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SUMMARY

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Conservation | Sustainability | Climate Change

Strategic flood risk management

Developed in partnership with the General Institute of Water Resources & Hydropower Planning, Ministry of Water Resources, People's Republic of China

About this summary

This document summarises the findings of a collaborative effort between WWF, the General Institute of Water Resources & Hydropower Planning (GIWP), Ministry of Water Resources, People's Republic of China and a number of leading international experts from the UK, South Africa, Australia and the US. The effort was originally conceived to review and disseminate modern approaches to water management in challenging environments, and provide new insights into strategic planning and risk management of water resources.

This paper focuses on basin water allocation planning and is one in a series of three covering (i) strategic basin allocation planning (ii) strategic basin planning, and (iii) strategic flood risk management. A series of books on these three topics, encompassing both a major international review and a summation of world best practice in these fields, will be published in August 2012, in both English and Chinese.

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Authors

Paul Sayers
Sayers and Partners, England
paul.sayers@sayersandpartners.co.uk

Gerald Galloway
University of Maryland, USA

Edmund Penning-Rowsell, Kang Wen
Flood Hazard Research Centre, Middlesex University, England

Fuxin Shen, Li Yuanyuan
General Institute of Water Resources & Hydropower Planning (GIWP), Ministry of Water Resources, People's Republic of China

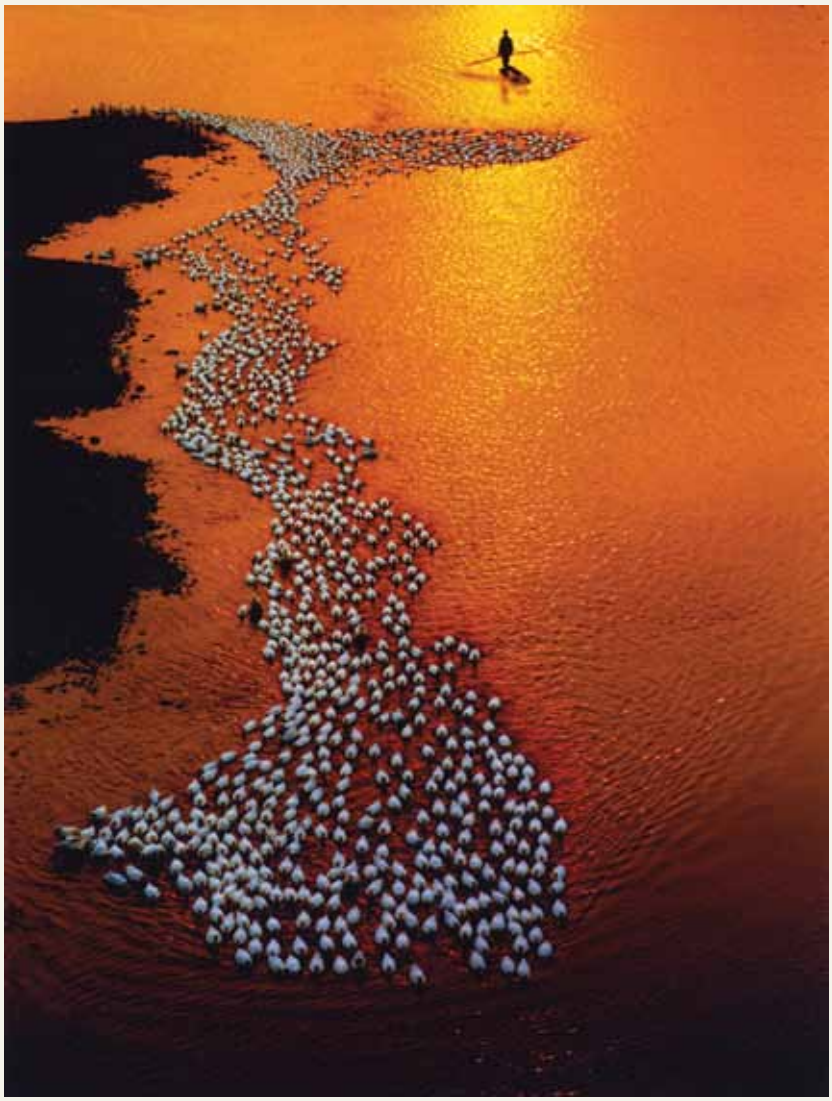
Yiwei Chen
Nanjing Hydraulics Research Institute, People's Republic of China

Tom Le Quesne
WWF-UK, corresponding author: tlequesne@wwf.org.uk

INTRODUCTION

The concepts of flood risk management have been widely embraced over the past decade. In many instances this conceptual acceptance has resulted in changes to decision-making practice, highlighting risk management as potentially more complex, but more efficient and effective in delivering multiple goals, than a traditional engineering standards-based approach.

In particular, the emergence of strategic flood risk management is enabling a longer term, catchment-wide, perspective to emerge. The decision process based on an explicit trade-off of the whole (life-cycle) risks reduced, opportunities promoted and the resources required. In doing so, the advantages of adopting a portfolio of integrated multi-sector responses (including structural and non-structural measures as well as policy instruments), has moved centre stage.



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A BRIEF HISTORY OF FLOOD RISK MANAGEMENT

The earliest civilisations recognised the need to live alongside floods; locating critical infrastructure on the highest land (as seen through the Churches and Cathedrals of England); providing flood warnings to those that may be flooded (common practice in ancient Egypt); making flood sensitive land use planning choices (as practiced by The Romans).

The requirement for "protection" and a belief in "our ability to control floods" started to increasingly dominate attempts to "deal with flooding". During the early part of the 20th century the concepts of modern flood risk management began to emerge, in particular, recognising flood management not only as an engineering pursuit but also as a social endeavour. Throughout the 1960s to 1980s, the principal means of mitigating the impacts of floods remained, however, flood control (via the construction of levees, dykes, diversion channels, dams and related structures). As populations as populations grew and flood plains were developed, flood losses continued to increase, and the need to do things differently became more apparent. A new approach was needed, one that utilised the concepts if risk in decision making practice not just theory.

This progression is summarised in Figure 1.

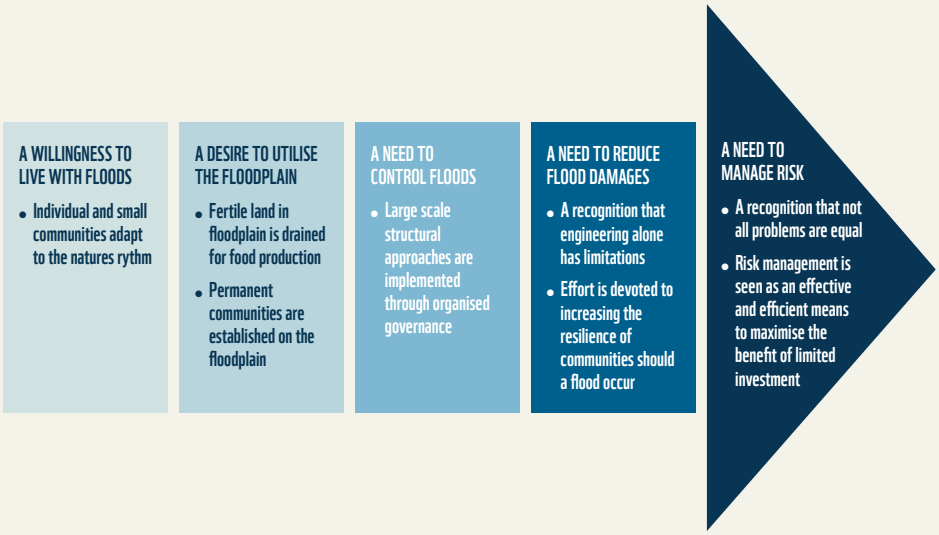


Figure 1: The evolution of flood risk management

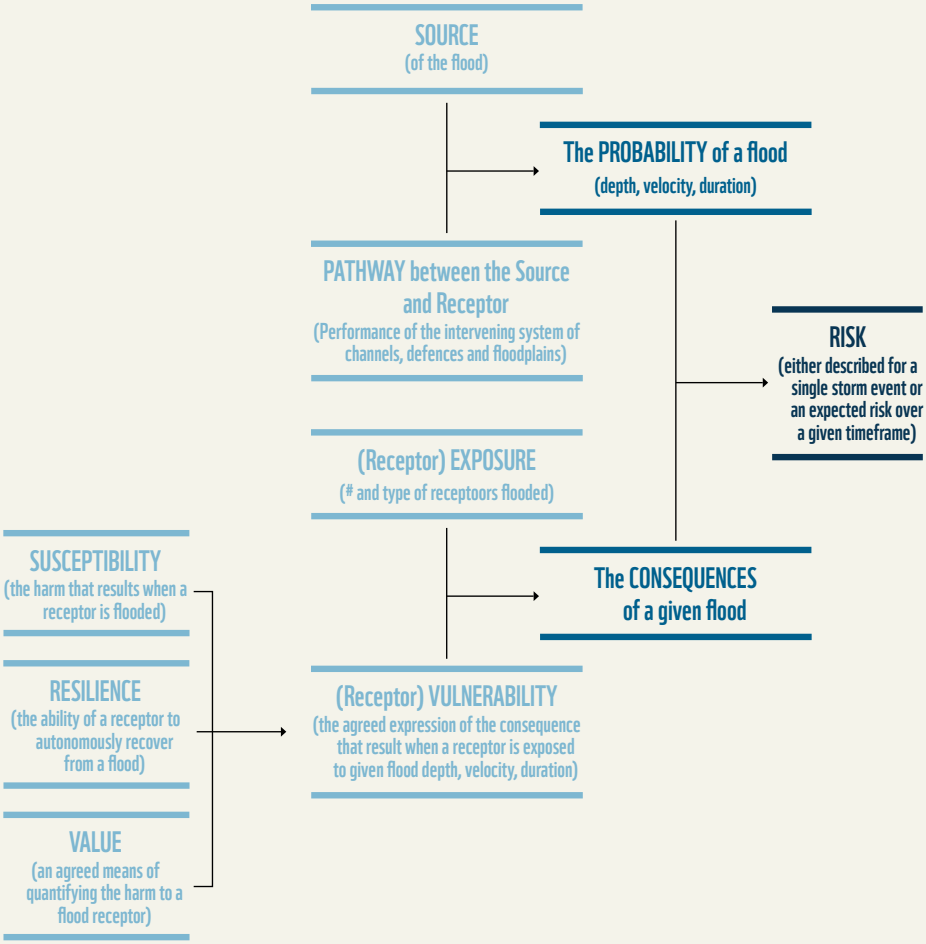
Despite this, traditional flood control approaches continue to persist today in many policies and, perhaps most importantly, in decisions taken; decisions that ultimately we may come to regret.

But practice is changing, slowly. Adopting a strategic approach to flood risk management is central in aiding this transition. Although there is no single roadmap to follow, and few comprehensive examples, many of the elements of good practice and the supporting tools and techniques do now exist.

DIMENSIONS
OF RISK

A number of important concepts underlie our understanding of risk and bridge the gap from assessing the risk towards making risk informed decisions. One of the most important of these concepts is the multiple, and sometimes subtle, dimensions of risk itself (Figure 2).

Figure 2: The components of risk – to understand risk, the individual components of the risk must also be understood



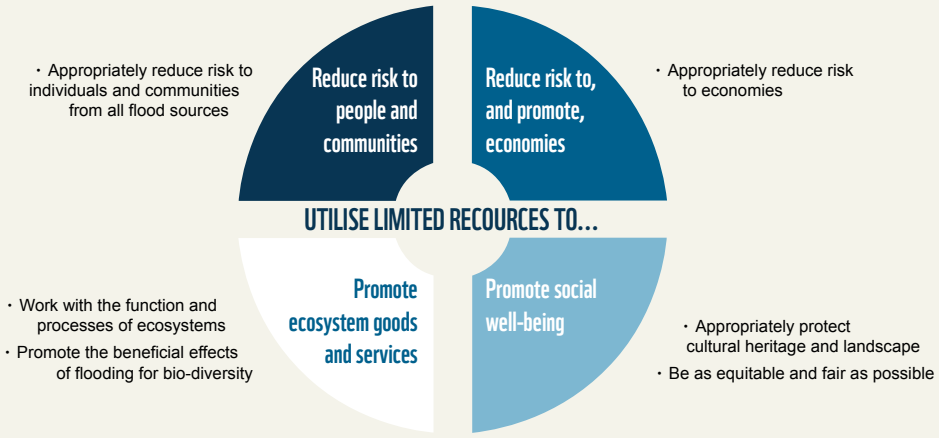
All of these dimensions are subject to change – either through autonomous pressures or purposeful intervention. Traditionally the focus has been on reducing the probability of flooding through extensive structural defence systems such as those in the Rotterdam; Netherlands; New Orleans; USA; Huai River; China. Increasingly, there is the recognition that non-structural actions offer a vital contribution to risk management. Many non-structural options exist, including actions to (i) reduce the exposure of people, the economy and ecosystems to flooding (through, for example, effective planning control in flood prone areas, as in the City of Cape Town, South Africa), or (ii) reduce the vulnerability of those exposed to flooding (through, for example, the use of safe havens, better warning and evacuation planning, modern flash flood forecasts through to flood specific building codes and insurance arrangements).

Recent actions in Bangladesh, alpine regions of Europe and China bear out the effectiveness of such approaches.

STRATEGIC FLOOD RISK MANAGEMENT

Flood risk management has multiple goals relating to multiple time and space scales (Figure 3). Achieving these relies upon the development and implementation of appropriate portfolios of measure (where the advantages of one compensates for the disadvantages of another); a process that is complicated by the changing nature of the flooding system (through climate, geomorphologic and socio-economic influences). Accepting the future as unknown impacts the way in which plans are made and decisions implemented. Flood risk management therefore embeds a continuous process of adaptation that is distinct from the 'implement and maintain' philosophy of a traditional flood defence approach – an approach central to the decision to delay the construction of the new major defences within the Thames Estuary (Table 2).

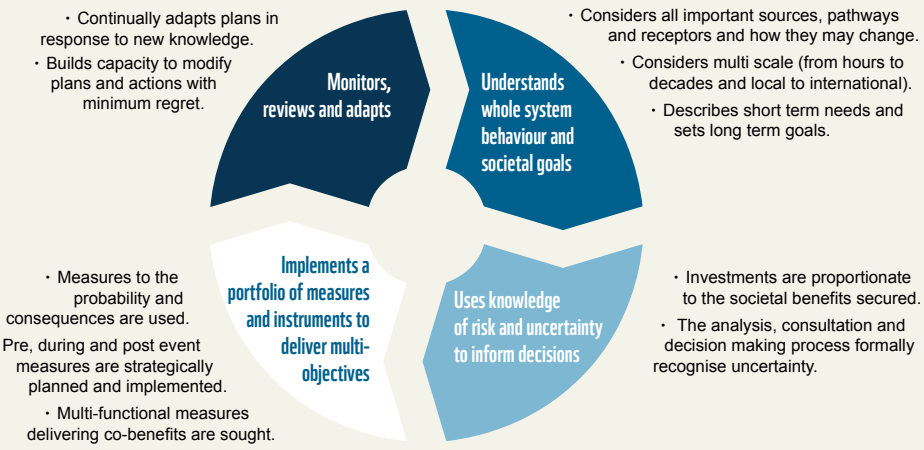
Figure 3: The primary goals of strategic flood risk management



Taking a longer term, whole system view, places a much higher demand upon those affected by flooding and those responsible for its mitigation. It involves collaborative action across governments, public, businesses, voluntary organisations and individuals. This places an increasing emphasis upon effective communication of the residual risks and actions to be taken.

These characteristics form the building blocks of good flood risk management (Figure 4) – an approach that concurrently seeks to make space for water whilst supporting appropriate economic use of the floodplain.

Figure 4: The characteristics of good flood risk management



SUPPORTING SUSTAINABILITY

Supporting sustainability is much more than simply maintaining the long-term integrity of flood control structures. It also includes promoting the long-term health of the associated eco-systems, societies and economics. The manner in which these higher level goals are translated into specific objectives shapes the nature of the flood risk management that is delivered. For example:

Delivering efficiency and fairness

Flooding is not fair per se: the inherent natural spatial inequality in the frequency and extent of flooding, plus the legacy of differential interventions, being the cause. Every intervention in flood risk management tends to prioritise one group or location over another, creating further inequality and 'unfairness'. Maximising the utility of an investment, whilst ensuring that it is distributed through an equitable process that also protects the most vulnerable members of society, raises a number of practical problems. Providing protection to one community but not another, is unfair; providing a higher level of protection to one compared to another is unfair. However providing a common level of protection to all is impossible, and even if achievable would be inefficient. The desire to manage flood risk more fairly promotes the use of nationally consistent non-structural strategies that are available to all (for example better forecasting, improved building codes and grant\compensation schemes). Such an approach offers a greater contribution to equality and vulnerability-based social justice principles than the status quo of providing engineered solutions to the few.

Building resilience and adaptive capacity

Delivering resilience is much more than simply reducing the chance of damage through the provision of "strong" structures, and adaptive management is much more than simply "wait and see". Both are purposeful approaches that actively manage uncertainty – minimising damage when storm events exceed notional design values and enabling strategies to change with minimum regret as the future reality unfolds (Table 2).

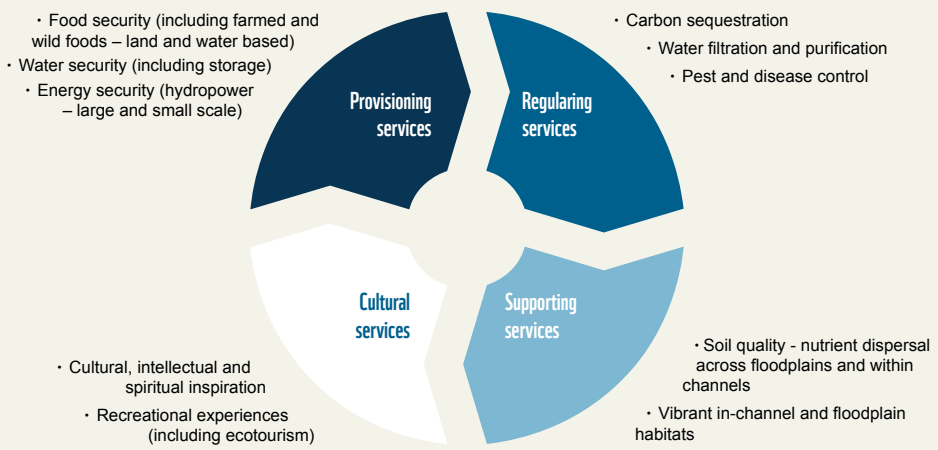
Table 2: The recognition of uncertainty has a profound impact on strategy development; forcing the traditional linear design model to be replaced with adaptive strategies

STAGES OF STRATEGY DEVELOPMENT	TRADITIONAL (CERTAIN) MODEL OF STRATEGY DEVELOPMENT AND DECISION MAKING	ADAPTIVE (UNCERTAIN) MODEL OF STRATEGY DEVELOPMENT AND DECISION MAKING
Deciding what to do	Pre-defined system of goals, objectives and desired outcomes. Defined set of activities and resource demands.	Emerging pattern of goals, objectives and desired outcomes. Flexible configuration of resources and priorities.
Deciding how to do it	Sequential process of planning, programming and implementation. Top-down strategy development.	Continuous alignment of plans, programmes and implementation activities with the changing world. Continuous reconciliation of the bottom-up initiatives and top-down strategies.
Understanding the external and internal influences	Stable system of decision making. Predictable (deterministic) future change – climate, demographics, deterioration, preferences etc.	Changing decision processes and priorities. Unknown future change - climate, demographics, deterioration, preferences etc.

SAFEGUARDING
AND PROMOTING ECOSYSTEM SERVICES

If implemented well flood risk management can have a positive influence on eco-systems and the provisioning, regulating and cultural services they provide. Flood detention areas in China and the US, for example, provide occasional flood storage and enhance habitat development. If little consideration is given to eco-systems, the impact may be devastating (as witnessed along the Danube where the historical defences have caused severe environmental disruption and led to significant restoration needs). “Soft path” measures (such as land use changes, wetland storage, and floodplain reconnection) selective “hard path” measures (such as bypass channels, controlled storage) offer opportunities to simultaneously deliver effective and efficient flood risk reduction and promote eco-system services; (Figure 5) a synergy all too often over looked.

Figure 5: The characteristics of a healthy ecosystem and mutual opportunities with flood risk management



Experience from the Mississippi demonstrates the need for co-ordinated policies and plans

For nearly 300 years, those living along the Mississippi River have experienced the devastating effects of floods. Over time, governmental and public organisations have attempted to provide increasingly higher levels of flood protection. Some of these efforts have been very successful; others have failed. Three distinct approaches have been tried (i) focusing authority, responsibility and resources for flood management in one body, (ii) a more laissez-faire approach allowing local, state, and federal entities throughout the upper Mississippi basin to act independently in an uncoordinated way, and (iii) again uncoordinated, but focused on defending against a specific flood threat, in this case a hurricane protection plan for New Orleans. History teaches us that when a major flood occurs, the first approach works and the other two fail. The reluctance of all levels of government to concede strategic authority and the resources, fearing federal government take-over and a reduction in local influence on decisions, continues however to undermine good longer term planning; addressing issues on a yearly basis with little attempt to coordinate succeeding annual efforts. Only following hurricane Katrina, and the devastating floods, has need for a longer term view and coordinated action been fully realised.

BARRIERS TO IMPLEMENTATION

The best strategy is of little utility if it cannot be implemented. The barriers that prevent the delivery of good flood risk management and the enablers that promote its implementation are summarised in Figure 6. Many good plans have failed due to the lack of clear roles and responsibilities for policy, planning and implementation. Past attempts to provide flood management in the Iguassu River basin in Brazil, for example, has been hampered by a lack of agreement among national, regional, and local authorities. Identifying the specific issues as early as possible and providing solutions before they become 'roadblocks' to successful implementation is a vital step – easily said but surprisingly often not done.

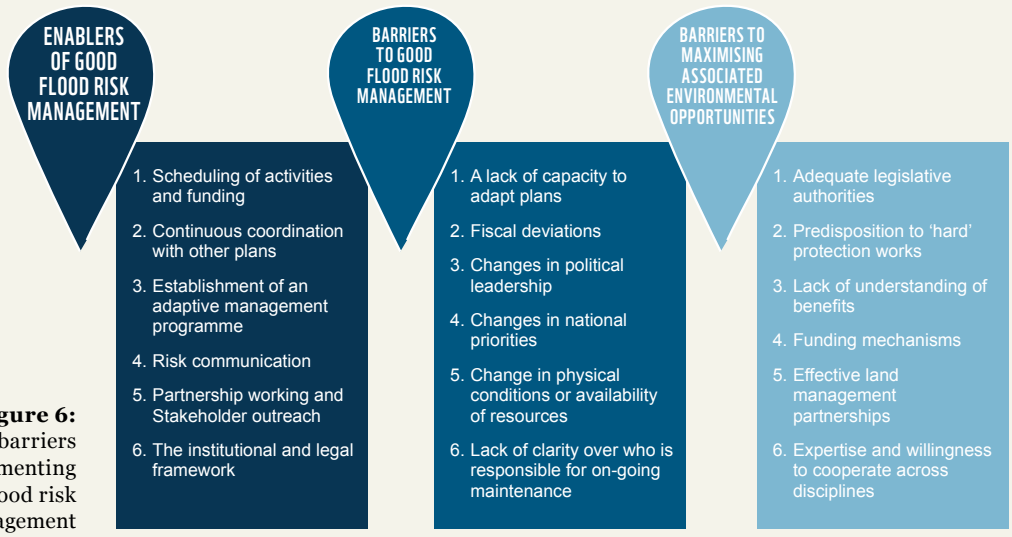


Figure 6: Enablers and barriers to implementing good flood risk management

PRINCIPAL
SUPPORTING TECHNIQUES AND TOOLS

The delivery of good flood risk management relies upon:

- **Appropriate risk and uncertainty analysis** - Exploring key questions as to (i) What might happen in the future? (ii) What are the possible consequences and impacts? (iii) How possible or likely are different consequences and impacts? (iv) How can the risks be best managed?
- **Spatial planning** - Active controls on (re)development of land and property provides perhaps the most direct and effective means of reducing flood risk.
- **Infrastructure management** - Ensuring acceptable performance of flood defence assets and asset systems they comprise is a considerable challenge. The concepts of risk help integrate short to longer term actions to maintain, repair, improve or replace assets appropriately alongside non-structural measures.
- **Emergency planning and management** - Loss of life and injury can be significant in major flood events. The Hyogo Framework for Action 2005–2015 highlights the central role for emergency planning to ensure a flood event does not become a flood disaster.
- **Flood hazard and risk mapping** - In recent years "flood maps" have increasingly been used to communicate risks to a wide range of stakeholders. As the supporting technologies continue to improve understanding the advantages and limitations of each is vital if communication is to be meaningful and useful.
- **Early warning systems** - Flash floods bring fast-moving and rapidly rising waters with a force to destroy property and take lives. Hurricane/cyclone intensity can quickly change and evacuation suddenly becomes necessary. Early warning of these hazards can dramatically reduce human losses and damage to high value property contents.
- **Effective land controls and building codes** - Avoiding development in high-risk areas limits the areal consequences of flooding and sound building codes can enable many structures to survive flood events with minimal damages.
- **Insurance** - For those insured, flood insurance provides a mechanism for them to transfer part of their risk and reduce their vulnerability to flooding; as such flood insurance is a major and legitimate activity in managing flood risk and mitigating flooding consequences.

Definining Strategic Flood Management
As our understanding and experience develops, a common definition of good flood risk management is also emerging:

The process of data and information gathering, risk analysis and evaluation, appraisal of options, and making, implementing, and reviewing decisions to reduce, control, accept, or redistribute flood risks. It is a continuous process of analysis, adjustment and adaptation of policies and actions taken to reduce flood risk (including modifying the probability of flooding and its severity as well as the vulnerability and resilience of the receptors threatened). Flood risk management is based on the recognition that risks cannot be removed entirely but only partially and often at the expense of other societal goals.

GOLDEN RULES OF STRATEGIC FLOOD RISK MANAGEMENT

As flood risk management approaches continue to evolve nine Golden Rules have emerged:

1. **Accept that absolute protection is not possible and plan for exceedence.** Design standards, however high they are set, will be exceeded. Structures may fail (breach, fail to close, etc) and early warning systems or evacuation plans may not work as expected. Accepting that some degree of failure is almost inevitable, places a focus enhancing resilience.
2. **Promote some flooding as desirable.** Floods and floodplains provide fertile agricultural land and promote a variety of ecosystem services. Making room for water maintains vital ecosystems and reduces the chance of flooding elsewhere.
3. **Base decisions on an understanding of risk and uncertainty.** An explicit trade-off between the risks reduced, opportunities promoted and the resources required to achieve them is central to flood risk management. The uncertainty within the data and models must be explicitly acknowledged.
4. **Recognise that the future will be different from the past.** Future change (climate, societal, structural condition etc) can profoundly influence flood risk. Developing adaptive strategies enable flood risk manages to respond to the reality of the future as it unfolds, minimising regret, in a purposeful and planned way.
5. **Implement a portfolio of responses, and not rely on a single measure.** Integrated management involves consideration of the widest possible set of actions. This includes measures to reduce the probability and measures to reduce consequences (exposure and vulnerability).
6. **Utilise limited resources efficiently and fairly to reduce risk.** The resources used must be related to the risk reduced and the ecosystem, economic and social opportunities promoted. Universal or generalised engineering standards of protection should not be used.
7. **Be clear on responsibilities for governance and action.** The role of governments, businesses, communities and individuals must be active participants – all sharing responsibility and contributing fiscal support within a clear framework of collaboration.
8. **Communicate risk and uncertainty effectively and widely.** Effective communication of risk enables better preparation and helps ensure support to mitigation measures where necessary. Communicating the risk after a catastrophe is too late.
9. **Reflect local context and integrate with other planning processes.** The preferred strategy for a given location will reflect the specific risks faced (and not arbitrary levels of protection that should be achieved).

The world's freshwater in numbers

100% RECYCLED

300M

people and the many of the world's most precious habitats are within 1m of the mean sea level

6,753

on average are killed each year by flooding. Proper planning can help reduce this risk

14B

of economic damage annually (1980 - 2008) is caused by flooding

59cm

Observable rise in sea levels continues with the latest projections suggesting an increase between 18-59cm by the end of the century

Why we are here
To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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