2010-2011 issue 1

a production of Change magazine

DELTAs IN TIMES OF CLIMATE CHANGE

Delta Alliance launched!

Connecting Delta Cities second anniversary

Salinity, subsidence, green adaptation, governance, space technology, community-based approaches, finance, ICT and more

www.deltatimes.org

Visit the special magazine pages online

On www.deltatimes.org you will find additional information and links.

- **The full content of this magazine**
- **Links to books, DVDs, videos, networks, events, tools and more**
- **With the send-a-friend function you can forward individual articles from this magazine or the whole magazine in digital format**

C40 CITIES
CLIMATE LEADERSHIP GROUP

co-operative programme on water and climate

Hoogheemraadschap van Delfland

Knowledge for Climate

DeltAlliance

DHV

Deltares
Enabling Delta Life

Hoogheemraadschap van Schieland en de Krimpenerwaard

project ijsseldelta

FUGRO

Provincie Noord-Holland

connecting delta cities

ARCADIS
Infrastructure · Water · Environment · Buildings

DURA VERMEER

Movares
adviseurs & ingenieurs

climate changes spatial planning

provincie ZUID HOLLAND

ROTTERDAM.CLIMATE.INITIATIVE
Climate Proof

waterschap Hollandse Delta

Ministry of Infrastructure and the Environment

UNDP

Tauw

KWR Watercycle Research Institute

WCRP
World Climate Research Programme

ROYAL HASKONING

Deltas in Times of Climate Change
Rotterdam 2010
Connecting world science and deltas

This is a special production of Change Magazine for the conference 'Deltas in Times of Climate Change'

Chief editors
Baud Schoenmaeckers
Martijn van Rijnsoever

Editorial board
Marijn Kuitert
Florrie de Pater
Michael van der Valk

The following people contributed to this edition
Jaco Boer, Danielle van Gils, Bruno Haghebaert, Antoinette Kleinhaarhuis, Michel Robles, Henk van Schaik, Maartje Smeets, Bram Vermeer, Michel Verschoor, Ria de Wit

Translation
Ian Priestnall
Gerry O'Neill
Sara van Otterloo

Design
Jacqueline Elich
Coen Mulder
Monique Willems

Publisher
Synergos Communicatie

Lithography
Nederlof Heemstede

Printing
HENK Grafimedia Center. Carbon neutral production process. This magazine is printed on Go Matt, FSC certified paper and packed in bio-degradable sheet.

Address
Synergos Communicatie
Postbus 5171
NL - 2000 CD Haarlem
info@changemagazine.nl
www.changemagazine.nl

Cover photo
I-Stock

Mixed Sources
Productgroep uit goed beheerde bossen, gecontroleerde bronnen en gerecycled materiaal.
www.fsc.org Cert no. SCS-COC-00652-EH
© 1996 Forest Stewardship Council
FSC

Deltas are ...

Places where water meets water. Places where land and sea meet in delicate equilibria. Places where, due to bountiful surroundings, people have gathered since earliest times. Places, where the richness of the sea merges with the fresh water of rivers. Deltas inspire our imagination.

Deltas have acquired many functions over the centuries; shipping, agriculture, fishing, housing, industries, recreation and protection from the elements are just some of them. Deltas house them all, in close quarters, often pressured by our pursuit of economic development. Today, deltas face even greater pressures due to the effect of climate change.

It was for these reasons that we organized the first international conference 'Deltas in Times of Climate Change', held in the city of Rotterdam at the end of September 2010. The conference drew over 1200 participants; scientists, policy makers, the business community and practitioners from 12 delta's and over 60 countries. Participants discussed diverse subjects of importance to deltas; they helped build networks between and within those concerned about the future of deltas.

To take this effort further we have created this magazine. By covering the broad spectrum of delta issues and examples on human interaction with nature we hope to inspire those who are actively involved in enabling a sustainable life in the world's deltas. This magazine contributes to extending delta networks: ours and, hopefully, yours.

We hope this magazine helps you to get in touch with those who might have the solution to challenges facing your delta.

The Conference Steering Commitee,

Prof Pier Vellinga
Knowledge for Climate programme

Paula Verhoeven
Director of Climate Affairs, City of Rotterdam

Dr Raimond Hafkenscheid
Cooperative Program on Water and Climate

contents

56 Required: climate-proof buildings

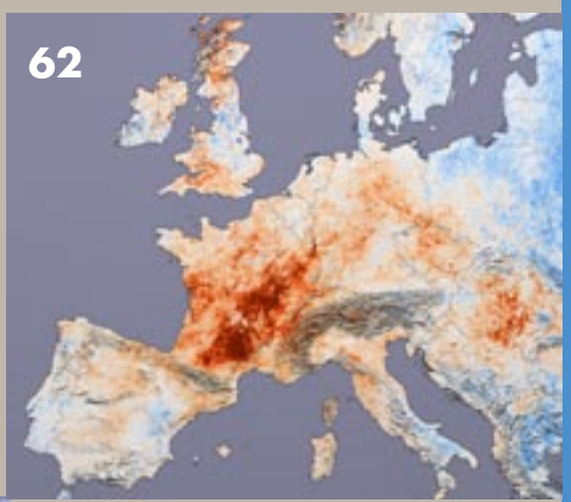
The building industry is expected to take the consequences of climate change into account.

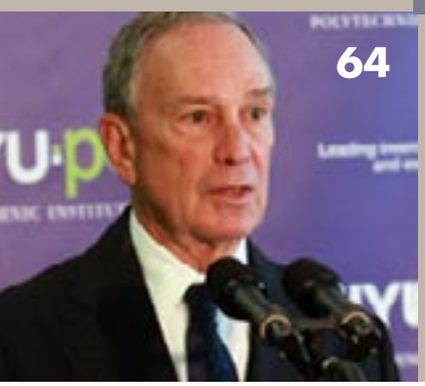
Listening to stakeholders pays!

Cities will have to take radical decisions to protect their businesses and citizens from the consequences of global warming. This will not be achieved unless they get their inhabitants and local organizations involved.

Climate change and public health

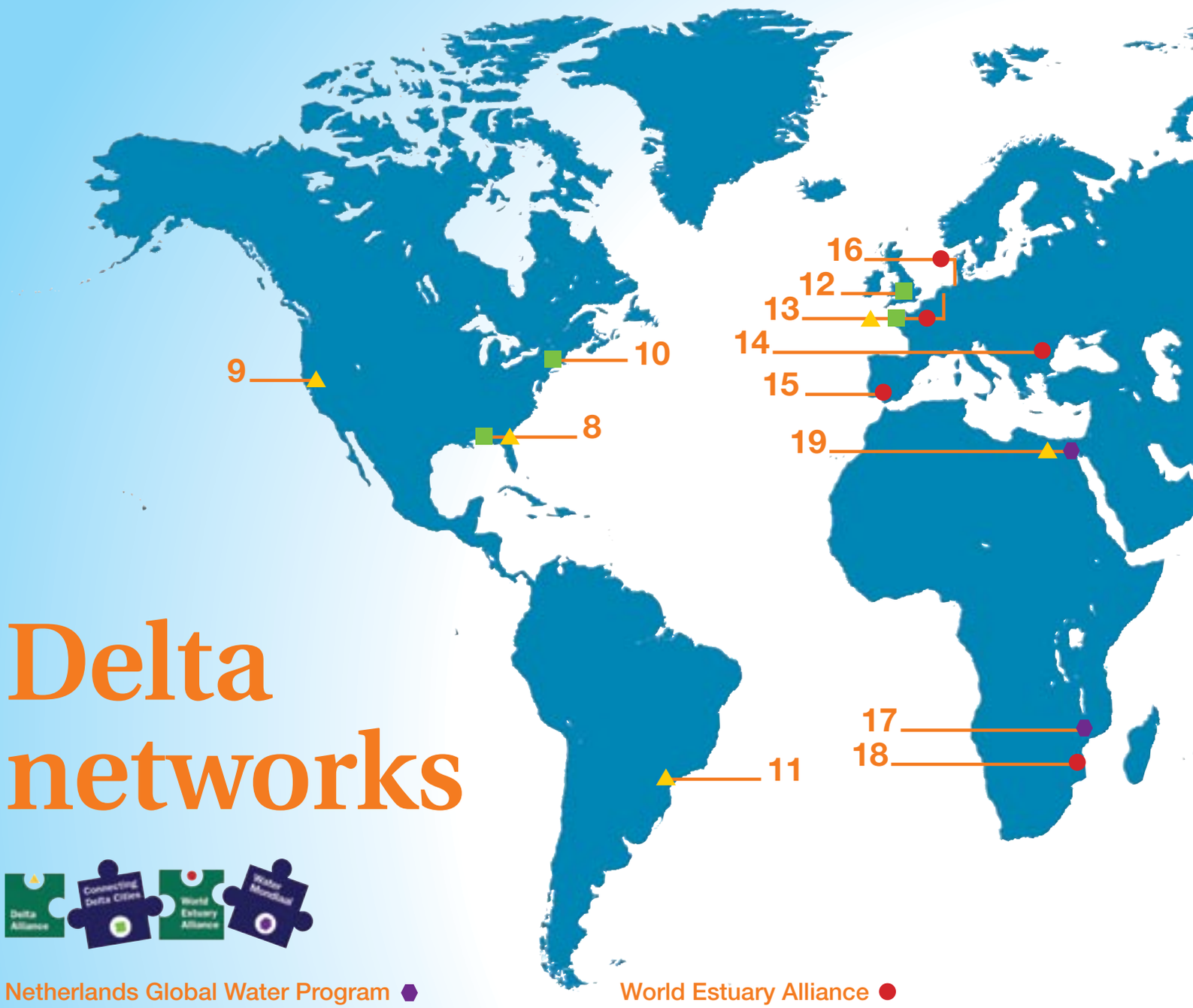
Many scientists are convinced that the effects of climate change on public health are substantial. Higher temperatures and heavier rainfall can cause more heat stress, waterborne infections and lethal infectious diseases.





64 Climate change places new demands on policy makers

How can you frame policies on such an uncertain subject as climate change?



Delta networks

Netherlands Global Water Program

"Exchanging knowledge and expertise"

The Netherlands Global Water Program (2010-2015) has a vision of the Netherlands cooperating actively with countries facing similar challenges. We focus particularly on cooperation in low-lying delta areas, in order to reduce vulnerability against floods, adapt to the effects of climate change, ensure supply of sufficient and clean water, maintain the food and ecosystem base and stimulate the development of integrated urban and rural planning.

Keywords: Water supply and sanitation; Water for food and ecosystems; Water & safety; Water & climate change; Water governance

Method: bilateral cooperation

Contact: www.government.nl

World Estuary Alliance

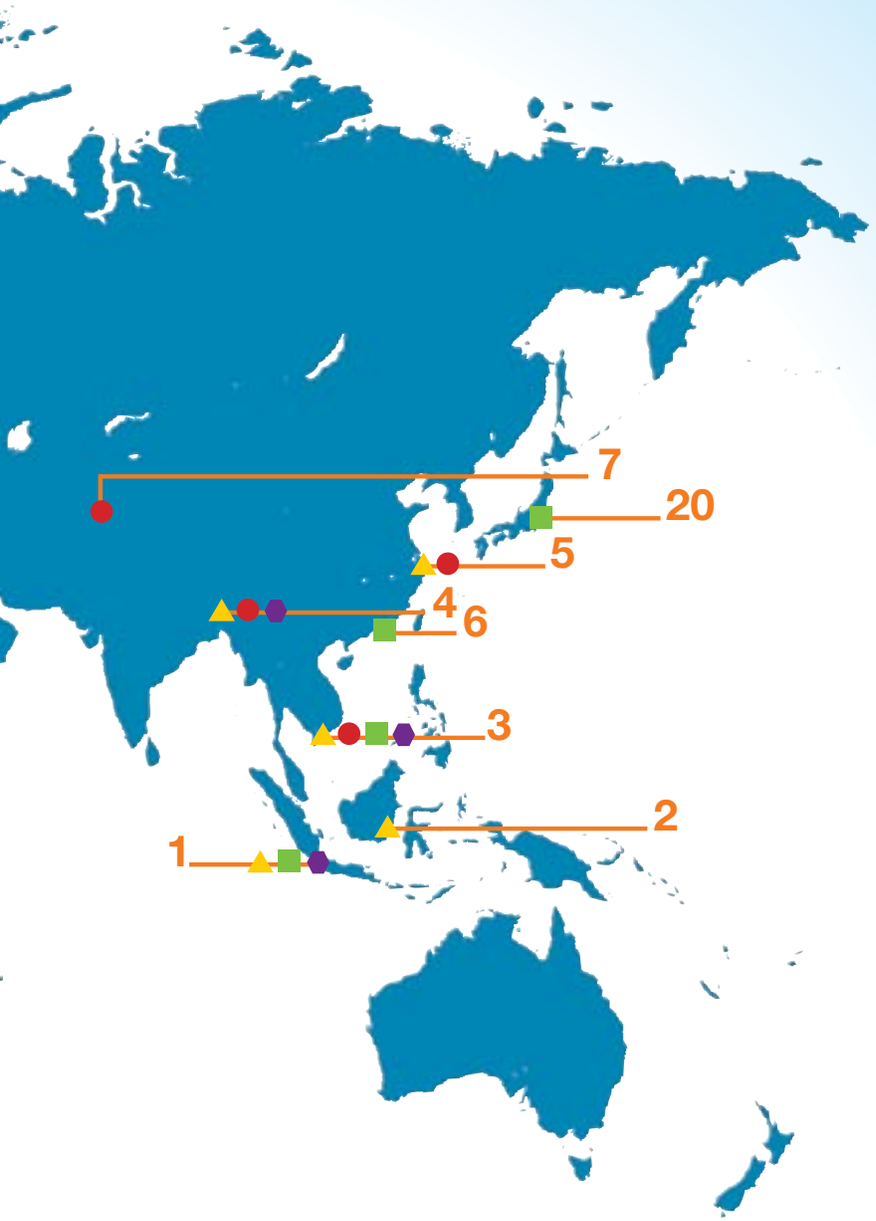
"Increasing awareness about ecological and economic value of healthy estuaries"

The WEA aims to raise awareness of the economic and ecological value of healthy estuaries and to stimulate exchange of knowledge and implementation of best practices. Where the rivers meet the sea has always been one of the most important habitats for humanity, but in the past centuries enormous damage has been done to the vibrant estuarine life. There is a need to work together to advance the best thinking in sustainable estuary development and protection. The WEA is a living network, with a shared belief that economic development and nature can go hand in hand. The growing network includes representatives from NGOs, business, science and policy makers. The WEA is currently based in Shanghai.

Keywords: practice (mainly ecology), rural delta areas, regional authorities

Method: creating awareness and stimulating action

Contact: info@estuary-alliance.org / www.estuary-alliance.org



Help build the Delta Zones platform

The Delta Zones site provides a free platform for sharing and linking to information to support the symbiosis of the many activities ongoing in delta regions.
You can find information on experts, projects, themes, events worldwide. The Delta Zones site is free to use and you are invited to list your activities.
www.delta-zones.com

1 **Jakarta / Ciliwung River Delta** *Indonesia*
2 **Mahakam Delta** *Indonesia*
3 **Mekong River Delta** *Vietnam*
4 **Ganges-Brahmaputra Delta** *India/Bangladesh*
5 **Yangtze River Delta** *China*
6 **Hong Kong / Pearl River Delta** *China*
7 **Indus Delta** *Pakistan*
8 **New Orleans / Mississippi River Delta** *USA*
9 **San Francisco Bay area** *USA*
10 **New York / Hudson Delta** *USA*
11 **Pantanal River Delta** *Brazil*
12 **London / Thames Estuary** *England*
13 **Rotterdam / Rhine / Meuse River Delta** *the Netherlands*
14 **Danube Delta** *Romania*
15 **Guadalquivir Delta** *Spain*
16 **Elbe Estuary** *Germany*
17 **Incomati Delta** *Mozambique*
18 **Zambezi Delta** *Mozambique*
19 **Nile River Delta** *Egypt*
20 **Tokyo Bay Area** *Japan*

Delta Alliance ▲

"Understanding and improving resilience across river deltas"

Delta alliance is an alliance of people and organizations committed to improving the resilience of the deltas in which they live and work. Members take part in activities that span the spectrum of researching, monitoring, reporting, advising, and implementing projects on resilience-building in deltas. Delta Alliance integrates knowledge and visions on a river delta as a whole, linking information and people from across sectors and countries for the common goal of improving resilience. Regional wings of Delta Alliance are self-organized and include individuals and organizations from across all sectors. An international secretariat coordinates international events and communications between the regional wings.

Keywords: science, delta regions, integration
Method: developing and integrating knowledge
Contact: info@delta-alliance.org / www.delta-alliance.org

Connecting Delta Cities ■

"Uniting delta cities that strive to make their cities climate proof"

CDC aims to exchange knowledge, share best practices and operate as a showcase regarding opportunities for sustainable integrated water management and climate adaptation that delta cities and their ports can offer. It is an existing and virtual network which connects deltas and coastal cities that are frontrunners in the field of climate change adaptation. It avoids creating additional workload by bringing together partner cities at events they are already attending and linking experts via primary contacts in each city. The CDC network develops in phases: first linking frontrunners (members), then including other interested delta cities (affiliate cities). CDC serves under the umbrella of C40. Its secretariat is located in Rotterdam.

Keywords: practice (mainly economy, water management and urban quality), delta cities, local authorities, climate adaptation
Method: exchanging best practices and knowledge
Contact: info@deltacities.com / www.deltacities.com

Delta dynamics

Three-quarters of the world's population lives in coastal zones, where over half the global domestic product is generated. River deltas are the most populated and productive areas of coastal zones. They have played an essential role in human history, serving as a cradle of civilization, the testing grounds for early agriculture, and the birthplace of hydraulic engineering.

The black outline on the lower right marks the location of Hong Kong positioned on the edge of the Pearl River delta. The city of Guangzou lies at the heart of the delta. At lower left is the Red River delta with the city of Hanoi in Vietnam. JACQUES DESCLOITRES, MODIS RAPID RESPONSE TEAM, NASA/GSFC

Vulnerable deltas, difficult choices

Deltas are economic and environmental hot spots. They are very fertile, strategic sites with rich ecosystems. But deltas are vulnerable to flooding and drought, especially in the face of climate change. Challenges and opportunities aplenty.

RIA DE WIT

There are dozens of large deltas in the world and most of them are densely populated. Throughout the centuries, people have made use of the riches available in these wetland areas, with their unique combination of salt and fresh water. They have adapted to nature and fought against it, which is how rice paddies came into being, as did fisheries, dams and dikes, floating dwellings and villages on artificial mounds. It has become clear that we need to know a great deal more about these areas, as climate change is starting to have a major impact on them. In fact, governments are sometimes faced with impossible choices: do we raise the height of the dikes to cope with higher sea levels in future, or would we be better off retreating to higher land? What measures can be taken when planning an area to accommodate climate change, and where is the infrastructure vulnerable?

Exchanging knowledge

Every choice has consequences. In the view of Marcel Marchand of the Dutch research institute Deltares, governments are better placed to make conscious choices when deltas are studied thoroughly and the knowledge gained is exchanged throughout the world. "Deltas are similar in a lot of ways, but it's the differences that are most interesting. That's where there's the most to be learned."

As an example he cites the two major deltas in Vietnam, the Mekong in the south and Red River Delta in the north. "They're both big, flat areas, very fertile with lots of rice planting and other agriculture, and a major city nearby. But the way they tackle flooding is very different: the Red River Delta has a lot of dikes and many polders; there are far fewer dikes in the Mekong Delta and the land is more adapted to flooding. It's interesting to look at why one country has opted for two such different solutions. Is it due to cultural differences? Or the river's drainage rate? If we can answer questions like these we can learn far more about deltas and how to respond to climate change."

Breaching the dikes

Marchand stresses that solutions in one delta can't simply be transferred to another. "Take the Flood Action Plan in Bangladesh. In the 1990s this was supposed to cope with the recurrent flooding in the area. The solutions looked at were mainly technical, like building dikes. In retrospect, you have to acknowledge that the choices made weren't the right ones. The fishing industry got into difficulties due to a lack of water, and as a result some of the dikes were breached once again."

Building dikes means you have to maintain them and increase their height regularly, Marchand explains: "Because the land level drops behind the dikes, there's no sedimentation any more." Purely technological solutions weren't the last word in Singapore, either, where a large part of Marina Bay was closed off to create a fresh water lake. Problems were expected with the water quality in the lake, and extra measures were needed to resolve them. Marchand goes on: "When planning radical public works it's important to look at the long-term effects." He's in favour of integrated water and coastal management. "It's difficult to do this in many countries, though, because the appropriate departments are too set in their ways." According to the coastal zone management specialist, England is an example of a country that has made the right bets in its integrated climate adaptation programmes. An extensive programme has been set out for the Thames Barrier, East London's major flood defence, with a range of options intended to ensure that the United Kingdom's capital city remains dry, even under extreme conditions.

Scorecard

Deltares, in association with the Delta Alliance and the World Estuary Alliance, is developing a scorecard to assist deltas round the world to make the right choices in the face of climate change. The scorecard is an extension of an earlier Deltares study, which described eight deltas. It is intended to provide a framework that allows deltas to be compared with each other to identify the differences and estimate the consequences of any choices made. Wim van Driel, Delta Alliance Programme Manager: "The scorecard facilitates integrated delta management. It's a comparative study of deltas' ecological, social and economic resilience. The scorecard indicates the degree to which an area can absorb extreme pressures, which may take many forms: explosive population growth, but climate change, too." Deltares's Marchand says: "We want to describe those three layers and also to indicate what the developments are. Then you can run them past the different climate scenarios and make a pretty good estimate of the consequences and the options available." A preliminary version of the scorecard will be available at the end of 2010. ■

Deltas are similar in lots of ways, but it's the differences that are most interesting. That's where there's the most to be learned.

Dr Marcel Marchand
Coastal Zone Management Specialist/
Advisor, Deltares
T. +31 152858558
marcel.marchand@deltares.nl
www.deltares.nl

Ir Wim van Driel
Delta Alliance Programme Manager
T. +31 317482308
wim.vandriel@wur.nl
www.delta-alliance.org

Dutch centre of water expertise

The Dutch water sector opened a centre of expertise for water, climate and energy in June 2010. It is a remarkable building, consisting of three inter-linked domes, floating in the Rijnhaven in Rotterdam. It is climate-proof, sustainable, innovative and flexible - an example of climate-resilient building in the areas outside the dikes. The floating pavilion will become the centre of expertise and a showcase for the National Water Centre. It is currently being developed into a cluster where different parties will come together: innovative and international knowledge institutions with expertise in water management, companies and government bodies.

The National Water Centre will facilitate research projects and the design and application of innovations in water management. New developments in the water sector will also be presented to the public here.

The idea for a National Water Centre was conceived from the Dutch Delta Design (DDD) project of the Netherlands Water Partnership (NWP). The founding fathers of the National Water Centre are Arcadis, DHV, Dura Vermeer, Evides Water Company, Ahoy, the Rotterdam University of Applied Science, Delft University of Technology and the City of Rotterdam.

MARC HEEMAN

Booming business

Delta networks are being created throughout the world and the formation of alliances is a much discussed topic during international missions.

RIA DE WIT

Conference Results

Official Launch of the Delta Alliance
Six deltas join the alliance: Vietnam (Mekong), Indonesia (Ciliwung/ Mahakam), Egypt (Nile), USA California (San Francisco Bay), China (Yangtze), The Netherlands (Rhine-Meuse)
Three deltas declare their intention to join the alliance: USA Louisiana (Mississippi), Brazil (Pantanal), Bangladesh (Ganges-Brahmaputra)
Celebration of the second anniversary of the 'Connecting Delta Cities' network and launch of the second book on climate adaptation
Rotterdam and Ho Chi Minh City agreed to develop a climate adaptation strategy called 'HCMC moving towards the sea with Climate Change'
Letter of Intent for Co-operation between New Orleans and Rotterdam within the CDC network
Plans for a European Delta Network within the ERA-Circle project
Start of a comparative overview of delta issues, including an analysis of the resilience of seven deltas

The Delta Alliance is a network of deltas that is primarily aimed at sharing knowledge and jointly developing expertise. The basis of this network was the intensive cooperation between Vietnam, Indonesia, California (US) and the Netherlands under the Dutch Knowledge for Climate Research Programme. Programme Manager Wim van Driel: 'What began as bilateral cooperation between the Netherlands and the other countries, has developed into an increasingly larger network. Vietnam, Indonesia, Egypt, USA California and China have joined the Alliance. Others like Bangladesh, USA Louisiana, Brazil and Argentina have become very interested."

The Delta Alliance was officially launched during the international conference Deltas in Times of Climate Change in September 2010. According to Van Driel, it is very important that countries share their knowledge about deltas, because "only too often we are reinventing the wheel". Delta Alliance plays a key role in developing ideas. "The next few years will see the creation of quite a few adaptation funds that will allocate money for projects within the framework of climate change. If you come up with a good plan, you are in the race for the cash prize."

"Despite the fact that Delta Alliance focuses on scientific knowledge, there are also links with business and governance", Van Driel says. "We don't want to get stuck at an abstract scientific level, we also want to share best practices. An international conference like the one in Rotterdam is a very appropriate platform to achieve this."

Launch Delta Alliance. PHOTO: NOOR VAN MIERLO

Rehabilitating nature

The informal network, Connecting Delta Cities, also has a practical approach. Large delta cities throughout the world meet to exchange experience and expertise. (see page 15 Delta cities help each other). The World Estuary Alliance (WEA) is another informal network that was initiated by the Chinese branch of the World Wildlife Fund (WWF) in 2008. This network takes nature conservation as a point of departure in addressing the challenges of climate change. The Vietnamese and Dutch WWF branches joined immediately, and India followed soon after. WEA takes nature as its starting point when tackling the problems that deltas are facing. The key question is how best to create natural conditions in these vulnerable areas and make them climate proof as well. Rehabilitating nature is an important focus in this process. The WEA was officially founded during the Third Yangtze Forum in Shanghai in June 2010.

WWF International Director General James Leape said in his speech: "Where the rivers meet the sea has always been one of the most important habitats for humanity, but we have done enormous damage to the vibrant life in estuaries. Now, in many estuaries the tide is allowed in again. In many estuaries and deltas, species abundance is going up and pollution is going down. Where we have curbed our instincts to clear natural features for development or navigation, fisheries are returning. But some estuaries, particularly in the tropics, are not experiencing the same improvements, and the growing impacts of climate change are threatening to undo some of our progress. We need to work together to

advance the best thinking in sustainable estuary development and protection."

An expanding network

Meanwhile, nine countries have joined the estuary network and the number of parties that are interested is growing, according to Arjan Berkhuysen of WWF. "At the beginning, it was mainly the nature conservation organizations that joined the network but currently a growing number of local governments and universities are showing interest." Examples of this phenomenon are the Dutch province of South Holland, the Chinese Fundan University and the East China Normal University in Shanghai. Berkhuysen cites this as an improvement because cooperation among different 'blood groups' is not self-evident. "Those working for nature conservation organizations are as a rule passionate experts, who know exactly what is going on in the field. They are different from pure scientists."The same holds for policy makers who work for the government, argues Jeroen Aerts, professor at the VU of Amsterdam. "Generally speaking, policymakers do not like uncertainties and scientists tend to use a lot of professional jargon. It is quite a challenge to try and understand each other and form alliances." Berkhuysen adds: "And that is precisely the added value of those alliances." ■

Wim van Driel
Programme Manager, Delta Alliance
T. +31 317482308
wim.vandriel@wur.nl
www.delta-alliance.org

Arjan Berkhuysen
World Estuary Alliance
T. +31 306937333
aberkhuysen@wwf.nl
www.estuary-alliance.org

Arnoud Molenaar
Connecting Delta Cities
T. +31 102672939
a.molenaar3@bsd.rotterdam.nl
www.deltacities.com

JACQUES DESCLOITRES, MODIS RAPID RESPONSE TEAM, NASA/GSFC

Delta, estuary or coastal zone?

What is the difference between a delta and an estuary? Is every coastal zone a delta? If you ask four different experts you'll get four different answers. Opinions are divided. "There is a lot of bickering about definitions", says Marcel Marchand from Deltares. "There is not much difference. An estuary is a river mouth where fresh water and salt water meet, creating a zone of brackish water. A delta is formed by the interaction between rivers and coasts; sediment is deposited, creating new land. A delta can be made up of a number of estuaries." A prime example of this is the Nile Delta in Egypt, according to Marchand. "The Nile splits into three main tributaries at Cairo; each tributary is called an estuary." The best-known exception to this is the Okavango Delta in Botswana, which is an inland delta. The Okavango River never reaches the sea. Arjan Berkhuysen of the World Estuary Alliance does not want to waste too many words on the issue. " I find the discussion rather uninteresting. Deltas, estuaries, coastal zones; they are all low-lying coastal areas between seas and rivers which are particularly vulnerable to climate change. It doesn't matter what you call them. What is important is that we keep bearing in mind that human intervention in these areas must be carried out in a responsible manner so they don't become even more vulnerable."
In 2009, Deltares chose to avoid discussion on terminology, and produced the book entitled: 'Towards sustainable development of deltas, estuaries and coastal zones'.

Flooding in Jakarta (Nov. 2008)
CONNECTING DELTA CITIES

Delta cities help each other

Delta cities throughout the world have joined forces. Despite major differences, they all have to deal with the growing threat of flooding and innundation as a consequence of climate change. In the Connecting Delta Cities network, expertise and experience are shared.

RIA DE WIT

Two-thirds of the world's largest cities are situated in deltas or in coastal zones; areas that have been designated by the United Nations Framework Convention on Climate Change (UNFCCC) as very vulnerable. As a consequence of climate change, these cities are increasingly having to contend with flooding, due to rainfall and the rising sea level. It is expected that, in the course of this century, more than half of the world population will be living in delta cities.

Connecting Delta Cities, a practical network of delta cities, was formed in 2008. A number of initiatives had arisen simultaneously. Scientist Jeroen Aerts made a documentary about how cities were dealing with rising sea levels; water management expert Piet Dircke was closely involved in the American-Dutch exchange of expertise in water management, in particular in New Orleans, and with the Climate Initiative; and the city of Rotterdam wanted to strengthen ties with the other delta cities. Arnoud Molenaar, the Rotterdam Climate Proof programme manager, emphasizes the network's practical approach. "We are not just a formal organization with agreements that are signed by the mayors. Our focus is on exchanging know-how and experience as well as practical cooperation."

According to Dircke, each country makes its own choices. Up to now, the Netherlands has mainly focused on prevention; the Delta Works keeps the water out. In the United States, for example, New York has focused on damage containment and evacuation options. "Both countries are asking themselves whether the chosen approach can be sustained in the long term. It is useful to exchange ideas on these issues."

Wide support

According to Jeroen Aerts, professor at the Institute for Environmental Studies at the VU University of Amsterdam, the network of delta cities indicates that after a long period in which the idea prevailed that climate change could be stopped, climate change has indeed become an issue that needs to be taken seriously. "The focus on climate adaptation was first global, then national and now the discussion has shifted to cities. That is exactly where the discussion should take place; because in the cities the actual groundwork can be done."

Sharing knowledge can make all the difference, Aerts believes. "It pays to do some comparative shopping around the world. Which solution suits this city? Interesting and technically highly-advanced projects can be found everywhere. Tokyo, for instance, has built super dikes that are 300 metres wide and Hamburg is developing large building projects outside the dikes at 7 metres above sea level, while Rotterdam is constructing a parking garage with a large water buffer and is developing green rooftops and water plazas. Delegations from cities visit each other and bring back expertise to their own cities. An enormous advantage."

It pays to do some comparative shopping around the world. Which solution suits this city?

Aerts and Molenaar emphasize that adaptation is not only about finding technical solutions, but that rules and regulations also play an important role. Aerts concludes that current rules and regulations often show too little consideration for the consequences of climate change in the long term. "Things are shifting, however. Since 2007, New York has had a Climate Change Panel: a group of scientists and stakeholders that advises the city executive on adopting adaptation measures. Their advice is taken increasingly seriously." But even when local regulations provide opportunities to take climate-proofing measures, these are not always taken, Aerts says. "Jakarta is a very densely populated city that is growing very rapidly. In 2007 the city had 9 million inhabitants; in 2025 there will be almost 20 million. Under local law, a certain percentage of the surface area should be made available for the creation of green areas. Because such laws are not adequately enforced, the city is becoming too densely populated. This makes it more difficult to take adaptation measures. The

lesson that Jakarta can learn from Rotterdam, for instance, is that it actually pays to enforce or adapt existing legislation."

Moral obligation

The term 'network' may suggest that the cities are operating on the basis of equality. This should be put in perspective, says Molenaar. "In addition to climate change, cities in developing countries are facing a great many other serious problems. Western cities will provide rather than take expertise. I consider this a moral obligation." Rotterdam advises the city executive of Jakarta on the implementation of an organization to monitor dredging operations as part of a new water management scheme. "Developments in Ho Chi Minh City, for example, are more advanced and the city would like to expand its port. "Similar efforts are already underway in Rotterdam with the construction of Maasvlakte 2, a large-scale port development project extending into the North Sea. With the financial support of the Dutch Ministry of Infrastructure and the Environment, experts from Rotterdam are going to advise their colleagues in Ho Chi Minh City on implementing the adaptation strategy.

But it is not only one-way traffic, says professor Jeroen Aerts. "Self-reliance is

The focus on climate adaptation was first global, then national and now the discussion has shifted to cities

far greater in developing countries than in western countries. In the Netherlands, we have to use public campaigns to raise residents' awareness of living with water, whereas no one in Jakarta or Bangladesh needs to be told how to deal with flooding." Aerts: "In Jakarta they are very knowledgeable about ecological buffer zones; mangrove forests are being planted to absorb flooding due to rising sea levels." The US city of New Orleans, on the other hand, has become more vulnerable because many wetlands have disappeared through human activities, such as oil and gas exploration and the dredging of rivers.
The publication of the book 'Connecting Delta Cities' coincided with the first day of the conference. Subtitled 'Sharing knowledge and working on adaptation to climate change', this second CDC book explores the different aspects of climate adaptation in delta cities. It is an investigation of comparable adaptation challenges and opportunities and of progress in adaptation plans and investments in the eight Connecting Delta Cities (CDC) cities of Rotterdam, New York, Jakarta, London, New Orleans, Hong Kong, Tokyo and Ho Chi Minh City. ■

Connecting Delta Cities, sharing knowledge and working on adaptation to climate change
More information on the magazine webpage:
www.deltatimes.org

www.connectingdeltacities.com
www.rotterdamclimateinitiative.nl

Prof Jeroen Aerts
Institute for Environmental Studies,
VU University Amsterdam
T. +31 205989528
jeroen.aerts@ivm.vu.nl

Arnoud Molenaar
Programme Manager Rotterdam Climate Proof
T. +31 102672939
a.molenaar3@bsd.rotterdam.nl

Piet Dircke
Rotterdam University of Applied Sciences
T. +31 102532222
p.t.m.dircke@arcadis.nl

Ho Chi Minh City and its ports lie in the Saigon River Delta 60 km upstream from the East Sea. HH / ROEL BURGLER

Fishermen in Alexandria, Egypt mend their nets. ANP / Y. VAN TRAVERT

How many people live in deltas?

Everyone would agree that deltas are usually heavily populated.
But exactly what percentage of the world population actually lives in deltas? The most remarkable thing is that estimates differ significantly; from barely 10 percent to more than 60 percent. The Dutch Crown Prince Willem-Alexander, in his opening speech at the 'Deltas in Times of Climate Change' conference, said, "More than three billion people now live in the world's deltas", which amounts to roughly 50 percent.
In The Bulletin of Atomic Scientists of March/April 2009, co-author Charles J. Vörösmarty of the City University of New York wrote: "Today, deltas are home to a half-billion or more people and have uncharacteristically high population densities."
What is the real figure? It seems essential to first define the area concerned. Dr Vörösmarty, in the same article, describes the coastal zone as that area of the world in which three-quarters of the population live, and where "more than half of global gross domestic product is generated". He went on to describe: "Within the coastal zone, river deltas are among the most consequential of landforms and have played an essential role in human history, serving as a cradle of civilization, the testing grounds for early agriculture, and the birthplace of hydraulic engineering."

Woman in Alexandria, Egypt

Alexandria harbour, Egypt

Nile River delta: tough choices

Adaptation to climate change demands major investments. At the same time, many countries are trying to deal with other urgent issues: overpopulation, shortages of drinking water and food, and drought. Which is more urgent: tackling your current problems or protection for the future? In Egypt, the UNDP is working on an integrated approach to coastal zone management.

RIA DE WIT

The coastline around the Nile Delta is 240 kilometers in length; Alexandria is the westernmost city and Port Said the farthest to the east. Fifty percent of the population of Egypt lives in the Delta and forty percent of its industry is established there. The area hosts unique ecosystems while the majority of fishery and agricultural production comes from the Nile Delta. Moreover, there are very many valuable, historic locations. Alexandria alone attracts two million visitors from all around the world every year.

Pressure on the water system

Less rain has fallen on Egypt in recent years, while the population has expanded rapidly. Alexandria alone has a population of five million. The great demand for water from Egypt's agriculture means the Nile has great difficulty satisfying the growing need for drinking water. The residents of Alexandria regularly turn on the tap to no effect. To solve the problem the city draws water from Lake Mariut, but this has consequences for the water quality and the fish stocks.

Many fishermen depend on Lake Mariut for their income. According to Dr Khaled Abu-Zeid, Regional Water Resources Programme Manager at the Centre for Environment and Development for the Arab Region and Europe (CEDARE), the situation in Lake Mariut poses a dilemma to the decision makers: "What should we do? Solve the present problems or work on protection for the future? Which is more certain? The fishermen's problem now or the rise in sea level a century hence?"

A comprehensive solution

Dr Mohamed Bayoumi, an environment specialist, addressed the conference 'Deltas in Times of Climate Change' on behalf of the United Nations Development Programme (UNDP) about Lake Burullus. This vast brackish lake, with a surface area of 70,000 hectares, is also located in the Nile Delta, east of Alexandria. The lake provides a living to 50,000 fishermen and their families, with an annual yield of some 50,000 tons of fish. Lake Burullus had comparable problems to those of Lake Maiut, but they have to a large extent been resolved by an integral approach, with support from the UNDP. Bayoumi says, "We brought the key stakeholders together so we could work on an integral solution. Every conceivable party was involved in the talks, including the fishermen." Despite conflicting roles, the talks led to concrete actions, says Bayoumi. "The water quality in the lake has improved, partly thanks to dredging its opening to the sea and by hydraulic measures in the lake itself, which help the water to circulate better."

What should we do? Solve the present problems or work on protection for the future?

Besides these technical measures, a social-economic approach was also adopted, says Bayoumi. "Fishermen are being trained to take up another trade than fishing. That's a way to reduce the pressure on the lake. Illegal fishing has been tackled, too, and free-fishing zones have been indicated."

According to Dr Bayoumi the combined approach, with support from all the parties involved, both within and outside Government, is the solution for the entire Nile coastal zone. During the conference he spoke in favour of developing an "integrated coastal zone management plan for the Nile Delta coast." This, he believes, will allow present problems to be tackled, as well as future ones caused by sea-level rise. ■

Dr Mohamed Bayoumi
Environment Specialist, Assistant Resident Representative, UNDP Egypt
T. +20 23949033
mohamed.bayoumi@undp.org

NOOR VAN MIERLO

"We can adapt!"

Gordon Hughes: the charming messenger behind the seemingly grim report

He authored the World Bank report 'Economics of Adaptation to Climate Change', the most authoritative study thus far on the costs of adaptation in developing countries. Professor Gordon Hughes' estimate: anywhere from 70 - 100 billion US dollars a year, depending on the climate scenario you choose. "Quite affordable, really." In at the deep end with Hughes and World Bank executive Julia Bucknall.

MICHEL ROBLES

Old friends meet. Enjoying the view from the 23rd floor, Gordon Hughes and Julia Bucknall swap news and memories."Lucerne: superb!" "Did you see…" Both are economists and very British. Rumour has it that she used to be his student. "No, not exactly. But Gordon and I did work together for the World Bank in Eastern Europe, helping countries to comply with EU environmental regulation. And much of what I know I did learn from him."

Nowadays Bucknall is a manager at the World Bank's water unit. Hughes is a consultant, and a professor at the University of Edinburgh. He advises the British Government and was the chief author of the World Bank report.

There have been other similar studies. What is the added value of this particular one, especially as the real costs and efforts must be made not on a global level but locally?

Hughes: "When we started, some five years ago, the world focus was on the Kyoto Protocol, emissions reduction and on persuading countries to sign on. But there was a growing feeling that adaptation needed equal attention, because some climate change would be inevitable. Some countries asked the World Bank for a coherent over-all study.

"Earlier ones were sketchy on adaptation. With this report we have a reliable order-of-magnitude estimate for the big global numbers. But the true value is in the underlying figures from a regional, national and sectoral level, as pointers for policy.

"Most importantly: there is an enormous variability of impacts and costs across countries and regions and climate scenarios. Often the poorest regions face the highest costs. Sub-Sahara Africa, small island states, Myanmar... Also, we found that over 70 percent of the costs can be attributed to water management."

Bucknall: "For the World Bank, too, it was not so much about global figures. As a voice for the developing countries, we want to know: which region will need what? To me as a banker this report is a baseline for talking about adaptation. It is useful to have one big study that everybody knows about."

Both of you sound deeply involved with development issues. What got you into this line of work?

"Ehmm….wow!". They think for a moment, then launch into the stories of their professional lives.

Hughes: "When I was young I spent a year in Tanzania. That imbued me with a very strong interest in developing countries, especially in Africa."

Bucknall: "With me, there was this sense of outrage. I had it already as a kid. I didn't want to live in a world where kids went hungry. A bit childish, I fear, but I was an 'environmental vegetarian' (Hughes: "Were you??").

Hughes: "I would rather call it childlike: the ability to respond freshly to things. I think what binds us is that we both look at the environment as a driver for human welfare, the impact of environmental development on human development."

Bucknall: "Originally I studied German and English literature. Economics came later. Then, one day, I wound up in a consultancy firm, advising – of all things! – banks about making more profit. So embarrassing – at one point I literally hid in the loo! Luckily, at a lunch with the World Bank, I said some things which they must have mistaken for being very clever" (she chuckles). "Anyway, they offered me a job."

NOOR VAN MIERLO

Mr Hughes, your figures are depressingly much higher than the budget allocated to the Adaptation Fund….

Hughes: "Nevertheless, adaptation is affordable! One hundred billion may look prohibitive, but for the countries in question it is only 0.01 to 2 percent of GDP. The aggregate growth of the developing world economies is roughly 4.5 percent per year. By allocating only 10 percent of that, you could achieve adaptation.

"Such numbers are well inside the bounds of normal policy! What's more: 80 percent of those investments would have been sensible anyway, irrespective of the degree of climate change. So you don't need to wait until you know all the details: you just start with those 80 percent no-regret measures and take it from there.

"So the upside of the message is: we can adapt. Provided adaptation is integrated in all normal development policies. And clearly the focus must be on the countries and regions where adaptation costs are around 2 percent of GDP..."

Bucknall: "The only thing is: I'm afraid it's not going to happen. The money will not go to the regions that need them most."

Hughes: "...simply because these countries are not powerful in an economical or political sense. They might not get the attention they deserve."

But aren't you dramatically underestimating the costs? Critics complain that neither necessary private investments nor ecosystem adaptation were accounted for in the report.

Hughes: "Ours was only a starting point. The unknowns underpin the need for more research. As to private investments: my guess is, they will be at least as big as public ones. But don't get obsessed with investments alone. The real hurdle often is more-down-to-earth: big institutional changes are painful to people! They resist. That is why you should push decision taking responsibilities down to the lowest possible level."

Bucknall: "And ecosystems – well, they will always be missing in the reports, I guess."

We both look at the environment as a driver for human welfare

Hughes: "In our study we quantify all costs per sector of the economy against a baseline of economic growth in a 'no climate change' scenario. Fundamentally, we ask: how much does it cost to replace any loss of a particular service?

"First of all, replacement of ecosystem services turns out to be not very costly. Secondly, if you want to gauge, for example, the cost of relying upon sea walls instead of mangroves, it is difficult to estimate how much people might pay to protect ecosystems rather than build artificial substitutes. So that is something we haven't done."

So how should funding be organized?

Hughes: "The main focus must be on management of water resources. At all levels, and in a coordinated way. Part of our message was that adaptation is not an add-on, to normal policies. It is essential to development.

"Take Brazil. The poor North-East already suffers from heavy intermittent flooding and droughts, whereas the Southeastern region around Sao Paolo is booming and may benefit from climate change. Large scale North-South migration has been going on for decades. How should the government transfer resources to the North? Massive engineered transfer of water, for instance? Very expensive, and risky."

"In any case, first you should invest in those sensible 80 percent. Development assistance is likely to remain small compared to local resources. Therefore, one viable strategy is to generate the funds from existing sources – user charges, local savings, tax revenues – which will be funding the baseline expenditure anyway.

"As for multilateral funding, there is this cumbersome culprit-versus-victim climate debate. Ultimately, the solution may be to pool the usual resources for development assistance and adaptation, and direct them towards the communities or regions that are hit hardest by climate change."

Julia Bucknall
Manager World Bank
Water Unit
T. +1 2024735323
jbucknall@worldbank.org

Gordon Hughes
Professor of Economics,
University of Edinburgh
T. +44 1721760258
g.a.hughes@ed.ac.uk

THE SEARCH FOR ADAPTATION MONEY

Who pays the handyman?

How do we generate the funds required for climate adaptation? At the Rotterdam conference a variety of strategies were discussed.

MICHEL ROBLES

At COP15, last December in Copenhagen, the developed countries committed to providing more resources for climate change measures through international institutions. Nearly 30 billion USD has been pledged for the period 2010-2012, evenly divided between adaptation and mitigation. On top of that, these countries committed to mobilizing 100 billion USD annually by 2020 to address the needs of developing countries. The Rotterdam conference examined possible financing avenues.

An annual 70 to 100 billion dollars will be needed to cover the costs of adaptation in developing countries. But according to the World Bank 'Economics of Adaptation to Climate Change' report, the new UN Adaptation Fund will have a total budget of only 372 million US dollars by 2013. The remaining billions are supposed to come from a variety of sources: public and private, bilateral and multilateral, including novel channels like private equity.

International debate

But it's a doubtful scenario. The meteorological climate may necessitate action, the political climate is far from favourable. Further delays are due to a seemingly pointless 'additionality' debate: which measures may be labelled 'adaptation' and what comes simply under the heading of 'smart' development?

"Adaptation has no political traction at this moment", World Bank executive Julia Bucknall warned her audience. "So whatever applications you make for funding, don't call it adaptation." Clever rephasing of existing investments (e.g. in irrigation or ground water conservation) could help considerably, until more funding is channelled towards adaptation.

Often governments operate more cost-effectively than the private sector. But better coordination is imperative: cross-sectoral, across government levels and both within and between financial institutions. The Dutch Delta Fund exemplifies the integrated approach. This fund allows multifunctional spatial improvements. Water management, innovative agriculture, adaptation and ecosystem services can combine to draw from the Fund's resources, provided a given project helps to strengthen the nation's defences against flooding and drought.

Private sector comes in at the local level

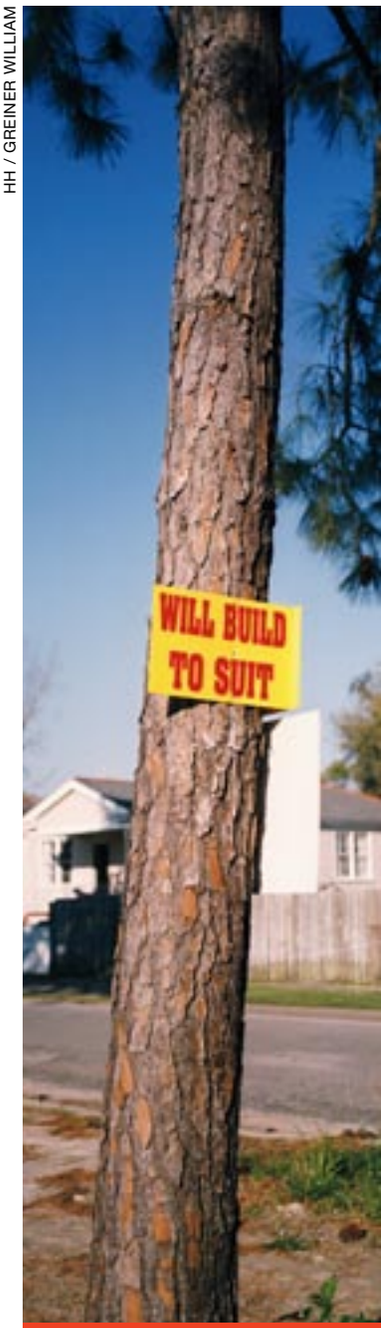
Cities, too, could help leverage public-private funding strategies. Families, local enterprises and other small-scale property owners may be very willing financers, at least for local adaptation measures. Indeed, no-one benefits more from a habitable habitat than the people living there!

In fact, small-scale actions already add up to trillions of dollars. Local communities, from the Inuit to the Aboriginal and Torres Strait Islanders, all practise home-made adaptation every day. Direct loans or public co-financing of those efforts by municipalities may be effective tools.

Cities also stimulate private investments through adaptation oriented building codes and other regulation. A third avenue is awareness-raising. An official New York task force urges all enterprises to carry out internal risk assessments and act upon the results.

Convincing corporate investors is a different ball game. Their bottom line is making a profit. Separate small rural projects in countries like Bangladesh do not offer that perspective, said Dr Ainun Nishat (IUCN Bangladesh). "Somebody needs to bundle projects, thus creating critical mass."

The most appropriate role for private enterprise, though, may not be funding, but technological innovation and getting innovations implemented on the ground. "The private sector is better than multilateral bankers at committing local entrepreneurs", Bucknall pointed out. ■



HH / GREINER WILLIAM

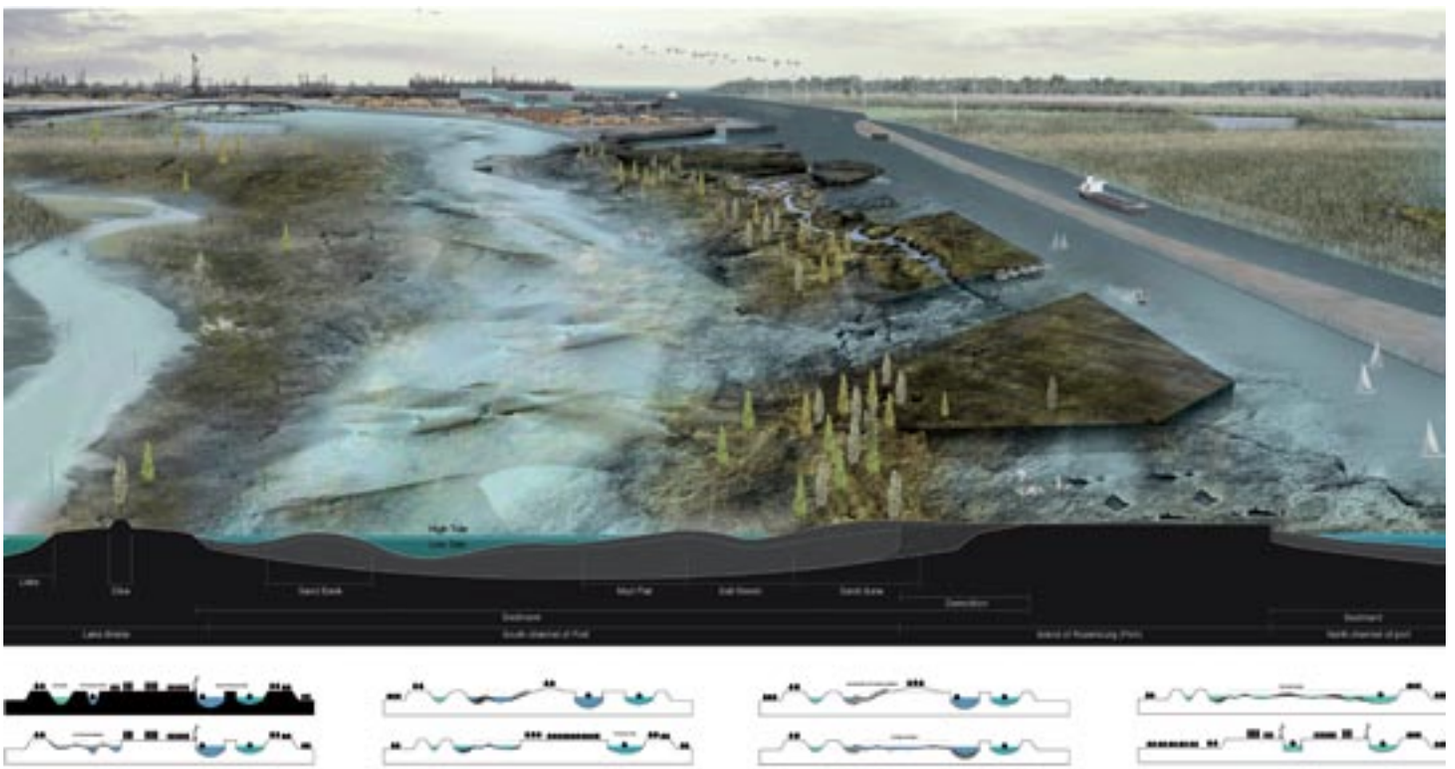
"Whatever applications you make for funding, don't call it adaptation."

Delta Competition 2010

Delta cities are under increasing pressure due to climate change. The Delta Competition 2010 challenged students to come up with creative and innovative solutions.

Entries were submitted by 24 students from all over the world. The Panel of Judges chaired by Prof. Sybe Schaap (Delft University of Technology) were impressed by the range of subjects and the innovativeness of this year's contenders. The top ten papers have been published in the Delta Competition 2010 book, and the three winning entries are presented below.

www.deltacompetition.com



Ecology as industry

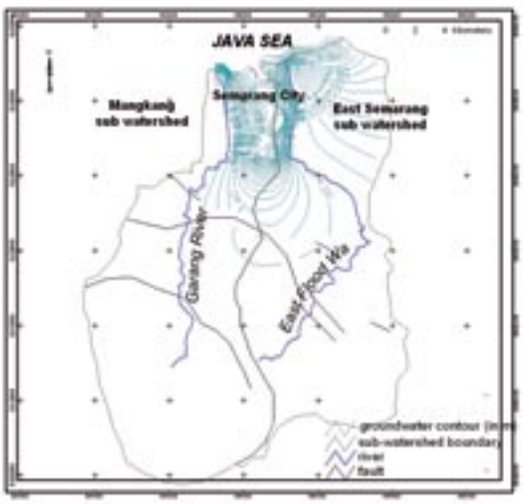
by Haein Lee, Gyoung Tak Park, and Soomin Shin, Harvard University, United States

Ecology as Industry is a long-term vision for de-engineering water management in the Netherlands. The group presented a regional plan for capitalizing upon the local ecology while addressing increasing flood hazards and land subsidence. To achieve this vision they propose they propose a number of transformations, including multi-use de-poldered areas, constructing barrier islands, relocating port activity, new industries of aquaculture and alternative energy production and an expansive recreational landscape. These specific measures were incorporated into a strong overall vision. Ecology as Industry illustrates that the issues facing delta cities require regional approaches that view the delta as a landscape system.

The Big Leak, adaptive responses to New Orleans' land subsidence crisis

by David Wooden, Virginia University, United States

The Big Leak proposes an adaptable stormwater conveyance system that intentionally "leaks" to maintain water tables in the city. It would do this by replacing the current stormwater conveyance system with surface canals that would act as an ex-filtrating infrastructure for recharging the water table, and thus stopping or reducing the rate of land subsidence. The Big Leak is an intelligently crafted concept for combating subsidence, and offers an integrated and very applicable solution for a sinking city. The jury was impressed by the innovative idea, detailed design of the solution and excellent presentation of this paper.



Groundwater zoning as spatial planning in Semarang

by Novi Rahmawati, Gadjah Mada University, Indonesia.

Like many of the world's deltas, the Semarang Delta is encountering increasing flood problems because of land subsidence. Groundwater exploitation and construction in parts of the delta are responsible for subsidence of over 16 cm per year. The concept of groundwater zoning – where spatial planning identifies the areas most degraded and at risk of degradation through groundwater abstraction – was considered a very practical solution. The jury recognized the importance of combating subsidence in Semarang and praised Rahmawati's solution, especially as it was supported by a model of the groundwater flow and detailed data. The solution is applicable and highly relevant for many deltas around the world.

LAND SUBSIDENCE AND SEA LEVEL RISE

Turning the tide

Of the 33 major deltas in the world, 24 are sinking as a result of land subsidence and rising sea levels, and 28 have experienced severe flooding in recent years. In Asia coastal villages are being abandoned as people move further inland. Climate change is compounding these risk factors.

MICHEL VERSCHOOR

A storm lashes the temple of Khun Samut Chin Village before the new sea defence. HH / RICHARD CRAMPTON

Global delta flooding could increase by 50 percent by the end of the century

In coastal Thailand, the Buddhist temple Wat Khun Samut is slowly sinking below sea level. Local workers are building a brick wall around the temple – it's a race against time and there is little money. But Abbot Smonuk Attipanyo is not willing to surrender. "If I quit defending the temple and leave, all the work that has been done will be lost forever", he says in an Al Jazeera report. The local fish farmers have moved two kilometres inland – their houses have been destroyed and electricity pylons mark the location of a flooded road. Here, coastal erosion is a result of climate change that brings rougher seas, with intensified waves causing severe flooding. All along the 600-kilometre Thai coastline, land is being lost to the sea. Breakwaters and pylons have been constructed to weaken the power of the waves, but this will probably not be enough for local fishermen. They fear they will have to move even further inland.

Wild shrimp

Locals in the Indonesian village of Rejorsori face similar misfortunes. The land they live on is sinking by at least ten centimetres every year. The flooded village, which lies just 15 kilometres from Java's fifth largest city Samarang, has only one family left. They catch and sell wild shrimp that has colonized the area since salt water entered a nearby river.

Thousands of kilometres away in the US, subsidence has been a problem for decades in the old swamps and peat lands that were dewatered for farming in the San Francisco Bay area. Settling created unstable conditions, and there are areas that lie up to 7.5 metres below sea level. Ingenious structures protect the farmland from flooding, but as the land subsides and the sea level rises, there is a growing risk that one day the dikes will burst.

New study

A study published in 2009 by the University of Colorado at Boulder indicates that human factors are causing deltas in Asia and America to sink significantly. The study concludes that this problem is exacerbated by sediments being trapped upstream by reservoirs and dams, man-made channels and levees that whisk sediment into the oceans beyond coastal floodplains, and the accelerated compacting of floodplain sediment caused by the extraction of groundwater and natural gas.

About 500 million people in the world live in river delta areas. According to the study, 24 of the world's 33 major deltas are sinking and 85 percent have experienced severe flooding in recent years, resulting in the temporary submergence of about 250,000 square kilometres of land.

Sediments

The authors predict that delta flooding could increase by 50 percent under current projections of a 45 cm sea-level rise by the end of the century, as forecast by the 2007 Intergovernmental Panel on Climate Change. The flooding will increase even more if reservoirs and other water diversion projects continue to capture sediments upstream from deltas, as this prevents the growth and buffering of deltas, according to the study.

Dr Jan Vermaat of the VU University Amsterdam: "In the Yangtze-Kiang and Ganges-Brahmaputra deltas, space needs to be provided for flood retention engineering, sedimentation and diversion channels, refuges and safe economic hotspots. In deltas with a high population density and limited space, like that of the Chao Praya in Thailand, adaptation measures must be sought outside the delta. In deltas with low population densities, such as the Lena, Yukon or Fly, natural delta dynamics can prevail."

Possible solutions

In southwest Taiwan, about 100,000 inhabitants living on the coast of Chiayi county are being informed about possible solutions for severe land subsidence. "In less than twenty years their land has subsided by more than two metres", says Dr Sinite Yu of the Taiwan International Institute for Water Education. The county government is planning land-use reformation, flood control measures and green adaptation at an estimated cost of 560 million USD. Three pilot projects have already been planned. ■

For further information on sinking deltas, download the Delta Conference audio-readings via the magazine website: www.deltatimes.org

Dr Sinite Yu
Taiwan International Institute forWater Education (TIIWE)
T. +886 223687833
sinite_yu@hotmail.com

Dr Jan Vermaat
Institute for Environmental Studies
T. +31 205989596

Building community resilience in Pueblo Viejo

Disaster response is often organized centrally, while building first-line capacity can help communities to act effectively themselves.

BRUNO HAGHEBAERT

Pueblo Viejo is a fishing community on a narrow strip of land on the Colombian coast. It is situated between the Caribbean Sea and a large lagoon, which forms the delta of the Rio Magdalena. Like so many vulnerable communities worldwide, the inhabitants are increasingly feeling the impact of a changing climate. In recent years Pueblo Viejo has been affected by a series of extreme events. Flooding, strong winds and severe coastal erosion are all in- creasing as a result of climate change. According to INVEMAR, a local marine and coastal environment research centre, Pueblo Viejo may well be totally inundated by 2030.

When a disaster or extreme event happens in a place like Pueblo Viejo, the local community is first to respond. In the hours following a disaster, search and rescue and immediate assistance to the injured and homeless are done almost entirely by family members, relatives and neighbours. In the case of small-scale events, communities may even be left entirely to their own devices, as there may be no external assistance available at all. Conventional disaster response programmes often fail to address the specific vulnerabilities, needs and demands of at-risk communities. However, it is easier to identify these vulnerabilities through a process of direct consultation and dialogue with the communities concerned, because they understand local realities and contexts better than outsiders.

Local resources

Even the most vulnerable communities possess skills, knowledge, resources (materials, labour) and capacities. These assets are often overlooked and underutilized and, in some cases, even undermined by centralized disaster response actions. The Red Cross uses a community-based approach that actively involves local people in the identification and analysis of the risks they are facing, and gets them to participate directly in planning, implementing and evaluating disaster risk activities.

For the last two years the Colombian Red Cross has implemented community-based disaster risk and adaptation activities in Pueblo Viejo, with support from the Netherlands Red Cross. The project started with a vulnerability and capacity assessment. The local community participated in an assessment of the climate risks they face, and then developed an action plan, together with the Red Cross, based on their needs and priorities. Awareness-raising and sensitization activities were organized to inform community members about the climate induced risks they are facing. For this an innovative Cli-

Tide gauge indicating different alarm phases.

Local communities are the first to respond when a disaster or extreme event happens

PHOTOS RED CROSS

mate Toolkit was developed, consisting of a board game and a puppet show.

Preparedness

In Pueblo Viejo, disaster response was strengthened by setting up disaster committees (*brigadas*). First aid training was given and the brigadas were equipped with search and rescue materials, such as stretchers, shovels, spades and ropes, and communication materials, including radios and megaphones. Schoolteachers and children were given disaster preparedness training.

Another important activity involved preparation for early warning and timely evacuation in the event of swells and storm surges. Signposted evacuation routes were developed and all community members took part in evacuation drills. Tide gauges were installed along the coastline, poles which indicate the different alarm phases – green: no action needed; yellow: flooding has started and population needs to prepare for a possible evacuation; red: evacuation required to a safe location on higher ground.

The inhabitants of Pueblo Viejo also indicated that the extreme events they face have a strong impact on their health and the drinking water supply. A number of community members were therefore trained to deal with diarrhoeal and respiratory diseases. Health kits containing essential drugs were provided, and they are regularly replenished by the local health posts.

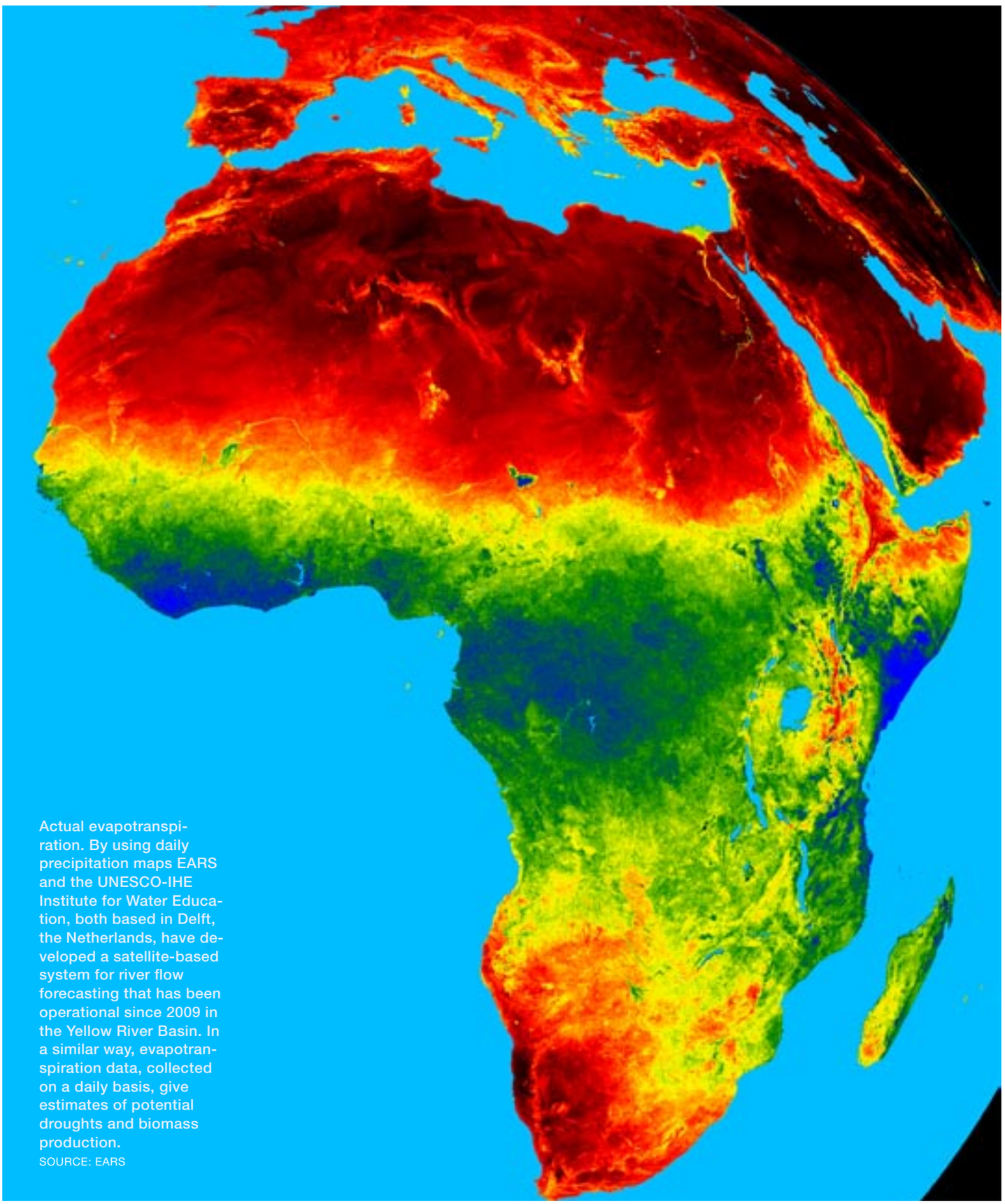
The poor quality of drinking water was identified as one of the main causes of the high infant mortality in the community. Especially after floods, drinking water is heavily contaminated and this substantially increases the amount of disease in the community. The Colombian Red Cross therefore developed a system so that households can store their own drinking water in small water tanks above flood water levels.

Confident

By engaging the local community, building on existing capacities and developing solutions that are adapted to the local context, this initiative has made a big contribution to increasing the resilience of this vulnerable delta community. Community members recently expressed the view that they are now confident that they will be able to face extreme events in the future with only limited support from outside.

The Netherlands Red Cross intends to use the lessons it learned in Colombia in a new initiative, the 'Partners for Resilience Alliance'. Five Dutch organizations (Netherlands Red Cross, Cordaid, CARE, Wetlands International and The Red Cross/ Red Crescent Climate Centre) will work together to soften the impact of natural hazards in nine countries through a combination of disaster risk reduction, climate change adaptation and ecosystem management and restoration. ■

Bruno Haghebaert
Disaster risk reduction/climate adaptation adviser
Netherlands Red Cross
T. + 31 703053918
bhaghebaert@redcross.nl



Actual evapotranspiration. By using daily precipitation maps EARS and the UNESCO-IHE Institute for Water Education, both based in Delft, the Netherlands, have developed a satellite-based system for river flow forecasting that has been operational since 2009 in the Yellow River Basin. In a similar way, evapotranspiration data, collected on a daily basis, give estimates of potential droughts and biomass production.
SOURCE: EARS

THE SPACE TECHNOLOGY COMES DOWN TO EARTH

Deltas in space

When unprecedented rainfall hit Pakistan in the summer of 2010, aid organizations worldwide urgently needed real-time data about the extent of the flooding, rainfall predictions and population concentrations. A dozen international organizations worked 24/7 on mapping this information. It was a Dutch website, www.hydrology.nl, that provided a comprehensive overview of information sources, such as maps, satellite images and other geographical data, and attracted hundreds of unique visitors daily from Pakistan alone.

BY MICHAEL VAN DER VALK

"Good interdisciplinary cooperation is key." Ruud Grim knows all about it. As Senior Advisor at the Netherlands Space Office (NSO) he is one of the key people working on broader application of data services. NSO's research indicates that there is still an enormous potential for unused current space technology. "Even though Dutch infrastructure is well developed, space technology is mostly put to use either in science or just goes back into more space technology. Other markets could make far more use of this technology, especially international cooperation projects, for example when it comes to achieving the Millennium Development Goals for food, water and biodiversity." According to Dr Grim, present end users of space technology are mainly governments and universities, whereas data assimilation techniques – using a variety of sources of information – can add more users to the chain. "Optimizing the information chain for water and climate could surely add value for everyday end users, whether they be Bengal farmers who need evaporation and water availability forecasts, or regional water management authorities in the Netherlands."

Room for improvement

Bas van der Peet, Marketing Manager Space at the Netherlands National Aerospace Laboratory NLR, confirms that many countries could benefit from the Dutch expertise in conversion of space data for everyday use. "But there's room for improvement in the Netherlands too", he adds. "There is a distinct difference in thinking between the space sector and the water sector. While the space experts are used to decades of research and development – involving hundreds of millions of euros – before a satellite becomes operational, we see that more short-term thinking prevails in the water management sector. We are now looking at how to bring these two streams together." Mr Van der Peet envisages a community of practice, where water and space specialists work together to define future data requirements: "We see a need for international coordination, for example through an umbrella organization that establishes and maintains chains with real-time satellite data for operational water management."

Despite the goodwill, Dr Grim says, "Space specialists and water managers often have little idea of the everyday problems each faces. Operational problems can be solved by improved cooperation between sectors. The solutions have to be translated in terms of sensors, spatial and temporal resolution and geographical coverage. This, of course, will lead to interesting discussions on responsibilities for the different parts of the data delivery chain, including the costs."

Both Grim and Van der Peet agree that facilitation of services should go beyond mere demonstrations: "We can't just show that it works, we need to include training, build capacity and involve hydrologists to demonstrate real world applications."

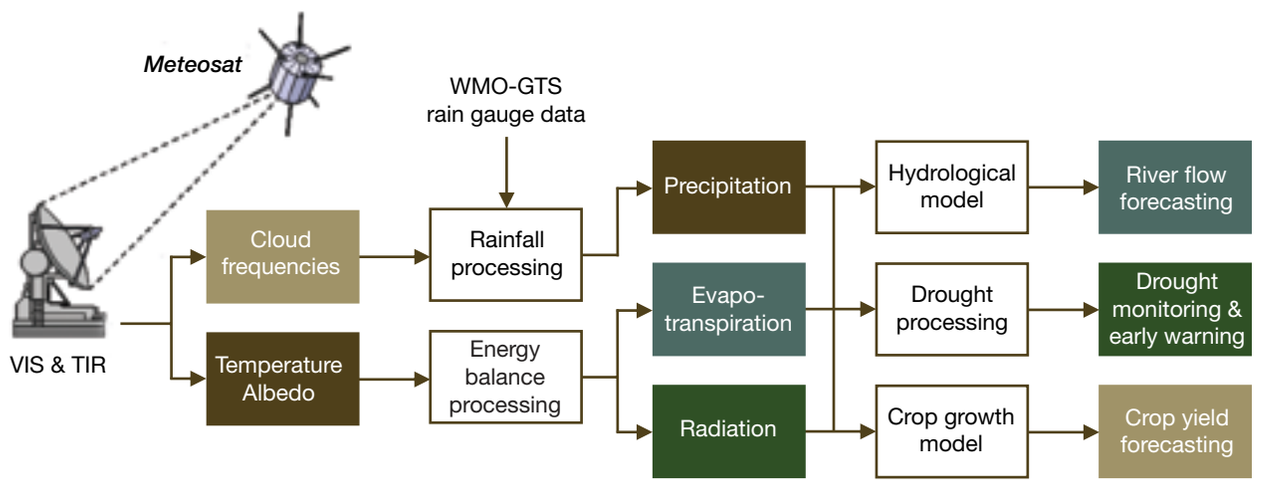
One of the organizations that could benefit from the developments is BRAC, a large organization working to alleviate poverty in Bangladesh and nine other countries in South Asia, Africa and Haiti. Based in Dhaka, Bangladesh, BRAC not only provides access to financial services but also to health, education, water and sanitation services. Dr Babar Kabir, BRAC's

Ganges River Delta. This is a false-color composite image made using green, infrared, and blue wavelengths. . SOURCE: NASA

Director for Water and for Disaster, Environment and Climate Change, explains that major challenges remain: "We need to ensure food security and reduce vulnerability to natural disasters. It is here that science (from satellite data downwards) can play a significant role, by providing early warnings and help us to better understand weather variability resulting from climate change." Optimizing the hydrological data supply chain is important, says Dr Kabir, as it would link science to grassroots development: "Researchers have limited themselves to linking to academic institutions. They have ignored the strength of the NGOs and others who work for the development of the common people." BRAC's work focuses on the poor, especially women and children, and better understanding of variations in the weather through reliable and advanced predictions will mean less loss of lives and crops.

Uncovering expertise

Dr Raimond Hafkenscheid, director of the Co-operative Programme on Water and Climate (CPWC), was one of the initiators of the initiative. "It is all about the chain: space and sensor technology – GIS and remote sensing – geomatics – hydraulics – water management. The Dutch partners are ready for this. It is an important step towards strengthening the application of space science in local, regional, national and international water-related decision-making." The consortium of initiators – CPWC, NLR, Geomatics



An example of the data processing line of the Energy and Water Balance Monitoring System (EWBMS). "EARS produces climatological data for the entire hemisphere on the basis of hourly Meteosat data: temperature, radiation, evapotranspiration and precipitation. The company has developed a 30-year database with full spatiotemporal coverage, thus enabling the provision of long data series for every desired location", says Mr Andries Rosema, EARS' director.

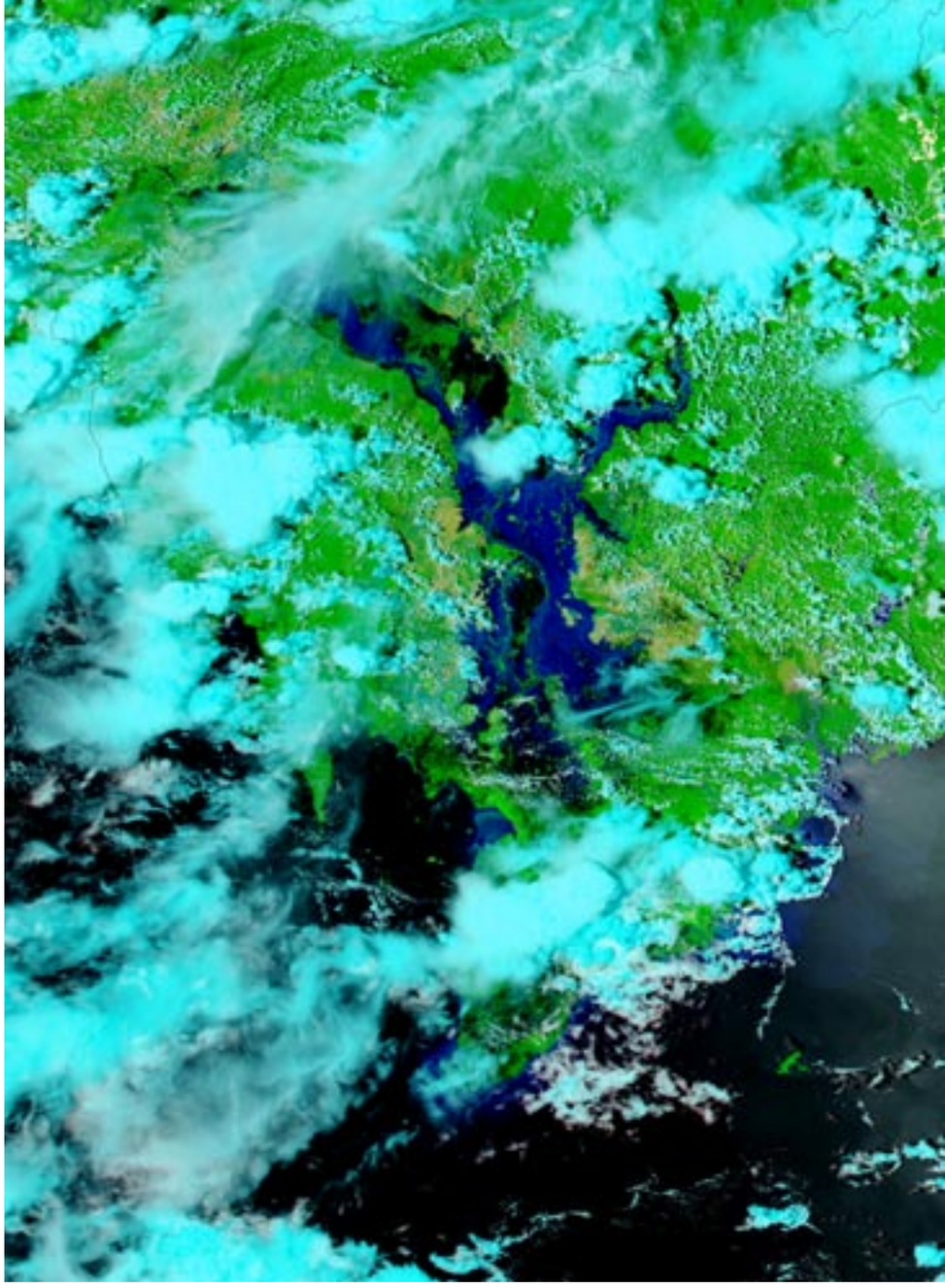
Mr Andries Rosema
General Director, EARS,
The Netherlands
T. +31 152562404
info@ears.nl
www.ears.nl

There is a distinct difference in thinking between the space sector and the water sector

Business Park, NSO and Deltares – aims for fast delivery of strategic output and key deliverables, explains Dr Hafkenscheid enthusiastically: "We would like to cooperate along the total chain in order to tackle the issues and are actively seeking international cooperation. This field of business will be a new focus area for the Netherlands, in addition to water technology and delta technology. In the end it will be organizations like BRAC that will be able to issue better seasonal forecasts for local rice farmers, so that the premium on crop insurance can be reduced from four to three percent – a net gain of 25 percent!"

Dr Kabir agrees. "Yes, definitely. Farmers, fishermen, small-scale private entrepreneurs – all will benefit. Given that the initial focus will be on weather forecasting and event predictions, the reliability of the data will be critical, whether it is to understand that a disaster is approaching or to provide very specific rainfall prediction. Tracking of the monsoon landfall is very important for agricultural activities in Bangladesh, as many crops are rain fed. Accurate rainfall prediction, when and how much, will help farmers to increase productivity. Once disaster prediction has been perfected, farmers can then be encouraged to engage in crop insurance." Reliable data will mean that BRAC would be able to save on insurance premiums, enabling them to purchase data from the streamlined process. Nevertheless, Dr Kabir adds, "While BRAC is trying to develop its own expertise to understand the scientific data, it does not wish to duplicate efforts or expertise that already exists elsewhere. We need to find an easy way of coordinating both between and within the scientific community. We need data analysis based on client needs, and reports that are in non-scientific language."

There is a clear relation between the strategic value of cooperation and payoff for those involved, according to Dr Hafkenscheid: "The GIS and remote-sensing market is a collection of small specialized enterprises, which is hard to bundle together, but very important when it comes to results." In addition, there is currently an imbalance between data needs and data supply. "We aim to close this gap, to have the space and water communities work more closely", Hafkenscheid says. "There is a lot of information out there for policy makers that is underused or not even looked at, just because people have no idea how to make use of it. We can help to remedy this by bringing together people with different expertise." ■



This image shows flooding in the Mekong River Delta in southeast Asia. In the false-color images black represents open water, green represents land, cyan represents low-level water clouds, white represents high-level ice clouds, and bright blue represents flooding in the marshlands. The river's outflows into the sea are the same bright blue color as the flooded, inland areas. That is because in both cases, the color is the result of sunlight interacting with soil (sediment) and water. JACQUES DESCLOITRES, MODIS LAND RAPID RESPONSE TEAM, NASA/GSFC.

Dr Babar Kabir
Director, BRAC Water, Sanitation & Hygiene Programme (WASH) and BRAC Disaster, Environment and Climate Change Programme (DECC), Bangladesh
www.brac.net

Dr Ruud Grim
Senior Advisor
Netherlands Space Office
T. +31 886024500
r.grim@spaceoffice.nl
www.spaceoffice.nl

Bas van der Peet,
Marketing Manager Space,
National Aerospace Laboratory NLR, Netherlands
T. +31 205113113
peet@nlr.nl
www.nlr.nl

Dr Raimond Hafkenscheid
Co-operative Programme on Water and Climate (CPWC), The Netherlands
T. +31 703043750
info@cpwc.nl
www.waterandclimate.org

www.hydrology.nl
Dutch portal to international hydrology and water management

HOTSPOTS COMBINE THEORY AND PRACTICE OF CLIMATE ADAPTATION

Rotterdam Climate Proof with Dutch hotspot approach

How can the urban region of Rotterdam, situated below sea level, with its international seaport, industries, economic activity and its many residents, be protected against climate change? Hotspot Rotterdam Region incorporates expertise, practical strategy and policy to make the region climate proof.

MAARTJE SMEETS

Water comes to Rotterdam from four different directions. The region is situated on the sea coast and the rivers Rhine and Meuse flow through the area. Precipitation has been increasing as a result of climate change and, combined with the rising sea level, is destabilizing the groundwater level. To prepare itself, the region has developed a long-term vision based on scientific research. Rotterdam Climate Proof - as part of Rotterdam's Climate Initiative - has translated that vision into more concrete action programmes that tackle issues and design concrete measures for the short-term.

"The hotspot approach enables us to acquire knowledge and learn from experience which climate adaptation measures are effective and which aren't", says Arnoud Molenaar, coordinator of the Hotspot Rotterdam Region. The work is based on the scenarios developed by the Delta Committee and the Royal Netherlands Meteorological Institute (KNMI). However, these scenarios contain national rather than regional data whereas urban deltas would benefit far more from knowledge concerning regional and local effects of climate change. "Farmers, for instance, often know a great deal about local climate patterns." Erik Hovingh, staff member of the Schieland and Krimpenerwaard District Water Board explains. "They can forecast very accurately whether a rain shower will move

Water plazas, Rotterdam.
ILLUSTRATIONS FROM THE BOOK 'THE URBANISTEN AND THE WONDROUS WATER SQUARE'.

across the river or not. But their knowledge is not scientific. The hotspot programme has initiated regional research in cooperation with the KNMI. The research findings should result in developing a local weather atlas, upon which the region can base its policy and take the appropriate measures."

In a hotspot the focus is not only on the distant future but also on tackling issues that are causing problems right now for residents and the business sector. After heavy rainfall, basements used for storage in the centre of Rotterdam are regularly flooded. For a long time the Dutch authorities told the population: "Go to sleep peacefully, we'll make sure there will be no flooding." But today the government wants citizens to participate. What can the government do and what can you do yourself? In the case of the flooded basements it means that the government will adopt mitigating measures to combat climate change. The occupants themselves should make their basements waterproof and only store things that won't suffer too much damage if flooding occurs. If your company is located outside the dikes, you should install your computers on the first floor, a very simple but effective measure that will save you a lot of trouble.

We are looking into ways of incorporating excess water into the infrastructure and into high-quality public space

The government, of course, ensures that the dikes won't break. But according to Hovingh, it will cost too much to guarantee that, in a densely populated region like Rotterdam, citizens will keep their feet dry at all times. "That's why, for instance, we are now looking at ways of incorporating excess water into the infrastructure and into high-quality public space. So we accept that there will be excess water but we will look for spaces to store it." Water plazas are an example of this approach. These plazas are designed to store excess water after heavy rainfall, thus preventing streets and basements from being flooded.

Molenaar adds that it is important that delta cities continue to exchange their expertise, as happened during the 'Deltas in Times of Climate Change' conference. "The measures we have devised for Rotterdam cannot simply be implemented in other cities without any adjustments. But cities can pick and choose what is relevant to them. We have learned a lot from the evacuation drills that are being held in Shanghai, for instance, or from the way New Orleans is now being redeveloped. Japan has a great deal of expertise when it comes to mediating for land expropriation. In this way, every city and every country is seeking the best possible solutions, which others can tap into".

Following the Dutch tradition of consensus, Hotspot Rotterdam Region has invited different parties for consultation to achieve the best possible result. The Port of Rotterdam Authority, for instance, is taking part in the discussion on the flexible closure of the Rijnmond area. Molenaar: "The economic damage to the port of Rotterdam will be limited if the closure is flexible. These kinds of considerations and input are extremely important because Rotterdam needs to adapt to climate change but at the same time it must remain an attractive place to establish business. The strength of the hotspot lies in its ability to facilitate close cooperation between public and private parties." ■

DAVID ROZING

Rotterdam Climate Proof

Permanent protection and accessibility of the city and the port are key elements of the programme. The full focus is on creating additional opportunities to enhance the attractiveness of the city in terms of living, recreation, working and investments. Rotterdam Climate Proof (RCP) has stimulated the development of green rooftops, which can retain rainwater longer. Another example is the Museum Park garage, which has a water storage capacity of 10,000 litres. Research is being done to gain an understanding of the local climate, urban heat islands, the rise in sea level and the increase in river discharge. Last but not least, RCP wants residents to participate. The authorities cannot cope with the anticipated extreme changes on their own; citizens are called upon to play an active role, one example being the subsidy that has been granted for creating green rooftops.

Arnoud Molenaar
Coordinator of the Hotspot Rotterdam Region
and Manager of Rotterdam Climate Proof
T. +31 102672939
a.molenaar3@bsd.rotterdam.nl

Erik Hovingh
District Water Board Schieland and
Krimpenerwaard
T. + 31 104537485
e.hovingh@hhsk.nl

THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY (TEEB)

Placing a value on nature

Deltas provide natural defence systems, fresh water and fish stocks, rich wildlife and a green environment for leisure activities. These ecosystem services are undervalued, they are not used sustainably, and they are threatened by global climate change. Ironically, in a world where everything is measured and under control, economic data on the loss of natural habitats and biodiversity is lacking.

MICHEL VERSCHOOR

HH / BAGUS INDAHONO

Mississippi Delta Louisiana.

Despite the improved conservation policies that EU member states have introduced, biodiversity is still under serious threat. Surveys have shown that over half of the freshwater fish species in the EU are threatened, along with over 40 percent of its native mammals, butterflies and reptiles, 30 percent of amphibians and 15 percent of birds. And a number of species are on the verge of extinction.

However, the EU is not alone: most of the world's prosperous regions show similar figures. Spawning grounds such as coral reefs are disappearing, melting ice caps are depopulating polar habitats, tropical rainforests are being transformed into farmland and a hitherto unknown disease is decimating bee colonies. The main causes of these losses are economic development, intensification of farming, and climate change.

Indispensable assets

Large organizations such as the EU and the UN are starting to recognize the need to value and nurture ecosystems as indispensable assets. The Economics of Ecosystems and Biodiversity (TEEB) was launched by Germany and the European Commission (EC) in 2007 to conduct a global study on the economic benefits of biodiversity and the costs of biodiversity loss. Inspired by the British Stern Review on the Economics of Climate Change, TEEB is hosted by the UN Environment Programme and receives financial support from the EC, Germany, the UK, Norway, the Netherlands and Sweden.

Without measuring tools we are now incapable of managing and nurturing nature in the way our ancestors did: through knowledge, tradition and instinct. "The irony is that rural communities would list nature as their key asset", TEEB study leader Pavan Sukhdev states in an interview in The Ecologist. "The level of awareness in the village is there. They know climate change is happening; that the flowers flowered at a different time last year than 10-20 years ago. They know that water is available to them only after they have drilled an extra 10-20 feet into the ground."

Natural capital

According to Sukhdev, an economist at Deutsche Bank, we should learn from rural communities and their ancient wisdom to find new ways to tackle climate change and biodiversity loss. The way forward is to incorporate the values of biodiversity and ecosystems services, our 'natural capital', into our national account systems. TEEB evaluates the costs of the loss of biodiversity and the associated decline in ecosystem services worldwide, and compares them with the costs of effective conservation and sustainable use. The recently published

The benefits of conserving biodiversity can outweigh the costs by up to 100 times

TEEB report, Mainstreaming the Economics of Nature, estimates that the benefits of conserving ecosystems or biodiversity can outweigh the costs by anywhere between 10 and 100 times.

TEEB has produced separate reports tailored to different groups of end-users. The TEEB for local and regional policy makers states: "In the northern coastal regions of Vietnam, where more than 70 percent of the population is threatened by natural hazards, local communities have planted and protect mangrove forests, as a more cost-effective strategy than building and maintaining artificial barriers (sea dikes). An investment of 1.1 million USD has saved an estimated annual 7.3 million USD in dyke maintenance alone." This is just one example of the cases that illustrate the benefits of protecting ecosystems. Other end-user groups for which tailored TEEB reports have been produced are local and regional administrators, businesses and consumers. ■

The reports are available at www.teebweb.org

Patrick ten Brink
Senior Fellow and Head of Brussels Office
Institute for European Environmental Policy (IEEP)
T. + 32 27387474
ptenbrink@ieep.eu

A TEEB COORDINATOR'S VISION

Patrick ten Brink is head of the Brussels office of the Institute for European Environmental Policy, a not-for-profit organization dedicated to advancing environmental sustainability in Europe. Ten Brink coordinated the TEEB end-user report for policy makers. "Momentum is growing when it comes to understanding the value of nature." We put five questions to him.

MICHEL VERSCHOOR

What is the key message of The Economics of Ecosystems and Biodiversity?
"The interaction between climate change and biodiversity is fundamentally synergistic. For example, if we don't deal with climate change, we will lose our coral reefs. They are very sensitive to temperature. Five hundred million people around the world depend on coral reefs. Their disappearance means that communities are losing their fish stocks and tourism value, but most of all they will lose their natural climate hazard defence systems. By accepting a two-degree rise in temperature, we have already given up our coral reefs. We shouldn't do that; it's unacceptable. Another example: green carbon stores 18 to 25 percent of our global CO_2 emissions. This is a major carbon sink, but we are running it down, causing it to emit carbon as well. So, if we really want to address climate change, we've got to stop deforestation."

And other new insights?
"The need for 'natural accounts' and the importance of ecosystem-based adaptation. We need to keep accounts of natural capital stocks, to know the value of the assets base of nature. This kind of accounting can help us to understand what we have, and keep track of what we're losing or gaining."

Is placing an economic value on nature the way out of misery?
"Some people would argue that there is a risk in placing an economic value on nature, because we will then forget the intrinsic value of nature. But some nature can be saved without valuing it: "natural crown jewels" are appreciated by everyone. There are cases, however, where an economic angle can help you communicate effectively. Some politicians only understand the language of economics. If we can communicate the benefits of ecosystems to them, they will appreciate them and open their eyes to biodiversity."

What are decision makers learning from the end-user reports?
"They seem to be showing real interest and willingness to look at the value of nature. A growing number of countries have taken up the concept since the launch of the TEEB process in 2007 at the G8+5 in Germany. Momentum is growing when it comes to understanding the value of nature. Now we need policy makers to take sound decisions in response to the evidence on the value of nature. One of many concrete responses is the call to reform subsidies nationally and internationally. Our subsidies need to be climate and biodiversity proof. We suggest publishing an annual inventory report on subsidies so that all parties can decide which subsidies are still valid."

What can delta cities do?
"Delta countries should do their bit to reduce carbon emissions. They can make sure that wetlands are not drained, as these store large amounts of carbon and are important for flood control. We also need to avoid conversion of peat lands, otherwise carbon emissions will soar. Go for the right bio fuels and invest in positive measures: the restoration of mangrove coastlines or wetlands, and natural corridors, such as river networks, buffer zones, lakes, swamps and other transport networks for wildlife. A well-preserved natural infrastructure helps with flood control and preserves biodiversity.

"It's not just a matter of quick gains, though. We need twenty solid years of motivated progress. If delta cities take the lead in ecosystem restoration and spatial planning, other stakeholders will learn from them."

THE SAND ENGINE

An innovative way of - long term - coastal defence, which also creates extra surface area whereby new knowledge and experience in coast safety is gained and space for new nature created.

The struggle against water is as old as the Netherlands itself. The changing climate poses new challenges for everyone. The Dutch wouldn't be the Dutch if we didn't go in search of new, innovative solutions for the impending rising sea level. The Sand Engine could be a solution. An innovative way of large-scale sand suppletion whereby we use the power of wind and waves to create new land. Building with nature: we let the sea do the work. In this way we combine two objectives. We create more space for nature and recreation and the coastline becomes safer and more solid.

After a thorough study of the possible alternatives, the consequences to nature and the environment and the safety of the coastal area, which is currently being finished up, the parties will start to build the Sand Engine in December 2010 at Ter Heijde, a part of Zuid-Holland's coastline. The first results of this pilot project will be discussed five years after building. In case the Sand Engine proves to have the desired effect on the coastal area, we will decide if this method of building with nature can be applied to extend and maintain the coast of the province of Zuid-Holland in the future. Should all tests prove successful, Sand Engines may be constructed along the entire Dutch coast or abroad.

The Sand Engine will protrude about 1 kilometre into the sea, in the shape of a hook. The base of the beach will be approximately 2 kilometres wide.

- *20 million cubic metres of sand, this is equal to 8000 Olympic-sized swimming pools full of sand*
- *100 hectares of new land, this is equal to 150 football fields*

provincie ZUID HOLLAND

Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

Nature's technology

The delta regions of the world need new solutions to help prevent flooding and drought. Natural climate buffers are a cheaper option than 'hard engineering'. Interest in 'nature's technology' is growing in many delta areas, including those in Vietnam, China and the Netherlands.

MICHEL VERSCHOOR

A quiet revolution is going on in the land of Hans Brinker. You may recall the old tale about Brinker, the Dutch boy who stuck his finger in the dike and saved his countrymen from a flood. The little lad in his clogs symbolizes the fight against the water in a country where large areas lie below sea level. But these dikes are no longer sacred in today's Netherlands. Dutch dike builders, nature conservationists and government organs are increasingly coming to agree: now the sea level is rising and the rivers are bursting their banks more often because of extreme rainfall, we must allow room for the water.

Breaching the dikes

So has dike building in the Netherlands had its day? By no means. The height of the river dikes is being raised at strategic and economically sensitive locations, and the sea defences are being strengthened. But we are also witnessing a new approach in sparsely populated areas. Farmers are being bought out, dikes breached and nature is allowed to go its own way. There is a new appreciation of the way low-lying areas of land can absorb and store water. The province of Noord-Holland is protected by a very old dike, which once sheltered people from the Zuider Zee and now keeps back the waters of the IJsselmeer Lake. Operations to strengthen this dike have now been put on hold. The engineers need time to look at draft plans and reconsider their calculations for a new, alternative water defence, consisting of beach faces reinforced with reeds, sand and clay to break up the waves' action and so lessen the harm that storms do to the dikes. Similar plans are being considered for both sides of the Afsluitdijk, the 30 km barrier that divides the IJsselmeer Lake from the Wadden Sea.

Collaboration

It is both cheaper and technically simpler to 'green' the water defences than to reinforce them by tipping rocks on them. This, though, is not the only advantage, even in these days of global financial crisis. Green water defences are also multifunctional. They provide a network of ecological corridors that offer a place for rare flora and

EPA: BAGUS INDAHONO

Planting mangrove trees at a Kapuk conservation area in Jakarta.

Investing in biologically diverse ecosystems lowers the risk of large losses to ecosystems and the services they provide when a drought or flood occurs.

fauna. Especially in urban agglomerations, corridors are vital to plant and animal species that are vulnerable to climate change. A network of corridors between new and old nature reserves offers them a route to habitats where they can still be sustained. Finally, policy makers in Holland, a country built on collaboration and combining forces, are delighted about a further advantage: new natural areas have a leisure role to play; nature attracts people and that generates income. So climate buffers can generate cash, too.

Mangrove buffer

Revolutions are seldom isolated, regional affairs. Evidently, then, developments in Holland are not isolated incidents. Elsewhere in the world, too, 'green adaptation' is being embraced as a significant complement to hard engineering. Viet Hoang is WWF's freshwater coordinator for the Greater Mekong in Vietnam. He wants Vietnam to invest in large, biologically diverse, well-connected ecosystems. Hoang explains they will help maintain resilience to climate-change impacts and reduce the risk of climate-related disasters. "Investing in biologically diverse ecosystems lowers the risk of large losses to ecosystems and the services they provide when a drought or flood occurs." Hoang (see interview on page 44) will soon start a number of pilot projects to restore degraded mangrove forests. Mangroves form a 'bio-shield' that protects coastal settlements. Where they

LUCAS KUKLER / HOSPER LANDSCAPE ARCHITECTURE AND URBAN DESIGN

This new idea for the 36 km long Dutch seabarrier the 'Afsluitdijk' does not involve raising the height of the barrier, but establishes natural tidal marshes on the sea side, to bear the brunt of occasional storm surges.

have vanished, flood damage is many times worse. "Just as in the past", Hoang says, "mangrove forests must join up to form a connected system. In all of these areas, connectivity is the key, so that species can move and processes can function appropriately." The WWF is seeking to put the importance of reclaiming delta ecosystems on the map with the World Estuary Alliance (WEA).

Housebuilding cancelled

The message also resounds in China. "There is a lovely nature area near Lingang Port City that was marked down for use as a residential and industrial area", says WEA chief Arjan Berkhuysen. "Local WWF staff went into action and the area is now acting as a climate buffer and nature reserve. Vanished species have even been reintroduced. At high tide the reserve traps water before it can reach the densely populated hinterland. They've cancelled housebuilding there." Berkhuysen expects more areas in the Yangtze Delta will be earmarked as natural climate buffers.

Wetlands International's Pieter van Eijk can also see a use for high moorland and marshland, which are like giant sponges that can absorb vast amounts of water. "All over the world, people have dug ditches in marshlands to drain them and reclaim them for agriculture. Rainwater drains away fast and the land compacts, with all the consequences that implies." Marshy areas should be given their old functions once again, so the water is retained longer.

Great white egret

Holland is experimenting with this in the provinces Groningen and Drenthe. Large areas of the city of Groningen were under water in the 1997 floods, including the university hospital and the renowned Groningen Museum. To prevent any future recurrence they are now working hard to excavate and landscape an area of 3,000 hectares, just south of the city. Agricultural land has been compulsorily purchased to set up a climate buffer. Just as in the past, the water that flows in the streams from the higher sandy soils in Drenthe will be retained here so that the city's nearly 200,000 residents can keep their feet dry. The new nature reserve, called the Onlanden, will consist of open water, marsh, wet woodlands, wet meadowland and pasture. It is expected that many protected plant species will be able to flourish there, as well as protected wetland birds, like the great white egret, the reed bunting and the bittern. ■

Viet Hoang
Freshwater Coordinator
WWF Greater Mekong, Vietnam
T. +844 7193049, ext. 156
viet.hoang@wwfgreatermekong.org

Arjan Berkhuysen
WWF Netherlands
T. +31 306937333
a.berkhuysen@wwf.nl

Pieter van Eijk
Technical Officer, Wetlands & Livelihoods
Wetlands International Headquarters,
The Netherlands
T. +31 318660910
pieter.vaneijk@wetlands.org

Mangrove coastline in Mekong Delta.

WWF

Green adaptation is cost effective

'Teeb for local and regional policy makers' states that Ecosystem services can provide cost-effective municipal services. Many cities around the world, such as New York (USA) and Quito (Ecuador), pay to conserve watersheds in order to secure their drinking water supply. In Curitiba (Brazil) and Mumbai (India), city managers cost-effectively enhance flood regulation by maintaining green spaces for rainwater runoff.

In Kampala (Uganda), an assessment of a threatened wetland revealed that the alternative, a replacement wastewater treatment plant, would cost approximately US$ 2 million annually to treat the city's effluents. Bangkok (Thailand) and Canberra (Australia) have recognized through public policy that urban health and quality of life are improved by planting trees and creating green spaces that enhance air quality.

In the northern coastal regions of Vietnam, where more than 70% of the population is threatened by natural hazards, local communities have planted and protect mangrove forests, as a more cost-effective strategy than building and maintaining artificial barriers (sea dykes). An investment of US$ 1.1 million has saved an estimated annual US$ 7.3 million in dyke maintenance alone.

Viet Hoang, WWF's coordinator for the Greater Mekong in Vietnam, believes that maintaining natural processes is a low-cost, effective way to minimize the worst impacts of climate change (see box on page 43). "Villages with restored mangrove forests suffered less damage during typhoon Durian."

Creating bio-shields in the Mekong River Delta

Throughout the world, countries are facing dramatic impacts of extreme weather events. Is the Mekong Delta in Vietnam struggling with similar problems?
"Due to climate change, the Mekong Delta has suffered more typhoons of higher intensity, and the typhoon season has shifted to later in the year. It's easy to recognize that rainfall has increased in rainy seasons. More heavy rainfall causes severe floods, which occur more frequently. On the other hand, precipitation has decreased in the dry season."

Do you have any specific examples of such extreme weather problems?
"In 1997 the typhoon Linda killed at least 208 people in the Mekong Delta, and 10,000 people were displaced. In 2000 the Delta experienced the worst floods in four decades as the waters rose to more than 5 metres, killing nearly 500 people. In 2006 typhoon Durian struck Ben Tre Province, causing 16 deaths and 470 wounded. Some 86,000 houses lost their roofs and nearly 20,000 houses were destroyed. Altogether, 5,000 hectares of fruit trees and 3,000 hectares of rice fields, vegetables- and aquaculture ponds were damaged. Salt water intrusion is another weather-related issue. In 2009 salt water was found in Vi Thanh, Hau Giang province, more than 70 km from the sea."

Is Vietnam experimenting with green adaptation?
"Within the next two years, WWF and Ben Tre Province will start working together to develop pilot schemes for ecosystem-based adaptation strategies in the province and to restore degraded mangrove ecosystems in coastal areas. The aim is to create a 'bio-shield' for the Mekong Delta by connecting this area to neighbouring mangrove forests. In all these areas connectivity is the key, so that species can move and processes can function appropriately. We have learned from typhoon Durian. When it hit coastal communes in December 2006, villages where mangrove forests were restored and maintained suffered less damage during the typhoon than areas with no mangroves. In 2005, the people in Long Hoa islet at the river mouth received technical advice and financial support from Cantho University to replant mangrove forest. "At this time, 123 hectares of mangrove have been restored and designated as the commune's nature reserve. More than 60 bird species were found there, together with juvenile crab, shrimp and fish. Local communities depend on such natural resources."

Can you convince policy makers of the benefits of green adaptation?
"There is sufficient evidence about the relationship between ecosystem integrity and ecosystem services. However, to be able to start persuading policy makers about the benefits of a green approach they need to be given data on costs and cost-effectiveness. This is why we need field demonstrations. Policy makers also need to realize that producing these data will take some time. In the meantime, it would be most prudent to hold off on major infrastructure projects that may foreclose future options or be maladaptive."

How important is international cooperation?
"Extremely important; Vietnam is part of a major economic region with a significant flow of people, goods, and services. The Mekong Delta especially is at the mouth of a major river basin with extraordinary diversity. Sediments from the Mekong settle in the Delta, allowing it to keep pace with sea level rise. Dams planned in Laos and Cambodia will prevent these sediments from arriving and exacerbate the impacts of sea level rise. Major deltas around the world, including the Mekong, are sinking not only due to sea level rise but also because of the extraction of ground water and loss of sediment input. A key adaptation strategy for the Delta is therefore to maintain the free-flowing nature of the Mekong River, which can only be accomplished by international negotiations with the lower Mekong countries that signed to the Mekong River Basin treaty. But another key consideration is to improve coordination and collaboration across sectors end agencies." ■

BIG CHALLENGES REQUIRE JOINT SOLUTIONS

Let's work together

Meet your Water Partners from the Netherlands at:
www.dutchwatersector.com

WATER IN A CHANGING WORLD

The world is changing. We need new solutions to meet the needs of a growing world population and expanding economy. The Netherlands have a history of adapting to water. Water has become a way of life. Tradition is combined with state of the art technology and solutions.

Big challenges require joint solutions.
The Dutch Water Sector is your partner for a wide range of water issues. From water treatment technologies to integrated water management strategies.

NWP Netherlands Water Partnership

Holland

Experiments with artificial reefs. PHOTO ECOSHAPE

LIVING COASTAL DEFENCES, WIDER

Innovative

Officials and engineers from Japan to Holland are experimenting with new types of flood prevention. Dikes and rivers are being widened and provided with natural buffers and wetlands. Nature is no longer the enemy – now she's our ally.

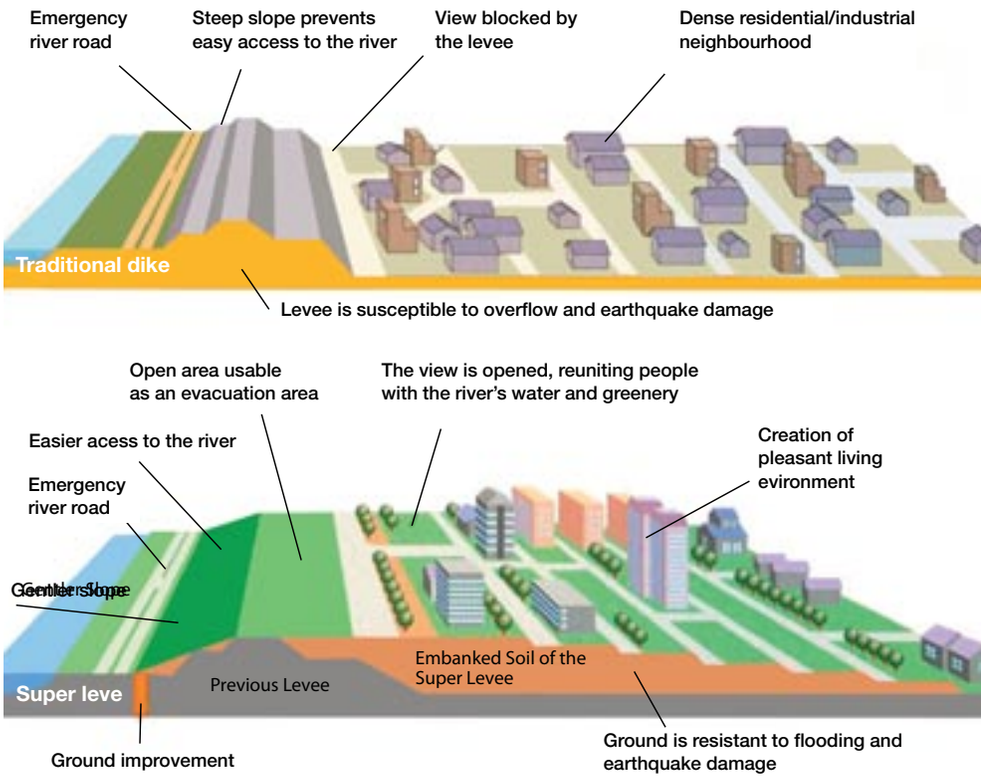
JACO BOER

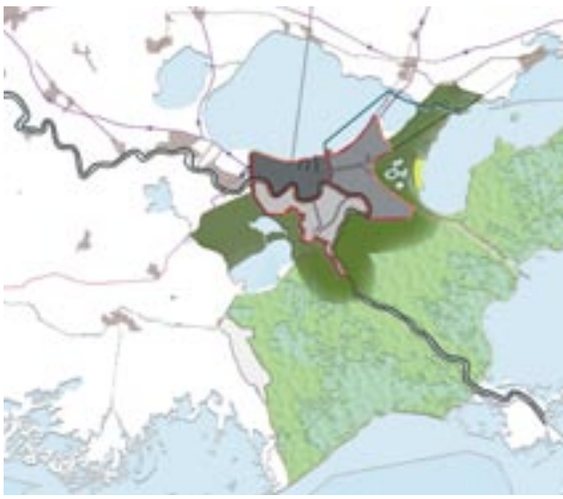
There's a lot going on in the world of the hydraulic engineer. In the past, when seeking to protect the coast and hinterland, engineers thought mainly in terms of dikes and dams, but now they're experimenting with new solutions. Even if they do opt for a dike in the end, it often looks very different from what we're used to. The water engineers in Tokyo, for instance, dreamed up the 'super levee'. Step-by-step since 2006 they have been building a ten-metre-high dike along the Arakawa River, with banking that can stretch as much as 300 metres. A wide defence like this is much sturdier than the traditional, narrow dike, because the bank on the landward side has only a gradual slope. Moreover, you can build housing, roads or offices on the dike, so the space can be used in two ways. This is a major advantage in densely populated cities where land is scarce and expensive.

Living coastal defence

Hard flood defences are nowadays also often combined with natural buffers, like tidal salt marshes and swamps. These living barriers drain the power out of the waves before they reach the high dikes. Moreover, the area gains a valuable nature reserve, which people can use for recreation. Mindert de Vries from the independent research institute for Delta Technology

flood defences





An example of the potential of Green Adaptation by Building with Nature for the Mississippi delta. Restoration of marshes could enhance the protection against storm surges and enhance the vitality of the local ecosystem. A comparable case in the Netherlands indicates that construction of a wave reducing marshland forest in front of a dike could be a safe, multifunctional and cost-effective solution.

Deltares is involved in a number of these 'eco-engineering' projects in America and Singapore. "The idea of building in cooperation with nature has been around for some time, but working with living organisms is quite new for the hydraulic engineer." Recently his company did a feasibility study for Louisiana, looking at restoring the swamplands that had been destroyed by hurricane Katrina. "That would protect the area against new storm surges as well as delivering 40 hectares of new nature reserve", De Vries said. The main challenge was to find inexpensive ways to create a dense swamp in a short time frame. They succeeded in the end, and Deltares is now waiting for the green light from all parties so they can get on with the project.

Mangroves and coral reefs

Deltares is also involved with Dutch engineering companies, such as DHV and Arcadis, in a study to improve coastal protection in Singapore. This doesn't involve setting up tidal salt marshes or swamps; instead, they're considering planting tropical vegetation like mangroves and sea grasses. They are also looking at constructing artificial reefs where coral can attach itself. The main thrust of the research involves the environmental conditions under which these tropical plants and animals flourish best. In this way the scientists hope to discover how these ecosystems can be used deliberately as natural coastal protection. Deltares is mainly involved in actual experiments with these natural embankments. "We're doing a lot of field tests right now", says De Vries. The project is being conducted in close association with local government and universities in the region, both of which are interested in this new type of coastal protection, which should deliver solutions that are both more climate friendly and space saving. This is why the Government is paying a large portion of the research costs.

Liberate the river from its straitjacket

Room for the river

Many experts now agree that it is far better in many cases to give water more room and 'liberate the rivers from their straitjackets'. This increases their resilience and their ability to cope with extreme flows. Solutions like this can even deliver building opportunities in urban areas. In the Dutch city of Nijmegen, for example, the city managers and several businesses have put together a plan to widen the bed of the River Waal by building a river park right in the city's centre. This will involve relocating the northern flood defence 350 metres inland. An extra arm of the river will flow through the new area outside the dike, which means that at high water the level in the Waal can drop by 27 centimetres or more. Marten Hillen, who is working on the plan for engineering company Royal Haskoning, believes the project is unique. As he puts it, "The city is better protected against floods and right in the middle you gain a beautiful nature area, which can be used for housing or leisure pursuits. That will give an enormous boost to Nijmegen." ■

Mindert de Vries
Deltares
T. +31 883358201
mindert.devries@deltares.nl

Marten Hillen
Royal Haskoning
T. +31 104433802
m.hillen@royalhaskoning.com

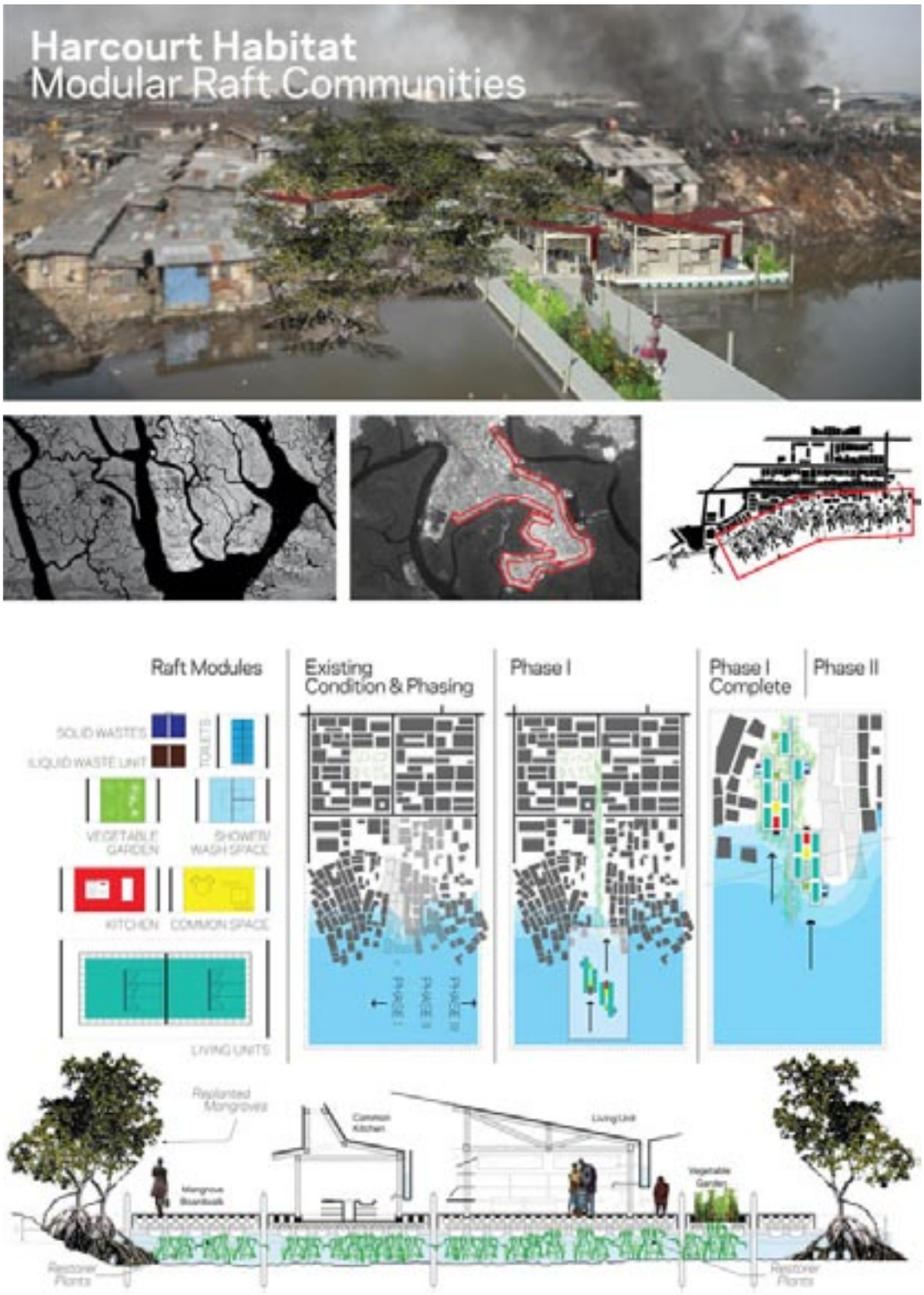
Artist's impression of how the Waal River at Nijmegen will look after relocating the northern flood defence. ILLUSTRATION ROYAL HASKONING

Delta Cities of the Future

The Delta Cities of the Future competition aimed to gather a collection of ideas for delta cities to cope with current and future climate threats. The participants were free to propose ideas in any domain.

Fifty-seven entries were submitted from 19 different countries, and seven ideas were selected for a pressure cooker session in Rotterdam. The jury selected the team of David Garcia as the winner with their idea of Modular Raft Communities for the waterfront of Port Harcourt in Nigeria, a rapidly expanding urban area which casts a heavy burden on the ecology of the delta.

The team designed a system of adaptable, floating modular platforms supported by reused oil barrels that integrate the social and ecological functions of the cityscape into the wetlands ecosystem. In addition to modules for housing, cooking and bathrooms, there are floating gardens which employ bioremedial technology consisting of specifically-chosen aquatic and semi-aquatic plants to absorb heavy metals and toxins. A particular quality of the idea is that floating platforms are immediately inhabitable and modularity allows for communities and extended families to remain intact. ■



More information: www.unesco-ihe.org/delta-cities-of-the-future

SLURRY WALLS, INFILTRATION WELLS AND BRACKISH WATER

Combating salinity

Climate change, salinization and freshwater scarcity are significant threats to Delta areas around the world. A variety of concepts are being developed and pilot projects implemented to deal with water shortages. "Do not ignore the fact that this is happening," says Professor Gerard Galloway, a researcher at the University of Maryland, USA. "You have to be ahead of the game."

MICHEL VERSCHOOR

Bangladeshi village people collect drinking water from a pond at Perikhali, Bagerhat, Bangladesh. Thousands of people from 50 villages collect drinking water from this pond as the rest of the ponds are full of saline water. In the southern part of the country salinity is increasing daily due to climate change, and drinking water is becoming scarce.

HAYWARD BAKER, GEOPENTECH AND PSOMAS (HGP)

Southern California: a Trench Remixing and Deep wall (TRD) machine digs a trench and uses a mix of in-place soils and additives to create a barrier wall. This will then be tested for its effectiveness in preventing salt water intrusion.

ANP/ABIR ABDULLAH

California

Addressing salinization for the benefit of future generations

Salinization is not a new problem in coastal regions around the world. “In California it is a challenge that we have faced for over half a century”, says Professor Gerard Galloway. “California is a relatively arid region where we have been pumping groundwater for irrigation and municipal use. Extracting the water has lowered the water table, resulting in intrusion of salt water from the ocean. Policy makers have been taking steps to deal with the problem for over 60 years.” The initial measures adopted were to inject fresh water along the coastline to prevent intrusion of salt water. The fresh water was taken from the state’s interior and was transported by pipelines to the coastal regions, countering the pressure from the ocean onto the groundwater. There was a problem, though: “We were using fresh water, and fresh water is now scarcer than ever. Over time Californians started to recycle water. Nowadays we are looking at the use of impervious slurry walls, with which we fill up very narrow trenches. That keeps salt and brackish water out.”

Impervious slurry walls

The problem of salinization in California will become even more severe in the years ahead, according to Galloway. “The challenge is to plan for the future. We have to carefully evaluate the consequences of sea-level rise, future alternatives and scenarios, and then take the best steps possible. Political support is essential. Local and regional governments should not ignore the fact that this is happening; they should be prepared for it by planning adequately, and then take the proper steps in an intelligent programme and in a reasonable time frame.” According to Galloway there is no one solution: “California can start protecting its fresh water with slurry walls, or by bringing more water in from other areas. At the same time some of the losses could be compensated for by reducing demand. We need multiple approaches and have to be ahead of the game. We cannot wait till it is there but need to start addressing these problems now”.

In the middle of a salt water flood, fresh water is pumped up deep from under protective clay strata.

Bangladesh

Responding to impending sea-level rise and increased flooding

Countries respond in different ways to salinization. In some, such as Bangladesh, salinization has always been part of the natural cycle, so farmers and others have learned to live with it. But now that droughts are more intense and last longer, and saltwater intrusion has become irreversible, the resilience of one of the world's most densely populated and poorest countries has come to an end. The coastline of Bangladesh in the Bay of Bengal is 575 kilometres long, and most of the 156 million inhabitants live in the delta of the Ganges and Brahmaputra Rivers. Their waters flow into the delta from opposite directions. While the land is very fertile thanks to the sediment deposits, it is also very vulnerable to flooding. Tornados and storm surges hit the country almost every year. Nearly half of the population lives below the poverty line and has very little ability to bounce back.

Dr Kazi Matin Ahmed works with Dhaka University's Department of Geology: "Ten million Bangladeshis have limited access to fresh water. They depend on groundwater, but in coastal regions it is becoming more saline as sea water penetrates inland more often." In contrast to prosperous nations like the US, Bangladesh has minimal research funds available. "We do not know what the impact of climate change will be and urgently need our own data to prepare for the future", says Ahmed. "If the predictions are right, we are facing sea-level rise and more frequent storms. If the Himalayas do not deposit enough sediment in our delta, land formation will not be strong enough. Current long-term forecasts suggest that our rivers will receive less meltwater from the Himalayan glaciers, and a rising sea level will make our water brackish and saline. With the help of international funds we are looking for innovative solutions. Without this aid we can hardly manage the challenge ourselves, since adapting to climate change is unaffordable. We are an innovative and optimistic people, though, and I am sure we will survive."

Infiltrating wells

Dr Koos Groen, a Dutch senior hydrologist with Acacia Water, is involved in an innovative project in Bangladesh. "North of the Khulna district, fresh water is only available during the monsoon season", says Groen. "We have started to infiltrate wells with monsoon water, so there's also fresh water in the dry season. If salt water floods the land, people with drinking water wells also suffer. UNICEF is funding small-scale pumps, which we use to pump fresh water into aquifers under deep clay strata, where salt water does not penetrate, so they can extract it when needed. We have five pilot projects running at the moment. UNICEF is considering using the technology on a wider scale. It's not just useful in the tropics, by the way. It might even provide a solution in Holland, for the market gardeners in the west, whose crops are suffering from saline seepage."

HH/NICO VAN KAPPEL

The Netherlands

Adapting to brackish water

Water managers in delta regions can choose between two strategies to combat salinization and freshwater scarcity: use technical measures, or accept them in part, while trying to find a new balance with nature. Dutch policy makers are taking the best from both approaches. According to Alphons van Winden, a consultant at Bureau Stroming, the Netherlands is adopting a more open attitude towards sea water. Van Winden: "This is inevitable as the prospect of rising sea levels looms ever larger. As the sea comes further inland at high tide, it becomes increasingly difficult to discharge water during rainy periods." Local authorities and water boards are generally worried about salt water, rivers flooding and drinking water shortages in times of drought. Van Winden thinks the coastal region of the Netherlands will just have to get used to the new situation: "We need to learn to deal with subtle transitions between fresh and salt water. In the near future we will see the sea gradually flowing in and the rivers pushed back. At the moment saltwater-freshwater transitions are quite abrupt due to storm surge barriers, but the more we let nature take over, the more subtle these will become." As far as drinking and irrigation water supplies are concerned, Van Winden states that there is in fact no water shortage in Holland. "The problem is that we do not store enough and that we distribute our water inefficiently." Dutch visionaries foresee the future development of a sufficient number of freshwater buffers inland and new agricultural activity in marshland areas, with salt-tolerant crops like salicornia and perennial goosefoot. ■

Gerald Galloway, Professor of Engineering, University of Maryland, USA
T. +1 3014051341
gegallo@umd.edu

Dr Kazi Matin Uddin Ahmed, Department of Geology, Dhaka University, Bangladesh
T. +880 171846840
kmahmed@univdhaka.edu

Dr Koos Groen, Acacia Water, the Netherlands
T. +31 182686424
E. Koos.groen@acaciawater.com

Alphons van Winden, Bureau Stroming, consultancy firm for nature and landscape development
T. +31 243512152
alwinden@stroming.nl

SARMIN SULTANA – DHAKA UNIVERSITY

'Koudekerkse Inlaat' in the Dutch province Zeeland in September with red glasswort and edible sea aster.

COMPUTER MODELS ARE BEING LINKED TO SOCIAL PROCESSES AND SOCIAL MEDIA

Climate management: it's a serious game

If you link up computer models, you learn how processes interrelate. That's how we can now show how physical measures and social support influence each other. Or, to go even further, how to manage disasters using Facebook.

BRAM VERMEER

Flooding app for Jakarta

Floods are practically a daily occurrence in Jakarta. There is a major disaster roughly once every five years, but the rivers that flow into the city from the Puncak burst their banks far more often than that. Heavy rainfall also regularly makes the roads impassable.

Jakarta is one of the world's biggest cities. It's a difficult place to grasp fully. For that reason, work is now being done on a project called 'Flood Control Dashboard Jakarta'. The aim is to develop a smart phone application (app) that lets everybody see at a glance which areas are flooded and what the forecasts are. The system combines observations from measuring networks in the region. A number of significant areas on the map remain blank, though, even after these sources have been linked up. The official

The game shows how the water system and the public interact

measurement data often fail to spot local rainstorms and closed-off roads for some time. This problem is solved by linking social media with the meteorological data. One Indonesian in ten has a Facebook account. The public can report local flooding via their Facebook account, thus sharing the information directly with other users. The people themselves can indicate how deep the water is, and even post a photo. There are still a few technical hurdles, but when the system goes into operation Jakarta's residents will no longer have to depend on official warnings and decisions. They'll get their own detailed picture of the floods.

Serious game

Interactive applications simulate complex situations with many variables and complex interactions. These serious games, as they are called, have become possible thanks to the high speed of model computations, coupled with the accurate visualization of the results. This means that simulators can be built, like the ones the army and air force have been using for some time.

Waas City (Waasstad) is one of the serious games that have been developed in recent years for water management (see box). Ten players are divided into a number of groups which have to make compromises, recruit public support, and take appropriate measures. The players see immediately how their decisions work out. They see how the river changes; they get to know how the population responds to events inside and outside the Waas region, and how the public's support for the measures develops. The river management game takes place over one century.

The social and physical developments in the region are computed in a simulation model that contains physical elements, such as climate change, river drainage, and the probability of flooding. The computer also shows the public's response to disasters and such measures as are taken (or not), as well as changes in public support.

The game and its supporting model was developed by Marjolijn Haasnoot and Astrid Offermans in collaboration with Deltares, the universities of Maastricht, Utrecht and Twente, Carthago consultancy, Pantopticon and the Royal Dutch Meteorological Institute. It is very instructive for the players to learn how their own standpoints often hold for only a short period of time. The game shows them how the water system and the public interact. It sensitizes them to the paths along which solutions might diverge, rather than focusing on some desired end result. For the scientists it is important to gain an insight into the way administrators and the public respond. This allows them to develop more realistic scenarios into which they can integrate the social and physical systems that surround a river.
One idea, for example, is that the Demonstrator Flood Control Room, which Deltares has been developing since 2009, can also be used for serious games. This brings together in one control room all the measurements and predictions from a number of systems, which allows training to be given on high tides, floods, evacuation and crisis management. Simulators like this usually contain mainly physical scenarios, but the Waas region model shows that social processes can also be built into this sort of simulator. ■

Marjolijn Haasnoot
Senior Researcher, Deltares
T. +31 883358175
marjolijn.haasnoot@deltares.nl

Dashboard Jakarta:
Jurjen Wagemaker
HKV Consultants,
T. +62 81389263705
wagemaker@hkv.nl

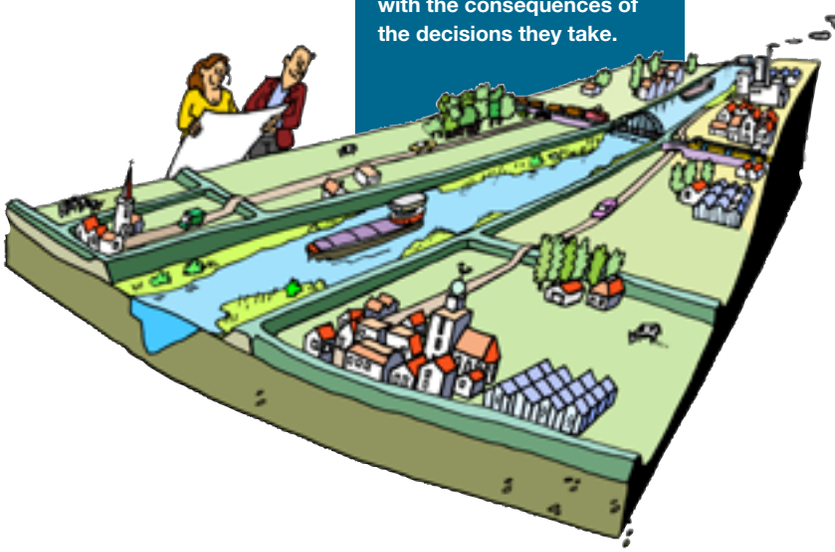
FC2015 Dashboard Jakarta

The 'FC2015 Dashboard Jakarta' is an initiative of HKV Consultants, Haskoning, Fugro en Deltares in association with the Indonesian Ministry of Public Works, the Province of Jakarta and the Jakarta Red Cross. The project is being conducted under the Flood Control 2015 innovation programme.

Waas City is under threat

The dikes channel the Waas River into a narrow space. The area has recently suffered two major floods, resulting in damage estimated at millions of euros. To make matters worse, the water level is often too shallow for shipping. The new administrators of the Waas region are assigned the task of improving the water management.

The Waas does not actually exist, but the situation around Waas City is very realistic. The administrators in the game are confronted with the consequences of the decisions they take.



HEAT, DROUGHT AND FLOODING PRESENT NEW CHALLENGES FOR THE BUILDING INDUSTRY

Required: climate-proof buildings

The building industry is expected to take the consequences of climate change into account. It has already developed energy-efficient houses and offices, but how does one cope with higher temperatures, drought and flooding? A vanguard of architects and developers is showing the way.

JACO BOER

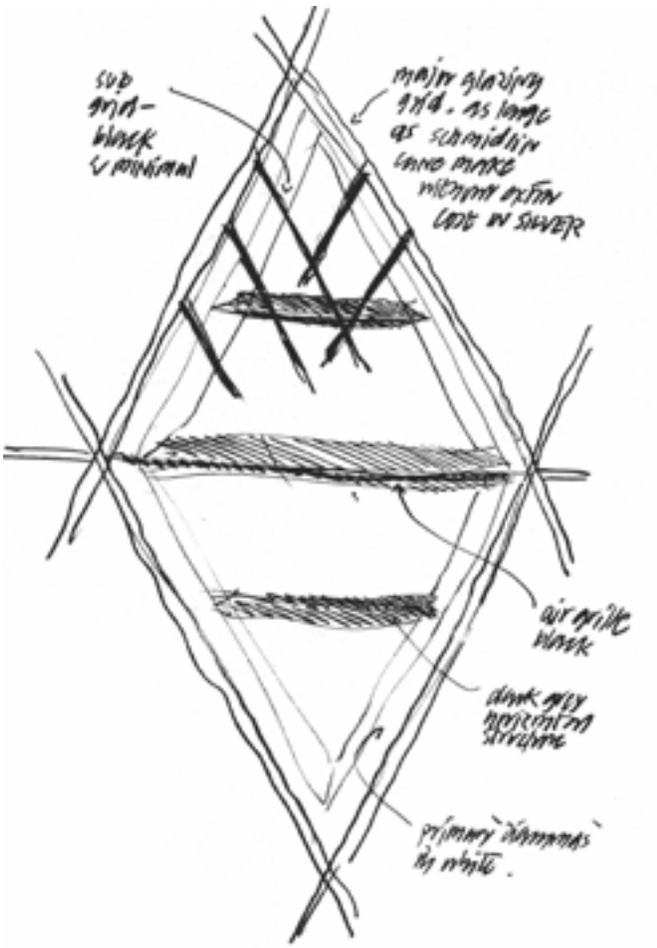
Climate change is presenting construction companies and project developers with a new challenge. How to build houses and offices which not only use less energy and water, but are also climate proof? According to the IPCC, we will be more often faced with hot dry periods as well as spells of high precipitation in the coming decades. As a result, architects will have to design buildings and neighbourhoods that take into consideration extra high temperatures, and periods of drought and flooding.

"The building sector has already come up with several solutions for making buildings more energy and water-efficient. But there is still too little attention paid to climate adaptation", says Andy van den Dobbelsteen, professor of Climate Design and Sustainability at Delft University of Technology. The problem of higher temperatures in particular is an aspect that is not getting enough attention, in his view. But actually there are already simple ways of making buildings cooler and more comfortable without having to use energy-devouring air-conditioners. "The traditional architecture of Mediterranean countries demonstrates this."

HH / DOROTHEA SCHMID

◀ Water plazas and green façades

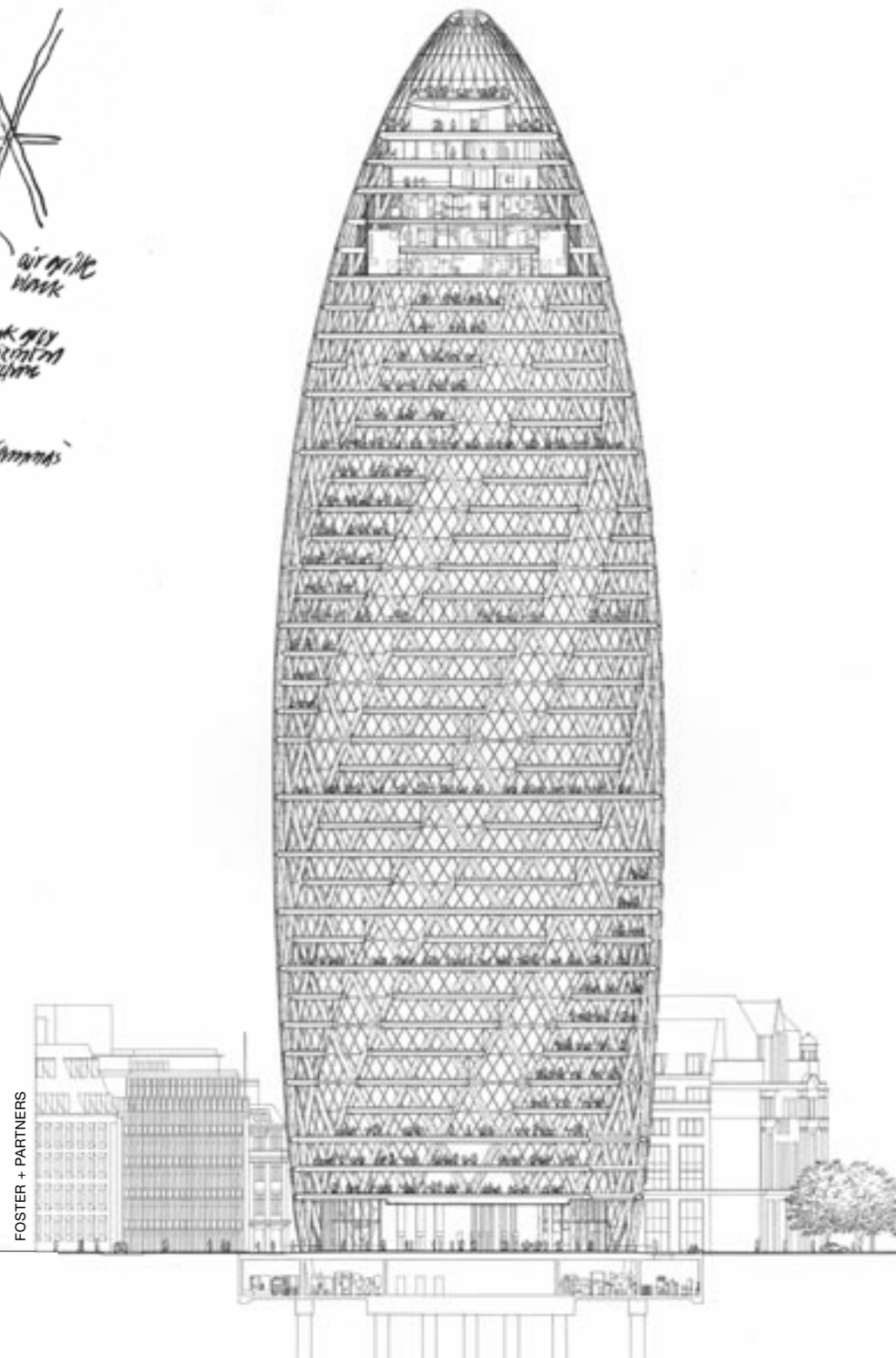
It seems paradoxical but, apart from having to take water shortages into account, builders will also have to consider the risk of flooding. Delta cities, in particular, are vulnerable. Rivers no longer just discharge more water but are also affected by rising sea levels. More and heavier rain showers are expected. Because of this a number of cities, in cooperation with architects, are actively involved in the search for smart options for water storage which do not take up too much space. For example, in Rotterdam, a new public parking garage has been opened with beneath it a reservoir with a 10-million-litre capacity. De Urbanisten, a recently established urban development office, has designed a multi-functional 'water plaza', which combines water storage with a children's playground area in rainy periods. Construction should begin next year.
By planting greenery on facades and roofs, and in gardens, excess rainwater can be retained for a longer period, which prevents flooding of drains. In Berne, the Swiss capital, houses in the district of Halen were already bedecked with plants and linked together by overhanging plants 30 years ago. In the meantime, all over the world, 'greened' buildings can be found, spectacular highlights being the Musée du Quai Branly in Paris and the 'drive through' roof-top showroom of Subaru in Singapore.



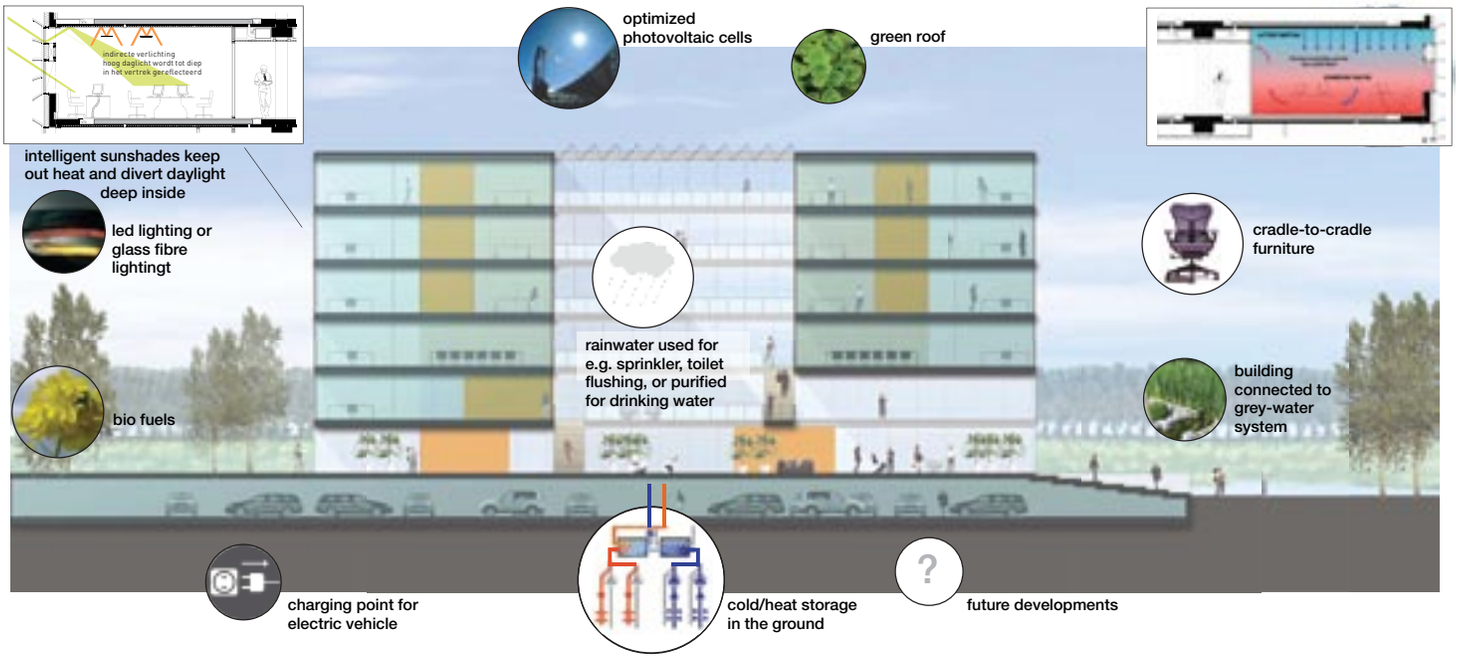
There are already simple ways to construct cooler and more comfortable buildings

Natural ventilation ▶

The urbanization of AlmaVerde on the Portuguese Algarve is an example of how the British architect, Jes Mainwaring, was inspired by old Moorish principles of design. The houses were fitted with sloping (cooler) roofs, white reflecting façades and particular attention was paid to the insulation of windows, exterior walls and roofs. In addition, an ingenious system of underground PVC pipes through which air is blown allows the villas to be cooled in a natural way in summer. Internationally renowned Norman Foster has also experimented with natural cooling and ventilation systems in recent years. He designed a spiral-shaped tower for the offices of SwissRe in London in which warm air climbs upward through a hollow glass frontage, providing passive cooling in summer and passive heating in winter. In Madrid, a few years later, he built a skyscraper in which the two supporting columns were situated in such a way that the workspaces were shielded from direct sunlight. This method resulted in substantial savings on cooling costs.



FOSTER + PARTNERS



▲ Dealing with drought

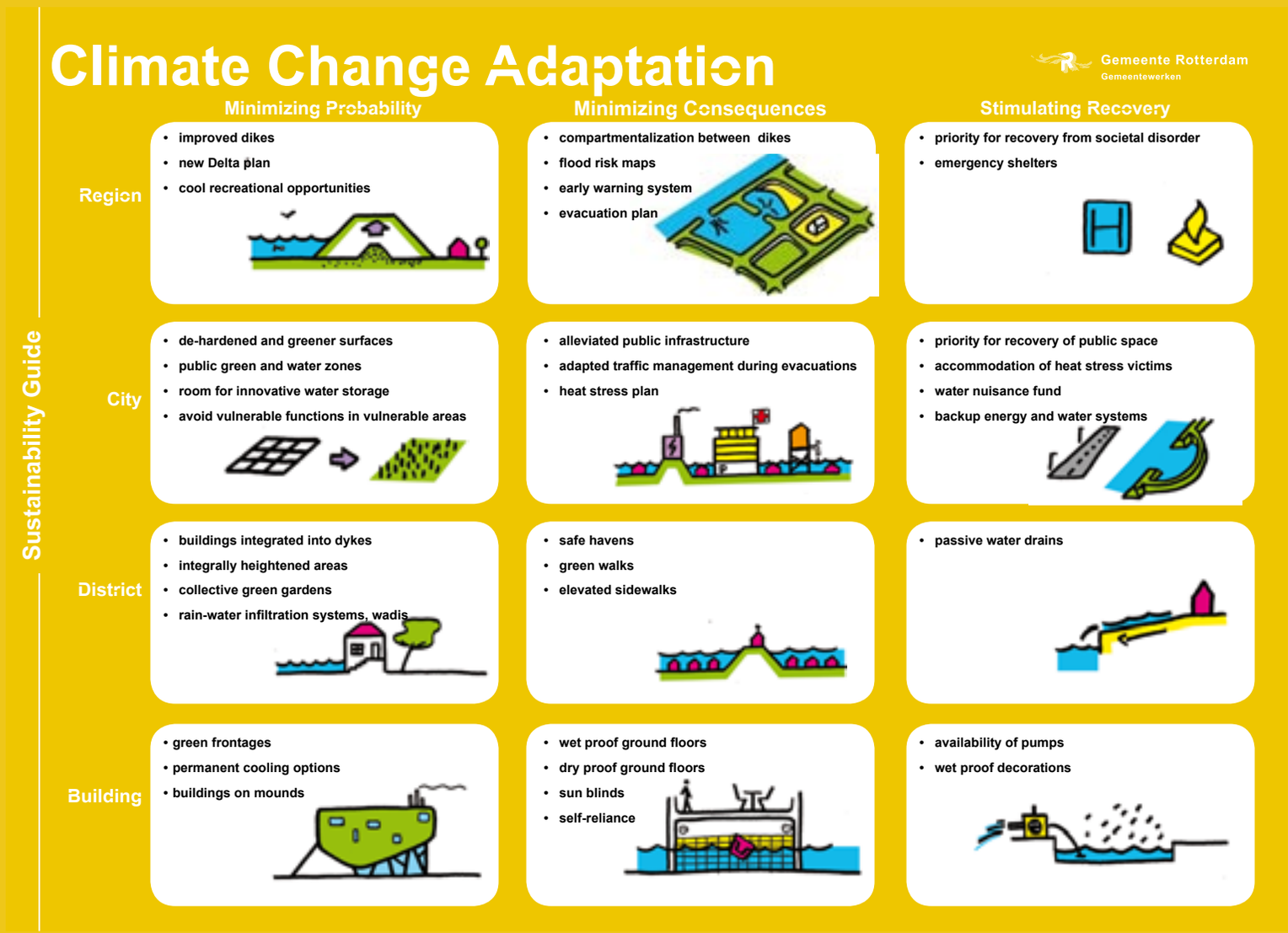
Cities are not only facing higher temperatures; drought is becoming an increasing problem too. Fortunately, more and more builders are installing water-saving taps and showers in offices and homes as a matter of course. Grey-water systems, whereby rainwater is recycled for flushing toilets, and for sprinkling gardens and flower boxes, are becoming more popular. These systems were mainly installed in dwellings in the past few decades. But recently, in Japan, a double waterworks system was installed in an indoor stadium with a seating capacity of 50,000. Rainwater was channelled from the roof to a reservoir with a storage capacity of 3 million litres, located under the stands. Close to Amsterdam, the innovative developer OVG is building a new climate-neutral head office for TNT, the international mail company, which will also be fitted with a grey-water system.

Prof Andy van den Dobbelsteen
Climate Design and Sustainability
Delft University of Technology
T. +31 152783563
a.a.j.f.vandendobbelsteen@tudelft.nl

▼ Water-resistant buildings

If the worst happens and a city is flooded, the important thing is to keep the damage to a minimum. By raising the height of door thresholds and banning crawl spaces, builders can avoid a lot of trouble. It also helps us to point out to residents that they should not lay parquet on ground floors. One step further is to lift up the home and let it float. Only then will you be completely immune from fluctuations in water levels. Developers all over the world are experimenting with ways of constructing floating villas. In Canada they have even laid a highway on water and, in the Netherlands, a nursery is growing tomatoes in a floating greenhouse. Developers could gain further inspiration from the floating villages in many Asian countries. Who will be the first to build a modern version of the Vietnamese sampan?

DURA VERMEER



Rotterdam Sustainability Guide

An excerpt from the Rotterdam Sustainability Guide. Planners use it to incorporate sustainability in their design process. The guide is intended to stimulate creativity, provide practical solutions and create a common framework. The left-hand column shows a traditional resistance approach. The middle and right-hand columns of the adaptation scheme provide examples of measures that increase resilience and innovative solutions generated in a case study.

Wim de Jager
City of Rotterdam
T. +31 104893331
wfj.dejager@gw.rotterdam.nl

ROTTERDAM, LOUISIANA AND TATABÁNYA GET CITIZENS INVOLVED IN CLIMATE ADAPTATION

Listening to stakeholders pays!

In the coming years cities will have to take radical decisions to protect their businesses and citizens from the consequences of global warming. This will not be achieved unless they get their inhabitants and local organizations involved. The US State of Louisiana, Tatabánya in Hungary and the Dutch port metropolis of Rotterdam demonstrate how the involvement of stakeholders can be of value.

JACO BOER


BOSCH SLABBERS


BOSCH SLABBERS

Communities are rebuilt after the devastation of Hurricane Katrina.

In the US State of Louisiana, the inhabitants are closely involved in projects that reflect on the future of the Mississippi delta. "The diking of the Mississipi, oil and gas exploration, hurricanes and storm damage over the years have been causing large areas of the delta to disappear. The delta is no longer fed with new sediment and is slowly sinking away. This is causing the swamps, the natural defence against this annually recurring natural disaster, to disappear ", says Steven Slabbers of Bosch Slabbers Landscape + Urban Design, who is involved in various projects in Louisiana.

In the meantime, at a regional level, a coastal protection plan has been set up and, in the immediate surroundings of New Orleans, work is being carried out on the reinforcement and renewal of the existing defence systems. For the settlements outside New Orleans, Bosch Slabbers is currently working on a best practices manual, together with partners from Portland and Louisiana. In close cooperation with the local population, defence concepts are being developed in such a way as to

Government badly needs the input of stakeholders

ensure the safety of village communities and towns. " Apart from this we are working hard to think up new ideas for restoring delta formation so that sediment will again be deposited. What comes to mind is river tributaries, and swamp regeneration in combination with new living environments. Our planning is helping restore ecosystems, creating a safer and more attractive living environment and consequently an economic perspective."

Local warning systems

In the Hungarian city of Tatabánya – about 50 kilometres to the west of Budapest – the involvement of the inhabitants goes a step further. Encouraged by the City Council and under the supervision of researchers from the Hungarian Academy of Sciences, local organizations and citizens wrote a far-reaching plan to tackle climate change at a local level and to prepare the city for more extreme weather conditions. Apart from various measures to limit the emission of greenhouse gases and to stimulate environment-friendly transport, the climate group, together with the most important care organizations, conceived a warning system for high temperatures and UV radiation for Tatabánya. In an accompanying report, the group also stated in detail which measures local government and institutions were expected to take to limit the effects of a heat wave and exposure to an overdose of UV radiation.

The City Council was so impressed by what they had done that it decided to adopt the recommendations of the climate group and to implement the warning system. In addition, this remarkable citizens' initiative meant that Tatabánya was awarded a prize for the best health and climate initiative by the European Regional and Local Health Authorities and the Health and Environment Alliance. Barbara Botos, strategic & environmental manager for the council, is extremely proud of this achievement by her citizens. "Thanks to their efforts, we were the first municipality in Hungary with a local climate programme. Since then, our plan has been adopted by at least a dozen other municipalities and we have established a national alliance of climate-friendly cities with four other cities. Our educational programme on the subject of safe sun-bathing is even used by schools throughout the country."

Support for drastic measures

In the coming decades Rotterdam and its surrounding area will be faced with major challenges. As a result of climate change, the Dutch port will have to contend with the rising sea level and higher peak water discharge from the Rhine and Meuse rivers. If nothing is done, the likelihood of flooding will increase. In 2008 the Rotterdam Climate Proof Programme was initiated, to determine what Rotterdam can do to protect its businesses and citizens from this. This year the Delta programme 'Rijnmond Drechtsteden' – a regional branch of the national Delta programme – has been affiliated. Obvious solutions, such as closing the harbour entrance or increasing the height of the dikes, have major consequences for the densely built-up metropolis with its easily accessible harbour. In its search for the best approach, the city is happy to call upon the creativity and expertise of knowledge centres and stakeholders.

Along the River Meuse, buildings are not much higher than the high water level. As water levels continue to rise, the chance of flooding increases. PHOTO PETER HILZ

After two listening and brainstorming sessions, the next meeting focused on four possible solutions. There are several options available to guarantee water safety and fresh water. Each of these options has an effect on spatial planning and the different functions in the city: closeable barriers on all sides of the city, only one barrier on the seaside (as is currently the situation), a completely open situation or a closed system with dams and sluices. The options and the consequences have been mapped and discussed with different stakeholders. Local government needs their input to come up with an acceptable approach to flood management. This way the city hopes to create a greater involvement in the decisions which will soon have to be taken to safeguard the city from higher water levels. ■

Steven Slabbers,
Director Bosch Slabbers Landscape + Urban Design
T. +31 703554407
s.slabbers@bosch-slabbers.nl

Barbara Botos
Strategic and Environmental Manager
City of Tatabánya
T. +36 34515700/370
kornyezet@tatabanya.hu

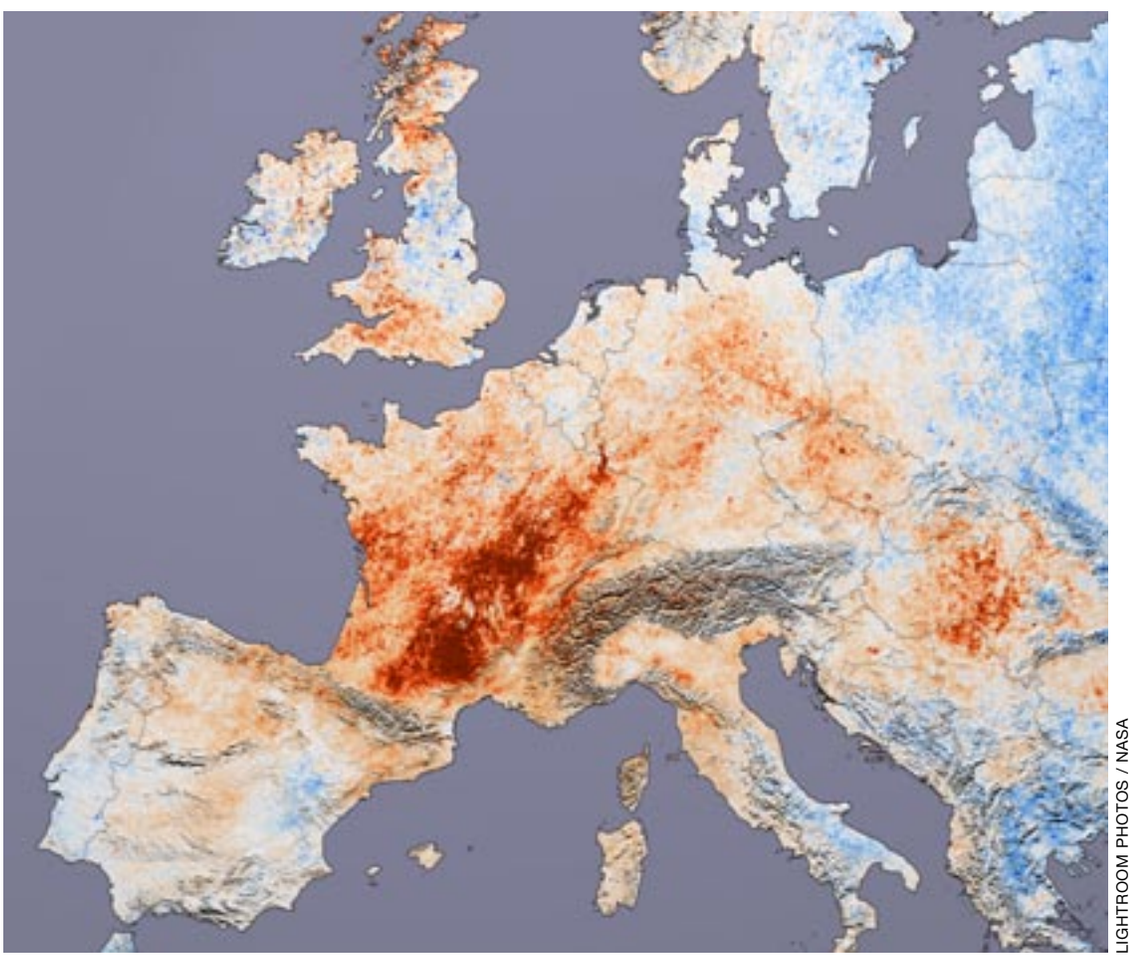
Corjan Gebraad
Senior Consultant Climate Programme Agency
City of Rotterdam
T. +31 102673883
c.gebraad@bsd.rotterdam.nl

HEAT STRESS, WATER QUALITY AND INFECTIOUS DISEASES

Climate change and public health

Many scientists are convinced that the effects of climate change on public health are substantial. Higher temperatures and heavier rainfall can cause more heat stress, waterborne infections and lethal infectious diseases. Nevertheless, more research is needed to draw clear-cut conclusions and tackle the problems.

JACO BOER



This image shows the differences in day time land surface temperatures collected by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite. A blanket of deep red across southern and eastern France shows where temperatures were 10 °C hotter in 2003 than in 2001.

LIGHTROOM PHOTOS / NASA

The summer of 2003 is engraved in the memories of European scientists doing research into the effects of climate change on public health. The continuous heat caused enormous problems for the elderly as well as for people suffering from cardiovascular and respiratory diseases. Political commotion arose in France when it turned out that almost 15,000 more people had died as a consequence of the heat wave. In hindsight, public opinion claimed that politicians should have intervened. The mortality rates during the heat wave were also much higher than usual in other countries, such as the Netherlands and Germany. Not only do mortality rates rise during a heat wave. More people are admitted to hospital, physical discomfort increases – particularly among the elderly – and more people take sick leave from work.

Too little attention

In large parts of the world, heat stress is one of the most obvious effects that climate change can have on our health, according to scientists. Particularly in cities, vulnerable groups may suffer from dehydration, or respiratory problems caused by summer smog. However, a warmer climate also has its advantages. Mortality rates decrease when winters are milder. The exact effects of climate change on our health are less straightforward than we might think. "We simply still know too little on this subject. Governments and health institutions often pay little attention to this subject", says Pim Martens, co-editor-in-chief of the international EcoHealth Journal, and Scientific Director of the International Centre for Integrated Assessment and Sustainable Development (ICIS) at the University of Maastricht.

Increase in exotic viruses

Higher temperatures and more hours of sunshine can cause not only heat stress but also the outbreak of certain pathogens in ponds and lakes. The researchers of the Federal Institute of Hydrology in the German city of Koblenz are concerned about the increase in micro-organisms, such as vibrio vulnificus, in warm seawater and rivers. This bacteria can cause serious infections to small superficial skin wounds, which can be sometimes fatal.

With warmer summers and milder winters the incidence of certain infectious diseases transmitted by insects might increase. The survival probability of those disease carriers is increasing and they can remain active for longer periods. In north-west Europe, for example, the rapid increase in the incidence of Lyme disease is associated with climate change. Although other aspects, such as changes in the landscape or recreational behaviour, can also play a role. Moreover, the habitats of all kinds of insects are shifting as a result of changes in temperature or rainfall. As a result, countries will be faced with diseases that otherwise only occurred in hotter or wetter regions. The number of Asian tiger mosquitoes in Italy is increasing and has already sparked local outbreaks of the Chikungunya virus, which can cause infections in arm and leg joints that last for months. Of the 200 individuals who were infected in 2007, one person died. In Portugal researchers are even worried about a possible outbreak of yellow fever.

Almost 15,000 more people died following a heat wave in France in 2003

Africa and Asia more vulnerable

The problems of the developed countries, however, are nothing compared to the concerns that scientists from Asia and Africa have about the rapid increase in fatal infectious diseases such as cholera and malaria.

Dr Andrew Githeko of the Kenya Medical Research Institute sees that each of the African deltas has its unique health profile. "For example deltas in Mozambique have a history of malaria, cholera, typhoid plague and leptospirosis outbreaks after severe flooding events. The Niger delta's main health problem is lack of safe drinking water. Much of the water has been contaminated by oil drilling. The Nile Delta has seen an increase in filariasis as mosquito breeding grounds have grown. Schistosomiasis is the main parasitic disease in Egypt, while outbreaks of West Nile virus are expected to increase. All these health conditions are related to water. Increased flooding due to climate change will in one way or the other increase the impact of these diseases on the densely populated deltas."

Ali Shafqat Akanda of Tufts University in Medford, USA, has done a lot of research into the spread of cholera in Bangladesh. Two peaks in outbreaks of cholera that strongly influence one another can be observed in that country. During the dry season, the influx of seawater in the delta creates ideal conditions for the disease-carrying bacteria while, during the wet season, floods spread the micro-organisms across an even larger area. "A growing number of scientists have indicated that we will be facing more frequent and more intensive floods and droughts. This might extend the rainy season during which cholera is spread and increase the occurrence of new species of bacteria."

Better health care and clean water

The threat of cholera can be tackled to a certain extent. "It might be possible to cut back the spread of the disease during the dry and wet season if the freshwater supply from the rivers in the hinterland can be increased during the dry season", Akanda argues. Better health care and clean drinking water will, of course, also help fight this fatal disease. Some scientists have even suggested that climate change might encourage rich countries to earmark extra money for better amenities in the poorer countries. Akanda supports this view. In addition, it is essential to better understand the complex relationship between climate variables and health problems. He agrees with his colleague Martens: "We simply still know too little about this." ■

Dr Andrew K. Githeko,
Centre for Global Health Research
Kenya Medical Research Institute
T. +254 722849382
githeko@yahoo.com

Prof Pim Martens
ICIS University of Maastricht
T. +31 433883555
p.martens@maastrichtuniversity.nl

Ali Shafqat Akanda
Tufts University Medford USA
shafqat.akanda@gmail.com

SPENCER T. TUCKER

Mayor Bloomberg delivers a speech accepting his role as chair of the C40 on 21 September 2010.

NEW YORK CITY OFFICIALS COLOUR THE BIG APPLE GREEN WITH INNOVATIVE POLICIES

Climate change places new demands on policy makers

How can you frame policies on such an uncertain subject as climate change? This is the big question that confronts policy makers in the 21st century. Cities often turn out to be surprisingly flexible and innovative in their approach. New York City is a good example.

BY MAARTJE SMEETS

It was not without reason that New York City Mayor Michael. R. Bloomberg was elected in late September 2010 as the new chairman of the C40. This is a network in which 40 major cities are combining their energies and knowledge to lower their CO_2 emissions and adapt to the consequences of climate change (see box).

New York City leads the way in adaptation and mitigation. "While global warming clearly requires action at the national and international levels", Bloomberg said when accepting his role as chair of the C40, "those of us in city government have a responsibility to act boldly and quickly to address these problems. No one has a monopoly on good ideas, and the C40 cities, by working with one another on innovative carbon reduction strategies, have an opportunity to show the world what is possible."

GREENFORALL

New York's Green Infrastructure

Examples of green infrastructure projects include blue roofs and green roofs, which use mechanical devices or vegetation to prevent roof water from draining too quickly; porous pavement on parking lots, which allows water to seep through; tree pits and street-side swales for roadways, which allow water to pool in underground holding areas; wetlands and swales in parks; and rain barrels in some residential areas.

It saves taxes

In 2007 New York launched the long-term *PlaNYC*, which has already led to a 9% reduction in CO_2 emission. New York City has great ambitions in the field of water management, too. In late September 2010 it launched its Green Infrastructure Plan, which will improve water management on all fronts in and around the city. Approximately 21 billion USD has been allocated to water system capital projects. Part of the plan is to utilize 'green infrastructure' to improve the quality of waterways around New York City by capturing and retaining storm water so as to reduce sewer overflows. Severe rainfall, which will occur more frequently as the climate changes, often fills the old New York sewer system to capacity, so a mix of storm water and waste water must be discharged into New York Harbor. The new plan will reduce sewer overflows into waterways by 40% by 2030 by capturing more storm water. The plan will reduce the City's long-term sewer management costs by 2.4 billion USD over the next 20 years, helping to hold down future water bills.

Green and grey

Steven Cohen is Executive Director of the Earth Institute at Columbia University. He

is a critical observer of New York's 'green' ambitions. In an open letter to the Huffington Post, Cohen calls the Green Infrastructure Plan a good example of the sort of sustainability management that climate change demands. In his view, sustainability developments require managers to move beyond an understanding of an organization's financial, human and strategic resources. "Managers", Cohen states, "must develop a more sophisticated understanding of their organization's use of resources and their impact on the ecosphere. The move from reliance on 'grey infrastructure' to the combined use of 'green' and 'grey' techniques is an indication of the growth of sustainability management in New York City's government. My hope is this represents the beginning of a trend that will expand as we learn more and as our large institutions adapt creatively to the challenges of growing our economy while preserving our planet."

In times of climate change, major, expensive infrastructure projects like the New York Green Infrastructure Plan demand a new, flexible approach. Over the long term, after all, policy makers are faced with a big, unstable factor – climate – for which plans must be continually modified over the years. Caswell F. Holloway has been appointed by mayor Bloomberg to lead New York's department of environmental Protection. "For the plan to truly succeed, we will need to work in a creative collaboration with our regulators and stakeholders now, and for many years to come. The traditional enforcement dynamic must give way to a partnership model that demands success, but is flexible enough to accommodate change along the way."

Under the current grey infrastructure plan, the City would invest USD 6.8 billion in traditional sewer infrastructure. As an alternative, the NYC Green Infrastructure Plan will invest 2.9 billion USD in grey infrastructure and 2.4 billion USD in green infrastructure – a total of 5.3 billion USD. The funding for the green infrastructure plan includes 900 million USD from new development, bringing the total savings for the City's water customers to 2.4 billion USD. By making the costs and benefits so clear at such an early stage, the city is recruiting support among both the residents and the business community. Actual, concrete projects are also attracting support for the policy. The city has more than 30 demonstration projects to test the performance and costs of green infrastructure over time. A robust monitoring programme is measuring and analyzing the effectiveness of each of these demonstration projects (see box).

By making the costs and benefits so clear at such an early stage, the city is recruiting support among both the residents and the business community

Demonstration projects like these are very important for the C40 network. Simon Reddy is C40's Executive Director. According to him, major metropolitan regions are setting to work practically and creatively to make their policies 'climate proof'. It is national policy that puts a brake on their ambitions and the possibilities open to them. This is why C40 made an urgent appeal to national governments at the climate summit in Copenhagen. Reddy: "Engage with city leaders on climate change action, since so many cities have answers ready to be implemented at a national scale. Empower cities with greater authority over sectors responsible for emissions. And resource them with the finances, or the power to raise funds for these programmes to reach their full potential. How cities can best work with their national governments is something we all need to figure out, and fast. They need to understand that while national governments can set the international targets within Kyoto it will be down to the cities to deliver, because cities are by far the biggest source of greenhouse gases." ■

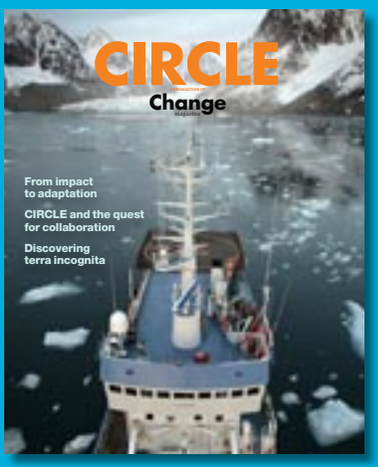
C40

In 2005 Ken Livingstone (former Mayor of London), saw the need for an organization to act as a catalyst for action at city level. Cities consume over two-thirds of the world's energy and account for more than 70% of global CO_2 emissions. The C40 cities and their metropolitan areas are home to 393 million people and involve USD 8 trillion in economic activity; they are responsible for over 2 billion tons of greenhouse gas emissions annually. The following cities are members of C40: Addis Ababa, Athens, Bangkok, Beijing, Berlin, Bogotá, Buenos Aires, Cairo, Caracas, Chicago, Delhi, Dhaka, Hanoi, Hong Kong, Houston, Istanbul, Jakarta, Johannesburg, Karachi, Lagos, Lima, London, Los Angeles, Madrid, Melbourne, Mexico City, Moscow, Mumbai, New York City, Paris, Philadelphia, Rio de Janeiro, Rome, São Paulo, Seoul, Shanghai, Sydney, Toronto, Tokyo and Warsaw. The C40 also has 19 affiliate cities selected for their pro-active or innovative climate policies: Amsterdam, Austin, Barcelona, Basel, Changwon, Copenhagen, Curitiba, Heidelberg, Ho Chi Minh City, Milan, New Orleans, Portland, Rotterdam, Salt Lake City, San Francisco, Santiago de Chile, Seattle, Stockholm and Yokohama.

Change
magazine

Creates access to climate knowledge

- Objective
- Complete
- Reliable
- Accessible
- Profound



For the international market we produce special theme issues in cooperation with various partners. Each issue contains in-depth discussions of innovations, opinions and policy on topics concerning adaptation and mitigation. Does your organization have an important message to share on Climate Change? Our editing board of experienced journalists and graphic designers helps you translate this message into an accessible and attractive magazine.

Change Magazine is published by Synergos Communication, specialists in climate communication

www.changemagazine.nl/english

A leading research institute and specialist consultancy for water, soil and subsurface issues

Throughout the world, more and more people are settling in opportunity-rich, but vulnerable, deltas, coastal areas and river basins. Delta areas have major economic potential because of their strategic location close to the sea and waterways. The ground is fertile and rich in minerals and raw materials. But these low-lying areas are also vulnerable. That vulnerability is being spotlighted because of rising sea levels, extreme river levels, subsiding soft soils, and increasing pressure on space and the environment.

Deltares supplies state-of-the-art consultancy and expertise about water, soil and the subsurface. We are a leader in the development, diffusion and application of knowledge for the sustainable planning and management of vulnerable deltas, coastal areas and river basins.
Our professionals engage in practical research and provide specialist advice – in the Netherlands and throughout the world – for clients who want the latest developments to be implemented in practice. We advise governments and other clients in the search for solutions that are rooted in society as a whole.

Our 150 software products cover the entire spectrum of Deltares' expertise, including coastal waters and estuaries (Delft3D), rivers and urban water management (SOBEK), the design of diaphragm wall structures (MSheet), the stability of flood defences (MStab), an operational flood forecasting system (Delft-FEWS) and groundwater modelling software (iMOD).

We develop knowledge in partnership with universities, other research institutes and the business sector, not only in government research programmes but also in contract research. Deltares has 900 employees, and it is based in Delft and Utrecht.

Deltares

Enabling Delta Life

info@deltares.nl www.deltares.nl