Prioritising flood risk management interventions: how to make best use of limited funds

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ABSTRACT: The approach to funding flood risk management reflects a country's culture, legislation, perception of risk and wealth. This paper compares the established approaches in both England and the Netherlands, and the impact of the economic downturn, and aims to inspire policy development elsewhere.

In the Netherlands, the legal standard of protection has always implied that funding would simply have to be made available. However, as improvement costs rise and funds become scarce, there is now a need for prioritisation: perhaps not which defence to improve, but rather which to do first. This is technically complex, but explaining the outcome to politicians and public will be the bigger challenge.

In England, the established prioritisation system ensures that funding is allocated to those interventions that achieve the best possible outcome. Many viable schemes are not carried out due to lack of Government funding; a new approach to prioritisation aims to address this, and to stimulate local funding and ownership.

1 INTRODUCTION

Flooding causes massive damages worldwide and is often described as the most damaging natural hazard. From a rational point of view, it is often worthwhile to invest more in flood risk management than is currently happening, because the benefits of preventing damage and casualties outweigh the costs.

There are various reasons why in practice, the investment in flood risk management does not reach the theoretical optimum point at which the marginal investment equals the marginal benefits. An important reason is that in reality, available funding is limited, particularly if all funding has to come from one (government) source. There are other sectors that compete for the same funding: building roads, hospitals and schools also often have benefits that outweigh the investment costs. Compared to other sectors, flood risk management probably suffers from the fact that the benefits are mainly about preventing something bad that may happen in the future: probabilistic whole life benefits are more difficult to explain to the public and political decision makers than a road that reduces queues. Until a major flood happens of course: this is still the only trigger to increase funding in the majority of cases.

As a consequence, there are always more beneficial schemes than can be done for the available funding, which means there is a need to prioritise.

This paper uses England and the Netherlands as case studies and examples. These two countries provide useful lessons because they are both international leaders in flood risk management, but their approaches are strongly contrasting. Both countries have a long history of flood risk management and have established mature processes, supported by comprehensive methods and strong research and development programmes. The main strength of the English approach to flood risk management is that it has been developed to make best use of limited budgets. The main strength of the Dutch approach is that it has been developed to guarantee a level of flood protection that the country needs, protecting it from short-term political or economic issues.

Chapter 2 is about England, Chapter 3 about The Netherlands. Both chapters start with some background on how flood risk management works in each country, followed by an explanation of the processes that determine how much the countries invest in flood risk management and where they spend it, including broad scale amounts. Both chapters end with an introduction to the new or emerging approaches that are being developed in the face of the current economic constraints. The final Chapter 4

compares the two approaches and draws conclusions for wider international application.

2 ENGLAND

2.1 *How flood risk management works*

The essence of the English approach to flood risk management is to make best use of limited budgets. There is no legally prescribed standard of protection (apart from exceptional cases such as Thames Estuary). Instead, the Flood and Water Management Act gives authorities 'permissive powers' to carry out flood risk management activities. Government provides a budget for investment and sets high level priorities for the flood (and coastal erosion – not discussed in further detail in this paper) risk management outcomes that it wants to achieve. It is then the role of so-called operating authorities to spend the available budget in a way that maximises the outcomes, taking into account the government's priorities.

The responsible Ministry is the Department for Environment, Food and Rural Affairs (Defra); Defra sets overall high level policy and works with the Treasury (Ministry of Finance) to determine national budgets. The Environment Agency has an overview role for all flood risk management. It is responsible for implementing Defra's policy and for allocating the national budget across projects to maximise the outcomes. The actual projects are carried out by the operating authorities. The Environment Agency itself is the largest of these: it is responsible for flood risk management from all designated main rivers (broadly, any water course wider than 3m), estuaries and the sea. In that role, it builds flood defence structures, operates and maintains these, is responsible for flood forecasting and warning and has important roles in development control and in incident management. Local Authorities are also operating authorities; they are responsible for local flood risk, and are the primary contact point for the public on flood risk (from any source). Local Authorities are also responsible for coastal protection on high ground frontages. Finally, the Internal Drainage Boards are responsible for water level management in the low-lying parts of the country.

The Government's priorities for flood risk management are described in the National Flood and Coastal Erosion Strategy for England (Defra & Environment Agency, 2011). The overall aim is to ensure that the risk of flooding and coastal erosion is properly managed by using the full range of options in a co-ordinated way. This is specified in three strategic aims:

– manage the risk to people and their property;
– facilitate decision-making and action at the appropriate level - individual, community, or local authority, river catchment, coastal cell or national;
– achieve environmental, social and economic benefits, consistent with the principles of sustainable development.

Figure 1. Managing flood and coastal erosion risks (from Defra & Environment Agency, 2011).

Figure 1 illustrates the methods for achieving these three strategic aims.

The final part of this section is a discussion of the public perception of flood risk. England is a country where flooding happens regularly: there are significant local and regional flood events that make the national news every few years: Cornwall 2010, Cumbria 2009, Summer floods 2007, Boscastle 2004, Autumn floods 2000, Easter floods 1998. The impact of these events is local or regional. Flood risk is generally seen as a natural risk. In the mind of the public and the politicians, flood risk is important (especially after events, and especially where flooding has occurred), but it is one of many important issues – this is an important difference with the Netherlands, see Chapter 3.

2.2 *How much to invest as a nation*

Government determines how much national funding is available for flood risk management as part of its overall budgets in a three-yearly cycle called the Comprehensive Spending Review. In addition to the general drivers and pressures for setting public investment budgets, there are a number of specific informal 'lobbies' in the English context:

– Flooding victims and their political representatives lobby for local investment. However, in recent years they have also organised themselves in organisations such as the National Flood Forum. They speak for all flooding victims, aim to influence government in a general sense, and are also accepted as partners by the public authorities.

– The Environment Agency also plays an implicit lobbying role by providing factual evidence about the benefits of investment in flood risk management. They produced a Long Term Investment Strategy in 2009 (Environment Agency, 2009), setting out a number of national scale investment scenarios for the coming 25 years and comparing them on the basis of costs, benefits and the number of properties affected. This suggested that the most favourable scenario, in terms of the net return on investment, would require a year-on-year increase of around £20 million plus inflation. This investment profile has not been implemented as yet (see Figure 2), but these findings are informing high-level debate about flood risk management, for example in the House of Commons' Committee of Public Accounts recent report (House of Commons, 2012).
– The third important lobby is the insurance industry. There is currently an agreement between the Government and insurers that they will provide cover to almost all properties, even those at significant risk, in exchange for adequate Government investment in flood risk management. There have been ongoing discussions between the parties about renewal of this so-called Statement of Principles after it expires in 2013, but it was confirmed in early 2012 that this will not be the case. The Association of British Insurers (ABI) has been vocal in recent years that investment will have to increase for them to continue their commitment. The impacts of the non-renewal of the Statement of Principles will become clearer over the coming months and years.

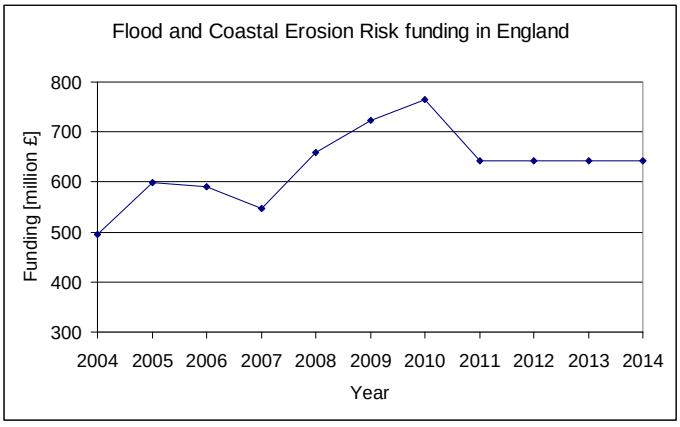

Figure 2. Flood and coastal erosion risk funding in England.

Figure 2 summarises how the level of Government funding has developed over the last ten years. It shows a marked increase following the 2007 Summer floods, a 6% decrease as part of the overall budget cuts in 2010, and the current level of approximately £640 million per year. There are approximately 11 million people at risk of flooding in England, so this amounts to approximately £58 per person at risk. The amount for 2011-2014 is based on an assumption that the Local Authorities' own expenditure will remain at its 2011 level around £100 million per year.

2.3 *Where to invest - prioritisation*

Prioritisation of investment happens through a combination of a bottom up and a top-down process, see Figure 3. The description in this section is based on the approach followed until May 2011. This is still applicable in broad terms, but the changes since then are described in more detail in Section 2.4.

The top-down element is that Government sets its priorities in so-called Outcome Measures. These are a very high level steer on end results: the broad economic benefits, the number of households protected, the ratio of these households that are deprived, and the broad influence on designated habitats.

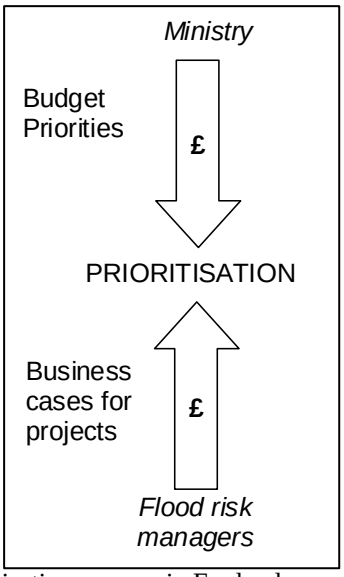

Figure 3. Prioritisation process in England.

The bottom-up element consists of business cases produced by the local teams of Operating Authorities who put forward flood risk management projects for national funding. These business cases, or Project Appraisal Reports, have a better chance of success if they maximise the outcomes in line with Government's outcome measures. The principles of this appraisal are set out in Defra's policy statement on flood and coastal erosion risk management appraisal (Defra, 2009a). This is supported by the Environment Agency's appraisal guidance (Environment Agency, 2010) and a well-developed body of supporting documents and evidence to demonstrate the economic, social and environmental benefits of flood risk management projects. The appraisal guidance outlines a systematic process of problem understanding and objective setting, option development and appraisal, and preferred option decision making and testing to develop a business case for a preferred solution for reducing flood risk. The decision on the

preferred option is primarily based on the relative performance of each scheme in terms of benefit/cost and incremental benefit/cost ratios. While the overall project needs to be cost/beneficial, the extent to which external contribution is available also affects the decision, because such contributions are subtracted from the overall cost to give the benefit/cost ratio of the investment from the central government. Other factors also affect the choice, including the relative scales of intangible benefits, extent of delivery of the project objectives, adaptability to climate change and uncertainties and the preference of the local community.

The top-down and bottom-up processes come together in the Environment Agency's decision making about the allocation of national funding. In broad terms, the prioritisation process looks at all the available schemes and selects those which, as an overall national package, deliver the best return on investment, measured by Government's outcome measures.

2.4 *New approaches*

A new approach for funding flood and coastal erosion risk management, called Flood & Coastal Resilience Partnership Funding, was introduced by Defra in 2011. A wide consultation took place from December 2010, and the new method came into force in May 2011. See Defra (2011a, 2011b) for details of the approach. Section 2.5 of this paper gives further background on the governance rationale behind the change in approach.

The essential change is that the new system facilitates local funding contributions. The old system was fully based on national funding only. If a project's outcome measure score was high enough, it would receive 100% national funding; if not, no national funding was available. In the new system, the level of national funding is calculated on the basis of the outcomes. There are calculation rules for the payment rates in terms of the number of households protected at particular levels, the number of deprived households (in classes), the extent of habitats created, and the remaining economic benefits (e.g. for business, infrastructure, health, tourism, etc.).

If the calculated national funding for a project is more than the project costs, then in principle it will still be fully funded. If not, then it can still receive its share of national funding if the shortfall is complemented by local contributions, from local authorities or other sources.

The Flood & Coastal Resilience Partnership Funding Approach fits with the overall vision of the current Government for localism, which is also reflected in the strategic aims of the National Flood and Coastal Erosion Risk Strategy (see section 2.1 and Defra & Environment Agency, 2011). The three key aims of the Flood & Coastal Resilience Partnership Funding approach are:

- Increase local funding and ownership: it is clear that there are many viable and desirable projects that were not being carried out due to the shortage of national funding, so it is expected that local partners will be interested in contributing funding. Local funding will also generate local ownership, and it is a key part of the approach to promote this.
- Increase efficiency: the level of national funding per project is fixed and is related to outcomes only. This means first of all that a lower cost estimate increases the chances of receiving national funding. It also means that any cost savings will directly benefit the local parties; conversely, any cost overruns will have to be borne locally. This should be a strong incentive for efficiency.
- The payment rates are set in such a way that vulnerable and deprived households have a larger chance of receiving funding. The rates were particularly set up to maximise the number of households that would achieve a 1 in 75 per year standard of protection, as this is (for the moment) the threshold at which insurance companies are prepared to provide cover.

The change in approach responds to a number of recommendations from Sir Michael Pitt's review of the 2007 floods: improving efficiency and responsiveness by aligning those who benefit with those who pay; and developing a scheme which allows and encourages local communities to invest in flood risk management measures.

The appraisal guidance (Environment Agency, 2010) already enables the partnership funding approach to be delivered. It is however being updated to better link to Defra's partnership funding policy and other related advice including Environment Agency (2012). This is in recognition of the need to find external funding and the fact that finding contributions now needs to happen in parallel with the appraisal process.

The Flood & Coastal Resilience Partnership Funding approach is starting to work and is likely to be fine-tuned on the basis of experiences over the coming months and years. Government and the Environment Agency are reporting the first successes of the new approach (Defra, 2012).

2.5 *Rationale for Government intervention*

Whilst it is not possible to prevent all flooding and coastal erosion, Government intervenes in order to address severe market failures (see Table 1). If left to the market (i.e. individual actors) to manage risk, it is highly likely there would be systematic underinvestment and poor decisions taken, resulting in excessive flooding and macro inefficiency. Individuals, if acting in pure self-interest, would seek to postpone their own actions and free-ride on the investment of others. Such market failures justify Government intervention but not necessarily Government investment. Intervention in England has in recent years been funded almost entirely from general taxation, whilst the benefits from investment are realised by a relatively small proportion of the English population.

Significant benefits flow to individuals in England as a result of Government intervention to manage the risk of flooding and coastal erosion. These include reduced damages from flooding, better insurance terms, and improved property, land and rental values.

Where benefits are localised, or concentrated on a limited number of individual beneficiaries, economic theory suggests that those localities should pay for the actions taken, or at least contribute more towards the work they will directly benefit from than those who will not (as a 'club good'). In previous years, little by way of beneficiary contributions towards community defences have been made, meaning that when defences have been built and maintained those in the local area have enjoyed the benefits for free, or at least at no marginal cost, even though the costs and benefits involved are significant.

Table 1. Market failures in flood and coastal erosion risk management. Extract from Flood & Water Management Bill Impact Assessment (Defra, 2009b)

Market failure	Description
(a) Club Goods	Large number of individual beneficiaries that need to act together for the collective good of flood risk management. Beneficiaries fail to reach collective long-term agreement on what to do about flood risk and who should pay for it
(b) Negative Externalities	Individuals actions affect others in a negative way – actions in one area can cause bigger problems elsewhere. Too much exposure to floods and excessive costs brought about by individual actions by "polluters", e.g. those paving front gardens.
(c) Imperfect information	Decisions on flood risk are based on information, and the market would underprovide such information as it is costly to produce. Under-estimate of risk and inconsistent information would lead to poor decisions and an excessive exposure to risk.
(d) Moral Hazard and asymmetric information	Those insured have less incentive to prevent flooding from occurring ("moral hazard"). One party has more information than another and uses it to their own advantage ("asymmetric information"). Too great a flood risk is borne and there is a lack of incentive on individuals to protect themselves against risk or pay for others to do so on their behalf.
(e) Incomplete markets	Failure to provide a comprehensive solution to uncertainty. A lack of a basis for risk-pooling and potential inequity from a more competitive insurance market

3 THE NETHERLANDS

3.1 *How flood risk management works*

In the Netherlands, the Water Act prescribes the location (see Figure 4) and standard of protection of the primary flood defences that protect the country from flooding from the sea, the delta area, the large lakes and the main rivers (mainly the branches of Rhine and Meuse).

The Act also describes the roles and responsibilities for flood risk management. The flood defence manager plays a central role and is responsible for ensuring that the defences meet the legal standards, and for maintaining the defences. Water boards, which are independent local organisations with an elected board and tax raising powers, are the managers of most flood defences. The rest of the flood defences, particularly the larger barriers and dams, are managed by Rijkswaterstaat, which is an agency of the Ministry. Provinces have a supervisory role (although this may change in the near future), and in addition have a leading role in emergency management, with technical input from the flood defence managers, and in spatial planning. At a national level, Rijkswaterstaat has a supervisory role and is responsible for implementing policy from the Ministry of Infrastructure and the Environment.

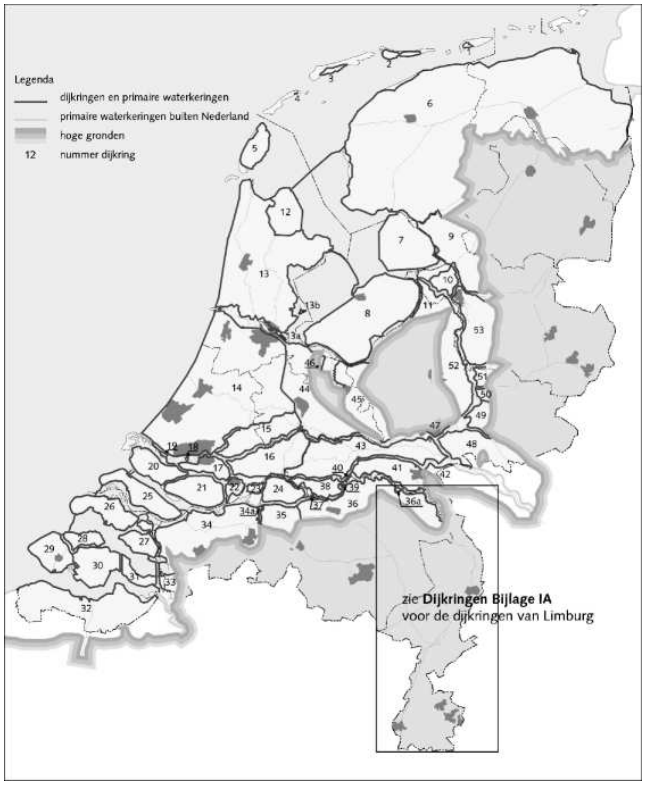

Figure 4. Location of dike ring areas in the Netherlands (from the Water Act).

The flood defence managers have to demonstrate that the defences meet the legal standards in a six-yearly cycle. This safety assessment is carried out on the basis of a prescribed method (Ministerie van Verkeer en Waterstaat, 2006), which contains an extensive set of procedures and calculation rules, covering each relevant failure mode. Government provides the hydraulic loading levels associated to the legal standards to be used in this assessment. If the assessment demonstrates that the defence does not comply, it has to be improved and becomes part of the Flood Protection Programme *(Hoogwater Beschermings Programma, HWBP)*, see section 3.2. If the assessment is not able to determine whether the defence complies, it receives a score of 'uncertain', which is an explicit trigger for further research.

For the regional flood defences there is a similar legal arrangement at provincial level. Local authorities (municipalities and water boards) are responsible for flood risk caused by local rainfall.

Dutch flood risk management does not consist of flood defence (prevention) only: there is an explicit policy of 'multi layer safety'. This consists of three layers: prevention (i.e. flood defence), spatial planning and incident management. The other layers have been receiving increasing attention in recent years, but the emphasis still is, and is likely to remain on flood defence.

Flood risk plays a special role in Dutch public perception. Flood risk management is essential to the country, with approximately 60% of the area and most of the urban areas in the floodzone. Most people are strongly aware that they live in a flood risk area, and there is a sense of pride in the Dutch having reclaimed their own land from the sea. At the same time there is a perception of absolute safety because of the obvious strength of the flood defences and the fact that no significant flood events have occurred since the 1953 flood disaster. The Dutch expect and trust their engineers to keep them safe from flooding. This also means that if there were a flood, it could well be seen as something close to an industrial disaster, caused by human failure.

A useful English description of water management in the Netherlands and the role of water safety is provided in Rijkswaterstaat (2011).

3.2 *How much to invest as a nation*

The legal status of the flood defences means that the authorities are obliged to spend as much as needed to achieve the legally prescribed standards. In practice, investment has been dominated in recent years by large programmes designed to improve the defences up to the legal standards introduced in the 1990s. These improvement works have thus far largely been funded by the national government, based on a legal arrangement that any defect caused by a change in assessment methods or boundary conditions would be funded nationally, while the Water boards were responsible for the costs of operation and maintenance.

The defence standards are prescribed, but there is also a strong political will, across the political spectrum, to provide strong defences and meet the legal standards. There is no strong short-term debate about the level of the standards, but there is a longer term process (approximately 25 years) in which the standards are reviewed, taking into account changes in the value of the protected areas and new methods.

Figure 5 illustrates how flood risk funding levels have developed in recent years. It shows a general increase since the early 2000s when the first safety assessment cycle was completed. There was a 10% decrease of funding levels in 2010 as part of the overall budget cuts, to be offset by efficiencies. The current level of investment is approximately €1 billion per year, which will increase to €1.3 billion in the coming years. There are approximately 10 million people at risk of flooding in the Netherlands (very similar to England), so the amount per person at risk has gradually increased from €40 to €135 per person. The comparison with England shows that the

amount per person was similar 10 years ago, but is now almost twice as high in the Netherlands.

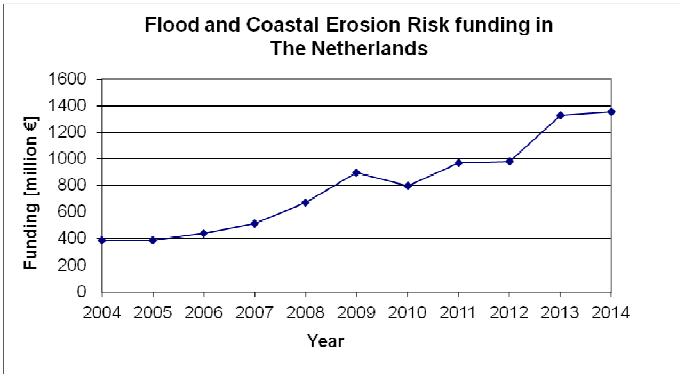

Figure 5: Flood risk funding in the Netherlands

It is very noticeable that there has been a strong increase in flood risk management in recent years, despite the absence of significant flood events in the country. To a small extent, it may be possible to explain this from high profile events elsewhere such as Hurricane Katrina. However, the main cause is the choice of Dutch society, following the disastrous 1953 floods, to set high defence standards with a legal status, providing some protection against short term political pragmatism.

3.3 *Where to invest - prioritisation*

At first sight, the legal status of the defence standards suggests that there would be no need for prioritisation of investment. However, the emerging results of the safety assessments are leading to constantly increasing cost estimates, and this is compounded by the difficult situation of the Dutch economy and the Government's policy to reduce the deficit. The Flood Protection Programme, instigated around 2005 to improve the non-compliant defences following the second safety assessment cycle, had to increase its cost estimate in 2010 by €1 billion. One year later, the results of the third assessment cycle indicated that there would have to be another Flood Protection Programme at a significant additional cost. In combination with the economic situation, this led to the conclusion that the improvement works will have to be spread out over a longer period. At the same time, an accelerated assessment programme was instigated to resolve the remaining defence sections for which the safety assessment score was still 'uncertain', in order to prevent further uncontrolled cost increases in later years. The currently ongoing second Flood Protection Plan is estimated to run until 2017; the third Flood Protection Plan should be established in 2014 on the basis of the additional assessment work.

3.4 *New approaches*

Prioritisation of investment in this sense is a new concept for Dutch flood risk management. There is a wealth of technical information and advanced calculation methods, which could be used and combined to produce a thorough and scientifically robust prioritisation method. The six-yearly safety assessment provides consistent information, but is focused on yes / no answers, which limits its value for prioritisation. A long-running programme called VNK ('Safety of the Netherlands mapped') has developed methods and tools to calculate the probability of flooding; this has not yet been accepted for formal use in the legal safety assessment, but it could support prioritisation, for example by using the ratio between actual probability of flooding and the legal standard. This programme and others have also developed calculations of economic risk, and finally, risk to life could be an important factor. A recent ministerial letter to Parliament confirms the likely role of the VNK methods in prioritisation (Ministerie van Infrastructuur en Milieu, 2012).

There is however much more to this prioritisation than technical considerations only. The method will have to be feasible, effective and efficient, to avoid that it initiates an industry of expensive research and studies. The results will have to be at least compatible with the legal safety assessment, even if the methods used are more advanced, because the safety assessment is the driver for the Flood Protection Programme. Most importantly however, the results will have to be transparent and explainable to the public and politicians, who will query why one area has more right to flooding safety than another. Finally, it will be important to establish clear roles for both Government and the Water boards, especially since it was established in the recent Policy Agreement Water (Ministerie van Infrastructuur en Milieu, 2011) that the Water boards are going to be responsible for a larger share of the funding. A practical and transparent method is currently being developed to enable the Flood defence managers to rank individual measures on the basis of probability, consequence and costs, and combine these into projects. These projects will then be prioritised on the basis of their effectiveness in achieving the required level of protection.

4 COMPARISON AND CONCLUSIONS

The analysis shows that the approaches to investment decisions are very different in the Netherlands and England, but that each country's approach fits in its context.

The different focus is illustrated by the volume and maturity of processes and guidance. The Netherlands

have an extensive body of technical guidance with a semi-mandatory character for the design of flood defences. In England the focus is on economic appraisal of projects, supporting the preparation of business cases to justify investment – this is reflected in a body of guidance of similar size, and the associated focus of research and development.

Common trends can be seen in both countries, as less money becomes available for flood risk management. In particular, there is a greater pressure on the operating authorities to generate efficiencies in the delivery, and there is a shift to more local funding contributions, coupled with more local decision making powers.

Both countries offer good examples of rational approaches, each in their own way:

- In the Netherlands, the legal framework secures a minimum level of investment, based on rationally derived defence standards. This is complemented by an excellent understanding of defence performance, relative to other countries.
- In England, the outcome measures enable Government to provide an appropriately high level political steer for prioritisation. The system is geared toward optimum use of limited funds, and this is supported by mature processes, guidance and research.

In both countries, flood risk management is characterised by a balanced relationship between science and engineering on the one hand, and politics on the other hand. Science and engineering provide factual information, analysis and design, while politics provide high-level steer and translate priorities into investment levels.

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