River Flood Risk Management Policies in different parts of the world: synthesis of a special session by NCR

Paul Samuels
*HR Wallingford, OX10 8BA, UK, (**FLOODsite** Coordinator)*

Frans Klijn
NCR & WL | Delft Hydraulics, PO Box 177, 2600 MH Delft, the Netherlands

Jos Dijkman
WL | Delft Hydraulics, PO Box 177, 2600 MH Delft, the Netherlands

ABSTRACT: The Netherlands Centre for River Studies (NCR) organised a special session (see Annex for the programme) on River Flood Risk Management in different parts of the world during the ISDF3 conference on 25 and 26 May 2005. Lectures were given on the past and present policy approach in Bangladesh (Ainun Nishat), the USA (Gerald Galloway), Germany (Jochen Schanze), England and Wales (Edmund Penning-Rowsell), and the Netherlands (Cees van Westen). Also, an introduction was given on UNESCO's initiative to promote integrated flood risk management world-wide by capacity building and training in developing countries (Andras Szollosi-Nagy). This paper summarises the common issues and differences between the approaches in the various parts of the world, and attempts to provide a synthesis of the discussions.

1 INTRODUCTION

In his opening address to the symposium, Prof. Erich Plate set the challenge for policy on flood risk management as to prevent flood events from becoming disasters. This means that we must clarify what we mean by a "flood", and what constitutes a "disaster"; moreover we need to understand, what flood "risk" is before we can address its management. Without laying out these basic concepts we are in danger of talking to each other but not communicating because we do not share a common understanding of what we mean by the words we use.

There are many definitions of flood in use, ranging from "water outside its normal confines" (FLOODsite, 2005) to "*inundation which causes damage*" (Prof. Nishat). For the purpose of this paper we choose to adopt the anatomy of flood "risk" as being the combination of flood hazard (i.e. inundation) with the consequences of flooding on what is exposed to the inundation (i.e. people, property, environmental assets etc). We view the description by Prof. Nishat as a flood being an event in which some "risks" are actually experienced. For flood risk management we prefer to define flood as water outside its normal confines, thus relating it to the concept of hazard, whereas damage relies on the vulnerability of the area which is being flooded. The combination of the flood (hazard) and the area's vulnerability determines flood risk. This means that flood risk is entirely a human concern, whereas floods are a natural phenomenon being an integral part of the hydrological cycle.

It is important to recognise that floods by themselves do not only pose a risk, indeed flooding (inundation) has contributed to the development of human civilisation. For example, water levels on the River Nile have been recorded for about 4,000 years because the annual inundation of the flood plains brought nutrients and water essential for agriculture. The height of the annual flood peak was crucial to the wellbeing of this ancient society with too little or too much water being a natural disaster. Figure 1 shows a "Nilometer" gauge set on a fight of steps down to the river with the translation of river level into social impact (Drower 1956).

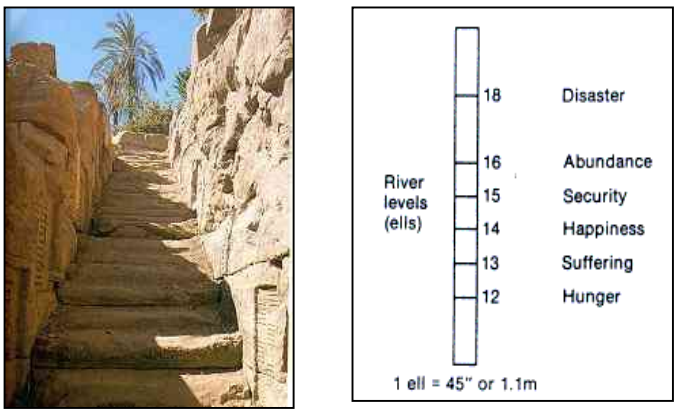

Figure 1 Nilometer and interpretation scale

The human perception of floods has changed over time, and so has the view on how to react on it. Originally, floods were regarded an "Act of God" and society accepted the vagaries of nature. With the Enlightenment and technological development in the C18th and C19th the concept developed of man attempting to overcome or control "Nature"; an approach or attitude which continued until very recently. During this period the dominant philosophy was one of flood "fighting", flood "defence" or flood "prevention". Now, with the emergence of sustainability as a dominant driver of international policy and human activity, there is a move towards what might be termed "social responsibility". Thus we find the approach of "Room for the River" in the Netherlands or "Making Space for Water" in the UK.

We are led to the definition of Schanze (2005) of flood risk management as the continuous and holistic societal analysis, assessment and reduction of flood risk. Flood risk is defined as depending on flood probability, exposure and vulnerability (see the Language of Risk available at www.floodsite.net)

2 FLOOD RISK MANAGEMENT: THE COMMON RATIONALE FOR CHANGES

Flood risk management strategies have developed in the past under the influence of societal debate and the power of coalitions. Hence, they are a result of a cultural process. In different countries, these cultural processes differ, as histories are very different indeed. These histories have resulted in different management policies in different countries as we show below. First, however, we emphasise the common finding that a policy change is very often triggered by a major flood disaster, see Figure 2 (Samuels 2000), on top of an incremental change that relies on new scientific insights, new societal views and new power coalitions.

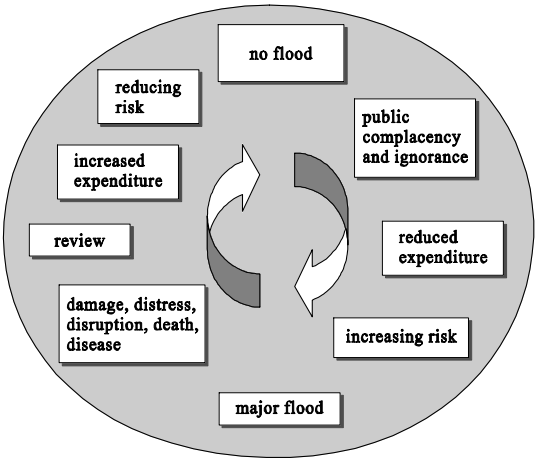

Figure 2 the Risk – Expenditure Cycle

Major floods are often a catalyst for policy change, as they cause public outrage and an increase of political pressure. However, before such a change takes place a broad professional consensus must exist on the need for and general parameters of the change in approach through a sound examination of potential policy options. Good understanding of the incremental policy making process is a prerequisite for being ready to seize the opportunity for policy change during a catalytic event.

At present, we see an increasing urgency to pay attention to flood risk management policy options as worldwide the risk is expected to increase. Besides climate change with its effects on both floods and drought, social, demographic and economic developments urge us to reconsider the current flood risk management strategies. There is a shift away from control of the flood hazard (structural defence measures) towards managing flood risks through influencing the vulnerability of societies, as the risk is essentially caused by humans and their activities. The need for this shift was identified by the IRMA-SPONGE research programme in one of its four main conclusions: "*The most effective flood risk management strategy is damage prevention by spatial planning*" (Hooijer et al. 2004).

Let us now briefly examine how river flood risk management is evolving in different parts of the world, in different socio-economic and cultural historical contexts, going from the old world (England & Wales, Germany and the Netherlands) via the new world (USA), to the third world (Bangladesh).

2.1 *England and Wales*

The historical development of flood risk management in England and Wales was presented by Prof. Penning-Rowsell of the Flood Hazard Research Centre. He emphasised that a flood risk management strategy or any change in it is not just a technical scientific issue, but the result of a political process, incurred by the dissatisfaction of the people with the current state of being. So one might examine how and why the strategy was changed in the past and what can be learned from that for the future?

Figure 3 River Flood in Southern UK

In the UK over the C20th, three stages can be discerned during which certain coalitions were strong, influencing the approach to water management. From the 1930's to about 1970, there was a strong drainage coalition for agriculture, benefiting from the post-war need to secure food production, with a policy for flood prevention. From 1970 to the early 1990s economic reasons predominated, leading to a flood defence coalition to protect people and property. From the mid 1990s onwards, there has been a gradual shift towards flood *risk* management, under the influence of an environmental movement. This includes also enhanced attention for social responsibility, community involvement and public awareness.

Further important background to inform a revision of flood risk management policy came from the Foresight "Future Flooding" project run from the Office of Science and Technology over an 18-month period in 2002-04. This project investigated drivers, responses and scenarios for flood risk over a time-scale of about 100 years. The flood risks were analysed at a scale of a 10km grid for four socio-economic scenarios, which were linked to standard IPCC global emissions scenarios and simulations of future climate by the UK Met Office Hadley Centre. The scenarios represent different policy frameworks for the country and the project considered flooding from all causes: urban storms, river, estuarine and coastal flooding. Drivers of flood risks were identified and ranked under each of these scenarios and the potential flood damages estimated for the 2080s.

Figure 4 Flash-flood damage at Boscastle (UK), August 2004

Substantial differences emerged between the scenarios with the damage increasing in all scenarios if current policies are maintained. Current annual flood damage was estimated as about €1 Billion, with this rising to over €30 Billion in the worst scenario without additional mitigation strategies. Future flood risks depend strongly on assumptions on global emissions of greenhouse gases which provide a clear link between international policy and impacts at the national scale. The report (OST 2004) poses many questions to policy makers such as:

- Should the increase in flood risks be accepted or actions taken to reduce them?
- How important is managing climate change to the risks faced from flooding?
- How should land be used in balancing the wider economic environmental and social needs against creating a legacy of flood risk?
- What is the balance between societal responses to flood risk and structural defences?
- What is the balance between government, developers, the individual and insurance in financing flood defence?

In late 2004 this culminated in the first new national policy since 1993 with the public consultation on the policy document "***Making Space for Water***". This new policy exemplifies the change of view since 1990, but needed the "wake-up" call of the wide-spread floods of Easter 1998 and the winter of 2000/01 and the scientific understanding of the Foresight project for its launch. The policy sets out a framework for the first time to cover all sources of flooding and contains an integrated portfolio of approaches which reflect both national and local priorities. It highlights the importance of spatial planning guidance and strives for sustainability. As new view it is very attractive, but its implementation will require answers to many as-yet unanswered questions, e.g. about:

- risk equalisation or sharing

– how to make space for people and water at the same time
– how to retrofit this space for water in a crowded country

2.2 *Germany (presented by Jochen Schanze, Dresden Flood research Centre)*

In Germany, a paradigm change can be observed since the floods of the Oder in 1997 and the Elbe in 2003. This paradigm change is based on the understanding that absolute protection against floods is unachievable. Therefore, the approach to managing flood risks is shifting away from protection only to holistic risk management by including spatial planning. This change of paradigm in practice was already introduced in theory during the Decade of Natural Hazards (Prof. Plate).

Figure 5 the 2003 flood in Dresden

In practice, this changing view is reflected by the wealth of plans which are being drafted or already implemented in Germany. Because of the federal structure of the country, plans are being made at various levels. There is a Flood Protection Act at the federal level, there are Water Management Plans in most Länder (e.g. the Saxony Water Management Plan) which address the issue of flood risk, and most large communities have an important role in decisions on land use. Land use zoning according to flood hazard zones should be enforced at local level by the communities. This means that on paper flood risk management is well organised. In practice, however, it is difficult to change things, as there is no single managing entity responsible for the whole. Moreover, things may be arranged differently in different Länder, which is the logical consequence of the federal structure. For any change, to work practice, co-operation is a prerequisite, both vertical and horizontal. This means that, in the special context of federal Germany, informal cooperative processes are much more important than the formal ones.

2.3 *The Netherlands (presented by Cees van Westen, Rijkswaterstaat DWW)*

The Netherlands has a long tradition of flood risk management, which gradually developed towards a flood defence approach in the 1950's. The 1953 storm surge, which caused the death of some 1800 people, was an important policy catalyst for better protection. It led to the installation of the so-called Delta committee, which performed many studies and came up with advice to the government. This advice focussed on the coast, but in its wake the polders on the former floodplain areas along the large rivers (esp. Rhine and Meuse) were treated in a similar way.

Figure 6 Eastern Scheldt storm surge barrier, the Netherlands

The Delta committee advised to base safety standard on flood risk, indeed as a combination of flood probability and flood consequence, in balance with the construction costs for realizing a certain flood probability. Because of insufficient knowledge and to keep things simple, in practice an approach has been adopted based on safety standards for 53 individual so-called dike-rings, each with a safety level of 1: 1250, 1: 2000, 1: 4000 or 1: 10.000. Those safety levels relate to exceedance probabilities of design conditions. Both the safety levels (with a differentiation into 4 levels only) and the location of the dike-rings are specified in the Law on Flood Defence. The state of the defences is monitored constantly and evaluated in relation to the latest measurements and scientific insights on river discharge every 5 years. Whether the standards for exceedance probability are still up-to-date and in

tune with economic development is not yet a point of consideration.

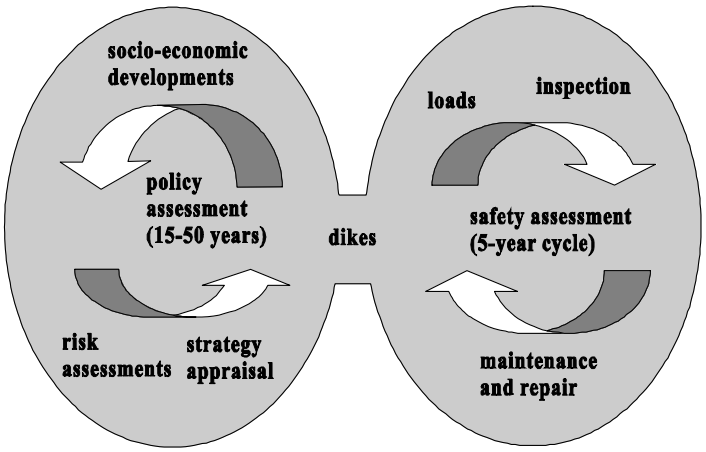

Figure 7 Cycles of risk and safety assessment for flood defense in the Netherlands

As the title of this law already indicates, the current approach in the Netherlands is not a full risk approach. There have been many attempts to change this in the recent past, e.g. by the Technical Committee on Flood Defences, WL | Delft Hydraulics, the National Institute of Public Health and the Environment (Ten Brinke & Bannink 2004) and the Central Planning Bureau (Eijgenraam 2005). The idea of changing towards a full risk approach is gaining ground, as can be deduced from speeches by the minister of Public Works and Water Management, but implementation seems to be delayed again and again because of the complexity of the analyses (especially flood probability instead of exceedance probability; cf. Klijn et al., 2004) as well as because of political opposition to any further 'differentiation of standards for safety' as such.

2.4 *USA (Dr. Gerald E. Galloway, University of Maryland)*

The US has national flood standards and a floodplain management program. Floods have been characterised as a menace to national welfare since the 1930's, after massive damage from the 1927 Mississippi floods. This led to the passing of the Flood Control Act in 1936, making flood risk management a national concern. On the basis of this act many engineered structures have been built, e.g. embankments, floodways etc. With these, it is estimated that some 18 G$ of damages have been prevented, in particular during the exceptional floods in the Mississippi basin in 1993. Since the 1960's, non-structural measures have been applied in addition, especially in the form of regulatory measures and insurance. For the implementation of those measures the designating of 1% flood probability zones provided the basis. This has resulted in the 1 % flood probability having become the accepted standard all over the USA.

Although the practice of *Flood Risk Management* is growing in the United States but *Flood Risk Management* is not a widely used, recognised or understood term. In the US, the three central approaches guide floodplain management are:
- a risk based approach used by the Corps of Engineers on new studies;
- a simple standard approach for the National Flood Insurance Program (NFIP) and related land use; and
- a social goal-based approach there should be no disasters.

Following the great Mississippi River Flood of 1993, the United States has closely examined its floodplain management policies and procedures, conducting several regional and national assessments and has reacted to those assessments. These assessments revealed that:
- major floods have been significant hydrometeorological events and they will continue to occur;
- people and property are at risk in the floodplain;
- the situation is not going to improve; and
- there are no simple answers.

Since the 1993 Flood the United States has reacted to the knowledge of the flood hazard through
- greater national awareness of flood threat;
- state and local attention to floodplain management;
- more comprehensive planning;
- selected relocations and land acquisitions; and
- increased attention to natural resources.

Based on the post-flood assessments, there is growing consensus that the National goals should be to reduce flood damages, whilst protecting and enhancing the natural environment and continuing economic growth. To accomplish this will require that the Nation should implement the following principles:
- share responsibility and costs for floodplain management among federal, state, and local governments and impacted populace;
- avoid unnecessary use of floodplain: don't develop when you don't need to;
- minimize damages to development that does occur and has occurred;
- mitigate damages that will occur;
- deal with the river basin as an ecosystem; and
- restore, maintain and enhance the natural environment.

However, despite the good progress in flood risk management, flood risk often increases as there are still large developments in floodplains; they remain

attractive areas for industrial and housing development and floods do not seem a big concern for local decision makers. Consequently, there are still counteracting policies on development in floodplains. It may thus be concluded that the implementation of a sound coherent flood risk management for the USA is hampered by the lack of one single Flood or Water Act which integrates these three approaches or resolves the contradictions in their underlying philosophies. See also (Loucks 2003).

The integration of homeland security following the September 2001 terror attacks has raised the importance of risk based multi-hazard management as part of homeland security risk management. The opportunity for change has increased through:

- a growing awareness of the water challenges of drought, floods and ageing infrastructure;
- two national water policy dialogues;
- legislation which is pending for a National Water Commission; and
- the current review of the NFIP.

Figure 8 flooded highway in urban area, USA

2.5 *Bangladesh (Prof. Ainun Nishat, IUCN country representative for Bangladesh)*

Some 50 years ago, the people of Bangladesh used to build above the expected flood water level. This suited a population of only 40 Million people which also strongly depended on floods, but since then, population has grown to in excess of 100 Million, requiring a substantial increase in agricultural production. From the time of Independence, controlling floods has been a national goal. However it is important to understand the definition of a flood in the social context of the country. If an area goes under and remains under water for some time, this is considered as *inundation*.

When inundation causes damage to property and crops, disrupts communication and brings harmful effects to human beings as well as to flora and fauna, it is *flood*. It is essential to understand that inundation supports fishing, navigation, soil fertility, ecosystems, ground water recharge etc. Thus in Bangladesh it is considered that *Inundation + damage = flood*. This "equation" is seen to be similar to the definition of risk as hazard and consequences.

Figure 9 Inundation causing damage in Bangladesh

Recently, the aim of controlling floods has been broadened to a more integrated flood risk management. This policy shift was catalysed by the 1987 -1988 floods, which was followed by the World Bank coordinated Flood Action Plan and culminated in an integrated Water Management Plan in 2004, specifying 11 guiding principles and applying a portfolio of measures and instruments, partly related to flood risk management.

In summary, Bangladesh's approach to flood management is to:

- safeguard life and livelihoods;
- minimise potential flood damage;
- improve agro-ecological conditions for enhanced crop production;
- meet the needs of fisheries, navigation, communications and public health;
- promote commerce and industry; and
- create flood-free land for a better living environment.

The eleven guiding principles of the flood management strategy of Bangladesh are:

1 Phased implementation of a comprehensive flood plan.
2 Effective land and water management of protected and unprotected areas.
3 Strengthening and equipping the disaster management machinery.
4 Improvement of the flood forecasting system and establishment of a reliable and comprehensive flood warning system.
5 Safe conveyance of the large cross-boundary flow to the Bay of Bengal by channelling it through the major rivers.
6 Effective river training works for the protection of embankments, infrastructure and population centres.

7 Reduction or distribution of load on the main rivers through diversion of flows into major distributaries or interception of local runoff.
8 Improvement of the conveyance capacity of the river networks.
9 Development of floodplain zoning to allocate space for habitation patterns, economic activities and environmental assets.
10 Coordinated planning and construction of all rural roads, highways and railway embankment with provision for unimpeded drainage.
11 Encouraging maximum possible public participation by beneficiaries in the planning, implementation, operation and maintenance of flood protection infrastructure and facilities.

Looking back, we discern major shifts in strategy of how to deal with floods, from adaptation, through flood control, to flood management. In Bangladesh, floods are so severe that full flood control is impossible. Thus flood protection measures focus on the urban areas only where the population are most vulnerable compared to the rural areas where inundation is either a benefit or only a nuisance. The relative importance of flood prediction and warning in the case of dangerous floods arises from the impracticability of full control of flood. In practice, Bangladesh has a good flood prediction, although the subsequent warning requires further improvement, hampered by the low level of development. However, evacuation and shelter management for coastal floods is a success story, which has saved many lives.

3 INTERNATIONAL CO-OPERATION (ANDRAS SZOLLOSI-NAGY, UNESCO INTERNATIONAL HYDROLOGY PROGRAMME)

UNESCO recognises that "something is wrong", given the increase in numbers of victims and economic damage by floods. In many cases, floods result in real disasters because of secondary effects, e.g. famine and disease from poor sanitation. This increase can be partly attributed to climate change, after all one cannot assume hydro-meteorological stationarity. But more important seems to be the growing populations, especially of urban poor. It is estimated that only about 20% of the increase of flood risk is caused by climate change, whereas demographic and economic developments are responsible for the other 80 % of the increase.

One of the questions behind the 2002 2nd World Summit on Sustainable Development and behind the 2003 3rd World Water Forum in Japan was how to respond to this increase in flood risk. In the wake of these, UNESCO is promoting an integrated approach to Flood Management (note *not* flood *risk* management) since UNESCO maintains that a design flood level approach does not work, because of the non-stationary climate. In addition, the concepts of flood probability associated with a design standard are difficult to explain effectively to the general public. The approach advocated by UNESCO includes:

- living with floods
- equity (both for current and future generations)
- participation
- an inter-disciplinary and trans-sectoral approach
- international & regional cooperation

As main objective, UNESCO recognises the transfer of knowledge and experience from developed to developing countries. In order to achieve this, a UN inter-agency International Flood Initiative is being taken, which establishes a new institute in Japan (ICHARM) in 2006 to focus on the dual Hazards of Floods and Droughts. It is to be an open initiative aiming at helping authorities, esp. in developing countries by capacity building and training.

4 SYNTHESIS

The first point of our synthesis of the views expressed in this theme of the Symposium is that of "**change**". No longer are the natural world or social systems viewed as static and flood risk management has evolved in response to the change to context in which it is set. In particular, we identify a change in approach and policy from controlling the flood hazard to safety standards and flood management to understanding and managing the flood risk. An important driving influence on this evolution in policy is the increasing rate of expenditure on the management of flood risks and the increasing financial consequences (insured and uninsured) of flood damage worldwide. The publicity given to the effects of floods whether they are of local, national or international impact has led to a perception that "something is wrong" with the natural system with climate change being identified as a cause for the increased damage and distress caused by floods. More important, however, are societal changes through economic development (as identified by UNESCO) and also potentially public attitudes and perception (OST 2004).

In many countries a wholly negative view of floods as posing risks is false. It is important to recognise that inundation from floods is part of the natural hydrological cycle and that there are opportunities and benefits of floods. For example, the annual cycle of inundation is essential to crop production and rural fisheries in Bangladesh. In more developed economies there is also a recognition that the adage of "Make space for water"

in many cases needs to be extended to "Make space for water *and people"*. Both people and water need the resource of floodplains in differing ways and our challenge is to design ways of sharing room between rivers and floods. This theme is also evident in the NCR-project "Freude am Fluss", which tries to design room for the river and people simultaneously (see www.freudeamfluss.org). The need for living with rivers and floods places emphasis on public education, communication and participation in terms of the development and implementation of policies, strategies and actions for the management of flood risks.

Understanding the context of flood risk management is essential in terms of governance and institutional structures together with the predominant culture, societal values, and national regulation for the use of land. As example of cultural difference, we cite the question posed in the Symposium from the US of why the Netherlands and Germany apply different standards for flood probability within the country, and how they explain this to the people. Set against the advice of the leading research institutions in the Netherlands to implement a further differentiation of design standards based on *risk instead of flooding probability* (e.g. Ten Brinke & Bannink 2004, Eijgenraam 2005) this question is remarkable; it can only be understood from the cultural perspective of the USA which is not risk-based in reality.

There are many actors with differing (and potentially conflicting) priorities involved in flood risk management who need to be engaged in the process of decision and action. Their decisions and actions need to be underpinned by information and sound science and effective communication is needed between them. For example, in the UK the management of flooding from river and the sea is a public sector responsibility whereas the private sector is responsible for controlling flooding from urban sewers. In Bangladesh different government agencies are responsible for flood control on the major rivers, flood control in urban areas and the construction of transport infrastructure, which often constricts the propagation of floods over the flood plains. In the USA flood control involves local, state and national responsibilities.

Common to all countries is the experience that major floods are a catalyst for policy revision, which should build upon a consensus of ideas, gained through incremental learning. However, there are no universal risk reduction strategies; it is essential to take account of flood type – in Bangladesh for example flash floods, urban or rural drainage congestion, major river and tidal surge flooding all need different solutions.

Alongside changes in policy, we observe that, worldwide, there is a related evolution in the approach to flood management by scientists and engineers. No longer is there reliance only on the construction of defences, but rather the implementation of a portfolio of measures and policy instruments for the integrated management of flood risk as combination of hazard control and vulnerability reduction. This involves a shift from controlling the source of flood hazards using only hydraulics and engineering to risk management incorporating all aspects of the natural and socio-economic system (ecology, spatial planning, economy, etc.). Also this holistic approach has involved a move from merely local analysis to a whole-basin view and from financial cost-benefit analysis alone to full impact assessment.

5 CONCLUDING REMARKS

Despite the change in philosophy from flood defence to flood risk management in all countries, real risk-based approach for both analysis and management is seldom explicitly applied. Prof. Eelco van Beek (NCR) underlined this in the conference closing session by pointing out that flood management is evolving towards flood risk management, but the latter is certainly not common practice yet. Also, the actual management methods differ strongly between countries, as each applies a different portfolio of technical measures and policy instruments. The differences in management approach seem partly related to differences in river type and flood regime characteristics, but there are also cultural differences. For example, in the USA, one flood probability standard is accepted nationally, whereas in the Netherlands and Germany different design discharges are applied. This can only be explained by cultural differences between Europe and the USA and their citizens, historic experience of the consequences of flooding, which are reflected in the very different institutional arrangements.

Another example is the significance of the insurance industry, which is very strong in the individualised and market-oriented UK, and still virtually absent in the Netherlands. In the Netherlands we see a relatively centralistic institution (Rijkswaterstaat) responsible for flood defence, inherited from the centralist French, who ruled the country some 200 years ago. In contrast, in Germany the Länder are the most important formal institutions who emphasise land use planning; an institutional arrangement which can be traced back partly to Germany's history of smaller kingdoms and dukedoms and partly to the C20th history of the restructuring of national institutions after the two world wars.

Still, the same gradual change towards flood risk management can be perceived, whereas a common denominator is the fact that real change only then occurs when triggered by a disaster. However, when

floods are the catalysts for change, the seeds for such a change must be there in order to make it an adequate change. Otherwise, political decisions may result which do not contribute to long-term sustainability. Sustainable development poses many challenges as it is multi faceted having the three pillars of the environment, society, and the economy. Moreover the development and implementation of policy requires effective public participation. The intergenerational time scales for sustainability assessments poses additional questions of how to account for future costs and how to handle the uncertainty in assessments in the decision making processes. Assessments will need integrated and consistent scenarios for socio-economic development, global emissions and climate, and for governance, institutions and values. The UK Flooding Futures project (OST 2004) indicates how this can be approached. Current research, for example in the EC sixth framework Integrated Project **FLOODsite** (www.floodsite.net), will add to our knowledge on the assessment and management of flood risks and it is expected that it will also provide concrete innovations on management approaches for the multi-cultural context of Europe.

6 ACKNOWLEDGEMENTS

The authors thank the lecturers who presented their national experiences for a large audience and who gave their un-censored views on what is going wrong in the current practice and on how to proceed. We would express our gratitude in particular to Ad van Os (NCR secretary) and to Eelco van Beek (NCR) for organizing the discussion and finally to Eric Marteijn (NCR) for chairing it.

REFERENCES

Drower, M. S. 1956. Water-supply, irrigation and agriculture. In Singer, C. S., Holmyard, E. J., and Hall, A. R. (Eds.) A History of Technology, Volume 1: From Early Times to Fall of Ancient Empires, pp. 520-557. Clarendon Press, Oxford, UK.

Eijgenraam, C.J.J. 2005. Veiligheid tegen overstromen. Kosten-batenanalyse voor Ruimte voor de Rivier, deel 1. CPB document no. 82, 's Gravenhage.

FLOODsite Consortium 2005. Language of Risk, Project definitons, FLOODsite Report T32-04-01, March 2005, www.floodsite.net.

Hooijer, A.; Klijn, F.; Pedroli, G.B.M. & van Os, A.G. 2004. Towards sustainable flood risk management in the Rhine and Meuse river basins: synopsis of the findings of IRMA-SPONGE. River Research & Applications 20(2004)/3 343-357

Klijn, F., van der Klis, H.; Stijnen, J; de Bruijn, K.M. & Kok M. 2004. Overstromingsrisico dijkringen in Nederland; betooglijn en deskundigenoordeel. WL-report Q3503.10, Delft.

Loucks, D.P. 2003. Managing America's rivers: who's doing it? Int. J. River Basin Management 1/1: 21-31

OST 2004. Future Flooding – Executive Summary, Office of Science and Technology, Victoria Street, London, SW1H 0ET, available at web site www.foresight.gov.uk

Purnell R.G. 2002. Flood Risk – A Government Perspective, ICE Proceedings, Civil Engineering, Vol. 150, Special Issue 1, May, pp 10-14

Samuels P.G. 2000. An overview of flood estimation and flood prevention, Invited paper presented at the First International Symposium on Flood Defence, University of Kassel, Sept. 2000

Schanze J. 2005. Theoretical and methodological basics of flood risk management in Europe. In: Schanze J, Zeman, E & Marsalek, J (eds.), Flood risk management . Hazards, vulnerability, mitigation measures. Springer Verlag

Ten Brinke, W & Bannink, B. 2005. *Risico's in bedijkte termen. een evaluatie van het beleid inzake de veiligheid tegen overstromen.* RIVM,- MNP, Bilthoven.

7 ANNEX

Wednesday 25 May 2005, parallel session no. 2	
14:00	Introduction (Ad van Os, NCR, the Netherlands)
14:15	UNESCO/WMO/UNU/ISDR Interagency International Flood Initiative (Andras Szollosi-Nagy, UNESCO, Division of Water Sciences, France)
14:40	FRM Strategies in Bangla Desh (Ainun Nishat, IUCN Bangladesh Country Office, Bangladesh)
15:05	FRM in the USA (Gerald Galloway, University of Maryland, USA)
15:30	*Break*
16:00	FRM as a societal process (Jochen Schanze, Dresden Flood Research Centre, Germany)
16:25	Flood crises as policy catalysts (Edmund Penning-Rowsell, Flood Hazard Research Centre, Middlesex University, UK)
16:50	A certain degree of risk, FRM in the Netherlands (Cees Jan Van Westen, Rijkswaterstaat-DWW, the Netherlands)
17:15	Closure, preview to plenary session (Ad van Os, NCR, the Netherlands)

Thursday 26 May 2005, plenary session	
14:00	Synthesis (Paul Samuels, with contributions from NCR, HR Wallingford Ltd, UK, **FLOOD*site*** coordinator)