



LEVEES IN A CHANGING ENVIRONMENT: FLEXIBLE, STRATEGIC PLANNING

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ABSTRACT: Water is wonderful and the Dutch love it! Yet there is much work to do. Now is the time to invest in plans to ensure the future flood safety and liveability of The Netherlands. Implementation of flood protection measures is already in full swing, with more programs scheduled to be executed over the following decade. However, the limits of the current approach have almost been reached. The Netherlands is densely populated, while climate change leads to increased flood risk of highly vulnerable areas. The cost to implement measures is increasing, with available resources being under pressure. It is clear, innovations are necessary, in addressing flood protection measures. In order to be able to anticipate on potential floods by means of effective and efficient protection measures, a more integral approach, in time and space, is required. A combination must be made between flood protection and spatial developments.

The current approach of dike reinforcements, is sufficient for the time being, but is nevertheless sectoral. Neither is it sufficiently robust for the long term. Opportunities to integrate flood safety measures with spatial plans seem to be few and hard to materialize. Processes and time periods are different between the two. In addition, policy making in public (national versus local), and public-private partnerships, are hindered by steering (legal) frameworks, complex organizations and a risk-averse attitude.

There is an urge for more insight into the possibilities for an integrated, flexible approach to dike reinforcement both in time and space. A framework enabling multifunctional levees, as part of this integral and flexible approach, has been developed and analysed on basis of several cases within the Netherlands both in urban and rural areas. In this paper, this framework is addressed, and insights are given into new flexible strategic planning processes for both flood risk management and spatial planning.

Key Words: Flood Risk Management, Levees, Spatial planning, adaptive strategies

1. INTRODUCTION: TREND OF INCREASING FLOOD RISK, BOTH IN THE NETHERLANDS AND ON A GLOBAL SCALE

In the future, the Netherlands will experience more pressure on land use. Argumentation for this trend is explained by a growing economy, leading to more urbanisation, intensification of agriculture and developing infrastructure (Hidding, 2006). At the same time, increasing water discharge and more extreme rainfall events, calls for innovations in the water management sector (Tromp & Van der Ven, 2013). The government is responsible for protecting the community living behind the flood defence against any type of natural disasters. As result of more economic activities and a growing population during the last century, the transformation from single to multiple land use started. The appearance of separate and independent land use no longer exist (Hidding, 2006). Multifunctional land use demands for collaboration between flood safety management and land use planning. This transformation is associated by the three closely related concepts which are constantly changing over time; political preferences, renewing policy and changing governance (Bekkers, 2007).

Large part of the world population lives in flood-prone areas. This includes coastal zones, river plains exposed to coastal or fluvial flooding risks and lowlands sensitive to flooding due to heavy rainfall or groundwater. More extreme weather events are expected to occur more frequently in many parts of the world, thus increasing the risk of damage to residents, economy, ecology and cultural heritage (Colette, 2007; Prasad et al., 2009). According to Kron (2005) climate change will result, in many cities, into more extreme flooding.

The urban population is expected to grow over 4 billion in the next 30-35 years (UNFPA, 2007). Population dynamics have a critical influence on each of the three pillars (social, economic and environmental development), leading to a necessity to arrange for sustainable cities in a broad sense (UNFPA *et al.*, 2013).

Expectations are that socio-economic and demographic trends will have a great impact on the Dutch way of living and working. Therefore, they will also have an impact on the way the Dutch deal with water and water management in the future. Economic interests must be protected. Behind the dikes lies 2.000 billion euros of invested capital. The size of the Dutch population may still increase (through immigration) or it may stabilize or shrink slightly (WPRB, 2009). The growth in the number of smaller households is slated to continue and, in the case of further economic growth and a continued rise in the ageing population, there will be a greater demand for living space and recreational facilities. This means that urbanization and the pressure on available space and water will continue to rise, especially in the Dutch Randstad conurbation. Space is becoming of high value for the Dutch. In a delta where people have drastically interfered with the landscape, water management will demand a sustained effort.

1.1 New thinking in flood risk management

A new Dutch policy, which was activated in 2009, is designed to create a change in thinking, almost a paradigm switch. Instead of increasingly adapting water systems to suit our own needs, the Dutch aim to give natural processes more space, making them more robust and less dependent on technology and changing circumstances. The consequences of climate change makes this new approach a necessity. Examples of climate change include an accelerated rise in sea levels, higher peak discharges in the rivers, periods of drought or flooding and a shifting ecological balance. Where the Netherlands, as defined in its name, is created in the delta of large European river systems, climate change potentially has a major impact on economic, social and cultural development. Therefore policymaking is undertaken based on newly developed flood risk management principles.

This paper introduces a new integrated and flexible approach to synchronise flood safety and spatial planning in both time and space. A framework enabling multifunctional levees, as part of this integral and flexible approach, has been developed and analysed. This framework is based on several cases within the Netherlands, both in urban and rural areas. Here this framework is addressed. Moreover insights are given into new flexible strategic planning processes for both flood risk management and spatial planning.

2. FLOOD RISK MANAGEMENT IN THE NETHERLANDS: A BRIEF HISTORY

The Dutch have a long history in their attempt to control the floods. In the 10th century the first dikes along rivers were built. The first functional government in the Netherlands is still active nowadays, namely the regional water authorities. Back then farmers joint forces in their attempt to prevent flooding. In the 18th century Rijkswaterstaat was established, as part of Dutch government. Its role is the practical execution of the public works and water management, including the construction and maintenance of waterways and roads, and -importantly- flood protection and prevention.

Prior to the devastating flood in 1953, dikes were built by the height of the previously known highest water levels plus a margin of safety. In the early seventies, a new system introduced 53 dike rings (Van Nieuwenhuijze et al., 2006). Each dike ring has its own safety standard and regulations expressed in chance of flooding. Since January 2014 every twelve years (prior every six years), the safety of Dutch

dikes and dams is assessed and tested against statutory standards and current technological and hydrological (pre)conditions.. Any part of the dike and dam, that does not fulfil the statutory standards, must be reinforced. The regional water authorities and the national government are partners in the protection of the Netherlands against flooding. The national government is in charge of the protection of the coastline and the maintenance of the dams, which close off the major sea-arms in the western part of the country. The other water barriers (dikes, dunes and quay-walls) are managed by the regional water authorities.

Approximately 700 million euros per year is available for construction and maintenance of the dikes, to maintain the required safety level. The Netherlands is probably one of the best protected deltas of the world. However, continuous investments are required in order to keep it safe. The required yearly budget is expected to increase in the future due to sea level rise, subsidence and increasing safety levels going hand in hand with economic growth and climate change.

In recent years, a new strategy has emerged in the Netherlands related to new governmental policies on spatial planning and water management. The vision and mission of both policies are linked together, creating opportunities for incorporating measures for water management into city (re)building and landscaping. It is essential to find solutions for potential future flooding problems, not only technical but also in governance, in funding and more integrated design processes. We also have to ensure that the Netherlands can adapt to the consequences of climate change.

3. CONCEPTUAL FRAMEWORK

Based on the so-called 'Dutch layers model', the researchers identified three layers of spatial changes:

1. the layer of the substratum
2. the layer of the networks
3. the layer of the occupation pattern.

These layers have different temporal and spatial scales. To these three layers, we added the element of coherence. We consider this coherence between the layers as the domain of spatial planning. Main assumption of the developers (De Hoog, Sijmons and Verschuuren, 1998) of the original model was that the substratum physically transforms slower than the networks, which in turn, transform at a lower rate, than the physical structures on the occupation layer (see figure 1).

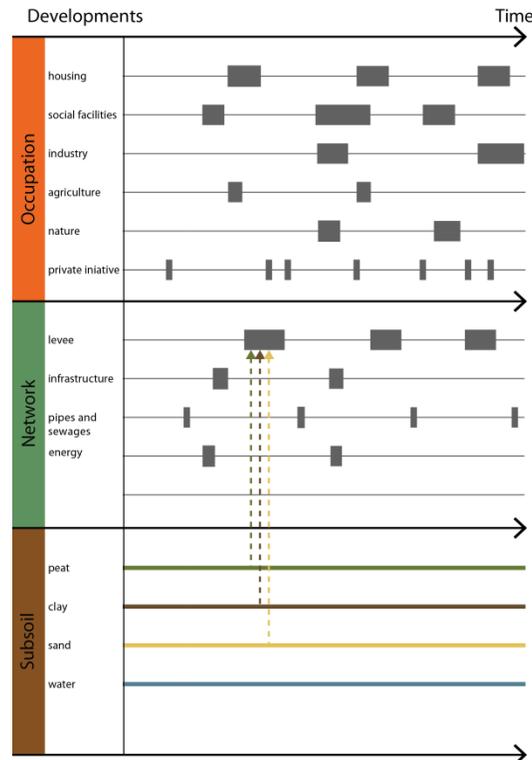


Figure 1 Three layer model

For this research a literature review and several interviews were conducted to develop the framework. The framework was then tested on a fictional case in strong collaboration with one of the local stakeholders (regional water authority). The framework was then adjusted and used on a real case. The data is gathered through triangulation of methods, such as a literature revision (secondary data) and by investigating a case with reference to semi-structured interviews, and a workshop (primary data). Triangulation in research refers to the use of multiple techniques for collecting data within a single study (Adami & Kiger, 2004).

Research showed that opportunities are created in the spatial area around a dike if the perspectives of time and space are taken into account. Integrated water management transcend boundaries in the physical system, as well as in the human system (2) include organisations both public and private and (3) is focussed on horizontal and vertical (national and local) (Karstens, 2009).

3.1 Temporal Scale

Dikes and dams know for the domain space, a relative slow development path. Until now they are being constructed for a life span of 50 – 100 years in the Netherlands. Recently questions arose whether this long planning horizon is still relevant, as new technological insights and changings norms, induce a shorter life span. Road infrastructure already knows a shorter life span. The built environment (housing) has a life span of 30-50 years, but demands and wishes are always present. From a cultural heritage point of view, buildings have a longer life span.

Figure 1 show that planned developments in time usually occur in the occupation and network layer. De substratum layer is of importance on the life span of dikes and dams and the development of water systems. This layer is a 'driver' for dike reinforcement projects. For example: a dike on peaty subsoil knows more subsidence and therefore a shorter life span to maintain the statutory standards. Insights in behaviour of deltas are continuously progressing. Tidal movements and wave heights change based on

more general changes in climate. River flows increase due to changes in land use and climate. These changes urge a permanent assessment if dikes and dams can meet up with statutory standards.

3.2 Combining Spatial And Flood Risk Management Development

It is possible that the adjustments to dikes and dams can be synchronised to one or more other (spatial) developments. Whether the pace is equal to each other should be determined. The same applies for the spatial scale in which the development takes place.

In case the improvement of flood safety and spatial development cannot be executed in more or less the same time frame, opportunities must be sought to create flexibility for future spatial development in all dimensions. Naturally the dike offers space for spatial development, either for existing or new functions. When the dike will not be reinforced, the water authority can offer flexibility. But only when the new function will not hamper the (daily) maintenance and reinforcements of the dike.

Developments can be developed independently in time of each other. Although there is a need for anticipation on each other (figure 2).

- Dike reinforcements can anticipate on future spatial developments
- Spatial developments can anticipate on future flood safety developments, like dike reinforcements.

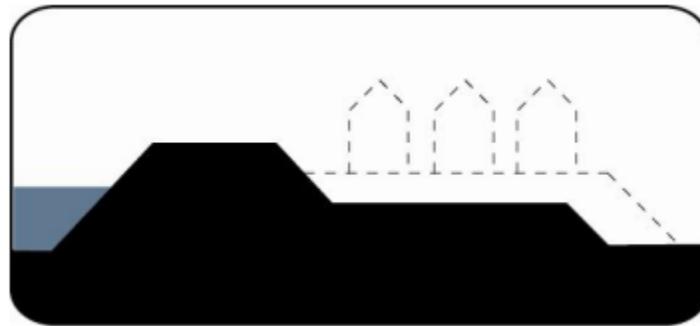


Figure 2 Schematic representation of anticipation on developments.

3.3 Combining Both Scales

According to Karstens (2009), the human system refers to the science around economics, spatial planning, sociology and policy. These social phenomena sometimes emerge on different scales in time and space. For this study the focus lies on the 'governance' around flood safety and spatial planning. The definition 'governance' does not only refer to a shift from problem solving capacity of the central and formal institutions of the government to decentralised authorities, market and social community. It also refers to the more hybrid arrangements in what political decisions about dealing with social issues take place (Bekkers, 2007). Typical for 'governance' is the self-regulating capacity. The government does not control from top-down approach, but becomes the inspector of the project. As stated before, decisions are taken in the presence of full-member group discussions. Another characteristic of 'governance' indicates the dependence between involved actors, which means, that collaboration is required in order to manage the environmental issues (Bekkers, 2007).

Another aspect identified by Karstens (2009) are the cross-scale interactions. Humans do not think in the long term, while most of the physical and human system processes operate at a very slow rate. Hence, if the long-term processes are being recognized and accepted, the humans are challenged to combine these two scales.

In the report of multipurpose levees (Tromp et al., 2012) reflection indicates that integrated flood risk management can be improved by positive incentives and a pro-active attitude of stakeholders. Distrust against the collaboration is large because the pro-activist is usually the person with financial responsibility. The level of participation by stakeholders can be divided in seven stages with a matching governance style (Neuvel and van der Knaap, 2010). Table 1 is a reproduction of diverse literature reviews; the 'level of participation' is a long-standing division of Arnstein (1969) which is combined with insights from Propper and Steenbeek (1999) about governance styles. These styles are, subsequently, linked to specific forms of governance. In the table the level indicates how closely the private stakeholders (residents, companies, developers) are involved. The last column, governance style offers the associating term used to define the interactive policy-making process. As stakeholders are dynamic, the governance style can change as well. Therefore it should be adopted as dynamic too.

Table 1 Level of participation, after (Neuvel & van der Knaap, 2010)

Level of participation	Definition	Governance style
<i>Co-deciding</i>	The development and policy-making process is left to the initiators and stakeholders. This process is facilitated by authorities.	<i>Facilitating</i>
<i>Co-producing</i>	The government authorities and stakeholders are partners. Agenda setting and problem-solving are joint activities. The government commits itself to the results of the process.	<i>Cooperating</i>
<i>Delegating</i>	The authorities give participants the power to make decisions within the decision-making context provided by these authorities.	<i>Delegating</i>
<i>Advising</i>	Citizens have the opportunity to bring up problems and formulate solutions, but the government defines the agenda. The politicians are committed to the results in principle, but can deviate from them.	<i>Participatory</i>
<i>Consulting</i>	Authorities define the problems and possible solutions. Citizens are consulted about the problems and solutions and can give their points of view. The authorities are free to commit to these points of view.	<i>Consultative</i>
<i>Informing</i>	The citizens are informed about the policy process, but are not allowed to have input	<i>Open-authoritarian</i>
<i>No-participation</i>	The public is not informed about the policymaking process and is not allowed to influence it	<i>Closed-authoritarian</i>

Intergovernmental collaboration is defined as working together within the public domain. Public agencies are not fully capable to ensure flood safety independently; but need to synchronize with land use planning. Woltjer & Al (2007) describe a quadrant with four possible approaches to policymaking. The paper delineates the movement from regulation to strategic planning in what managers on different governmental levels are forced to collaborate during the process of decision making. When water is related to other issues rooted in larger social and cultural region (addressing economic, environmental, agricultural, and social and water problems), the structured coherence seems to develop. On the vertical axe of table 2, there is distinction made between regulatory and strategic planning. Regulation such as performing a water impact assessment are methods to take water individually into account in spatial planning to prevent or compensate for negative effects on the water system (Woltjer & Al, 2007). Motionless sectoral planning is acknowledged in this approach. Strategic planning shows water management as a strategic element in spatial planning, and not solely a regulatory task. Water becomes legal connected to land use planning.

The second strategy points planning at a larger scale whereas flood safety management becomes part of a larger geographical scale so that water management does contribute to the social coherence and economic competitiveness (Woltjer & Al, 2007). On the horizontal axe of table 2 two regions are defined; the functional region is a geographical designated area that has to deal with specific issues and achieve for a limited well defined policy sectors, for example transport, education or water. Hydrology is defining the boundary for this region. Socio-cultural region have shared social patterns that can create homogeneity. This could imply a bigger challenge for collective action in comparing to the functional region. This region is characterized by social networks and cultural assets resulting from social and economic relations. Table 2 shows the strategies that create four new approaches to policymaking.

Table 2 Four approaches to synchronisation optima forma

	Functional regions	Socio-cultural regions
Regulatory	<p>1. Conventional</p> <p><i>Key objectives:</i></p> <ul style="list-style-type: none"> • <i>Public management of water quantity and quality</i> <p><i>Key instruments:</i></p> <ul style="list-style-type: none"> • <i>Technical expertise</i> • <i>Functional separation of water from other policy subjects</i> • <i>Reliance on draining water away and blocking water out</i> • <i>Reliance on norms and standards</i> 	<p>2. Spatial planning</p> <p><i>Key objectives:</i></p> <ul style="list-style-type: none"> • <i>Water integrated into broader policy making</i> <p><i>Key instruments:</i></p> <ul style="list-style-type: none"> • <i>Comprehensive approach, water as broader issue</i> • <i>Stronger references to water in the practice of spatial planning</i> • <i>Water as a source of aesthetic quality in planning</i>
Strategic	<p>3. Water planning</p> <p><i>Key objectives:</i></p> <ul style="list-style-type: none"> • <i>Making water management more important politically and socially</i> <p><i>Key instruments:</i></p> <ul style="list-style-type: none"> • <i>Separate water management regions and agencies</i> • <i>Process for creating political and public support</i> • <i>A role for water management demands in land-use decisions</i> • <i>Ensuring sufficient space for water</i> 	<p>4. New water culture</p> <p><i>Key objectives:</i></p> <ul style="list-style-type: none"> • <i>Water as a source of social coherence and participation- a new water culture</i> <p><i>Key instruments:</i></p> <ul style="list-style-type: none"> • <i>Using water strategically to create new capacities, new identities</i> • <i>New coordinating institutions</i> • <i>Water as part of attractive living and working conditions</i>

Each approach will be shortly introduced:

Conventional: This regulatory approach give water boards the responsibility for flood risk management for functionally defined regions such as polders, lakes and dike rings. Water management is separated from other land use disciplines and from other policy considerations. The tasks are mainly performed by experts that play a regulatory and technical role. From

Spatial planning: This approach recognizes the social function of water. This approach is against 'blocking water out' and claims for the aesthetic value, useable waterways, defence, agricultural benefits and its role in ecosystems. Water management becomes part in land development plans and is thus incorporated in the metropolitan landscape. The liveability should increase here.

Water planning: Water managers actively seek opportunities to address water and other policy issues together. This approach ensures that water is considered when spatial planning decisions are being made. In addition to ensure sufficient water, space for water and protecting water quality, this approach also aims to create political support and assumes a stronger planning role.

In this approach the regional water authorities retain separate independent agencies, but play a less technical role and higher strategic role.

New water culture: Water is a strategic asset and is fully incorporated in regional planning, creating a new water culture. Water is beneficial for economic or societal purposes when informal networks are built in informal arenas.

Woltjer and Al (2007) states that planners are able to help promote the synchronisation by emphasizing water concerns more strongly in spatial planning, and using strategic water management as a vehicle for integrating economic and environmental interests. Synchronization is another word for harmonization or basically combining two or more stakeholders defining the legislation, finances and governance.

4. TWO STRATEGIES: SYNCHRONISATION & ANTICIPATION

Two strategies have been identified during research in the past years. In this research two dominant strategies have been pointed out bases on the principal question whether there is a flood safety issue and/or a spatial development plan and to which level a flexible approach is available so both developments can coincide in time.

Strategy 1 deals with synchronising both developments in time. If this isn't possible the task lies ahead to create enough space to anticipate on possible future developments (strategy 2). In the next paragraph both strategies will be further discussed.

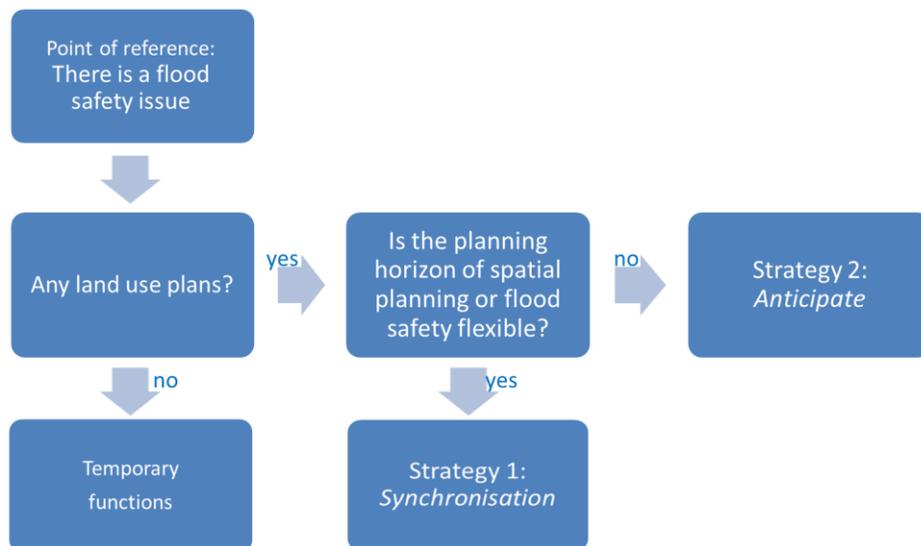


Figure 3 The different strategies explained

For each strategy we can also define different time scales, leading to different visions on possible solutions to create flexible and strategic land use planning.

4.1 Strategy 1: Synchronisation

Synchronisation is another word for harmonization, or basically the linkage of the agendas from two or more stakeholders. Defining budget, execution, sharing costs and maintenance together. During synchronization, stakeholders are overlying and combining activities and developments.

In addition, there might be 'forced' synchronization, whereby developments are being accelerated or slowed down in order to bring them together (figure 4). In practice, investments on an early stage lead to

more benefits for the common developments. Flexibility in time and budget is one of the requirements to achieve synchronisation. More important is the prevention of programs and policies that introduce double regulations and perhaps conflicting policies after synchronising.

Collaboration not just happens, collaboration must be managed, although in a different way ([Agranoff & McGuire, 2004](#)). For successful sustainable collaboration conditions, such as openness, security, progress and content are required ([van den Heuvel et al.](#)). In this synchronization, it should be noted, that future visions, climate changes are important, but cannot be entirely investigated. This part will mainly focus on strategies that enhance collaboration which can be applied to future challenges.

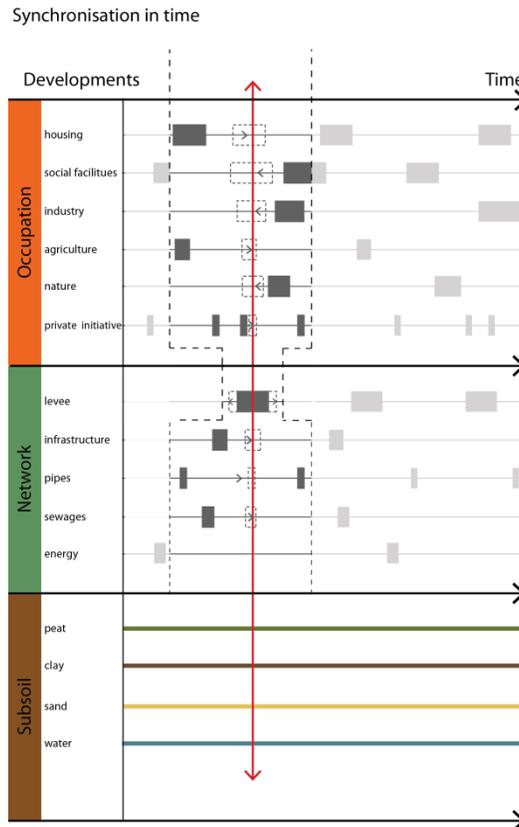


Figure 4 Synchronisation opportunities

In table 3 the benefits and obstacles are further explained. These aspects are specifically applicable in the Netherlands.

Table 3 Opportunities and obstacles further defined for 'synchronisation'

Synchronisation	
Opportunities	Creating surplus value for environment
	Increasing public support
	Local and financial profitable solution
Obstacles	Dependent on third parties
	Tension between individual versus public interest
Institutional aspects	New law as juridical instrument for integral approach
	Formal project decision on managerial level needed to ensure integral exploration
	Political involvement based on agreements (co-deciding, co-producing)
Financial aspects	No flexibility in current debate
	Positive stimulus in cooperation required
Organizational aspects	Managerial space, recognition and support needed for integral approach
	Integral project manager needed, different competences
	Involvement of triple helix required, public-private partnerships

4.2 Strategy 2: Anticipation

In case synchronisation is not an option, two other possibilities can be identified. The first is a sectoral approach where the two developments occur independently from each other. The second option with possible cost-benefits and societal surplus value is anticipation. Depending on the temporal scale, either the flood safety task or the spatial development will be starting point for anticipation.

For each temporal scale (short, mid and long term) different benefits and obstacles can be mapped out. These are listed in table 4. They include institutional, financial and organizational aspects.

Table 4 Opportunities and obstacles further defined for strategy ‘anticipation’

<i>Time scale on which flood safety occurs</i>	Short (0-12 years)	Mid long (12-24 years)	Long (>24 years)
Opportunities	<p>More synergy, delaying dike reinforcement by taking temporary measures</p> <p>Ability to facilitate future spatial development</p>	<p>Temporary functions in order to anticipate</p> <p>Adaptive building, and thus anticipating on flood safety</p>	<p>Adaptive building is feasible</p> <p>Ability to facilitate future spatial development</p>
Obstacles	<p>Outlay must precede returns and lay with different stakeholders.</p> <p>Stakeholders are not aware of each other's agenda</p>	<p>Temporary use of land is difficult to anchor in legislation</p> <p>Desire to adaptive building cannot be tied in plans</p>	<p>Difficult to anticipate on this long term due to possible changes in law and regulation.</p> <p>Execution of measures should be in a certain time frame</p>
Institutional aspects	New legislation as juridical instrument for integral approach		
Financial aspects	<p>Anticipation on future development does not have any stimulus</p> <p>A fund at the regional water authority would be an option or public investment company based on public arrangements. This creates an entity to facilitate in- en outgoing financial resources so beneficiaries (also non risk-driven participants) can receive a return on investment. In anticipation a possibility for a great time-lag occurs between costs and benefits. This time lag should be minimalized.</p>		
Organizational aspects	<p>Different views on the integral approach</p> <p>On going cooperation by public stakeholders. De political en governmental agendas need to be continuously filled with the combination of spatial en flood safety development issues. This provides dependency between public stakeholders and a complementary advising/consulting role for all stakeholders bonds the involved partners.</p> <p>Communication is important due to dynamics and complexity of the task</p>		

5. CASE REGIONAL WATER AUTHORITY RIVIERENLAND, THE NETHERLANDS

5.1 Case description

We focus on the dike strengthening project between the villages Kinderdijk en Schoonhovenseveer (KIS), as shown in figure 7.



Figure 5 Photos from the location

The Lekdijk itself is one of the main characteristics in the area, which was constructed back in the middle ages, when the first people settled in the area. These first settlers started with building on the sand hills rising above peat lands (World Heritage Centre UNESCO, 1997). Next development focussed on the reclamation of marshland by draining the area.

The Lekdijk is a primary flood defence that directly protects the hinterland from potential flooding out the Rhine delta. First expansions of villages were concentrated near the dike and around the churches. This led to a long ribbon development along the dike. Also the land division of the agricultural fields, which stand perpendicular on the dike, are distinctive for this landscape. Buildings are often located within 30 metres of the dike. In addition to providing safety, flood defences often have other social functions, such as transport, leisure, cultural historic value, residential and nature. These facilities have to be taken in consideration in the dike reinforcement. The safety of the Dutch dikes and dams are, temporarily, assessed. The dike section of KIS failed to meet the safety criteria in 2005 and was put on the list of the National Flood Protection program (HWBP).

During the preparations for the dike reinforcement project, it is important to acknowledge the cultural values. During the last dike reinforcement in the 1980s, several dike sections were strengthened with a 'tuimelkade'¹ on the riverside, illustrated in figure 8. By using this kind of infrastructure to strengthen the dike, the buildings were preserved. For the upcoming dike reinforcement fifty-three households could experience disturbance, with possible demolition and rebuilding.

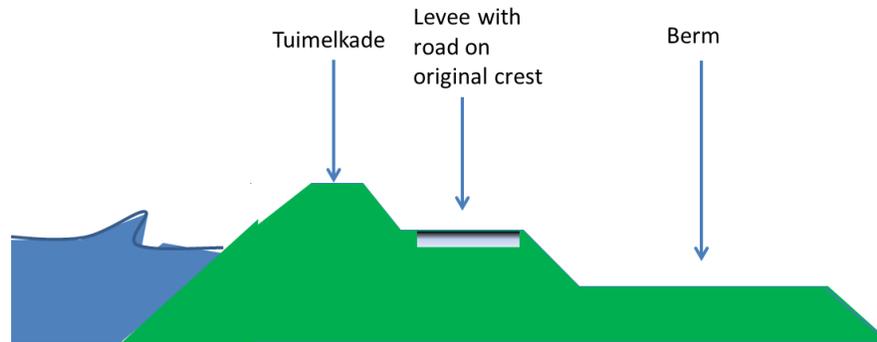


Figure 6 A 'tuimelkade'

The Regional Water Authority Rivierenland (hereafter: Rivierenland) had the responsibility to develop a plan for the dike reinforcement. Rivierenland had the ambition that the proposed solution would be sustainable and flexible, knowing the uncertainties around climate change and water level rises. The widely accepted solution, building a construction between the houses and the road such as sheet piles, meant disturbance and damages to buildings during the execution phase. Moreover constructions can never be removed from the dikes as that would mean hydraulic cracks in the subsoil.

Several options were investigated where the local stakeholders were actively involved. In the whole reinforcement project citizens had the opportunity to bring up problems by a steering group, but the government in the end defined the agenda. The level of participation (Neuvel & Van der Knaap, 2010) was an advising. The governance style can be described as participatory.

5.2 Both Strategies Identified: Synchronisation And Anticipation

During the development of the plan several stakeholder meetings were organized. And several opportunities for synchronisation and anticipation were identified. In this paragraph these are described in more detail. In general it was observed that the citizens were on an advising level of participation. In the sounding board they had the opportunity, which meant that in the sounding board, to bring up problems and formulate solutions, but the government defines the agenda. Even the next level of participation, namely 'delegating' was observed, as the sounding board had a strong influence on the overall project. Meaning that they had in a way the power to make decisions within the decision-making context provided by the regional water authority.

5.2.1 Multi purpose levee

Within the project there was sought to identify innovative solutions to strengthen the dike. One of the proposed solutions is to construct an unbreachable dike. This is a dike which is around 100 times stronger than the current norm and on which housing is possible. This unbreachable dike, also known as a climate robust dike, will be built in Streefkerk, see figure 9.

¹ Tuimelkade= soil barrier on top of the dike

The dike reinforcement was seen as an opportunity for spatial development of centre of the village Streefkerk (as proposed in the plan of the municipality) and the expansion of the marina (wish of the owner of this marina). The whole design is based on strengthening the relationship between the village and the marina and river. Living with the water instead of only protection. This historical relationship is restored by a system of public spaces, which are connected with each other by means of a walking route, between the town centre and the river. The original starting point was to synchronise, also the institutional plans, as well as the execution phase. During the project this appeared not to be possible, as there was a tight time frame for the dike reinforcement. So two different development plans will be developed, one for the dike body and one for the development of the town centre. The local municipality was not pleased as the spatial and financial opportunities, couldn't be cashed in with the dike reinforcement. Therefore Rivierenland facilitated the whole process around the spatial design of the unbreachable dike. The design of the public space is fully detailed, whereas the buildings are yet to be decided upon.

Also the mentioned walking promenade formed a point of discussion between Rivierenland and the municipality, as there was no financial resource available. Rivierenland was not able to adopt it in the reinforcement plan, as it was not subsidized and the municipality had no funding options either. The cooperation in institutional way was quite optimal.

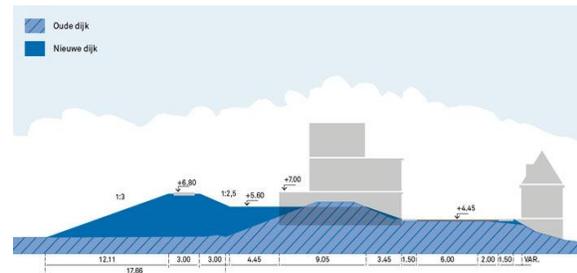


Figure 7 Impression of the location of the multi purpose levee (left) & schematic representation of the levee (right)

5.2.2 Separate cycle path

A second opportunity was the free lying cycle path on the dike between Kinderdijk en Schoonhovense Veer. The cycle path is now part of the road lying on the crest of the dike. Main argument for a free lying cycle path was the safety of the cyclists. The desire came from the sounding group (with representatives of residents and civil society) and the municipality. The latter forced by the wishes from the sounding group.

The finances turned out to be the biggest stumbling block. The cycle path was not part of the provincial cycle path plan. Moreover it was not directly part of the dike reinforcement, so the flood protection program was not willing to subsidize it. Moreover Rivierenland also felt no responsibility for the realization. The desire for the cycle path was, however to great extent, emphatically expressed by both the municipality and the sounding group. Ultimately, the Province of Southern Holland was willing to provide necessary funding. The question about responsibility came very late in the planning process for the dike reinforcement project. Only a high level management and governance intervention ensured funding on time.

5.2.3 Bypass Nieuw-Lekkerland

A third opportunity lay around the church in the village Nieuw-Lekkerland. The current road capacity (see figure 10) is insufficient for common traffic flows. The municipality had a desire to improve road safety, liveability and flow by creating a bypass of the main road for main traffic. The desired new location would be on the crest of the dike. This dike was constructed next to the church during the last reinforcement in the eighties. The existing road would be more care-free and safer for cyclists. Also here the financial issue was the main hurdle, because available funds were limited, there also an administrative component played a role.



Figure 8 Impression of the location of the bypass in the village Nieuw-Lekkerland

The construction of a new access road on the already constructed dike did not belong to the primary task of Rivierenland. In context of efficiency and smooth acceptance of dike reinforcement by local inhabitants Regional Water Authority Rivierenland was willing, to cooperate in the creation of this bypass and therefore contributed financially to this development. The remaining costs are paid from municipal funds and from the provincial cycle path plan - given the fact that this development makes the existing dike road safer for cyclists. The role of Rivierenland can be described as ensuring that their interests are kept and, sometimes that, means given in for certain demands from other stakeholders. For the municipality this development was a serious wish. At the administrative level there were quite a few discussions needed for closing the financial gap.

5.2.4 Adaptive building – demolition and reconstruction of houses

As mentioned earlier, the dike between Kinderdijk and Schoonhovense Veer is characterized by ribbon development. To retain that image, the municipality required rebuilding homes scheduled to be demolished. In total 54 owners were given the choice whether to sell their home or to rebuild after the dike reinforcement - about 30 owners have decided to sell, the others for rebuilding. Rivierenland decided, on policy basis, that every house up for rebuilding should be designed and constructed for jack-up possibility. This ensures flexibility for (possible) future dike reinforcement.

The value of future-proofing and flexibility is difficult to express in financial figures. For that reason, it is difficult to compare both approaches. Another difficulty is lack of sufficient legislation, both by municipality as by the Regional Water Authority to make homeowners comply to more flexible building methods. Therefore a more integrated set of policy and rules for building nearby of on dikes has to be developed in cooperation and co-deciding by Regional Water Authority and municipality.

6. REFLECTIONS

On-going urbanization, changing demands of society, and climate change are major drivers for more climate resilient development. Moreover, due to future uncertainties, such as sea level rise, subsidence and public demand for increased safety levels, the amount of Euros spent on the maintenance of dikes, will increase in the coming decades in the Netherlands. Next to this, pressure for space enables us to adopt multifunctional spatial planning approaches. From this perspective, the traditional dike with the sole function of a hydraulic barrier might not prove to be the most optimal and sustainable use of limited availability of resources.

Based on Woltjer & Al (2007) we identified for the case that the regional water authority used 'water planning' as an approach. Water managers actively seek opportunities to address water and other policy issues together. This approach ensures that water is considered when spatial planning decisions are being made. It also aims to create political support and assumes a stronger planning role. In this approach regional water authorities retain separate independent agencies, but play a less technical role and higher strategic role.

The regional water authorities have developed themselves to real network players. From a sectorial point of view, they are seeking for an integral perspective with support from (regional) partners in order to fulfil their functional tasks. Water authorities not only play a role as manager of flood defences, but also a developer of flood defences. Interventions on flood defences are by definition interventions in space, both horizontally and vertically.

For the regional water authority, creating space for future developments is of great importance to ensure affordable flood safety in the Netherlands. This space creates a solid basis for the future. We see it as the starting point to be able to anticipate and synchronize together with local (public and private) partners. We strongly encourage regional water authorities and other public and parties to take the following steps:

1. For synchronization and anticipation *collaboration between organizations* is essential. This means that policy frameworks, legislation and agendas of one organization, has to adapt in one form or another to the frameworks and agendas of other organizations. The aim is to work towards an integrated approach. For the regional water authority, this means that they proactively seek and understand the interests of other parties. The Dutch government is nowadays working on integrated environmental legislation where domains amongst space, water, nature and building are combined. The legislation creates more coordination in planning processes and authorization of spatial development (permissions).
2. *A spatial 'dike vision' (strategic, long term plan) from a life-cycle analysis.* The reveals the agenda of the regional water authority for a certain period and it makes it easier to seek to common opportunities with other stakeholders. In this way, a win-win situation can be created. This provides flexibility and enhances their role of a network partner.

A dike vision can be an important element in integrated planning processes and makes the regional water authority an active partner in the spatial environment at the strategic level. Such a vision is already partly offset by the area- visioning in the Dutch National Delta Programme developed with government, provinces and municipalities .

3. *Funding.* With a fund a regional authority can make investments in spatial development & flood safety provided that the benefits come over time. This buffer does not develop by itself. Benefits can occur from multiple aspects, profits from wind turbines for instance can later be used to pay for the more complex statutory assessments. Or investments in spatial development, placing them already on a berm, leads to less expensive future dike reinforcement projects. Also the regional water authority can act as a developer, as around many dike reinforcements purchase and sale of land and buildings are required. Perhaps a public investment company with several public shareholders can provide the necessary step ahead in controlling risks and uncertainties

for private investors to participate in integrated development of riverbanks and coastal zone, based on hydraulic flood protection.

4. *Active 'building' policy for space on and next to flood defences.* More space for development can be created, when insight is given how 'simple' techniques create more flexibility, with and around building for future reinforcements. Given the fact, that this area around a dike is a special environment, it is not illogical to require specific construction methods around dikes. The municipality has to support this policy as they are the competent authority for the buildings. Even so this policy has to be synchronized with policies and rules of other regional and national governments.

In creating a flexible strategic planning both, regional water authorities as well as municipalities, have to show their will and start working together. Respecting each other interests, formal tasks and political agenda's and seeking for the most optimal solutions, is the key issue to create surplus value for your local residents.

7. REFERENCES

Adami, M. F., & Kiger, A. (2004). *The use of triangulation for completeness purposes.* Nurse researcher, 12(4), 19-29.

Agranoff, R., & McGuire, M., (2004). *Another Look at Bargaining and Negotiating in Intergovernmental Management.* Journal of Public Administration Research and Theory 14(4):495-512.

Bekkers, V. (2007). *Beleid in beweging*, LEMMA: Den Haag.

Colette, A. (2007) *Case Studies on Climate Change and Cultural Heritage.* UNESCO World Heritage Centre, Paris.

De Hoog, M., Sijmons, D. & Verschuuren, S. (1998a), *Laagland HMD (Het metropolitane debat) – Herontwerp*: Amsterdam (Dutch only)

De Hoog, M., Sijmons, D. & Verschuuren, S. (1998n), *Herontwerp van het Laagland*, in D.H. Frieling(Ed.) *Het Metropolitane debat*, pp 74-87. THOTH: Bussum (Dutch only)

I&M (2008a) *Structuurvisie Randstad 2040 (Randstad 2040 Strategic Agenda)*. Den Haag: Ministry of Infrastructure and Environment. In Dutch; English summary available.

Hidding, M. (2006). *Planning voor Stad en Land* Bussum (in Dutch): Coutinho

Karstens, S. (2009). *Bridging boundaries: Making scale choices in multi-actor policy analysis on water management* (Vol. 4): IOS Press.

Kolen, B., Maaskant, B., & Hoss, F. (2010) *Meerlaagsveiligheid: Zonder normen geen kans.* (Multi layer safety, without standards no chance, in Dutch), *Ruimtelijke Veiligheid en risicobeleid* (2), 18-25

Kron, W. (2005) Flood. In: *Weather catastrophes and climate change. Is there still hope for us?* Munich Re Group, ed., 122–131.

Neuvel, J. M. M., & van der Knaap, W. (2010). A spatial planning perspective for measures concerning flood risk management. *Water Resources Management*, 26(2), 283-296.

Prasad N., Ranghieri F., Shah F., Trohanis Z., Kessler E. & Sinha R. (2009) *Climate resilient cities, a primer on reducing vulnerabilities to disasters.* International Bank for Reconstruction and

Development/TheWorld Bank/ISDR – Global Facility for Disaster Reduction and Recovery. ISBN 978-0-8213-7766-6.

Tromp, E., Van den Berg, H., Rengers, J., & Pelders, E. (2012). *Multifunctionele Waterkeringen Onderzoek naar de mogelijkheden voor flexibel gebruik van de waterkering*, Deltares: Delft.

Tromp, E., & Van der Ven, F. H. M. (2013). *Creating new opportunities by integrating water safety and spatial planning*. In A Chavoshian & K Takeuchi (Eds.), *Floods: From risk to opportunity: Proceedings of the 5th international conference on flood management (ICFM5)* (pp. 143-150). s.l.: IAHS Press

UNFPA (2007) *State of World Population 2007*. New York: United Nations Population Fund. ISBN 978-0-89714-807-8.

UNFPA, UNDESA, UN-HABITAT, IOM (2013), *Population Dynamics in the Post-2015 Development Agenda, Report of the Global Thematic Consultation on Population Dynamics*, 28 April 2013

Werkverband Periodieke Rapportage Bevolkingsvraagstukken (WPRB) (2009) *Bevolkingsvraagstukken in Nederland anno 2009 Van groei naar krimp. Een demografische omslag in beeld (Population issues in the Netherlands in 2009 from growth to shrinkage. A demographic shift in focus)* (in Dutch), NIDI rapport 80, ISBN nummer: 978-90-6984-594-4, KNAW Press, Amsterdam, The Netherlands.

Van den Heuvel, J., Roovers, G., & Eijer, M. (2011) *Multi-Layer Cooperation in Flood Management: How to cooperate within Flood Management in Public areas*. Antea Group, Netherlands. 5pp

Van Nieuwenhuijze, L., Sschengenga, P., Laeremans, C., & Van Slooten, I. (2006). *Hoogwater als uitdaging*.

Van Walsum, P. E. V., Aerts, J. C. J. H., Krywkow, J., Van der Veen, A., Der Nederlanden, H., Bos, M. Q., & Ottow, B. T. (2005). Framework for integrated design of water and land management systems. In P. Van Walsum (Ed.). Wageningen: Alterra, Wageningen UR.

Witteveen+Bos. (2013). *Dijkversterking Kinderdijk-Schoonhovenseveer -projectplan*, (Waterschap Rivierenland, Trans.). (Dutch only)

Woltjer, J., & Al, N. (2007). Integrating water management and spatial planning: strategies based on the Dutch experience. *Journal of the American Planning Association*, 73(2), 211-222.

World Heritage Centre UNESCO. (1997, 2014). *Mill Network at Kinderdijk-Elshout*. Retrieved 02-01, 2014, whc.unesco.org