Regional planning for a changing climate in Groningen province

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Abstract

Unpredictable changes in climate will cause turbulent environments for the next century. In spatial planning it is difficult to deal with uncertainties and long term perspectives. In order to deal with an uncertain future, these shortcomings in planning need to be taken away. This can be done by starting to look at climate change and regional planning as a wicked problem instead of as a tame problem, like we usually do. In the planning process an environment needs to be created, in which the characteristics of wicked problems can be tackled: a wicked bypass. This has been done in the Groningen case, in which environment the backtracking method was used. This method shows an area specific point in history when Groningen was in a sustainable equilibrium state. The key elements of this equilibrium state inspired future thinking and formed the basis of a new planning approach, which is able to deal with a complex and uncertain future. Instead of a blueprint plan for the upcoming century, strategic interventions are defined, which start spatial developments and enhance resilience in the surroundings of the intervention. The strategic interventions enable people in the area to be better prepared for unexpected circumstances and thus less vulnerable for the effects of climate change.

1. Groningen - key characteristics and problems

1.1 Map 800

The province of Groningen is located in the northernmost part of the Netherlands. The province has a long and intense history in having to deal with water. The entire province is surrounded by water. Fringed between the Wadden Sea and the high sandy plateau in Drenthe Groningen historically had to deal with dynamic marine circumstances as well as runoff water, which is transported from the plateau, through brooks, towards the sea.

The map of 800 AD shows the northern part of the Netherlands at a time when there was a very subtle and sustainable balance in the natural system (figure 1.1). Man had had almost no influence on the forming of the landscape. The dynamics of the sea changed the landscape permanently and a natural process of land forming secured the balance. Along the coastline in a broad zone marine clay was deposited on peat and in front of the coast a tidal salt marsh emerged. Little brooks discharged the rainwater from the plateau, where the water was stored in the vegetation in a sponge like way, into the sea. Several bigger rivers, like Lauwers, Fivel, Eems and Middelsee, were penetrating the coastline (Ven, 2004). In between brooks and rivers, where grounds were high enough, people started to live on so called wierden, artificial hills amidst the periodically flooded landscape. People living in this area were
only protected from drowning by natural processes, which cause a continuous rise of the ground level of the land.
After this period, man started to make use of the natural processes by capturing sand and mud in front of the coast actively and when the land was high enough they built the first dikes around it. This process of land reclamation went on for centuries until the current coastline was reached (figure 1.1). The final result of the occupation is that the land is well protected against storms and high tides, but the fierce dike stops the natural rising of the land. Another effect of the subsequent reclaims was that the grounds near the coast are the highest ones and the inside landscape lies lowest. The difference between the highlands and the deep polders is 1.5 meter on average.

![Historic map (800 AD) of Northern Netherlands, compared with current situation](image)

*Figure 1.1 Historic map (800 AD) of Northern Netherlands, compared with current situation [Sources: Ven, 2004 & DLG, 2005]*

The landscape as it is now can be characterised as a controlled landscape with a strong diversion between land and sea. The rainwater is discharged through a system of canals, pumps and dams and is transported into the sea as quickly as possible. The waterways are standardised in order to be capable of discharging just the right amount of water. The requirements according to which the dike is built take into account a representative storm, which occurs once every 4000 years. Because every inch of the land is standardised, the landscape is very inflexible in comparison to the landscape in 800 AD.

### 1.2 Climate change

The climate in the province of Groningen is affected by changing temperatures and precipitation as well as a rising sea level.

The annual precipitation increases or decreases slightly, depending on the chosen scenario. The precipitation in the six months of winter is increasing in both scenarios, while the six months of summer show a severe decrease in one scenario and stabilisation of precipitation in the other (figure 1.2) [Alterra et al. 2008]. These shifts in timing of rainfall cause extra water to be discharged in winter and dry circumstances in summer.

![Climate Maps for Groningen and Drenthe: average precipitation, precipitation in winter and summer](image)

*Figure 1.2 Climate Maps for Groningen and Drenthe: average precipitation, precipitation in winter and summer [Source: Alterra et al., 2008]*

In addition to precipitation changes there are more variables that change. The amount of days with intense rain showers increases, the number of frost days decreases and the number of tropical days
increases. The increasing number of days with intense showers may cause trouble in urban areas and agricultural ground, because a sudden large amount of water cannot easily be discharged. The increasing number of tropical days may influence the comfort in urban areas and may even cause heat stress there. Fewer frost days may cause an increase of plagues in agriculture.

The projections for the relative sea level rise (rise of sea level measured in relation to ground level) in the Netherlands show a maximum of 40 centimetres in 2050, 130 centimetres in 2100 and four metres in 2200 [Deltacommissie, 2008]. An average soil subsidence of five centimetres was discounted in these figures. Due to gas extraction in the province of Groningen the soil subsidence in 2050 is expected to be 42 centimetres in the most threatened places [NAM, 2004]. It is expected that there will be no further soil subsidence after 2050. Therefore, the maximum relative sea level rise in the Groningen area in 2050 will be 77 centimetres (40-5+42) and will reach 167 centimetres by the end of the century. This will cause serious problems with the coastal defence, which is not strong enough at some parts even today.

1.3 Problem
The general problem, which has become apparent for the last decennia, is that the balance between the pace of depletion of natural resources and the carrying capacity of the earth is lost [WWF, 2008]. One of the main reasons behind the disturbed balance is that mankind strongly believes that people can create the environment according to their own will and that technological solutions ‘overrule’ the laws of nature. Besides this, the environment increasingly has to deal with turbulent circumstances. A turbulent environment is defined as follows [Emery and Tint, 1985]: “the dynamic properties arise not simply from the interaction of the component organisations, but also from the ground itself. The ‘ground’ is in motion“.

Translated to a spatial context a turbulent environment may be defined as follows: the development of the region not simply arises from the interaction of the component functions, but also from the natural system itself. Natural resources are in motion. Mankind depletes and pollutes resources in such a way that the natural system is thrown out of balance. For example, the relations between the atmosphere, the water cycle and ecological systems become unpredictable and the dynamics of the earth system change, probably in an uncontrollable way.

If the concentration of CO₂ in the atmosphere will not be brought back to a level of 350 ppm within the next 5-12 years the system will be out of control [Hansen, 2008] and uncertain rapid changing circumstances will occur. The urgency for mitigation measures is evident, to start with phasing out the use of coal, according to Hansen. But even if the CO₂ concentration will be brought back to a reasonable level the inertia of earth’ system implies that the effects of global warming will be felt for decennia [Hansen, 2008]. This means that as of today up to at least the end of the century society will have to deal with a turbulent environment. The changes in climate are unavoidable. The consequence of this is that mankind needs to adapt to uncertain changes in climate.

Spatial planning is a potential powerful tool to do so.

In Groningen the main climate induced changes are the changing precipitation amounts. The wetter winter in combination with the rising sea level and the subsidence of the soil cause problems with the discharge of the water into the sea. In addition to this also the higher dikes are at risk due to a rising sea level and in summer fresh water needs to be taken in from elsewhere to prevent agricultural grounds and ecological reserves from drying out.

The final question that may be raised is to what extend the planning practice is ready to deal with unforeseen, unpredictable and turbulent circumstances, used as it is to predictable and measurable programmatic input.

2. Development of a planning method

2.1 Existing shortcomings
When current planning practice is analysed a couple of characteristics are relevant:

- The first one is the time horizon of spatial planning. The regional plan for the province of Groningen has a horizon of ten years [Provincie Groningen, 2008]. This causes difficulties because, as stated before, the time frames of climate change are decennia or more (figure 2.1).
- The second characteristic of current planning is that a ‘from A to Z’ planning process is used in which the problem is seen as a tame problem. In these planning processes the first phase describes the calculated needs such as housing program, need for office space and the required amount of water and nature hectares etcetera (figure 2.2). The second phase consists of putting together a zoning plan in which the programmatic needs are arranged. Climate change cannot be calculated exactly. Space required for adaptation to climate change is changing under influence of new insights and can only be given within certain margins. This makes it difficult to integrate climate change in regular spatial planning [Roggema, 2008a].
- The third characteristic of current spatial planning is that it is thinking in standards (figure 2.2). If every sector meets its own standards, the planning is OK. Climate change requires an integrated coherent approach, because if one sector is affected by changes it immediately has impact on the entire natural system and thus on several other sectors as well [Roggema, 2009].
It may be concluded that existing planning practice has at least these three shortcomings in dealing with climate change.

![Graph showing difficulties between time frames of climate change, planning, and politics](image)

**Figure 2.1** Difficulties between time frames of climate change, planning and politics [Roggema, 2008b]

![Diagram showing existing shortcomings in spatial planning](image)

**Figure 2.2** Existing shortcomings in spatial planning [Roggema, 2008a and Roggema, 2009]

### 2.2 Climate proof adjustments

The planning practice requires adjustments in order to provide climate proof spatial developments. The problems associated with the regular, tame, planning processes can be characterised as [Conklin, 2001]:

- Relatively well-defined and stable problem statement;
- Definite stopping point, i.e. we know when the solution is reached;
- Solution can be objectively evaluated as being right or wrong;
- A problem belongs to a class of problems which can be solved in a similar way;
- Solutions, which can be tried and abandoned.

If climate change is looked at in a time perspective many uncertainties are experienced. Different aspects of climate change are interrelated and mutual influences are difficult to define. In several occasions the problem becomes clear when a solution is found. These characteristics correspond with wicked problems, which are characterised as [Rittel and Webber, 1973]:

1. There is no definite formulation of a wicked problem;
2. Wicked problems have no stopping rules;
3. Solutions to wicked problems are not true or false, but better or worse;
4. There is no immediate and ultimate test of a solution to a wicked problem;
5. Every solution to a wicked problem is a “one-shot operation”; because there is no opportunity to learn by trial-and-error, every attempt counts significantly;
6. Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated in the plan;
7. Every wicked problem is essentially unique;
8. Every wicked problem can be considered to be a symptom of another (wicked) problem;
9. The causes of a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution;
10. [With wicked problems,] the planner has no right to be wrong.

Wicked problems need to be approached in a more integrated and holistic way. For a wicked problem it is impossible to define standards, which function in every similar situation. For wicked problems a
A specific and unique environment is to be created every time, which meets the requirements of the problem at that time. It is essential that the specifications of the location are clear in order to understand the local functioning and potential solutions.

If climate change is taken into account two pathways can be defined (figure 2.3) [Roggema 2008a]:

1. Creation of understanding the local potentials (i.e. climate and energy potentials) and integration of these potentials in the regular planning process;
2. Creation of a wicked bypass, which functions parallel with the regular planning process and in which wicked problems are discussed, new insights permanently enter and possible solutions are proposed.

![Two pathways to integrate wicked problems in regular planning processes](source: Roggema, 2008a)

The wicked bypass is also useful in tackling the described unbalance in the natural system, caused by a more rapid depletion of natural resources than the carrying capacity of the earth can handle. The wicked bypass offers the environment in which insights can be gained in the natural balance at a certain location, using the backtracking method.

### 2.3 Backtracking method

Several ways to gain insight in future developments and prepare society for these changes are known: forecasting, back casting and backtracking (figure 2.4) [Dam et al. 2005]. The forecasting method predicts trends that have developed over some time already, estimates the consequences of current developments and leads to gradual steps based on the current paradigm. The back casting method describes a desired future (sustainable) state and translates this desired future back to strategies and measures to be applied, starting from today. Finally, the backtracking method defines historical circumstances at the time of a sustainable equilibrium, brings these valuable historical solutions back to present-day planning, links the present to qualities of the past and defines the strategies and measures to be taken, starting today.

![Forecasting, Back-casting and Backtracking](Source: Roggema, 2005a)

Originally, the term backtracking is used in computer science. When an optimal solution needs to be found in a large pool of possible solutions backtracking can be a useful method, because in backtracking not all solutions need to be taken into account. During the process of problem solving choices need to be made. When at some point it turns out that a wrong choice has been made the process needs to return to the point where the choice was made and find another track, which is better capable of solving the problem. It is not necessary to research all other tracks (figure 2.5). In the practice of backtracking it means that every branch is followed to an extent that a solution or a dead end is found [Koljonen & Alander, 2004]. If this backtracking principle is used in a planning process, the right track can be found by looking for a moment back in history when a sustainable equilibrium functioned. Starting on that track a sustainable future can be defined, followed by the definition of the steps from present day onwards that are necessary to realise that future (figure 2.5).
3. The Groningen case

3.1 Backtracking Groningen

If the backtracking method is used in Groningen province the track back to a sustainable equilibrium can be given by figure 1.1. The key elements are: a continuous rise of the ground level, marine clay on peat and a tidal salt marsh in the coastal zone, little brooks and sponges storing water on the plateau, bigger rivers penetrating the coastline and people living on higher grounds between rivers and brooks. When these characteristics are combined with an accelerated climate change with sea level rises of five metres or more in 2300 [Veilinga, 2008] and are used in a planning process, the following three spatial models can be developed (figure 3.1) [Pauw et al. 2008].

**Natural heightening behind the dike** aims to continue the free discharge of surplus water into the sea by creating a lake around the Eemskanaal, which will increase its water level in order to make this possible. The consequence of this is that surrounding areas need to be heightened. The proposal is to let this heightening happen in a natural way by the reintroduction of the sea in well-defined areas. In these areas the agriculture has to move temporarily. Therefore, the areas are inundated subsequently. After heightening of the first area agriculture can re-enter this fertile area and the inundation moves to the next area.

**Something above Groningen** proposes to meet the fast rising sea level with several offensive defence lines. The existing islands form a connected line of new dunes and behind this island-line a sweet water reservoir for storage emerges. The existing dike is broadened and transformed into an unbreakable multifunctional dike zone. Behind this dike zone compartments with different functions are created: Storage basins, the energy-colony or the renewed granary of Groningen. Every compartment is well protected against heavy storms in times of high sea levels by defensive walls and surrounding dikes.

**Drowned land of Groningen** states that a sea level rise of five metres urges the population of Groningen to withdraw in several stages. In the first, second and third phase the northern compartments are given back to the dynamics of the sea. This means that several higher rudiments of dikes and harbours will form islands. The strong dike of the A7 highway is a barrier for a long period. If this barrier breaks the ultimate situation is reached. People live on existing higher grounds (above current 5 metres above sea level) and on higher grounds in the newly formed sea. In front of the ‘new coastline’ a Wadden-like wetland environment emerges, with sandbanks and islands.

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In the three scenarios several key elements from the historic sustainable equilibrium were used as inspiration and can be found in transformed form in the sketches:

- Dynamics of the sea and land forming, natural heightening (I and III)
- Living at higher places or in protected compartments (I, II and III)
• Creation of a water reservoir in order to keep water available (functions like a resilient sponge) (I and II)
• Sea and bigger rivers penetrating the land (I and III)
• Natural vegetation like tidal marsh will develop (III)

3.2 Strategic Interventions
From a perspective of planning strategy the results from the backtracking method cannot be implemented as a whole right away, since there is a strong demand for measurable solutions and people tend to give responses like “impossible” or “keep dreaming”. Yet, it is important to start taking the first steps, which will eventually lead to futures described in the models. It is unimaginable that from one day to another the entire landscape will be transformed. A different approach is necessary to start realising and adjusting the ideas step-by-step. In order to start-up spatial processes in the area, strategic interventions (figure 3.2) must be implemented [Roggema, 2008a].

![Figure 3.2](image)

**Figure 3.2** Strategic interventions in the regional spatial system Groningen [Source: Roggema, 2008a]

These interventions are projected at strategic points in the regional system, i.e. where they may have the largest impact in changing the region in the desired future direction. Regarding the adaptation to climate change these interventions should prepare the population for future changes, increase the resilience and decrease vulnerability of functions and people. An example of such an intervention is the heightening of the Lauwers Lake dike in order to create a large fresh water basin. This spatial intervention will not only accomplish this goal, but at the same time change the entire landscape upstream.

The way these strategic interventions function – intervene and emerge – can be compared with a swarm of birds, which changes its shape under influence of an impulse, but stays the same group of birds. The same thing happens spatially after an intervention: the landscape changes its shape but stays the same area. Therefore, this way of planning can be called swarm planning [Roggema, 2005b].

4. Eemsdelta case

4.1 Strategic intervention
In the Eemsdelta region the strategic intervention consists of letting the dike overtop with seawater (figure 4.1). This results in a temporary (in times of heavy storms) inundation of the hinterland by salt water. In future times, when sea level will have risen, this inundation will happen more frequently. This strategic intervention has impact in two ways:

1. In a spatial sense it creates an attractive environment behind the dike. High ecological qualities will develop here, living amidst the dynamic water is possible and one can experience the seasons and the weather. This offers a chance to create new typologies of housing, which is a welcome option in this area where the population is shrinking.

2. Psychologically, the people behind the dike are getting used to circumstances of the future at a very slow pace. First, they experience water in their surroundings once a year, in 2050 this will happen every month and by the end of the century weekly. During this period people start to adapt themselves to these new circumstances. Farmers shift to new cultivation; inhabitants transform their houses so they become waterproof. It makes the people highly resilient and less vulnerable. When water enters the surroundings once again, they will already have adjusted to it. Compared to a heightened dike, which seems strong but proves vulnerable in case of a breech, the people are more resilient.
4.2 Process
In order to define, design and implement such a strategic intervention, an A to Z (tame) process is dysfunctional. A wicked bypass needs to be designed, a process architecture, which makes it possible to think outside the existing procedures and which includes intensified involvement at the same time. Only if wicked thinking is rewarded with joint efforts and commitment to the project, the long term and unforeseeable developments of climate change can be successfully dealt with. Therefore, a joint problem definition by the key decision makers of all involved parties as well as several Eemsdelta summits and a multiple-day charrette with participation of all key stakeholders are part of the proposed process for the climate proof area development of Eemsdelta (figure 4.2) [Boulevard Management & Advies, 2008]. These strategic steps and moments in the planning process shape the required wicked environment.

5. Discussion
The adaptation to climate change is necessary and can be applied at a regional scale. However, several conditions need to be fulfilled.

- The planning process needs adjustments. Space needs to be created for off the beaten track routes of thinking via a wicked bypass. Commitment from principals of involved organisations needs to be arranged through immediate and open involvement. The adjustment of the regular planning process is not easy. A wicked bypass approach does not have yet proven results yet and large groups of people are used to the existing way of planning;
- The backtracking method is very useful, but because of the long term perspective used the results are often wide in range. This requires a very careful approach in presenting results and explanation of the concrete effects of these results for individuals today: prepare the audience!
Swarm planning is a powerful tool, but it requires from decision makers that they release their need for control afterwards and that they trust the self-organising capacity of the population. This is especially hard for politicians;

The implementation of strategic interventions needs to be done very carefully, because he spatial effects may be surprising over time. A secure definition of the boundaries of the area in which the effects of the intervention may be felt as well as the best possible insight in expected effects is necessary.

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