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On sustainable delta development

Delta Urbanism's main ingredient is dialogue. The integration of concepts, ideas, language and measures can only be done through conscious exchange in continuous dialogue. This is not taken lightly, just exchange is not good sufficient, a solid dialogue is conscious and supported by methods that orchestrate steps, information and design.

Therefore a section that presents the dialogue between two professionals is essential to this journal. The exchange is directed through writing and editing, taking time to think responses through and to position them clearly.

This issue represents the dialogue between Bas Jonkman and Henk Ovink who continue the dialogue that they started as keynote speakers at the conference of Delta Urbanism in Times of Climate Crisis in March 2020.

Sustainable coastal adaptation is possible
S. N. (Bas) Jonkman

Around the world, many low lying coastal areas are at significant risk from floods and other hazards. Rising sea levels further necessitate the development, preparation and implementation of coastal adaptation strategies. Coastal adaptation will be costly, drastic and challenging. But is it possible and affordable, particularly for low-lying countries? In this article, it is argued that sustainable coastal adaptation *is* possible, when coastal protection strategies are streamlined with other development ambitions and cleaner construction-methods are found. This will require multidisciplinary collaboration and governmental commitment and investment.

In the Netherlands, 26% of the country is below mean sea level, and 60% is prone to flooding. Most of the che current defence system can already accommodate up to one meter of sea level rise. This should be sufficient until the second half of this century – even in scenarios with higher sea level rise rates. Various studies (Stijnen et al., 2014; Haasnoot et al., 2019; ENW, 2019; Wilmink et al., 2019) have investigated if and where the system would need to be adapted for varying levels of sea level rise – also see *figure 1* for an overview.

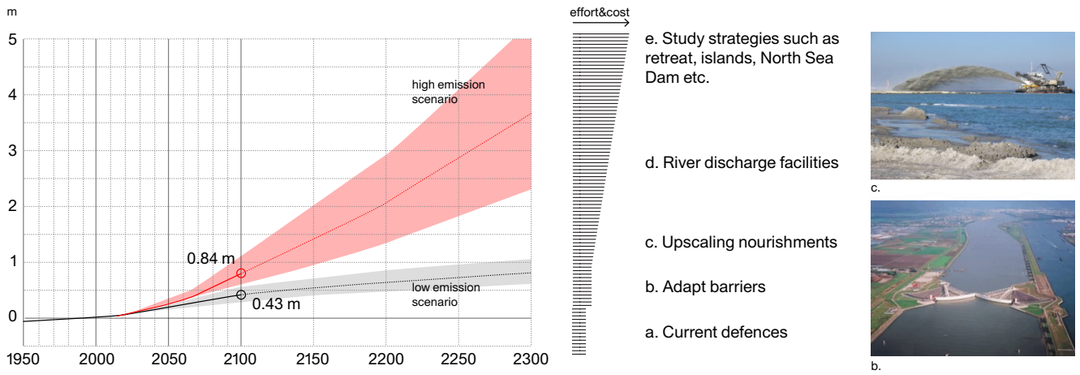

figure 1 Sea level rise projects for the Netherlands (left) and adaptation efforts required (based on ENW, 2019; left figure adapted from NRC 250919/RL, Source: IPCC)

Approaching about 1 meter sea level rise, the first large-scale adaptations would be needed in the Southwestern part of the country, more specifically for the Maeslant and Eastern Scheldt storm surge barriers and their surrounding regions.

Options include removal, upgrading of barriers and the implementation of new open or closed barrier systems. For example, an open Eastern Scheldt estuary with dikes raised around the estuary, or a dam with a shipping lock near Rotterdam. The dam with lock-combination intervention would imply massive changes to logistic and economic functions in the region, and the way water is managed in urban areas, such as Rotterdam and Dordrecht.

For higher values of sea level rise, the nourishment on sandy parts of the coast would have to be scaled up drastically. This seems possible given the vast sand supply that is available in the North Sea. For multiple meters of sea level rise, natural discharging of the main rivers (Rhine, Meuse) to the North Sea becomes problematic, and solutions such as mega-pump stations would have to developed.

Overall, adaptation for two to three meters of sea level rise is expected to come at a high cost – but it should be *technically feasible* (Stijnen et al., 2014, ENW, 2019). Moreover, as such levels of sea level rise are only projected in the 22nd or 23rd century, several decades or more will be available to fund and implement these solutions. In the past, the Dutch have already upgraded their system in a matter of decades. After the 1953 storm surge disaster – which killed more than 1800 people – a new system of storm surge barriers has been constructed, and the sea defences in the South West have nearly doubled in height and footprint since then.

Are these levels of adaptation economically feasible? Current expenditures for flood management in the Netherlands are about one billion Euro per year. In case of accelerated sea level rise, this amount could double (Stijnen et al., 2014). This is, of course, a major investment. But it is still considered affordable compared to the current gross domestic product, which was around800 billion Euros in 2019 and is expected to grow in the longer term future.

Higher values of sea level rise (3 to 5 meters) are projected after the year 2200 in the highest scenarios. Studies are ongoing to develop national strategies (retreat, defend or seaward expansion), and to give more insight in their costs, implications, and possible links with other transitions (Haasnoot et al., 2019). At a higher spatial scale, an international solution is considered in the form of the

Water as catalyst for sustainable development
Henk Ovink

With the world at risk, investing in water inclusively and holistic is our best bet for a sustainable and resilient future. Disasters are layered and interdependent, increasing in their impact not only in terms of damage but also exacerbating our future vulnerability. Practices from the past are replicated massively only to make us more vulnerable tomorrow. In the light of the need for a better - more inclusive, integrated and sustainable – future, the world came together in 2015. Five years ago, we agreed on a comprehensive set of global goals: the Sendai Framework for Disaster Risk Reduction in March, the Addis Ababa Action Agenda on Financing for Development in July, the Sustainable Development Goals in September, the Paris Climate Agreement in December and the New Urban Agenda in October of the next year (2016). A suit of commitments that together form the 2030 Agenda for Sustainable Development. A midterm-plan for the planet and society to overcome our current challenges together and prepare ourselves for a challenging future. And its through leveraging water's values and capacities that we can achieve these goals and use the next years as springboard for a true sustainable future for all.

Water is linked to all these global commitments in many ways, across the full 2030 Agenda. From climate mitigation and adaptation in the Paris Climate Agreement, where major climate adaptation challenges include water security issues with respect to increases in water scarcity, drought and flood risk, and rising water temperatures affecting water quality and biodiversity. With its link to human health and well-being, clean water and sanitation, food production, sustainable cities and communities, and the quality of ecosystems, water is directly and indirectly linked to many - not to say all - of the Sustainable Development Goals (SDGs, *figure 1*). Improving protection against water-related disasters is also covered under the Sendai Framework for Disaster Risk Reduction. The New Urban Agenda from 2016 specifically concerns the sustainable development of cities and urbanizing deltas (Ligtvoet et al., 2018).

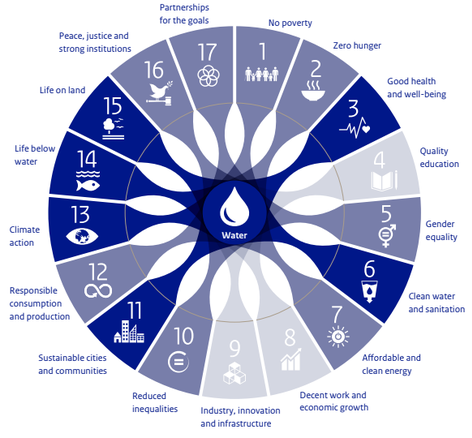

figure 1 Water and its interdependencies across all SDGs, from "The Geography of Future Water Challenges" by the Netherlands Environmental Assessment Agency (PBL, 2018)

And we see our vulnerability exposed with every disasters and its links to water security. From floods to droughts to migration, and now with the current COVID-19 pandemic. In places already plagued by war, climate change and poverty, Covid-19 is the breaking point. The pandemic not only exposes how complex and interconnected our challenges are; it also reveals transcending solutions. Investing in water, sanitation, and hygiene (WASH) is the first line of defence and the first step towards a sustainable recovery. Never has the sixth UN Sustainable Development Goal (SDG) been more vital for saving and protecting lives. But to deliver on our promise of the SDGs, we need collective commitment, continuity in our programs and consistency of our ambitions.

Water comes to mind first and foremost in times of climate suffering: too much and too little increasingly linked to climate change impact. Wet places get wetter, dry places drier. Our cities flood through cloudbursts and storms, or dry out in the mix of unsustainable water use, depletion of our aquifers and infrastructure failures. But it seems we learn by default and disasters only. While we all know preparedness pays by preventing losses and reducing impacts costs go down while prevention measures also helps us better prepare for future uncertainties. Investing in preparedness therefor safes lives, costs and adds values: from better health, more security, improved ecology, a decreasing gender gap and strengthened youth capacity - the benefits are numerous. Why then shy away from sustainable investments that increase resiliency and open up our portfolios for more and a much wider range of opportunities?

The 2020 WEF Risk report lists water again in the top (WEF 2020). Linking it to everything risky: the economy, geo-politics, the environment, climate change and more. The report reiterates an over and over played painful song: Water scarcity will increase already affecting a quarter of the world's population. Crop yields will likely drop in many regions, undermining the ability to double food production by 2050 to meet rising demand. How we grow food, produce energy, dispose of waste and consume resources is destroying nature's delicate balance of clean air, water and life that all species—including humans—depend on for survival. And climate change not only dries out our lands and waters, floods our coasts destroying our economies, it is also "the greatest threat to global health in the 21st century" (WHO). With extreme weather conditions putting populations around the world at risk of food and water insecurity. Today's children face a future of increasingly serious climate-related hazards: less nutritious crops, air pollution exacerbated by burning fossil

Northern Europe Enclosure Dam (NEED). The solution concerns a nearly 500km long dam through the North Sea, to protect the entire coast of Northwestern Europe against storm surge and sea level rise (Groeskamp & Kjellson, 2019).

In the Netherlands, adaptation to several meters of sea level rise seems technically and economically feasible. But it remains a major task. The situation is different and much more urgent in other parts of the world. Low-lying small island states (e.g. Kiribati, Tuvalu, Maldives) and parts of Bangladesh and Indonesia, need coastal adaptation on the very short term – and in more challenging physical, organizational and economic conditions. Some of the building blocks of the Dutch approach, such as feasibility studies on adaptation alternatives and systematic governance and funding arrangements, could still be of merit here.

TOWARDS SUSTAINABLE COASTAL ADAPTATION

From a civil engineering perspective, the concepts and building blocks to protect the coastline seem largely available. The toolbox contains solutions ranging from 'hard' (e.g. dikes, sea walls, barriers, dams) to 'nature-based' or 'soft' interventions such as wetlands, nourishments and mangroves or other forms of vegetation. Moreover, mitigating measures such as elevating, zoning or flood proofing of urban areas, or crisis management, may limit impacts of coastal disasters. A question remains how successful and sustainable coastal adaptation can be realized. After all, a *multi-disciplinary* approach is needed to shape coastal adaptation. Ideally, the design and development of water infrastructure should be intertwined with long term urban and development strategies. Given the long life times of 50 to 100 years it should also be streamlined with other major transitions, for example for energy systems. This requires involvement of other kinds of expertise then hydraulic engineering only.

It has been argued that such a multi-disciplinary approach towards delta design would involve urban design and planning, hydraulic engineering, environmental and policy sciences (Meyer & Nijhuis, 2013). These could jointly deliver an *integrated design* of future coastal cities and landscapes. The integrated designs also need to be adaptive to account for climatic, economic and social uncertainties.

This leads to intriguing questions for the case of the Netherlands. For the example of the Rotterdam area of the Netherlands, not only a coastal protection strategy has to be developed, but also a transition strategy of the current "fossil energy" port towards a green port (focussing on sustainable means of energy), as well as an urban development strategy. These developments are strongly interdependent and need to be synchronized. This hinges to a large degree on the way the current Maeslant barrier system will be adapted. This, after all, will determine whether there will be open access between the city and the port; and if there will be a controlled water level (like in Amsterdam), or tide (current situation) in the city.

Perhaps the most challenging aspect is to develop sustainable forms of coastal adaptation, particularly in tougher economic circumstances. Initially, it might seem attractive to expand and extrapolate existing forms of coastal management. Yet, the existing solutions could reach their technical limits, and/or come into conflict with other functions. For example, more and more space will be needed for upgrading coastal defence (i.e. higher and wider coastal dikes or dunes) which will lead to planning problems in densely populated coastal zones. It is therefore a challenge for hydraulic engineers, planners and other disciplines to develop sustainable strategies, that enhance ecosystem services and society and that are adaptable to changing conditions. In the Netherlands and other nations, coastal and delta management are already moving towards more nature-based forms of management (De Vriend et al., 2015). At the same time, hard engineered structures are often still required to protect urbanized areas against the high impacts of storm surge.

Coastal protection-projects have a major carbon footprint and environmental impact. It is therefore crucial that cleaner approaches for construction, such as the use of electric equipment and vessels, and other solutions that minimize adverse impact, or preferably enhance ecosystems, are developed. It is particularly challenging to develop and invest in sustainable solutions in times of economic crisis (like the current pandemic-induced one). Government investments and tenders could slow down, and the market situation leaves less room for companies to invest in sustainable innovations and construction technologies. Here lies a particular responsibility with the funders of the coastal adaptation projects, most often governments. Speeding up investments in coastal adaptation, fastening planning and permitting, and putting more value on sustainable solutions will support the economy and enhance coastal adaptation on the short and long term.

The past has shown that coastal communities are able to adapt rapidly and drastically, but so far mostly after disasters. A massive hurricane protection system was built around New Orleans within 5 years after hurricane Katrina. The Dutch delta works were built after the 1953 storm surge. However, there are hopeful signs that fewer disasters will be needed for future adaptation. The Dutch have adopted a Delta Fund and Delta program, that safeguards funding and planning efforts for the coming decades. And major coastal adaptation projects are ongoing in other parts of the world, for example in Bangladesh. Also, the global response to the pandemic has demonstrated that large-scale action and investments are possible when the urgency is felt. A next major global challenge is develop sustainable approaches for coastal adaptation pro-actively.

RESPONSE BY HENK OVINK

Professor Jonkman rightly states that around the world, in our deltas and coastal zones at risk, investing in coastal adaptation demands a multi-pronged approach. Investing in our low lying deltas only helps us prepare if we both mitigate climate change with reducing our carbon footprint and offset carbon emissions, while preparing with adaptation and resilience-measures the protection of our coasts and low lying deltas. Professor Jonkman rightly argues that while costly and challenging, investing in our coasts in a comprehensive and inclusive way not only helps to reduce risks, this will also add values across our societal needs. This integrated and inclusive approach matches the

fuels, rising average temperatures and other weather-related disruptions to livelihoods.

The climate crisis is a water crisis. Nine in ten natural disasters are water-related. Between 1995 and 2015, wind and water caused 1,700 billion dollars' worth of damage worldwide, according to UN estimates (UNESCO, UN-Water, 2020). Without water, no energy and no food. Too much water and increasing "extremes" go hand in hand with far too little water; periods of drought align with flows of refugees and conflicts. While we are depleting our natural water supplies at a ruinous rate, sea level rise is jeopardizing our cities and deltas. And without water, women and children often have to walk the wells. With water, these women can carry their communities towards more prosperity, while their kids go to school and progress even further.

So, the choice between prevention and repair is false. Both are essential. We need to start at the source: to reduce greenhouse gases, and make efficient and careful use of our planet and all its resources. Yet at the same time, we need to prepare boldly, comprehensibly and inclusively for tomorrow's extremes. Our man-made systems are not fit for the future. Our cities are built in hard structures. No capacity to hold the rain, no calamity-storage, parks or green roofs. No sewage systems that can hold these massive events. All over the world, our cities and communities face these shocks and stresses. And everywhere, the impact reveals our vulnerability. We have wrecked our natural systems too. Our rivers are channeled up, urbanized or even covered by infrastructure and buildings. While these natural systems used to meander, shrink and grow depending on the flows, they are now stuck in man-made barriers. Barriers again designed and engineered according to outdated standards. And our communities are fragile, vulnerable. Poor people live in poor places all over the world. The vulnerable are hit hardest, while it is exactly the vulnerable who need to invest more and longer to recover.

Cities and deltas are the global hotspots; collective places, collaborative places where everything and everyone comes together, and where we can tackle our challenges comprehensively, inclusively and sustainably. We know that everything is connected: the economic, social, environmental and cultural. Only through a comprehensive approach that connects the dots can we mitigate the risks and adapt for the future. This is exactly what we need to do – connect the dots. And the opportunity to connect the dots is best in our cities and deltas, where we can make the biggest difference. Beware of simplifying this approach. It is very complex and there are no silver bullets to solve these wicked issues. This very complexity, however, is our best opportunity for lasting change. The understanding and exploitation of this complexity is our way forward. We should embrace it for the amazing thing that it is!

The answer to this complexity lies not in single focused solutions - stupid infrastructure - coming form our vested interests and outdated agenda's. Stupid infrastructure pays off, but only on the very short term and only from a financial-economic perspective. It is devastating for climate mitigation and resilience. And we lose out as people and planet, with disastrous impacts on marginalized communities and our biodiversity system, wrecking our food security and economy on the longer run. When will we learn to do better? To mitigate and adapt, to prepare before response and invest everything we have in a sustainable future, leaving no one behind? We have no choice but lessons learned are costly. Yet we have every opportunity to change course now.

Changing course with water as the leverage for sustainable development and climate action, tackling social, economic, cultural and ecological challenges. The availability of clean drinking water safeguards health, education and development, equal opportunities and inclusive sustainable growth. Preserving our ecosystems and natural resources ensures the resilience of our planet and society. By taking a preventive approach on our coasts and in our deltas and cities (in both drylands and wetlands), we can avert the most serious problems and prepare ourselves and our world for a sustainable future that is strong and resilient. Water and water narratives can unite people around the world – politicians and scientists, city dwellers and country dwellers.

With this ambition and perspective we started Water as Leverage for Resilient Cities Asia (World Water Atlas, n.d.), which focuses on this inclusive, collaborative and comprehensive approach to arrive at really transformative climate adaptation projects. Interventions that make a difference and can lift up a community, a city, region, after which we can replicate and scale up for maximum impact. We have to come up with new solutions to tackle our future challenges, since the solutions of the past will make the world a worse place tomorrow. By being proactive, we can understand that future and can build resiliently. We know that the current evaluation standards of our financial partners are not fit for that future. Our policies are based on the understanding of yesterday and not on the understanding of tomorrow. Innovation also involves the task of helping to change our policies and practices, and helping our partners to bypass the system in such a way as to create a free place.

And for that we need a new approach; one that is rigorously inclusive, innovative and comprehensive with everything and everyone working together from beginning to end. A mechanism through which future understanding becomes an inspiration and drives innovation forward, and which includes everyone in the process; bankers and investors are as much a part of this as policymakers and politicians, as community leaders, NGOs, academics and the businesses that develop these solutions. Because with a better collective understanding of the future we can gain a better idea of how to fund innovations arising from that understanding. This is the millions we need to invest in the process to secure the billions for the projects that will really make a difference, and really prepare our society and planet for our challenging future.

There is no time to waste if we want to achieve our climate and sustainable development goals and thus safeguard our planet and our future. For this, we need big and small successes. Together we must take a step forward and invest in water capacity, management, and infrastructure – blue, green, and grey. It is time to invest in integrated,

global goals of the 2030 Agenda, and therefor investing in "sustainable coastal adaptation" is not only possible but also a pathway for reaching our global commitments together.

inclusive, and sustainable water programs and projects. Doing so pays off, according to the UN, every US$ 1 invested in safe drinking water in urban areas yields more than US$ 3 in saved medical costs and added productivity. For every US$ 1 invested in basic sanitation, society makes US$ 2.50 back. In rural areas, US$ 7 is gained or saved for every US$ 1 invested in clean drinking water.

So far, we have failed to seize this opportunity. While we have great and inspiring examples, we lack a steady flow of sustainable investments. We continue to invest in infrastructural projects from the past, taken from the shelves, to fill economic stimulus packages. Focused on jobs, jobs, jobs for fast economic recovery, these projects offer no added value for integration, inclusion, or sustainability. Our promises compete with our outdated infrastructure investments. Our commitment is challenged by our vested interests in past mechanisms. The full 2030 Agenda for Sustainable Development with all 17 SDGs should lead the way for recovery, and really prepare us for the challenging future ahead. We need to accelerate and expand a robust pipeline of investment opportunities across the 2030 Agenda. We must practice what we preach. Investing in water across the agenda is the added value enabler we so urgently need. If we continue replicating the past, we'll end up more vulnerable, more unequal and more fragile than before. So, let's build a robust blue and green pipeline of sustainable and transformative investment opportunities now and start to deliver on our promise!

RESPONSE BY BAS JONKMAN

The contribution by Henk Ovink sketches the bigger picture and points the importance and water and climate related challenges in global sustainable development. He rightfully points out the importance of adapting delta cities by means of sustainable and inclusive interventions that have a long term horizon. I observe that a lot of the infrastructure construction and planning that takes place in the field at the moment does not yet account for the broader set of goals that Ovink points out – or using his words can be characterized as "stupid infrastructure". It is a task for engineers, planners and policy makers to close the gap between current construction practices and longer term goals. In this respect there is a key role for the initiators of infrastructure projects (most often governments) to include long term sustainability aspects in the planning of projects as well as in tender processes.

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N.1 / Premises / Dialogues / 01
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