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Onderzoekscentrum voor leren, doceren en technologie

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Authors: Fleur Prinsen & Christian Stracke

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CHAPTER 9
ONE COUNTRIES' RELATIONSHIP WITH WATER: DEPENDENCE AND INTERDEPENDENCE IN ACCESS TO (DRINKING) WATER IN THE NETHERLANDS

9.1. Introduction

This chapter revolves around the relationships that the people of the Netherlands have formed with, and around water. Water and physical safety are narrowly related, but over and above that immediate connection, the historical and cultural experiences with water are very important for how the Dutch people handle it, treat it, and even innovate around it. The aim of this chapter is not only to recount the history of one particular countries' relationship with water, but to frame water management historically and culturally and thus give a more extended meaning to how the Netherlands interacts with, and around water. The relation to drinking water treatment might not be immediately apparent, but the following exploration of the Dutch dependence on water, and of the interdependent factors providing the country with access to safe drinking water today, will hopefully reveal it.

This chapter will start with some information about the physical context of the Netherlands and its geography. Next, its environmental history will be described, which will clearly demonstrate the country's ambivalent relationship with its watery environment and how it deals with it, both institutionally and through a model of negotiation. The high degree of interdependence of the Netherlands with surrounding countries for the accessibility of safe drinking water will be discussed, and how the Dutch people do their water management according to the 'polder model' (Photograph 9.1). Finally, a recent innovative water treatment process developed in the Netherlands is highlighted.

Photograph 9.1. The 'Kamerik' polder as example of the Dutch polder system[i]

9.2. Physical Context and Geography

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The Netherlands is situated in North-Western Europe and extends for around 300 km from North to South (longest distance) (Figure 9.1). It is one of the most densely populated countries in the world. The population is currently estimated at 16,929,326 (Reinhard, 2009). The Netherlands is surrounded by the North Sea in the West and North, Germany in the East, and Belgium in the South. It shares some major rivers (4 river basin districts) with surrounding countries; namely Belgium, France and Germany.

The Netherlands has 451 kilometres of coastlines. The Dutch dunes are part of a larger system called Deltawerken (in English: Delta Works)[ii]. The delta works consist of dams, sluices, locks, dykes, levees, and storm surge barriers. The former 'Zuiderzee' (Southern sea) is now an internal artificial lake (IJsselmeer, since 1932) in the middle of the country, with mainly fresh water (from rivers IJssel and Vecht), which is a major supply for drinking water. The Zuiderzee Works, which closed off the IJsselmeer lake from the sea by dams and locks, is the largest hydraulic engineering project undertaken by the Netherlands during the twentieth century[iii].

Figure 9.1. Map of the Netherlands

Together with the Delta Works in the South-West, the Zuiderzee works have been declared one of the Seven Wonders of the Modern World Works [iv].

The Netherlands has a unique geographical history, since much of the current land was won from the sea, and still much of the country (about a quarter) is below sea level. The country is

very flat, with only some hills in the East and South for elevation. The Netherlands has always had a special relation to the waters surrounding it, with its sea-faring history and with major floods at the beginning of last century urging the country to take more care in shielding the land from the water (e.g., through the Delta works).

The country enjoys a so called temperate maritime climate, influenced by the North Sea and Atlantic Ocean, with cool summers and moderate winters. Daytime temperatures vary from 2°C - 6°C in the winter to 17°C - 20°C in the summer. The average rainfall in a year is 76.5 cm which is quite a lot.

Drinking water in the Netherlands comes from several sources. The Netherlands tries to use the best sources available to produce its drinking water: microbiologically safe groundwater, surface water with soil passage, and surface water which is directly treated in a multiple barrier treatment (Smeets, Medema, & van Dijk, 2009), and since 2005 most of it is produced without the use of any chlorine. Preferred physical process treatments are used, such as sedimentation, filtration and UV-disinfection. If absolutely necessary, ozone or peroxide is used for oxidation. Microbial growth in the distribution system is prevented by production and distribution of biologically stable (biostable) water, and the use of biostable materials.

Just because the Netherlands has such ample supply of (safe) water, it does not mean that the Dutch use it lightly. In 2004 the average municipal water use in the Netherlands was measured among the lowest in developed countries at only 128 litre/capita/day[v].

About 60% of Dutch drinking water comes from groundwater, mainly in the Eastern part of the Netherlands. The remaining 40% comes from surface water, mainly in the West where water utilities pump from the Rhine and the Meuse because groundwater is brackish.

9.3. Environmental History of the Netherlands, the Polder Model and Institutionalization

The environmental history of the Netherlands greatly contributed to how the Dutch society perceives and works with their water resources. Water has been both a challenge and a blessing to the inhabitants of the country, and much of Dutch history revolves around adaptation to their watery environment. Some would even say that water is in the Dutch genes (Dutch Water Sector, 2016). Up to about 1000 A.D. Holland was not a very habitable place, it consisted mainly of marshes (low, wet land) and people built mounds (terps) to protect themselves from floods and sea surging. In the early Middle Ages, the western part of the Netherlands still mainly consisted of peatland. Villagers drained the land themselves by digging ditches, building dams, and dikes (Rijkswaterstaat, 2016), but even then water management was based on cooperation among several owners and users of land.

Cooperation and 'the polder model' (a form of cooperation in search for the best compromise) have been typical of the Dutch approach to water management[vi]. From the beginning it was clear that the only way to manage water problems was to work together. The land was repeatedly ravaged by floods and large parts disappeared into the sea. The Zuiderzee (a large inland sea) for instance, was formed by such a flood around 1300 (Rijksuniversiteit Groningen, 2016). From the 13th century onwards larger co-operatives were formed, based on common interests in safe water. The draining of pools and lakes with the help of windmills (now part of the country's well known international imagery) started after 1400 (Photograph 9.2), when major sea-defences had already been constructed (Rijksuniversiteit Groningen, 2016).

Photograph 9.2. Dutch windmill

The 3,000 polders (see figure 1 for an example) that now exist in the Netherlands were predominantly created by drainage with the help of windmills and pumping stations.

The last big natural water disaster that the people of the Netherlands endured was in 1953 (Photograph 9.3). Also in more recent times cooperation has remained necessary, involving several policy areas, to address a multiplicity of water-related interests.

Photograph 9.3. Cooperation to build dikes after the great storm of 1953

The Netherlands Ministry of 'Housing, Spatial Planning and the Environment' is responsible for the Dutch drinking water supply. They currently work together with the Ministry of Transport, Public Works and Water Management, which coordinates water management and management of state waters.

Rijkswaterstaat, founded in 1798 as the "*Bureau voor den Waterstaat*" is part of the Dutch Ministry of Infrastructure and the Environment. Its role is the practical execution of the public works and water management, including the construction and maintenance of waterways and

roads, and flood protection and prevention. The National public health and environment agency also reports to Dutch government yearly.

There are lower levels of government that are also involved:

- Provinces (for regional environmental policy and regulations, ownership water supply companies);
- Municipalities (for sewerage, urban drainage, ownership water supply companies);
- Regional water boards[vii] (for operational regional water management, urban waste water treatment).

The Dutch water supply has been institutionalized by national legislation since the 1950's. Quality standards were introduced in the water supply act of 1957 and at the same time measures were taken to reduce water pollution. To prevent direct discharge of untreated sewage into surface waters, wastewater treatment plants were constructed by water boards and municipalities. But by that time this was not yet handled in a systematic way (Reinhard, 2009).

The Netherlands established the Royal Association of Drinking Water Supply in the Netherlands (KVWN) already in 1899. In the course of the last century small water supply companies have been integrated progressively into regional public companies (this took about 50 years). This resulted in 11 water supply companies for the country in 2006. To reach 99% coverage for Dutch households in water supply the government provided financial support between 1950 and 1970 (TU Delft, 2016).

KVWN was the birthplace of organisations such as VEWIN, Kiwa, Aqua for All. VEWIN is a Union of Dutch Water Supply Companies. There are also very strong collaborations on research; Kiwa and KWR (Watercycle Research Institute) are, for instance central partners in joint research programs, as defined by water companies. Most drinking water companies in the Netherlands are publically owned private, non-for-profit companies. These are full cost-covering, without municipal or governmental subsidies.

In 2009, there was a new Drinking Water Act for the Netherlands (Helpdeskwater, 2016) with new provisions regarding production and distribution of drinking water, and the organisation of the public drinking water supply. It covers, for instance risk assessment on the continuity of drinking water supply, management of disruption and emergency supplies and legal obligations/tasks of the water supply companies. This new act already takes into account new European developments, such as the Water Framework Directive (WFD), the Directive on Flood Protection and the Framework Directive on Marine Strategy (Directives 2007/60/EC and 2008/56/EC).

In the 2009 act several directives were formulated. Water supply companies shall:

- operate a sustainable and efficient public water supply,
- build, operate and maintain the necessary infrastructure,
- supply drinking water in accordance with legal standards,
- connect consumers and supply drinking water at charges which are fair, transparent and non-discriminating,
- ensure production and distribution from source to point of supply,
- contribute to the protection of water resources,
- contribute to quality assurance between point of supply and the point of use (tap), e.g., through inspection and public information.

Taking into account the very positive International reputation of the Dutch people for their water management, it seems the 'polder model' has been successful in providing Dutch citizens with safety, and enough, good quality water (Dutchwaterauthorities, 2015).

9.4. Interdependence Factors

Every country needs to deal with the interconnectedness of several water-related interests. Providing inhabitants with physical safety from the natural violence that water can exert is only one of them, but it historically shaped Dutch society's pre-occupation with water. Besides that, the Netherlands also has a long history in shipping, and even today the (river) shipping trade represents a major water-related interest that is interdependent with agricultural water interests, recreational interests, nature interests, and the interests of drinking water supplies.
The Dutch water system itself comprises several interconnected components, which are co-dependent for water quality and quantity (Rijkswaterstaat, 2016). The grounds, polders and rivers of the Netherlands cannot be seen in isolation from each other. Their interconnectedness is the basis for our water system management. Especially in periods of excess rainfall (in the Netherlands and in the countries upstream), or during longer drought periods, the water distribution system is constantly controlled and manipulated so that all water-related interests can be optimally served. Various scenarios, agreements and technologies (like sluice gates) facilitate this process.

Local case example

One main example related to regional water supply for drinking water purposes is the system management around the Amsterdam-Rijnkanaal and the Noordzeekanaal[viii] (see Figure 9.2). This system of canals, catchment areas, polders, ditches, sluices, pumps, lakes and locks, next to safeguarding the supply for drinking water production, is also of major importance for shipping connections between IJmond, Amsterdam and Germany. The rivers provide drainage of rainwater catchment areas. The system drains into the North Sea through discharge sluices, but when the sea level is too high a pumping station takes over.

In dry times, when river levels are low, and the polders absorb water from the lakes, navigable depth for ships has to be maintained. Extra water from Lake IJsselmeer (previous Zuiderzee, now a nature reserve of national and international importance) or the Waal river can then be supplied through the operation of locks. But the amount that can be supplied from the Waal depends on the amount of water needed to maintain water levels in the Neder-Rijn, downstream of the Waal. When less water from the Waal can be diverted, there is another possibility, feeding the Amsterdam-Rijnkanaal by flushing the Vecht, but only if the level of Lake Markermeer permits this.

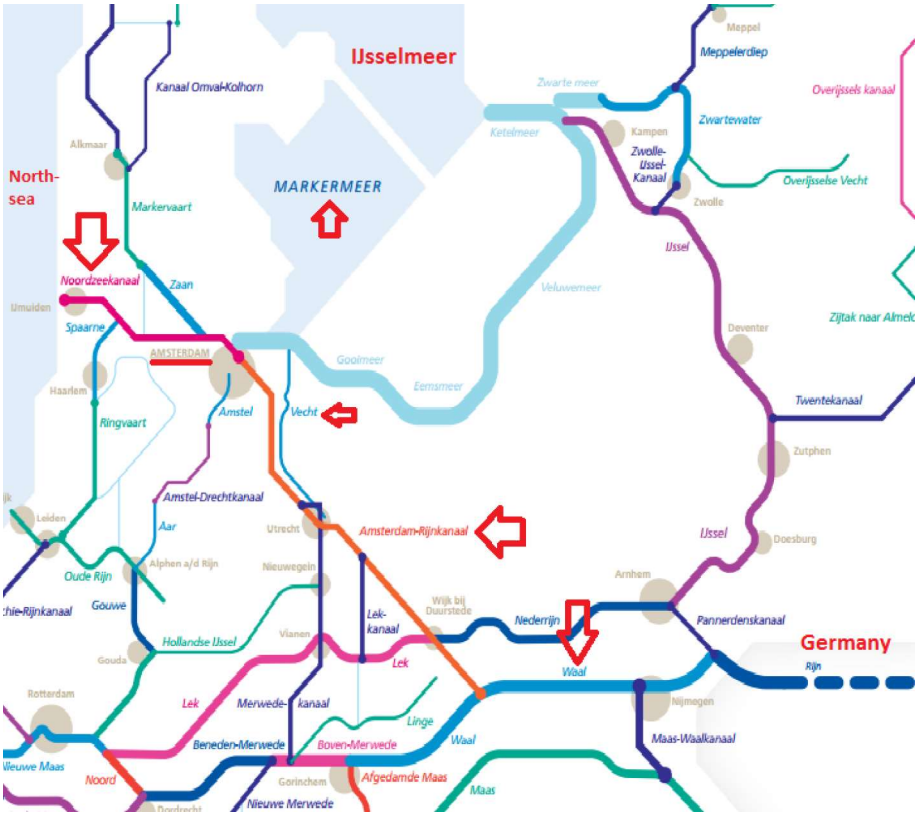

Figure 9.2. Map adapted from ideogram (2016)

As for water quality, salinization is an issue in this system. The ships that go through the sea locks at IJmuiden cause salt water to flow into the Noordzeekanaal, all the way up to where it connects to the Amsterdam-Rijnkanaal. Ecologically, the Noordzeekanaal has an important function in the migration of fish (that live in salt water, but bread in fresh water) and the saltwater gradient provides it with unique ecological characteristics (the gradual from salt to fresh water is important for the fishes to be able to adjust to the physiological different circumstances). The fish migration has suffered from the placement of sluices and locks, though (Van der Linden, van Alphen, Wanningen, van Herk, 2012) which necessitates more collaborative arrangements. Currently solutions are found by opening up recreational locks at night for the purpose of fish migration. A related issue, though, is the levels of salt water in the Noordzeekanaal. Since it connects to the Amsterdam-Rijnkanaal, which forms an inlet point for drinking water, it has to be insured that saltwater incursion does not advance too far. To halt this incursion at times water from lake Markermeer is let in. The water from the Amsterdam-Rijnkanaal has an additional function, though. In dry periods in can be used to combat salinization of polders (often consisting of farmland). This provision is subject to a water agreement from the 1980's entitled 'Small-scale Water Supply Provisions' that specifies exactly the m3/s of fresh water that have to be directed to the polders by the system of pumping to the polders during periods of water shortage.

The above local case example shows that several scenarios have been worked out, agreements have been recorded, cooperations forged, and technologies applied in this regional system. But the Dutch water system is not only a locally interconnected system as the shipping

example already hinted at this, the Netherlands is also very interdependent with its surrounding countries, through so-called transboundary aquifers (UNGA, 2008).

In terms of hydrological basins, the Netherlands shares its major river basins (Figure 9.3) with other European countries. The main ones are the Rhine and the Meuse.

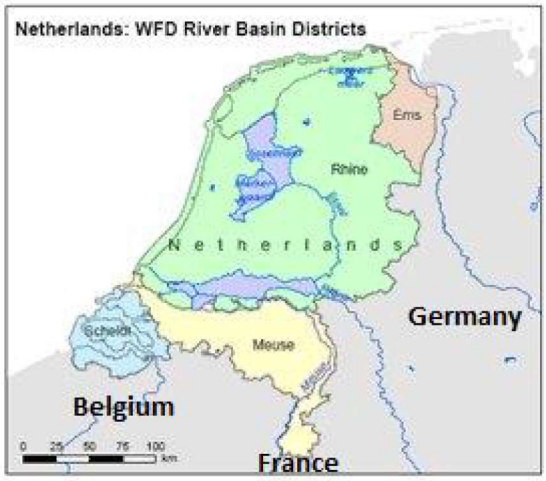

Figure 9.3. River basin districts[ix]

Flowing through eight sovereign European states, the Rhine is an international geopolitical entity (Mediation project, 2016). An International Commission for the Protection of the Rhine has been established. Currently, the Rhine River is a mixed snowfed - rainfed system. Due to climate change, it may change into a predominantly rainfall driven system. The economies of the countries it crosses benefit from access to the Rhine in many ways (navigation, drinking and industrial processing water, agriculture irrigation, hydro-power, discharge of pollutants and cooling water). Most of the Meuse basin area is in Wallonia (Belgium), followed by France, the Netherlands (8,000 km^2), Germany, Flanders (Belgium) and Luxembourg.

As the above example shows, countries can on a (more) global level pursue the development of international water law (e.g., through the ratification of conventions on transboundary acquifiers). In certain cases, development actors such as the Netherlands can also provide (donor) aid on a regional level, providing technical assistance or capacity building programmes based on their knowledge (regarding sanitation, water systems, irrigation solutions, flood control and hydropower, for instance; van Genderen en Rood, 2011).

9.5. Innovation in the Dutch water sector

"The Netherlands lives with water. Developments such as population growth, urbanisation and the rising sea level are making it an ever greater challenge to make sure that water is managed sustainably. Ingenuity is needed to ensure that the right quality water is available constantly, and in the right quantities" (SenterNovem, 2016).

One recent innovation to make sewage treatment more efficient is Nereda. ***Nereda***® is an innovative, advanced biological wastewater treatment technology that purifies water using the unique features of aerobic granular biomass. A youtube video can be watched here to explain the process: https://www.youtube.com/watch?v=P6fWCEHPt_0.

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QUESTIONS AND ANSWERS FOR CHAPTER 9

Q 9.1
It stated in the Introduction of Chapter 9 that "…our historical and cultural experiences with water are very important for how we handle it, treat it, and even innovate around it." The chapter explains some of the environmental history of one particular country (the Netherlands) as an example. What historical and cultural experiences have shaped the Dutch relationship with water?

A9.1
Answer should include a reference to the historical need of the Dutch people to adapt to their watery environment (e.g. floods, it being both a blessing and a challenge), and the fact that this has always been done in cooperation (polder model).

Q 9.2
In the introduction of Chapter 9 it is claimed that framing water management historically and culturally gives a more extended meaning to how we interact with, and around water. Why would it be important to understand the ways in which stakeholders of a certain nation (or any nation within the EU) interact with water in this extended way?

A9.2
Answer should include an argument that shows understanding that solutions which are found and which work locally may not be easily transferrable into other historical and cultural contexts. Or at least the answer should contain a sense of how the (realisation of the) dependence and interdependence of the Dutch water system came about (that it is comprised of interconnected components)

Q 9.3
Chapter 9 states that every country needs to deal with the interconnectedness of several water-related interests. The Dutch water system for instance, comprises several interconnected components, which are co-dependent for water quality and quantity. Name at least three of these interrelated interests.

A9.3
Answer should include at least three of the following: (physical) safety, shipping, agriculture, recreation, nature, drinking water, fishing, industry (e.g. cooling water), hydropower etc.

Q 9.4
There is a large number of institutions (and several policy areas) involved in the Netherlands to address the multiplicity of water-related interests. Among them are several ministries. Which option below represents the involved ministries accurately?

a) The Ministry of 'Housing, Spatial Planning and the Environment', the Ministry of 'Transport, Public Works and Water Management', and the Ministry of 'Infrastructure and the Environment'.

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b) The Ministry of 'Housing, Spatial Planning and the Environment', and the Ministry of 'Transport, Public Works and Water Management'
c) The Ministry of 'Transport, Public Works and Water Management', and the Ministry of 'Infrastructure and the Environment'.

A9.4 a)

Q 9.5
Water consumption can be measured in several ways, e.g. as the consumption per household per day (l/hh/d) or as liters per capita per day (which provides more information on water efficiency than l/hh/d). The average in Europe momentarily still lies above 150 liter/capita/day. What is the consumption level in the Netherlands?

a) 150 l/c/d
b) 128 l/c/d
c) 180 l/c/d

A9.5 b)