Without coastal dunes and river dykes two-thirds of The Netherlands would be flooded at times of high water. But for some years, especially since the nearly disastrous high river waters of '93 and '95, the Dutch have been changing their attitude to their traditional enemy. "Make way for rivers" is their new slogan.

About 5,000 years ago the first settlers came to "the low lands". There they found an extensive poorly drained flat marshy delta, a floodplain intersected by creeks, tidal inlets, and small and large rivers. To keep their goods and cattle dry, and protect themselves against high waters they raised embankments. To create conditions for agricultural activities they made small dikes to protect their fields, and flumes to drain their lands.

Life was not very comfortable at that time. The Roman writer Pliny, who visited The Netherlands in the first century, wrote: "The miserable people lead a poor existence in primitive huts on earth heights that they put up themselves. Twice a day the water inundates their residential area. You wonder if they live on the land or in the sea."

A millennium later big parts of The Netherlands were cultivated to increase the production of cereals for the growing population. In the land of peat and clay they dug drains and ditches to
lower the groundwater table and make agriculture possible. At that time the groundwater surface was 2-3 metres above sea level. Due to the drop in the groundwater table the peat and the clay layers subsided. Moreover some peat oxidized. The subsidence forced the people to deepen the drains and ditches again. This led to further subsidence of the surface. The permanent need to lower the groundwater table in order to keep the land suitable for agriculture provoked an irreversible subsidence process.

Around 1200, this process had gone on so far that large areas would be flooded during high tide. To prevent this from happening, dykes were built. Apart from protection against water from outside it was also necessary to avoid high water levels inside the embanked areas. Therefore the excess waters were discharged through outlets during low tide. In that time the water boards were born, the oldest democratic institutions in The Netherlands. The inhabitants of an embanked area were responsible for the construction and maintenance of dykes and ditches. Every landowner had the duty to maintain a section of the dyke and the ditches. Because the strength of a dyke depends on its weakest point, their condition was strictly controlled by representatives of the water boards. They are still working very well.

But through tidal creeks and inlets the sea could come far into the land. That resulted in many floods. To prevent this in the following centuries the Dutch started to connect the local embankments by dams closing the tidal creeks and inlets. There the sea couldn't come in any longer. Cities like Amsterdam, Rotterdam and Zaandam were developed around the dams in the tidal inlets of rivers like the Amstel, Rotte and Zaan.

Because of land subsidence behind the dykes, the ground level dropped below sea level. It was no longer possible to discharge excess water during low tide. Therefore the Dutch started to remove the excess water artificially. First they did this by hand and horse driven mills, but their capacity was small. Fortunately in the 14th century windmills became available. Vital for the survival of the Netherlands was the invention of turning the vanes of the mills into different wind directions.

With this new technique it also became possible to reclaim shallow lakes. In the 16th and 17th century, the Dutch Golden Age, rich merchants from Amsterdam and other cities invested their capital in enlarging agricultural areas. Thus large lakes like the Purmer, north of Amsterdam, were reclaimed. When steam-driven pumping stations became available in the 19th century, large lakes like the Haarlemmermeer (where Schiphol Airport is now), could be reclaimed.

But the struggle against high water is never won because of the ongoing man-made subsidence of the land and the rising sea level. In 1916 large areas were flooded when the dykes around the Zuiderzee burst. The Government decided to close this part of the sea by means of the 32 km Afsluitdijk. In 1953 the worst flood disaster in recent Dutch history took place. In the south-western part of the country 1,835 people lost their lives when the sea broke through the dykes in some 900 places. This disaster led to the famous multi-billion Delta Project. Most of the estuaries, into which the Scheldt, Meuse and Rhine discharge, were dammed. Only the waterways to the ports of Rotterdam and Antwerp were excluded. The first part of the Deltaplan was completed in 1958, the last part in 1997.

Now the Dutch are preparing themselves for the next phase in their never ending struggle against the subsidence of the land and the rising sea level. Sometimes it is no longer an integrated framework.

"If you try to cage a river it will struggle to break out like a wild beast." 
Dutch Crown Prince Willem Alexander

MANAGING WATER CONFLICT
THE NETHERLANDS WAY

Until the 1950s the main aim of Dutch water management was to keep people's feet dry. In the 1960s and 1970s attention moved from quantity management to quality management of surface and groundwater. Water pollution has been tackled by legislation and extensive investments in waste water treatment. The problems of pollution by point sources like industries and households are largely solved. Pollution by diffuse sources like agriculture (fertilizers and pesticides) and traffic is still a problem.

In the 1980s and 1990s the concept of integrated water resource management (IWRM) was developed because water policy was too fragmented to be effective. IWRM implies that every aspect of water is considered within one integrated framework. It is a kind of comprehensive water management that takes into account quantitative aspects (consumption, drought, flooding) combined with qualitative aspects (chemical pollution, changes in water temperature, ecological effects) and different types of water (surface water and groundwater; salt, brackish and fresh water). It is also a form of conflict management. Actual and potential conflicts between various interests and users (households, industries, agriculture, nature, fisheries, recreation, shipping), and different scales can be resolved in an integrated framework.
possible to open the large discharge sluices in the closure dams. When the Meuse and the Rhine bring large masses of water from their hinterlands to the delta, the water in the rivers and in the former estuaries rises to critical levels. This was the case in 1993 and 1995 after heavy rains in the catchment areas of the two rivers. In 1995 250,000 people along the branches of the Rhine were evacuated. The Dutch escaped a disaster. Their dykes were strong enough. In 1998 the rainfall in The Netherlands itself was so heavy that many of the western and northern parts of the country were flooded. The next step will be mega-pumping-stations on the big sea dykes like the Afsluitdijk.

So every five to seven generations the Dutch need to find a new answer to the combined effect of land subsidence and rising sea levels.

The near-disasters of 1993 and 1995 led to the Great Rivers Delta Project. It was set up firstly to improve the safety of the areas and cities along the main rivers. Within a few years hundreds of kilometres of dikes were made higher, wider and stronger. But the near-disasters led to a new awareness as well. Water engineers became aware that the water-holding capacity of the river systems was too severely reduced by canalization, normalization, land reclamation, the closure of overflows and economic activities in the floodplains; that the sponge function of large areas in the watershed was reduced by intensive agriculture and urbanization; that they cannot go on pumping their land downwards and making their dykes higher, because that will finally lead to a larger inundation depth and more damage, when a dyke bursts.

For many decades the Dutch felt quite safe behind their huge dykes, but the narrow escapes in 1993 and 1995 opened their eyes. "The classical approach of land use and water management had to be fundamentally changed", said the Dutch Crown Prince Willem Alexander in 1998. For some years water management has been his most important activity. He is chairman of the Commission for Integrated Water Resource Management and will be the chairman of the Second World Water Forum as well.

At the New Approaches to River Management conference Willem Alexander said: "We have learned by trial and error that the resilience of our rivers needs attention. Rivers are like living creatures. They are dynamic and need space. It is the nature of rivers that they refuse to stay straight. If you try to cage a river by building dykes too close to the main stream and by excessive normalization and canalization, it will struggle to break out like a wild beast. It will increase its pressure upon dykes, dams and artificial banks; it will look for their weak spots; and it will break through them. The usual response is of course to strengthen our dykes. But this only increases the water's pressure. It gets us into a spiral, which only makes us more vulnerable. Therefore, in The Netherlands, we opted for another approach. Nowadays we say: 'Make room for the river'."

"Give way to rivers" and "More room for water" became cornerstones of Dutch water management and spatial planning. In the new (fifth) National Plan, which is expected in the summer of 2000, water will be one of the guiding principles. Some polders will be transformed back into lakes and wetlands, other low-lying areas will become water reservoirs in times of high water, while in the lowest parts it will be forbidden to build and overflows will be created along rivers and retention basins. Obstacles in the floodplains will be removed, old side-channels will be reopened, dykes will be moved away from the main river channel and so on. It has not yet been decided which polders will be transformed, where the retention basins will be located and so on. The implementation of "water as a guiding principle in spatial planning" is politically not as easy as its announcement.

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