create and restore an additional 4,000 ha of controlled flood areas along the river and intends to integrate these measures into the WFD River Basin Management Plan for the Scheldt.

Rainwater run-off and the Meuse river basin

The Meuse is mainly a rain-fed river. This means that it is largely supplied with water from the low mountain ranges in Western Europe: the Ardennes in France and Wallonia. The result is extremely high water peaks, but also extremely low water levels in the summer.

For many years, the governments of Belgium and the Netherlands have searched for solutions for the Meuse. The best known are the plans for enlargement of the Grensmaas, the 40-km stretch of river forming the border between Flanders and the Netherlands. Widening the river over this distance will substantially reduce high water levels and will increase the safety of residents in villages along the Meuse. It will also create a 1,400 ha nature area where the river can go its own way and forge a dynamic river landscape (i.e. the project will create 'room for the river').

Plans and works are underway, but will not be sufficient – on their own – for combating the flood problems along the Meuse and further action is still required upstream. Therefore, WWF-Netherlands, in cooperation with WWF-Belgium and the Walloon Nature Organisation, have initiated a new project[85] to

[85] Cf. Litjens, G., Helmer, W., Winden, and A., Overmars, W., 2000, *Mountains of Water - Water management as sport in the Rhine River Basin* (*'Bergen van water - waterbeheer als topsport'*, full English version available), WWF – Netherlands as well as Winden, A., Overmars, W. and Braakhekke, W., 2004, *Natural water storage in the low mountain ranges in the*

increase the retention capacities of upland areas. The better the functioning of the 'natural sponge' upstream, the higher the amount of rainwater that can be retained, and the higher the chance that a given rainfall event will end before the sponge becomes saturated. The project demonstrates that through implementation of multiple low-cost measures in various small wetlands in the low mountains of the Ardennes, it will be possible to retain rainwater just long enough to avoid extreme water damage downstream.

The impacts of urbanisation

The very high population density and the lack of a long-term vision for spatial planning have changed Belgium into one vast urban area, the result being that natural floodplains have been cut off from their rivers and built over. Rivers have therefore lost their 'breathing space' and some aquifers have dried up.

Under the Flemish Environmental Plan, every municipality or province has to strive towards a sustainable local water management and focus on the sub-basin approach. In this way, intensive cooperation between the different municipalities within a watershed is needed. The steps that have to be taken at different levels are thus a balanced mix of actions, vision-building and planning. Municipalities and provinces receive subsidies from the Flemish Government, the level of which depends on the progress made in developing plans and agreements. Since local authorities very often have a lack of financial resources to develop their own policies, this instrument has proven to be an incredibly powerful tool for achieving real, tangible environmental benefits at the local level.

As for the Brussels Region, problems of excessive rainwater run-off have not yet been discussed, and the approach tends to be one of looking for conventional – but unsustainable – hard engineering, end-of-pipe solutions.

The Walloon government recently agreed the 'Plan PLUIES', a plan to combat flooding. It foresees, among other measures, a reduction in rainwater run-off from both urban and rural areas by increasing rainwater infiltration, restoring wetlands and the functioning of floodplains, and combating erosion from agriculture areas.

Far-reaching measures – regardless of how costly and sometimes unpopular they are – will be needed in Belgium if the country wants to solve its current and future water problems, given that these have resulted from poor water-management policies over the course of many decades.

4.4- Local policy initiatives

WWF work across Europe has confirmed the crucial role of local communities in developing and managing projects, especially with regard to water management. Active participation of local action groups – formed by members of communities and different stakeholders – is a firm basis for the bottom-up and cross-sectoral approach that is essential for successful integrated river basin management, including ecologically sustainable flood management.

4.4.1- Olsavica river, Slovakia

The Olsavica river basin is located in Eastern Slovakia. Intensive agriculture over the second part of the 20th century disrupted the intact river system by the removal of terraces, extensive drainage and integration of arable soil into large blocks, which resulted in severe soil erosion and flood damage in the Olsavica valley. The negative effects of agricultural practices were noticed by non-governmental organisations, who entered into dialogue with local people and raised awareness of the flooding problem. The interest and the will of local people to change the situation

catchments of the Rhine and the Meuse - Storing water near the source (abridged version available in English), WWF – Netherlands. Both available at http://www.wnf.nl/wnf/website/index.cfm/id=098E1828-ECA8-4DD7-BD590FF22AE5A939

encouraged the DAPHNE Institute of Applied Ecology to raise funds for improvement of soil and water management in the Olsavica valley. The project concept was recognised by the Ministry of Environment and later financed by a World Bank/GEF project.

The initiative, supported by detailed mapping of the landscape structure and valuable scientific data, has an emphasis on the involvement of local people and their participation in the decision-making process related to managing the catchment area. Intensive discussions with the main stakeholder groups started from an early stage (in 1999) and several workshops were held with representatives of the local community, farming cooperative, and regional bodies for water management and agriculture. As mentioned many times elsewhere in this paper, flood protection requires an interdisciplinary approach. Therefore, the next step was to involve ecologists and water-management experts, who used the results of hydrological analyses to evaluate a proposal for land-use changes in order to increase the natural retention capacity. The model was also examined in terms of socio-economic benefits.

The proposal for land-use changes was endorsed by key institutions for water management, agriculture and nature conservation, and this helped to achieve agreement with the farming cooperative that operates in the area. Implementation of the restoration plan started in spring 2003. This example clearly indicates that improved watershed management needs close cooperation and coordination of experts from different fields (water management, ecology, agriculture etc.) as well as support from the decision-making authorities. In this case, implementation of the proposed measures relies mainly on farmers and landowners and the project would never have been successful without the involvement of all key stakeholders from the early stages of the process.

4.4.2- Somerset Levels and Moors project, UK

The 'Wise Use of Floodplains' project[86] aims to demonstrate how floodplains can contribute to the sustainable management of water within river basins through effective cooperation and active involvement of stakeholders. Such an approach can be a model for mitigation of flood risk and effective implementation of the Water Framework Directive. One of the components of the overall project is the Somerset Levels and Moors[87] (a highly regulated floodplain area in southwest England), which has focused on the basin of the river Parrett. Agriculture, flood management and sea-level rise are among the key issues in this basin.

The project aims to demonstrate methods and combined approaches that have benefits for multiple sectoral interests. The main message during the process was that settlements and strategic assets must be protected from flooding in conjunction with ensuring the future of a farmed, freshwater, wetland environment that restores and maintains biodiversity. The project has worked very closely with national and local management authorities related to water and environment. Participatory workshops were held to encourage stakeholders to share views and address problems jointly.

The ideas for improvement of flood management were developed through a gradual process, ensuring all organisations and sectors were involved equally. As a result, eleven potential solutions for managing flood

[86] The 'Wise Use of Floodplains' project was a trans-national partnership – led by the UK-based Royal Society for the Protection of Birds – involving government departments, research organisations and non-government organisations (including WWF) in six project areas throughout England, Ireland, Scotland and France. Five catchments were used as demonstration sites to develop and test a range of techniques from public participation through to the sustainability appraisals of floodplain management options. Cf. www.floodplains.org

[87] Fore more information see the 'Wise Use of Floodplains' Somerset Levels and Moors Parrett Catchment case study at www.floodplains.org

events have been agreed. Each of these solutions or 'components' has involved detailed analysis of policy barriers and opportunities, as well as appraisal of economic costs and benefits. These important contributions to more integrated thinking were achieved through use of an enhanced hydrological model and digital terrain models to predict potential floodwater storage and an up-to-date socio-economic profile of the Parrett floodplain.

Another real benefit of the project is that the implementation process has generated the most intensive debate on water management in 30 years, leading to a new consensus between conservation, farming, drainage and rural community views. The future is now in the hands of all of the stakeholders involved, who have shared responsibility for implementing an Integrated Catchment Management Plan. As this project confirmed, the maintenance and further enhancement of stakeholder dialogue is essential to the long-term success of ecologically sustainable water management, including for flooding.

4.5- Conclusions

It is evident that 'traditional' flood management strategies, based mostly on protecting people and property by building 'flood control' infrastructure, have generally failed to generate the safety that many had thought would be provided. Furthermore, these strategies have left many wondering why such investments – thought previously to be the only real solution – have failed to produce benefits equivalent to the money spent on them. Many countries, regions, and local authorities are now, therefore, considering other options, which in most cases, take advantage of the natural environment.

WWF believes that the Water Framework Directive (WFD) has a crucial role to play in this respect. By putting the focus on integrated river basin management (IRBM) – and thus allowing for public participation of all relevant stakeholders – it sets up a process in which ecological and sustainable measures for flood management can be considered and put into practice. The River Basin Management Plans (RBMPs), in which all measures necessary for achieving 'good ecological status' by 2015 need to be defined, must be the umbrella plan, including measures for ecologically sustainable flood management. The WFD Common Implementation Strategy (WFD CIS) guidance documents, in particular the horizontal guidance document *Wetlands*, and the *Best practices on flood protection, prevention and mitigation* paper also developed in the context of the WFD CIS, should help with that task.

Thus, it would make no sense at all – economically, environmentally or administratively – to develop and implement a separate planning process for flood management[88] given that the outcomes are likely to be less effective and less sustainable. Worse still, measures proposed under a separate 'flood plan' might even become an obstacle for achieving the legally biding objective of under the WFD's RBMP. Indeed, to avoid such a situation, any measures developed for managing flood risks and that might have a negative effect on the achievement of 'good ecological and chemical status' must go through the requirements of the WFD RBMP planning process, including derogation tests.

A single RBMP governing overall spatial integration of **all** measures for sustainable water management, including for flood (damage) protection, prevention and mitigation, will allow for more coherent, streamlined and strategic planning of the water management problems affecting a given river basin and its population, including at the transboundary level. This approach has been supported by several international conferences/frameworks that have dealt with flooding issues, including documentation

[88] As seems to be suggested by the European Commission services developing the Communication and Action Programme on 'Flood prevention, protection and mitigation'

produced as part of the WFD CIS. As just one example, the Flemish government is following this recommended approach by integrating its Sigma-Plan into the WFD's RBMP for the Scheldt *river (see section 4.3.1 above*).

Other EU, international, national and local legislation, plans, processes and initiatives further strengthen the case for a different type of flood management; one that is ecologically sustainable, based on 'working with nature and not against it'. This must involve planning for the whole river basin – including storage of water in upland areas – and has been shown to generate the greatest success when all relevant stakeholders are fully involved in the process at the earliest possible stage.

5. EU funding possibilities for ecologically sustainable flood management

5.1- EU Solidarity (emergency) Fund

Following the floods in Central and Eastern Europe of summer 2002, the European Commission set up a new EU financial instrument to grant emergency aid in the event of major disasters. In an exceptionally short period of only three months, a Regulation laying down the implementation models of a European Union Solidarity Fund[89] was adopted. This Fund applies directly to all Member States without the need for transposition into national legislation, and has been designed as a rapid response to recent floods and as a mechanism for reacting quickly to future flood disasters, (alongside finance provided under the EU Structural Funds). The Fund is accessible to current and future EU Member States and countries for which Accession negotiations are underway. In 2002 € 500 million were allocated to this Fund and it is expected that this amount will grow to € 1 billion in subsequent years.

The Solidarity Fund is focused on giving immediate financial assistance to help people, communities, regions and countries return to normal living conditions as quickly as possible in the event of a major natural, technological or environmental disaster. Its scope is therefore limited to covering the most urgent needs. 'Major disasters' are those causing damage valued at EUR 3 billion or more, or which represent more than 0.6% of the state's gross national income. Besides this, and under exceptional circumstances, a disaster that affects a substantial part of a region or state's population shall also be considered as eligible for support. In this context, the Commission and the European Investment Bank (EIB) will work closely together.

The Fund provides financial aid[90] for:

- Immediate restoration to working order of infrastructure and plants/installations in the fields of energy, water and wastewater, telecommunications, transport, health and education.

- Provision of rescue services and temporary accommodation to meet the needs of the population concerned.

- Immediate securing of flood-control/prevention infrastructure and measures for immediate protection of cultural heritage.

- Immediate clean-up of disaster zones, including natural areas.

The first investment aid from the Solidarity Fund was provided during the Copenhagen Conference in November 2002, when agreements where made with Austria, Germany, Czech Republic and France. As highlighted in the table below, funding has been invested, in line with Fund priorities, mainly into securing flood protection and river management facilities and energy supplies. In other words, into more river regulation, dikes and dams...

[89] Council Regulation (EC) No 2012/2002 of 11 November 2002

[90] For more information: http://europa.eu.int/comm/regional_policy/funds/solidar/solid_en.htm

Table 3- Member States severely affected by flooding events since August 2002 and their use of the EU Solidarity Fund financial allocations. Underlined are measures that promote an unsustainable, 'business as usual' approach to flood management

Country	Measures supported through the EU Solidarity Fund	Allocated investments (2002)
Germany	• Reimbursement of aid operations • Immediately securing flood protection facilities • Repairing the waste water plants • Restoring energy supplies, welfare infrastructure, etc.	444 million Euro
Austria	• Partial reimbursement of expenditure for short-term repair of damaged transport infrastructure and water-supply plants, • Securing of river-management facilities, essential supplies to stricken populations, etc.	134 million Euro
Czech Republic	• Reimbursing expenditure on aid operations • Securing flood-protection facilities • Repairing waste-water facilities • Restoring energy and drinking water supplies as well as transport infrastructure.	129 million Euro
France	• Compensate costs linked to emergency operations	19.625 million Euro

This means that, in most places, the Solidarity Fund money is going to support short-term, 'traditional' structural measures, which have already shown their shortcomings, instead of examining the extent to which "inadequate land-use and water management policies have contributed to these problems", as the European Commission stated in its Communication[91] in response to the 2002 flood disaster. Thus, so far, investments are much more focused on emergency repairs for damage to transport infrastructure, without consideration of long-term strategies for flood control. WWF shares the Member States' general concern that communication links and other vital infrastructure have to be restored, but it also needs to be recognised that in many areas the very same infrastructure has contributed significantly to the catastrophic impact of floods in the first place.

At the time, when details of the Solidarity Fund where first being defined, WWF urged the European Commission and European countries[92] to consider the focus for this tool and to use it wisely. WWF believes that the application of the Solidarity Fund should avoid the repetition of mistakes from the past and deal with the root-causes of flooding rather than with the symptoms. Taking into account the fact that the Fund provides relatively large investments over short periods of time, national governments should consider and

[91] European Communication to the European Parliament and the Council COM(2002) 481 *The European Community Response to the Flooding in Austria, Germany and Several Applicant Countries* Brussels 28th August 2002.

[92] Through a Background Briefing paper *Managing Floods in Europe: The answers already exist. More intelligent river basin management using wetlands can alleviate future flooding events* available at http://www.panda.org/downloads/europe/managingfloodingbriefingpaper.pdf

select only the most effective (environmentally and economically) flood-protection measures. The mere reconstruction of facilities and infrastructure may be a waste of money and time, and may also constitute an obstacle to implementation of the WFD and the ultimate achievement of its objectives – a statutory obligation on Member States. WWF considers that access to the Fund should be conditional on adoption of ecologically sustainable flood-management and risk-reduction strategies. Although it is a short-term tool intended essentially for reconstruction, the relevant State authorities should be more forward-looking and identify more progressive and sustainable ways of using it. The Solidarity Fund has to be regarded by both 'donors' and 'recipients' as a means of adding value to flood prevention and protection in the future, and not only as a temporary measure to address present problems.

5.2- Regional Development Funds[93]

Flood (damage) prevention and protection cannot be taken as a 'stand alone' issue but must be considered and implemented in conjunction with sectoral policies of the EU. WWF is constantly emphasising the importance of policy integration at EU level, which implies the need for integration of environmental objectives and coherence between the major policies and financial instruments that are the driving forces behind current land- and water-use practices across Europe. This is very relevant to transport policy, the Structural Funds, and the Common Agricultural Policy (CAP) – the latter with regard to both production payments and rural development measures.

These policies, as they are reformed over the coming years and, in particular in view of enlargement, must include clear obligations to ensure coherence with the requirements of the WFD and to provide financial support (in particular from the CAP) towards its implementation. The revision of these major policy areas should be regarded as an important opportunity for the EU to correct what have proven to be the incorrect approaches of the past and to increase integration with other policies. Only in such a way will these policies work effectively together and not impede each other's goals and targets – as is frequently the case at the moment. Note also that existing instruments, such as the Rural Development Regulation or the Structural Funds are not being utilised effectively by Member States to meet environmental objectives enshrined in EU legislation. This should be corrected in the context of policy/instrument revision.

Whilst the current CAP does not directly refer to the objectives of the WFD or flood prevention and management several of the existing CAP instruments, especially under the Rural Development Regulation, allow for measures that can already be used indirectly to support such activities. Unfortunately, however, the prevalent approach of both the Commission and the Member States is to provide financial compensation aid to agriculture in the form of state subsidies. "The Community rules on state aid in agriculture and fisheries stipulate that, where a natural disaster can be proven, compensation can be considered compatible with the common market provided it does not lead to over-compensation for the damage suffered"[94]. Aid is disbursed from national funds and the primary objective is always to restore production potential, e.g. through the replanting of trees, crops, or repairing damage to property.

From this it is clear that financial aid is available to address problems related to flooding, and that current policies provide a useful framework within which to address this issue. It is also clear that the strategy chosen is still to 'manage' the impact of floods rather than prevent damaging floods from occurring in the first place. However, the EU's financial

[93] From the Structural Funds and the Common Agriculture Policy

[94] DG Agriculture, Agricultural News Digest, 19 September 2002

instruments can be applied from different perspectives and with different objectives in mind. It all depends on the view of national and local governments, the opportunities they are prepared to take up and the investment decisions they make. The policy and legislative tools and funding mechanisms are there. On one hand, greater efforts are needed to ensure that all decision-makers are fully aware of the existing options; on the other hand, it is a question of political will to show leadership and forward thinking.

What follows is a general assessment of some EU policies and financial instruments for regional development, explaining why/how they could be used for ecologically sustainable flood management.

5.2.1- Structural Funds

The priority objectives under the Structural Funds[95] require Member States and Accession Countries to ensure that operation of the funds is in harmony with the requirements of environmental protection and in conformity with Community policies and actions. This must include, for example, evaluation of environmental impacts of major projects. Both Community initiatives established by the Structural Funds Regulation, namely Leader+ and Interreg III, have potential for contributing to floodplain restoration projects and IRBM. Interreg is a Community initiative for the support of "cross-border, trans-national and interregional co-operation intended to encourage the harmonious, balanced and sustainable development of the whole Community area", that is particularly relevant to management of rivers crossing two or more countries.

Leader+ aims to "encourage and help rural actors to think about the longer-term potential of their area" and "seeks to encourage the implementation of integrated high quality, original strategies for sustainable development designed to encourage experimenting with new ways of (*inter alia*) enhancing the natural and cultural heritage". All rural areas are eligible, although Member States may choose to limit the application of Leader+ to specific areas identified on the basis of clear criteria. Leader+ takes a 'bottom-up' approach requiring the development and implementation of projects by 'local action groups' (LAGs). Among the "priority themes which the Commission considers to be of special interest at Community level are making the best use of natural and cultural resources, including enhancing the value of sites of Community interest selected under Natura 2000". There would appear to be significant potential for innovative floodplain restoration projects to be considered for Leader+ funding, especially where trans-regional and trans-national projects are concerned[96].

Nevertheless, these options still remain overlooked. The Structural Funds could be used to co-finance some measures that contribute to flood prevention and mitigation at the same time as helping to ensure compatibility with the WFD and its integrated river basin management (IRBM) approach. This is particularly the case with regard to the use of EU funding to promote non-structural measures for flood prevention, such as wetland and floodplain protection and restoration. As a consequence, the EU needs to guarantee that the revision of the Structural Funds contributes to halting and reversing ecosystem loss and degradation caused by the misuse of these same funds. Investments need to be diverted away from heavy infrastructure for flood 'control' and 'protection' to those designed, for example, to make more space available for rivers by reconnecting them with floodplains and wetlands[97]. It is up to forward-looking

[95] The European Regional Fund (ERDF), the European Social Fund, the European Agricultural Guidance and Guarantee Fund (EAGGF), Guidance Section, and the Financial Instruments for Fisheries Guidance (FIFG)

[96] Jones, T.; 2000; *Policy and Economic Analysis of Floodplain Restoration in Europe – Opportunities and Obstacles*. WWF European Freshwater Programme Report available at http://www.floodplains.org.uk/pdf/other_reports/Policy%20and%20Economic%20Analysis%20-%20Tim%20Jones.pdf

[97] For more information *Structural Funds in an Enlarged EU: Learning from the Past - Looking to the Future.* WWF European Policy Office. Available at http//:www.panda.org/epo

governments, river basin authorities and NGOs to promote such investments and to seek their future enhancement.

The Commission Communication on *The Structural Funds and their coordination with the Cohesion Fund. Revised indicative guidelines* (COM 2003, 499 final) is a good first step in this direction, specifically when it mentions in relation to the WFD, that "...while specific measures targeted at waste-water treatment and drinking water provision will continue to be a priority [under the Structural Funds support], such actions must be seen as part of an overall strategy for ensuring the ecological status and chemical quality in the entire river basin [as required by the WFD]. Integrated programmes for river basin management, including the development of the management plans foreseen under the WFD will also be eligible for support." This means that a River Basin Management Plan (RBMP) prepared under the WFD, and all associated analyses (e.g. of pressures and impacts) and characterisation can be co-financed by the EU. This should help to eliminate lack of funding as a credible reason for Member States to delay river basin characterisation, and should also be an incentive to look at alternatives to traditional flood management infrastructure.

5.2.2- Cohesion Fund/ISPA

The Cohesion Fund[98] is intended to provide additional funds for Member States whose gross national product falls below 90% of the Community average for large-scale infrastructure and environmental projects with a theoretically balanced expenditure over these two sectors. In practice, however, most expenditure has been allocated to transport and telecommunication infrastructure. A similar scenario is noticed in Accession Countries while applying the ISPA[99] financial instrument that provides support for environmental and transport infrastructure measures. ISPA includes environmental priorities focused on improving water quality and offers a unique opportunity to support the development of sustainable alternatives for water management, including for flooding. However, the ISPA excludes small projects to be undertaken at a local and regional level by setting high thresholds of € 5 million and supporting large-scale infrastructure projects. This limit should be lowered[100].

After the catastrophic floods of 2002, the Commission allocated up to € 48 million to the Czech Republic, and several million more to the Slovak Republic, from unallocated 2002 ISPA money under more favourable and flexible conditions. The ISPA Regulation provides that under exceptional circumstances, the Commission will increase the ceiling on public aid to 75% and the Community contribution to 85% for relevant projects in areas affected by exceptional natural disasters[101]. The finances are to be used for repairing transport links (i.e railways, roads, motorways and bridges) and water treatment plants in the affected regions. Though such repairs are clearly needed, unless consideration is given to use of ecologically sustainable flood prevention measures, the rebuilding of existing infrastructure may actually lead to further loss of life, property and money.

WWF believes that nature protection and sustainable use of natural resources should be clearly recognised as priorities for EU funding. Therefore, the European Commission should guarantee to promote opportunities under existing EU financial instruments to support WFD implementation, and in particular to protect, enhance, and restore wetlands and floodplains. Pre-Accession investment priorities also need to be examined to ensure that the integrity of floodplain functions and values in Accession Countries is respected – especially given that a high proportion of Europe's remaining natural areas are found in

[98] Council Regulation (EC) No 1264/1999
[99] Instrument for Structural Policies for Pre-Accession for period 2000-2006,Council Regulation (EC) No 1267/1999

[100] For more information "*WWF Briefing Paper on ISPA*". WWF-European Policy Office, Belgium. Available at http://www.panda.org/downloads/europe/ispabriefing2002.pdf
[101] For more information http://www.evropska-unie.cz/eng/news.asp?year=2002&month=8

central and eastern Europe. Special attention should be given to the potential impacts of proposed new road and waterway developments that may significantly increase the occurrence, duration and impacts of damaging floods.

5.3- Common Agricultural Policy

The Rural Development Regulation[102] (RDR), covering the period 2000–2006 states that "a prominent role should be given to agri-environment instruments to support the sustainable development of rural areas and to respond to society's increasing demand for environmental services". Indeed, agri-environment measures still represent the only compulsory element within the 'menu' of rural development instruments. Agri-environment payments are land-based payments made on an annual basis. They are not the only relevant instruments for flood prevention and management. 'Less Favoured Areas' compensation, aid for afforestration of farmland that includes support for wetland restoration, extensive farming and reversion of arable land to grasslands can all be targeted to make more space for natural water management.

Nevertheless, the potential of these instruments is limited by the relatively small budget available to the RDR in comparison with the huge investments going into market subsidies (10% for the former, 90% for the latter). Of the € 4 billion available annually for rural development, approximately half is available for the above-listed instruments combined. Approximately € 40 billion per year is spent on market subsidies. These are paid for entirely from the EU budget without national co-financing. These subsidies continue to favour intensification and consequent loss and degradation of functioning floodplains. An important achievement in developing the RDR was the inclusion of 'modulation', i.e. a shift of funding within each Member State from the first ('common market') CAP pillar, to the second (RDR) CAP pillar, effectively increasing the budget for RDR. So far, Member States have shown little willingness to apply modulation in practice. It is up to governments and regional authorities to use the RDR to promote measures for co-financing of WFD implementation and, thereby, of integrated river basin management and associated improvements to land and water use.

In the framework of the EU accession process, the SAPARD[103] programme was established to provide Accession Countries with support for agriculture and rural development. Measures proposed by the Commission for inclusion in each country's Rural Development Plan include support for agri-environment schemes (AES) and investments into forestry. However, in many cases, Accession Countries have only decided to implement AES due to long and persistent lobbying by WWF and its partners. The agri-environment budget allocations defined by the relevant ministries are tiny in comparison with investments for agricultural production (on average, 3% of total budget) and this significantly limits 'on the ground' benefits. Moreover, the measures for the period 2000-2006 were selected without any real consideration of their potential contribution to implementation of other EU policies/legislation, particularly the WFD, which have to be implemented upon accession.

Under the existing rules, SAPARD does not provide for any specific provisions relating to actions in the wake of natural disasters. Nonetheless, in the autumn of 2002, following severe floods in the Czech and Slovak Republics, the European Commission proposed that the ceiling on public aid allocated under SAPARD should increase from 50 to 75%, and the EU contribution from 75 to 85% of public aid for relevant projects in

[102] Council Regulation (EC) No 1257/1999

[103] Special Action for Pre-Accession Measures for Agriculture and Rural Development, Council Regulation (EC) No 268/1999

areas affected by natural disasters. This clearly relied, however, on the willingness of the national authorities to use the measures available to them and to provide the required levels of national co-financing.

The Working Document on *The Water Framework Directive (WFD) and tools within the Common Agricultural Policy (CAP) to support its implementation*[104], produced by the European Commission Directorate General for Environment, is a good source of further information on how the CAP could promote ecologically sustainable flood management. This paper explains the interaction between agriculture and water and corresponding EU policies. While the paper is mainly related to the 'Agenda 2000' and 2003 CAP reforms. It is significant in that it promotes alignment of the measures planned under the Rural Development policy and the WFD.

5.4- LIFE-III

Funding under LIFE–Nature[105] targets management measures for Natura2000 sites and conservation measures for species both inside and outside these sites. LIFE–Environment covers a wider range of environmental projects with the aim of promoting sustainable development. These should include innovative and demonstrable actions for industry; examples, promotion and technical assistance actions for local authorities; and preparatory actions to support community legislation and policies, also indirectly related to flood protection. Restoration and maintenance of key habitats and species to favourable status is an objective of the Habitats Directive itself, which includes also floodplains and wetlands. Article 2.2 of the Habitats Directive, dealing with restoration, should be read in conjunction with article 6.1, dealing with conservation measures[106]. This demonstrates the scope of the Directive for favouring measures that restore and rehabilitate, as well as maintain, the river ecosystem and its processes, and thus mitigate and prevent floods.

Nevertheless, the budget for LIFE is minuscule in comparison with money being spent on CAP and Structural/Cohesion Funds. Moreover, much of the funding is restricted to use at Natura2000 sites and provided in the form of one-off grants, which can only initiate but not complete long-term restoration projects, and which cannot meet ongoing management costs.

5.5- Phare

The Phare programme priorities are directed towards preparatory support for Accession Countries to assist institution building and investment. Investment is targeted towards bringing major infrastructure up to Community standards, particularly in the fields of environment, transport, and industry. Phare offers opportunities for environmental measures such as maintenance of extensive agriculture on floodplains, or conservation and restoration of floodplain wetlands to regulate water quality in rural areas with low population densities.

Moreover, Accession Countries have identified compliance with EU water legislation as a short- to medium-term priority, providing opportunities for promoting the role of floodplains in regulating water quality and quantity. However, this opportunity is not sufficiently taken up. In terms of agriculture and regional development, governments of

[104] Available from the European Commission's intranet (CIRCA) at: http://forum.europa.eu.int/irc/DownLoad/m6ZvH5G1kfI2fqYmhIspAam3RppMkOfS/zMqw8BcGer6YRxosB1ZGeDfsLJ_2bjhp/eSGGkeZSp14g6BR0dmAdEdPvKUqTc9Yd/1GjtI/3.2%20-%20FWD%20and%20Agriculture.doc .To gain access to this web page please contact: env-wfd-circa@cec.eu.int

[105] LIFE = Financial Instrument for the Environment – L'Instrument Financier pour l'Environnement. Applicable to Member States, Accession countries and other countries bordering the Baltic and Mediterranean regions

[106] Jones, T.; 2000; *Policy and Economic Analysis of Floodplain Restoration in Europe – Opportunities and Obstacles*. WWF European Freshwater Programme Report available at http://www.floodplains.org.uk/pdf/other_reports/Policy%20and%20Economic%20Analysis%20-%20Tim%20Jones.pdf

Accession Countries are liable to attach priority to conventional agricultural intensification, traditional infrastructure approaches to flood management and major transport/communications infrastructure projects, leaving little for use on truly sustainable measures[107].

In response to the floods of 2002, the European Commission made an immediate provision to the Czech Republic of an additional € 9.75 million from the Phare 2003 reserve and under more flexible conditions[108]. The Czech government also reallocated funds under the National Phare Programmes for 2001 and 2002 and launched relevant grant schemes. Under the first Phare flood-related grant scheme**,** regional authorities submitted their proposals for the repair and reconstruction of local transport and environmental infrastructure, environmental protection facilities, and supply systems for water, gas and electricity. Other schemes were oriented towards NGO volunteer help and cross-border cooperation[109].

It is evident, that damages to vital communications links and other infrastructure need to be repaired. Yet when setting up priorities for the use of flood-related funds, national governments need to recognise that, in many areas, transport corridors are themselves factors amplifying floods and that flood (damage) protection and prevention needs investments into long-term, sustainable solutions.

[107] Jones, T.; 2000; *Policy and Economic Analysis of Floodplain Restoration in Europe – Opportunities and Obstacles*. WWF European Freshwater Programme Report available at http://www.floodplains.org.uk/pdf/other_reports/Policy%20and%20Economic%20Analysis%20-%20Tim%20Jones.pdf

[108] *The European Community response to the Flooding in Austria, Germany and several applicant Countries. A solidarity-based initiative-European Union Helps Mobilise Civil Society Flood Relief* . COM(2002) 481 final, Brussels, 28.8.2002.

[109] For more information see http://www.evropska-unie.cz/eng/news.asp?year=2002&month=8

5.6- Others

Further information on EU financial instruments suitable for funding ecologically sustainable flood management can be found in the *Handbook for Environmental Project Funding* recently published by the European Commission Directorate General for Environment[110].

The stated objectives of this handbook are: "*…to increase the capacity of individuals and organisations to engage in issues of local govern*ance *through involvement in projects leading to environmental enhancement and sustainable development at the local level. The goal of the handbook is to* ***increase capacity for undertaking local environmental interventions by helping individuals and organisations gain access to key information on the funding instruments dedicated to environmental improvement****. (...) If you are an officer or a member of a municipality, an NGO, a business, a governmental or non-governmental institution or a concerned individual, working or involved in the activities of environmental protection, improvement or education, then this guide is for you*."

The *Handbook* provides a fact-sheet for each environmentally-relevant EU funding mechanism, detailing in each case:

- The title of the instrument: e.g. Cohesion Fund
- The time frame for its application
- Its general/overarching/strategic objectives
- The types of actions that can be financed
- 'Good practice' examples of current financing
- Geographic coverage
- Eligible organisations
- The EU legal basis, i.e. reference to different EU legislative tools
- Contact points in the Commission and elsewhere

[110] This is available at http://www.europa.eu.int/comm/environment/funding/handbook_2004.pdf

- Useful links to sources of further information

The *Handbook* provides information that could be very useful to everyone (whether Member States or NGOs) seeking to develop plans for ecologically sustainable flood management and looking for ways to support them financially.

5.7- Conclusions

As with policy and legislative tools, an array of EU funding instruments suitable for promoting ecologically sustainable flood management already exists. These range from the use of the Structural Funds under the newly revised Indicative Guidelines, to Rural Development measures under the CAP, to LIFE funding under EU environmental legislation.

All of these already contain provisions that allow Member States to strive for sustainability, helping not only to cope with the effects of floods when they happen, but also – and most importantly – changing current water- and land-use practices at river-basin level to prevent severe flood damage in the future. Currently, huge sums of tax-payers' money are wasted by spending several times over; first causing increased flood damage, then trying to treat the symptoms, rather than the causes. For example, an EU or national subsidy is given to support intensive agriculture in a former floodplain even though this will increases the risk and severity of flooding. Additional money is then needed to repair flood damage. After several cases of severe flooding, more money is spent on engineered 'flood protection' measures such as new dikes.

The opportunities to use EU funding sustainably are there for Member States and regional and local authorities to grab. It comes down to a question of political will to promote better integration of the major EU-funded policies affecting water and land use (e.g. agriculture, transport, regional development, environment). The EU institutions should strive for integration to happen 'at source', i.e. when the funding mechanisms and budget lines and their relation to EU policies are being developed or revised. Only in this way will damaging conflict or overlap at a later stage be prevented.

6. Overview of policy recommendations for ecologically sustainable flood management

1. European public authorities at all levels need to realise that mismanagement of human activities influencing land and water use at the river basin level – including destruction of floodplains and wetlands, river fragmentation (e.g. cutting off meanders), and changes in land-use patterns – as well as global warming, have significantly contributed to increases in the frequency, extent, intensity and impacts of flood events during the last decade.

2. Public authorities and the population at large, across Europe, both need to be aware that flooding is a natural – and in some ways beneficial – process that will continue to occur. They also need to face up to the high probability that future flood events will have an ever greater destructive potential if the current trend for fighting against nature is not reversed and global warming is not properly addressed. Responding effectively to this scenario will require a long-term vision for flood (damage) prevention, protection and mitigation, including the implementation of measures that can deliver the desired results (security for people, property, goods and the environment) by actually addressing the root causes of damaging floods and not just the symptoms.

3. Public authorities and the population at large cannot continue to disregard the important role that natural systems play in flood (damage) prevention, protection and mitigation – for example, through the natural water-holding capacities of wetlands, floodplains, and upland areas. There needs to be a realisation and understanding that traditional flood management strategies – mostly based on engineering infrastructure for the immediate protection of people, property and goods – have failed to deliver the long-term security they promised. Furthermore, if floods are to be managed properly in the future, all-encompassing 'integrated' approaches, which give higher priority to non-structural (nature-related) measures, are needed. Only then will there be a shift away from the traditional short-term paradigm of engineered 'flood defences' to ecologically sustainable flood management.

4. The EU institutions and the Member States need to realise and act upon the need for Integrated River Basin Management (IRBM), which is the internationally recognised vehicle to deliver flood (damage) protection, prevention and mitigation. This is because IRBM takes proper account of environmental carrying capacity, long-term functioning of ecosystems, maintenance of biodiversity, joint assessment of the needs and expectations of all 'water stakeholders' **at a basin-wide level**, and the need to base final decisions on the best possible information. IRBM is now also the legal basis for water management across Europe because it is enshrined in the Water Framework Directive (WFD). This offers European governments and regional and local authorities a 'window of opportunity' for making strategic decisions about water management – including flood management – that are economically, socially and ecologically sustainable. This opportunity to reduce human and financial losses as a result of severe flood events must not be missed.

5. EU countries are obliged to use the WFD's River Basin Management Plans for the definition of **all** measures necessary to achieve 'good ecological and chemical status' by 2015. This is also strongly encouraged in the case of transboundary river basins. '**All** measures' should

include those required to achieve ecologically sustainable flood (damage) prevention, protection and mitigation. National governments and regional/local authorities need to realise and act on the fact that there should not be two parallel planning systems - for water management on one hand and flood management on the other - but rather a **single**, **integrated** and **strategic** plan covering all the water-related issues in given river basin, including flood damage. The WFD River Basin Management Plan is that single, integrated and strategic plan – a conclusion clearly supported by Article 13.5 of the WFD. Developing a separate 'flood plan' for those flood management measures that are part of wider water management makes no sense economically or administratively (given the high chance that the same under-resourced and under-staffed administration would be responsible for developing and implementing both plans). Worse still, measures under a separate 'flood plan' could have negatively impacts on the ecological and chemical status of water bodies, thus becoming obstacles to achieving the legally biding objectives of the WFD.

6. EU countries at all levels need to make the most of existing EU policy tools and funding mechanisms to help the move to ecologically sustainable flood management strategies. They need to realise that there are current financial opportunities offered by different funding mechanisms under, *inter alia*, the EU's environment (e.g. LIFE), regional (e.g. newly revised Indicative Guidelines for the Structural Funds), and agricultural policies (e.g. some Rural Development measures under the Common Agriculture Policy). The WFD also offers policy support for such a change and can help push further shaping of EU funding objectives towards ecologically sustainable flood management.

7. The EU institutions should strive for increasing the integration between all policies affecting water and land use (e.g. agriculture, transport, regional development, environment) 'at source', i.e. when EU funding mechanisms and budget lines and their relation to EU policies are being developed or revised. This would help to maximise opportunities for ecologically sustainable flood management and to reduce potentially damaging conflict or overlap at a later stage.

8. The EU, Member States, regional and local authorities must realise that, from now on, the success or failure of their flood (damage) prevention, protection and mitigation strategies will be measured not only in terms of capacity to provide immediate relief and support to human populations, but also by their ability and willingness to plan ahead, and to develop and implement ecologically sustainable flood management strategies that make full use of nature's ability to prevent and reduce floods. This new approach can be largely implemented with existing EU policy and funding tools, will save tax-payers money and will provide additional benefits in terms of employment, recreation, and biodiversity conservation. It marks a decisive break from the traditional (but false) belief that only bigger or higher 'flood protection' infrastructure can guarantee the safety of people, property and goods.

Annex 1- Key causes for excessive flooding - floodplain degradation

Adapted from: Jones, T.; 2000; *Wise Use of Floodplains: Policy and Economic Analysis of Floodplain Restoration in Europe*. WWF. Pp 37.

Sector	Key factor causing deterioration	Remark on European situation
Agriculture	• Drainage and irrigation systems • Dike construction • Water abstraction • Fertiliser and pesticide use • Landscape simplification	• Biggest obstacles to floodplain restoration • Irrigation dams are a major threat • Land privatisation and abandonment are major factors
Forestry	• Deforestation and loss of vegetation in headwater basins • Local damage to forests • Conversion of meadows • Replacement of natural and semi-natural riparian forests with intensive plantations	• Remains a locally significant threat, though less widespread than formerly
Transport	• Navigation channels • Road and railway construction • Drainage and diking • Landscape fragmentation	• Most larger and many smaller floodplains have already been heavily modified • Transport infrastructure projects in the 1980 and 1990 adversely affected many floodplains • Major rivers and floodplains threatened by road rail and canal projects in EU accession countries
Energy	• Hydroelectric power dams • Electricity lines • Power stations • Mining	• Most large rivers regulated many smaller rivers unregulated • Massive recent expansion in reservoirs (e.g. Spain and Turkey) • Very few large rivers remaining unregulated
Tourism and Recreation	• Floodplain development • Leisure development • Local problems of excessive number of peoples degrading floodplain	• Strong pressure from use by multiple leisure interest groups • Limited future development could be acceptable if done sustainably
Urban and Industrial Development and Extractive Industry	• Construction of dams and dikes • Draining of land for new development • Waste disposal pollution • Ground and surface water abstraction • Disturbance • Gravel extraction • Mining waste	• • High population density means major impacts on water quality and quantity and direct loss of floodplains due to construction • Especially strong impacts on coastal floodplains • Many industrial and urban centres and most rural settlements lack adequate waste treatment • Gravel extraction has had a major impact on floodplains since 1950's • Huge threats from mining waste

Climate Change	• Changing rainfall patterns • Rising sea levels eroding coastal floodplains	• Increased risk of desertification means increased importance of floodplain wetlands • Major threat from accelerated coastal erosion around North Sea

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- conserving the world's biological diversity
- ensuring that the use of renewable natural resources is sustainable
- promoting the reduction of pollution and wasteful consumption

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