Combating flooding by planning: some Dutch experiences

Henk Voogd

Henk Voogd is Professor of Planning at the Urban and Regional Studies Institute, University of Groningen, The Netherlands.

Abstract: According to climatologists, the climate is changing. In the coming decades, annual rainfall in Western Europe will increase, as will water supplied by rivers. Recent flooding in Switzerland, Germany and Austria is not just an unusual incident but a call for adequate policy measures, both in the field of water management and with respect to land-use planning.
This article shows how the Netherlands, a country that has been combating flooding for centuries, is dealing with its water problems. A distinguishing characteristic of the Dutch approach is that the solution to water problems is not only sought in technical measures but also in spatial measures. In land-use planning, a water opportunity map (WOM) is currently being used to outline the relationship between water and land use. In addition, the water assessment test (WAT), which presents the consequences of a plan for water systems and water management, is obligatory for land-use planning.
Modern flood protection implies technical measures such as increasing the capacity of rivers by deepening riverbeds and moving dikes and/or making them higher. Retention areas for temporary relief in times of emergency have also been promoted in the Netherlands, but this has raised much opposition. Among others, from development corporations, who point at the opportunity to create floating homes.

1. Introduction

The widespread flooding in the summer of 2005 in Switzerland, Germany and Austria attracted worldwide attention. Heavy rains caused dozens of deaths and millions of euros damage to infrastructures and buildings. This is usually called a natural disaster, but how "natural" is this event? It can be argued that even natural disasters are to some extent "man-made" if preventive measures were inadequate or lacking.

A disaster can be defined as a community-wide crisis. This linkage with a "community" suggests that the severity of a disaster cannot just be measured in terms of numbers of deaths. Each disaster is unique in its emotional impact (Voogd 2004). It is clear from similar flooding disasters in recent years and from expected climatic changes that inundation problems will continue in the years to come, not only in Central Europe but also in other parts of the EU. Hence, water management must grow in importance, both regarding the quality of water (such as outlined in EU Directive 2000/60 of the European Parliament and the Council of October 2000), and the quantity regulation in river basins.

In most countries, water management is assigned to one or more public authorities that are responsible for protecting water resources, flood defences, drinking water supply, and wastewater collection and treatment. Especially with respect to water protection, much can be learned from Dutch experiences, both negative and positive. Obviously, the Netherlands has a centuries-long history in combating flooding. By discussing Dutch experiences, it will be shown that land-use planning has a key role to play in preventing and coping with these kinds of disasters. The general slogan of modern water policy in the Netherlands is: "Water should get space before it takes it!"

2. Exploring the problem

2.1 Flood protection

In river basins, flooding is usually the result of heavy rainfall and/or snow melting in a relatively short period, both leading to the discharge of substantial volumes of river water. In coastal regions, flooding is often caused by heavy storms and high tides. In both cases, the history of any country shows that technical measures can be taken to decrease the risk of flooding. The construction of dikes, dams, movable barriers, houses on stilts, etc., is seen throughout the world.

In the Netherlands, the urgency for water authorities to apply spatial measures in flood protection has become especially clear in the wake of flooding in the 1990s. In 1995, the substantially increased discharges of the rivers Rhine and Meuse caused serious problems. More than 200,000 people had to be evacuated, although in the end, the land protected by dikes was not

inundated. Again in 1998, heavy rainfall exceeded the capacity of the water discharge system as well as large parts of the regional water systems in flooded areas. These floods and the threat of flooding stimulated the public and increased political pressure to take preventive measures as far as possible; spatial measures were presented as an inevitable step (Ministry of Transport, Public Works & Water Management, 2000). This in turn supported initiatives by water authorities, who initially based their programs on the need to protect water resources. The (near) flooding encouraged them to incorporate flood protection as well. As a consequence, new instruments were introduced that will be explored in more detail in this paper.

2.2 Dutch water management

Water management in the Netherlands is the shared responsibility of the central government, the twelve provinces and the fifty-five water boards (Bressers *et al.* 1995; Kuks 1998; Perdok and Wessel 1998). Water policy is drawn up and implemented at both the national level and the level of the provinces and water boards.

At the national level, the Ministry of Transport, Public Works and Water Management (abbreviated in Dutch as V&W) coordinates water policies. This ministry includes the 200-year-old Rijkswaterstaat (Director General for Public Works and Water Management), which is responsible for all state waters and the national water infrastructure. The main navigable rivers and canals, the territorial seas, and all coastal waters and estuaries fall under the jurisdiction of the Rijkswaterstaat. The remaining regional waters fall under the jurisdiction of the water boards, with the exception of regional navigable waters, which come under the jurisdiction of the provincial and sometimes the municipal authorities. While water quantity management at the national level is supervised by the Ministry of Transport, Public Works and Water Management, the responsibility for water quality management is shared with the Ministry of Housing, Spatial Planning and the Environment (VROM), mainly regarding water quality standards, although it is still coordinated by Rijkswaterstaat.

Since the 13th century, the water boards have been responsible for the construction, maintenance and operational management of local and regional flood protection and water management. The structure of the water boards is based on a profit – payment – participation principle, that is, those having an interest in water management may participate, and must pay for water services in proportion to their interest. The general council of a water board comprises farmers, landowners, owners of buildings, local residents, and representatives from industry. The Dutch Constitution (1983) and the Water Board Act (1992) have charged the water boards with the operational tasks for local and regional flood protection and water management. Consequently, water boards are the most important institutions with regard to operational water management in the Netherlands (Bressers *et al.* 2001).

In Dutch practice, land-use policies often conflict with water management policies (Schwartz 2004). Two lines of argument illustrate the need for more effective integration of land-use and water planning, that is, the safety argument and the resources argument. In the Low Countries, the safety argument has prevailed for many centuries because a considerable part of the land is reclaimed from the sea. Although the risk of flooding has decreased due to technical measures (like increasing the height of dikes), climate change and soil subsidence are continual stimuli for additional measures.

The resources argument is another reason for improving the integration of water and land-use policies. Clearly, spatial development is facilitated by the physical resources of land and water. In the past, the availability of water for drinking, farming, production and navigation has been a condition for spatial development. At the same time, spatial development can also affect water resources in many ways. Groundwater levels may drop due to over-exploitation, water may be polluted by industrial, residential and farming activities, flow direction and speed may be altered by the construction of infrastructures and built-up areas. All this can affect the resources used by humans and ecosystems. In order to protect water resources, the impact of spatial development must be assessed.

Several types of measures can be taken to reduce the risk of flooding and protect water resources. These measures can be technical or spatial. Technical measures include the construction of dikes, dams and barriers, extra discharge channels and the reshaping of a river basin or coastline. Spatial measures address land use, and exclude the construction of built-up areas in sensitive locations and changes in land use so that the area can also be used as an artificial water basin, etc., when necessary.

Modern water management is based on a combination of technical and spatial measures. Technical measures alone are not sufficient to prevent floods and protect water resources.

Moreover, spatial measures may be more cost-effective in the long term (CPB 2000). Combinations of both measures can be found in Dutch water management. Two different guiding principles, three-step strategies referred to as "trios", are used to prioritize specific measures (Schwartz, Voogd 2004). The trio for water quality is: prevent the pollution of water, isolate polluted waters, and discharge the water into the sewer system or surface water. In short, protect – isolate – discharge. The trio for water quantity management is: collect water in aquifers and higher parts of the water system, hold it in lower parts of the water system (designed for emergencies), and discharge it into a downstream water system. In short, collect – hold – discharge. The sequence of measures indicates their priority. They can be spatial measures designed, for example, to change land use in order to (1) prevent fast run-off from surfaced areas, (2) enable and safeguard the storage and discharge capacity of the water system, and (3) prevent damage to built-up areas downstream.

There are at least two important reasons for strengthening the relationship between water management and land-use planning. First, spatial measures based on water resources and risk management are beyond the jurisdiction of the water boards in the Netherlands. Second, spatial policy could address future land-use developments that would conflict with water resource policy.

3. Water Assessment Test

Until recently, Dutch water boards focused heavily on the technical aspects of water management. Now, a broader perspective is required for proper water management that also involves land-use measures. However, the legal situation in the Netherlands is such that water boards are not authorized to manage spatial measures independently from other public authorities and private stakeholders. The water authorities can make their wishes clear to urban planners, who may then incorporate them into their spatial policies, but this simple view neglects the reality, or rather, the complexity, of spatial planning. Spatial planners have to deal with many interests in addition to those relating to water. It is therefore important that the water boards are formally involved in land-use planning. This is realized by means of the Water Assessment Test (WAT), which was introduced in 2002.

The WAT is a general framework for assessing land-use proposals. The WAT framework consists of a checklist and a clarification of the roles of the actors involved. The framework includes all relevant water management aspects (flood protection, water quality and depletion). Depending on the location, all aspects must be considered by the authority responsible for land-use planning. It is therefore embedded in a land-use planning process that provides for early consultation, advice, consideration and final judgements regarding water management aspects in spatial plans and decisions. All government authorities are required to use the WAT:

- It is an obligatory assessment of spatial plans that determines the consequences for water management.
- If water management priorities (collect, store, discharge) cannot be realized, explanations must be provided and compensating measures taken.
- Compensation and mitigation measures are part of the land-use decisions relating to the spatial plan. The cost must, in principle, be borne by the initiator. A WAT has three types of actors: the initiator, the advisor and the reviewer.

The initiator is the land-use authority that wishes to implement a land-use change, for example, the development of urban areas, infrastructures, or natural environments. This can be a local, regional or national authority. However, the initiator can also be a private organization. In such cases, the responsible public authority (municipal, provincial or national) performs the WAT. The advisor is the water authority with jurisdiction: the water board, groundwater authority or national Rijkswaterstaat. The reviewer is the authority that should review land-use decisions according to urban and regional planning legislation. For example, the provincial authority reviews land-use decisions taken by municipal authorities.

Most types of land-use plans and decisions (e.g., zoning, regional and infrastructure plans) can include a Water Assessment Test. The WAT can be used to review revisions and dispensations as well as new plans. The determining factor is the relevance of the plan or decision in terms of water resources. The exact meaning of "relevance" is the decision of the advisor: the water authority. The advisor bases this judgement on the specific circumstances in the water system. This implies (1) that advisors must clarify their vision on aspects within their jurisdiction that relate to water, and (2) that initiators must be aware of these aspects and decide whether they should be applied to the land-use plan or decision. A result might be that initia-

Initiator	Advisor	Reviewer
1. Land-use development initiative		
2. Review and decision on "relevance for water"		
3. Presents the initiative to the advisor	4. Assesses all aspects relating to water	
	5. Proposes mitigation and compensation measures	
7. Considers advice	6. Advises the initiator	
8. Decides on initiative for land-use development		
9. Draws up land-use decision, "water clause"		10. Reviews and decides on procedure and contents of land-use decision
11. Implements decision: – Review & modification – Licensing & construction		

Tab. 1: The role of initiators, advisors and reviewers in a WAT process.
(Source: Schwartz & Voogd, 2004)

tors, to be on the safe side, send all land-use plans and decisions to the advisor.

The delegation of roles and responsibilities among the various authorities is a key element of the Water Assessment Test. The WAT is based on the responsibility of the land-use authority with regard to decision-making on land use as established in the legislation on urban and regional planning. The water authorities are responsible for protecting and managing water resources. Because the water board is seen to have an advisory role, and is not regarded as an advisor with final decision-making power, the implication is that land-use authorities can decide to give their own responsibilities priority over the responsibilities of the water authorities. In such cases, land-use authorities must explain this "subordination", otherwise, the advisor will find in favor of the initiator.

A WAT emphasizes the interdependence of water authorities and land-use authorities, and is designed to encourage co-operation by clarifying the different roles in decision-making relating to land use. In addition, the WAT provides a checklist of water themes for incorporation in actual processes. The advantage of this approach is that responsibilities are clearly separate. Land-use authorities take the final decision on whether or not to incorporate aspects relating to water management. Water managers advise on how these aspects can be incorporated, using the WAT checklist as a guideline. If the aspects are not incorporated, and water managers are held accountable for shortcomings, they can point to the responsibility of the land-use authorities. In doing so, water management is subordinated to land-use management, although this must be explicitly justified. The water authorities, of course, are faced with the problem that they will be held accountable for inadequate protection and management of resources.

A disadvantage might be that focusing on responsibilities is not conducive to co-operation, but rather stimulates opponents to adopt a "wait and see" approach. The fact that initiators have to finance any mitigation and compensation measures conducive to a co-operative approach is also not conducive to co-operation. This is an undesirable situation for water authorities, as both responsible and dependent authorities.

4. Water Opportunity Map

Water boards are traditionally inclined to focus on the technical aspects of water management. The growing awareness of the relevance of spatial measures, however, has led to a more proactive approach by water boards with respect to land-use planning. The Water Opportunity Map (WOM) is part of this development. Thus far, water-opportunity mapping has lacked a general framework drawn up by national or regional authorities (jointly or individually). This has resulted in a wide variety of approaches, in fact, there is actually no such thing as the WOM. Several types of WOM can be distinguished (Van Dijk 2001; Vlist, Schouffoer 2001), including:

• WOMs that indicate suitability for a given land

Overflow areas as designated by the Commitee Luteijn (2002)

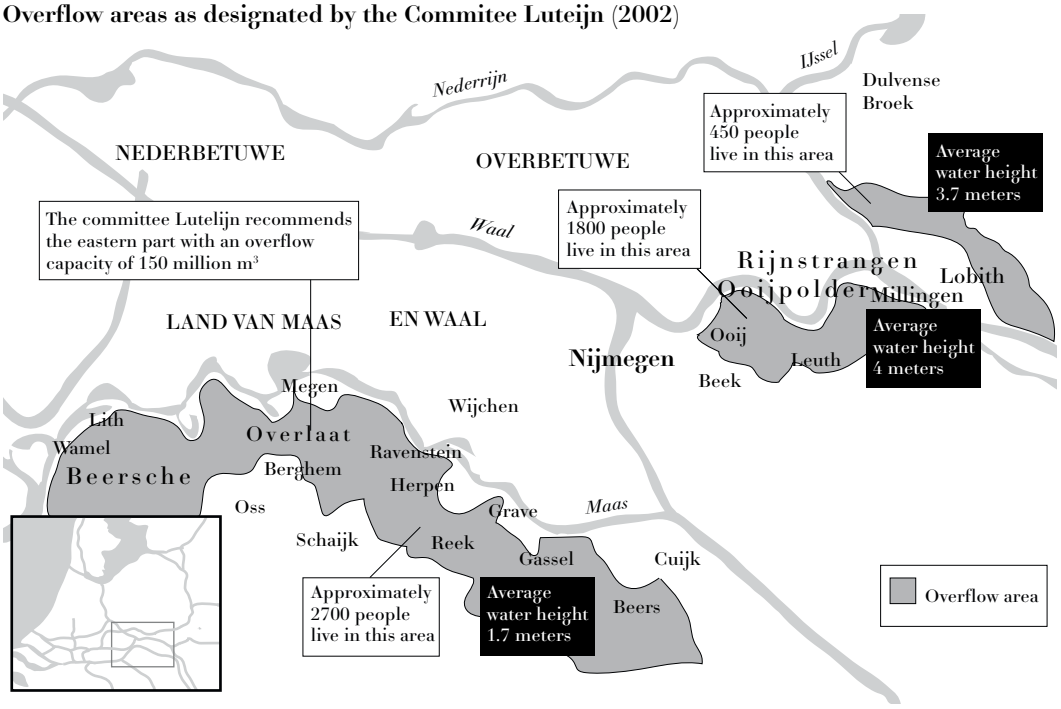

Fig. 1: Overflow areas suggested by a committee of the national government as a response to the (near) flooding of Rhine and Meuse in 1995 and 1998.

use (with a sub-type that focuses exclusively on urban land use, water storage, or combined land use).

- WOMs that present a vision of the future.
- WOMs that combine suitability and a vision.

Visualization is an important aspect of all WOMs. Fopma (2001) defines a WOM as "an information and communication instrument for land-use planning that visualizes land-use possibilities and impossibilities regarding sustainable water management." A WOM is a set of maps and explanatory notes. A geographic information system (GIS) is often used for this purpose. The maps are based on water system information, that is, hydrology, ground and surface-water flow and direction, soil conditions (unprotected aquifers, soil material).

This information is linked to types of land use, each of which has specific preconditions for levels, volumes and quality of ground and surface water. By combining the water system conditions and preconditions for land use, different types of land use can be combined and allocated to given areas. Based on the water system conditions and current land use, views on preferred land use for the future can be developed. The explanatory notes relating to a WOM include background information on how it was made, information about its relevance for decision-making and further procedures relating to land use. For example, a WOM may indicate the suitability of a given area for urban development. Spatial reservations are indicated on the map, for example, buffer areas for storm waters to be used during periods of heavy rainfall. A WOM may also show nature development areas and the lowest areas.

Soon after its introduction in 2000, WOM initiatives were taken up throughout the Netherlands. The popularity of this new instrument clearly illustrates the fact that the water authorities needed a tool to deal with land-use processes. WOMs are usually drawn up by one or more water boards, often in cooperation with water specialists from other authorities such as the provincial government, and, incidentally, municipalities and regional branches of the national government. In almost all applications, private consultants have supported the WOM (Van Dijk 2001).

Currently, a WOM has no legal status. Ideas vary as to its most appropriate status: should it take the form of legislation, be incorporated into regional plans, become part of water authority decision-making, or left to civil servants? The question of whether and how authorities should be involved is a relevant one for the WOM process: WOMs produced jointly with municipalities will probably be used as input for municipal spatial planning more frequently than if there was no cooperation. The extra efforts invested in preparing this kind of WOM could well be beneficial later in the planning process.

5. *Space for water*

The floods and the threat of flooding of the rivers Rhine and Meuse stimulated public and political pressure to take preventive measures as far as possible. One of the spatial measures was enlarging the capacity of the river basins, among other ideas, by designating special overflow or retention areas (e.g., see Figure 1). The idea was that villages and hamlets in a designated retention area should be protected by a surrounding dike.

The basic idea behind the overflow areas is that in emergency situations the pressure can be relieved by a controlled "harmless inundation" of areas that have "minor economic value", such as nature areas and grasslands. However, this idea met with opposition from the inhabitants of the designated overflow areas as well as the provincial authorities and the national parliament. In particular, the proposed size of the retention areas shocked many people, and the engineers added their criticisms that overflow areas can never substitute for "old-fashioned" engineering solutions such as increasing the height of river dikes and deepening riverbeds. A controversy could be picked out between "space for the river" versus "speed for the river", that is, getting rid of the abundance of water as soon as possible. However tempting it may be to drain

Fig. 2: Example of communicating water problems to a wider audience as it appeared in many Dutch newspapers (translated from Dutch by the author). (Source: © Ministry of Transport, Public Works and Water Management, The Hague)

the water as quickly as possible during periods of excessive water, it generally means that the problem is simply displaced to an area situated downstream. Therefore, "speed for the river" is not seen as a proper solution.

In the proposed key planning decision "Space for the River" (PKB 2004), the government drastically reduced the size of the retention areas, compared to the proposal in Figure 1. The choice was made to create overflow capacity near rivers, for instance, by linking it to clay and gravel production and repositioning of dikes.

6. Marketing water management solutions

Planning is a rational as well as a creative and communicative discipline. In particular, the communicative tools have improved tremendously in recent decades. Many planning documents now look like a glossy catalogue from a travel agency. However, most of these documents are targeted at politicians and their active supporters and not so much at the general public. Flooding, however, is an outstanding example of a problem that is not limited to the political arena. Flooding affects everybody in the inundated area – and beyond. Communication should therefore not only address the people who are active in the political arena, but the entire society.

The Ministry of Transport, Public Works and Water Management, the Association of Provincial Authorities, the Association of Water Boards and the Association of Netherlands Municipalities have therefore started a public awareness campaign: "Nederland leeft met water" (The Netherlands lives with water). The campaign aims to increase the awareness of climate change and the efforts water managers are making to deal with the consequences of this and ensure that the Netherlands remains safe and liveable in the future.

The campaign is supported by commercials on TV and in national and regional newspapers and a Web site: www.nederlandleeftmetwater.nl.* The leading role in these commercials is played by a TV weatherman, Peter Timofeeff, who explains water problems in simple terms with a humorous punch line, such as in Figure 2.

It is remarkable that this campaign has not resulted in an increased citizen participation in the national planning process of PKB (2004). According to the Web site of the Ministry of Transport, Public Works and Water Management, on 2 September 2005: "…only 12,000 people participated, which is modest compared to other projects of similar size." However, it may very well be that people did not object to the proposed plan since, thanks to the campaign, they agreed with it.

7. Amphibious Living

After the (near) flooding crisis of the 1990s, the Dutch national government decided that new building developments in river basins are forbidden. This created opposition from local governments near the rivers because they feared that they would have hardly any opportunities left for urban expansion, or at least for attractive new housing along the riverside. Other pressure against this decision came from private development corporations who were inspired by the idea of building waterproof buildings or, in marketing terms, "amphibious living".

In the early 1980s, the first example of a "floating hamlet" was created near the town of Roermond (see Figure 3). This project was stimulated by the sand and gravel production company Smals BV, who wanted to show that building housing on the waters of a former gravel pit could very well be possible.

In recent years, many innovative proposals have been put forth for "living on water", such as the "New Arcanie" design of a city on water or proposals to build floating greenhouses in the western part of the Netherlands. So far, such innovative proposals have not been realized, but this may change. In September 2005, the national government suddenly released the ban on building in riverbeds at fifteen places, provided that the developer creates at least a similar amount of overflow space for the river elsewhere as a kind of compensation. It will be interesting to see how this new development will evolve and whether it will evoke new forms of "amphibious living".

Fig. 3: Marina Oolderhuuske with floating homes near the city of Roermond.
(Source: Leaflet Marina Oolderhuuske)

* See: www.nederlandleeftmetwater.nl/UserFiles/File/tvc_waterindestad30.mpg

8. *Some concluding remarks*

The relationship between water and land use is obvious. The availability of water is a precondition for spatial development. At the same time, human activities can also affect water resources in many ways: dropping groundwater levels due to over-exploitation, water pollution from industrial, communal and other sources such as farming, and changes in flow direction and speed due to the construction of infrastructures and built-up areas. All these factors can affect the resources used by humans and ecosystems. Flood protection therefore needs a careful, comprehensive approach. Without a clear integrated planning system, spatial development could be both unattractive and, arguably, unsustainable.

The tools WOM and WAT described in this article can be very meaningful for improving the integration between land-use planning and water management. It has been shown that a water opportunity map (WOM) is a starting point for influencing decision-making on land use from a water perspective, but there must be a follow-up. A WOM is supposed to be a basis for negotiations with land-use authorities, for example, during the assessment of a land-use decision using the water assessment test (WAT). The planning, construction and maintenance of drainage infrastructure is complex and expensive. It is essential that water companies and their regulators have confidence in integrated water and land-use plans so that they provide a sound basis upon which to make long-term investment decisions.

The Dutch policy for flood protection is clear: in addition to river-widening measures, retention areas are required in the event of flooding. Practice in the Netherlands teaches us, however, that this is not a simple assignment in land-use planning. For example, in appointing grasslands as a flood storage area, huge emotional barriers from farmers will be encountered. Marketing of ideas, as it has been described in this article, will not be sufficient to convince them, but experience has shown that monetary compensation will do the job.

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Henk Voogd
Professor of Planning
Urban and Regional Studies Institute
University of Groningen
PO Box 800
9700 AV Groningen
The Netherlands
h.voogd@rug.nl

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