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Dutch waterscapes and collaborative climate strategies

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Highlights

- Dutch landscape is a Waterscape, a very complex landscape of water
- The creation of a waterproof city requires individual approaches and intensive cooperation
- Resilience thinking has to be incorporated in the policymaking and in the various initiatives across all domains of city government
- "United You'll Succeed, Divided You'll Fail"

Abstract

Dutch landscape is mainly a landscape of water, both in its urban and rural component; it is a landscape that has considered the resilience as its foundational feature as it is modelled and transformed in relation to the management of environmental risks and of climate change. Dutch landscape is conformed through an urban design and various strategies that desire not only to face the main risks but, above all, to anticipate climate change by integrating them into the future strategic vision. In the city of Rotterdam there is a strong interest in realizing some action selected by the Municipal Program on Sustainability and Climate Change; this interest is stimulated across social and economic stakeholders that are deeply involved in the opportunities offered by the climate strategies' implementation. Dutch people are agree that the climate change problems must be dealt with consciously and with the full participation of the population; Rotterdam is becoming resilient not just by fortifying its defences to a changing climate and rising seas, but also by building a more cohesive and inclusive society. Resilience thinking is being incorporated in the policymaking and initiatives across all domains of city government, including across social, physical and economical programs. The Climate Collaborative is an approach developed in the city of Rotterdam with the aim to reverse climate change, both on their own and by working together; it is an approach developed in some climate strategies and in various school program that stimulate the Rotterdammer since an early age. The Dutch education system aims to raise children's awareness so that they can refine their behavior with growth and be examples of best practices and smart communities.

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1. Dutch landscape is a Water-scape

In this paper are presented the results of some scientific researches started within the courses "Analysis and Design of the City Form" and "Socio-Spatial Processes in the City" of the MSC in Urbanism of the Delft University of Technology and developed in Zuid Holland, in particular in some districts of the city of Rotterdam. The topics are concerned the spaces of water called "waterscapes" that are spaces of deep vitality, areas of relationships, of exchange, a connective tissue, a fluid environment in which flows of people, goods and knowledge are realized; the water space, the limit between land and water, is a strategic space, often protected, where is recognized a strong landscape with environmental value, but is also a strategic space for the cities' transformation. The Netherlands has a coastline of about 451 kilometers but has always been characterized by a difficult relationship with the sea; Nederland literally means "low country"; because of the geomorphological conformation that places the country on average five meters below sea level (with peaks of 7 meters), at the mouth of three major European rivers (Reno, Meuse and Schelde) and with a percentage of about 60% of land that is vulnerable to flooding. The Dutch urban planning, at all levels of government, it has always questioned about the need to defend land and cities from rivers and sea floods; over the centuries a pragmatic approach it has developed, enshrined in various national laws and enforced by the establishment of the Ministry of Infrastructure and Water Management which has set as its main objective the defense of the land from the waters. Currently, about 75% of the Dutch coast is protected by sandy dunes that vary their length from 100 meters to several kilometers; 15% of the coast is made up of "hard" man-made constructions such as dams and artificial reefs, while the remaining 10% is characterized by flat and very wide beaches.

Climate in the Netherlands is changing. The average temperature, for example, has increased by 1.7°C during the last century, and the annual number of summery days increased by nearly 20. Annual precipitation also has increased by about 20% and periods of heavy rainfall have become much more frequent. The general adaptation policy is laid down in the 2007 National Adaptation Strategy (NAS), "Make Space for Climate", which sets out a general policy for tackling the effect of climate. The government published in 2013 the Climate Agenda, an integrated climate mitigation and adaptation approach. With regard to adaptation the goals of the NAS where reiterated and it a new comprehensive and integrated National Adaptation Strategy (NAS) was formulated during the last year (2017).

The Dutch landscape is mainly a landscape of water, both in its urban and rural component; it is a landscape that has considered the resilience as its foundational feature as it is modeled and transformed in relation to the management of environmental risks and of climate change. Dutch landscape is modeled through an urban design and various strategies that desire not only to cope the main risks but, above all, to anticipate climate change by integrating them into the future strategic vision. For centuries the Dutch have developed a great capacity to channel and manage water, and the sea's or the rivers' risks; two thirds of the Netherlands would be submerged if there were no major hydraulic engineering works, ie dams, water pumps, integrated coastal development projects and careful river basin management. The Rijkswaterstaat (the General Directorate of Public Works and Water Management of the Ministry of Infrastructure and Water Management), currently, monitors an area of 90,278 sq. Km of water, 214 kilometers of dams and dikes and 2,969 kilometers of rivers and canals. In the field of hydraulic works and hydro-geological management, the most famous flood protection projects are the "Afsluitdijk" and the "Delta Works" (a project of barriers built in the south-west of the Netherlands after the great flood of 1953), consisting of a system of dams, sluices and mobile barriers in the two Zeeland and Zuid-Holland provinces.

The two most important projects of the Deltaworks are the dam of the Oosterscheldekering, inaugurated in 1986, between two islands of the Province of Zeeland, and the Afsluitdijk, a 32-kilometer dam, designed during the 17th century but completed only in 1932, which separates the inland sea from the North Sea and links the provinces of Friesland and of Noord-Holland. This dam protects the coastlines of four provinces from maritime floods and creates the large inland lake IJsselmeer, a freshwater basin that is used during periods of drought.

From the Dutch experience emerges a continuous attention to the theme of the rural landscape but mainly due to its environmental vulnerability; Dutch landscapes are particularly fragile and vulnerable areas that, for their protection, must in-

clude well-defined strategies and appropriate instruments of government; the analysis presented in this essay shows how there should be a transversal approach to the management of these areas, involving not only administrators and politicians but also evaluators, ecologists, communities, and experts in the creation and management of urban strategies that may be able to put an effective protective action ensuring the changing in the making of such places; moreover, it is necessary that

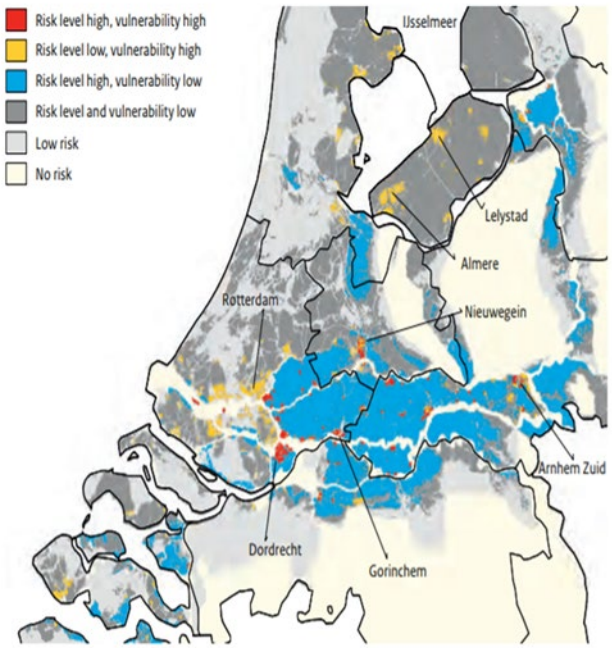

Figure 1: Flood Risks. *Source: De Bruijn and Klijn (2009)*

the actions are built according to a methodological path that begins with the identification of the strategies and culminates with the implementation of the landscape transformation project (Moraci & Fazia, 2013). Rotterdam is an example of a very good urban resilience and adaptation to climate change; the theme of urban resilience has been under the attention of the municipality for about fifteen years and Legambiente (Italian environmentalist association) has included the Dutch city as one of the examples to follow in the 2017 "Cities to the challenge of climate" dossier; moreover, in the central districts of Rotterdam, urban retrofitting actions are experimented through new technologies and new functions applied to existing structures, and in line with the climatic changes taking place. Rotterdam is also experimenting some innovative building technologies: for example, te municipality is adopting some architectural technology solutions that adapt to the fluctuation of water levels with the introduction of the obligation, by 2025, to create sustainable constructions with floating quarters, in areas outside the banks, and the urban water system is also being resilient with the creation of tanks for the storage of rainwater.

To establish a deep relationship with climate changes and to manage the risks deriving from it, the National Government, in 2007, clarified and composed its "Vision" on the water policy entitled "Reclaiming the Netherlands from the future", which emphasizes the need for sustainable management water resource in relation, above all, to climate change; the following year was published the the Second Report of the Delta Commitee entitled "Working with water", which contains twelve recommendations to guarantee national defense and security; in 2009 the "National Water Plan" came into force whose slogan is "Move in accordance with natural processes where it is possible, offer resistance where necessary and seize opportunities to promote prosperity and well-being". To achieve these objectives the theme of water will have a central importance in spatial planning. The main priority in the climate strategy is the protection of the city from floods and strategic attention is paid to the port and to some strategic infrastructures most at risk; in the most populated areas with the highest building density, some projects will be carried out on public space, such as water squares; water storage capacity will be increased through the regulation of the city's canals, and the permeable surface will be increased with an increase in green areas and a decrease in paved areas. The development of public areas used to store rainfall, which will in part be used to irrigate urban green areas, is also planned; the storage capacity of underground water will be improved; collective water gardens will be implemented, which will be implemented in the common private areas; green roofs will be implemented that will allow the storage of part of the rainwater. The water squares, the green roofs, the increase in the flow and the section of the canals are strategic elements for the increase of urban resilience; these interventions contribute to the maintenance of the water levels of the Schie and Rotte rivers, preserving the area from flooding. Some specific interventions are also planned to increase the

resilience, for example in the Merwe-Vierhavens dam, in Rozenburg and in some parts of the IJsselmonde; moreover, in the long run, the dams of Hoek of Holland and Maasboulevard will have to be reinforced. The construction of new dams for the protection of Rotterdam could also be envisaged, in addition to the existing ones. The group of architects "De Urbanisten" has defined several projects concerning the management of urban water in Rotterdam and in neighboring polders, realizing many water squares. For example, the project for is interesting the Benthemplein water square, a large multifunctional water square that combines rainwater collection with the creation of an outdoor public area; the project was defined after three preparatory workshops in which the natural elements and the form of public space were discussed. Additional areas of water storage are included in the projects that are currently being implemented in Rotterdam, for example in Centraal Station or in Kruisplein and also in the urban visions 2030 or 2050 as "Rotterdam child friendly city" or "Wilderness school playgrounds". A "blue and green" strategy will then be implemented which will also contribute to making the urban environment more attractive and enjoyable. The purpose of the Dutch National Adaptation Strategy (NAS) is to integrate climate adaptation into policy, implementation and relevant activities of governments, civil-society organizations, citizens and businesses. By 2020, it must be clear which parties are responsible (or will assume responsibility) for which urgent climate risks. This will ensure that the effects of climate change remain manageable.

2. Dutch Waterscapes, discovering an innovative urban design

Rotterdam's climate adaptation strategy is based on some actions to optimize the water defense system; on improvement of resilience through adaptive measures to be implemented throughout the urban environment; on the combined and agreed action with all urban stakeholders, considering climate adaptation as a strategy that can innovate the city making it more interesting and innovative. The strategy gives close attention to some key actions such as safe, flood-proof construction, floating buildings such as the Rijnhaven project, or water-based public spaces that increase the resilience of the system.

To counteract environmental risks and to tackle the climatic change, the Netherlands has implemented, since the early years of the 21st century, national directives and strategies that have sought to promote spatial planning, urban design and territorial governance in able to implement actions that would enable cities to be less vulnerable and to promote awareness-raising actions that would allow citizens and urban stakeholders to acquire knowledge and techniques useful for dealing with the climatic changes. The Dutch waterscapes are public-private spaces where the man-made dunes symbolize the value of the architectural and engineering project but are also evidence of a deep struggle between people and nature; these spaces have developed, in history, an alternation of projects that have made those places, once inhospitable and dangerous, public spaces of high urban value; studying them is recognizing their inspirational idea and discovering the chronological sequence of actions aimed at their composition and evolution. Responsibility for water management in the Netherlands is entrusted to Rijkswaterstaat (the executive branch of the Ministry of Infrastructure and the Environment) and to the Water Control Committees; the Rijkswaterstaat (RWS) is responsible for the management of the main waters, such as the sea and rivers, and ensures that the responsible authorities are promptly warned in the event of floods or stormy seas. Furthermore, RWS maintains dams, dunes, cages and overvoltage barriers and protects the coast by regimenting and expanding the floodplains and building secondary canals.

In the city of Rotterdam there is a strong interest in realizing some action selected by the Rotterdam Program on Sustainability and Climate Change; this interest is stimulated across social and economic stakeholders that are deeply involved in the opportunities offered by the climate strategies' implementation. The city of Rotterdam is considered a best practice in this field and is seen as a world reference for the management and governance of sustainability and resilient strategy; the municipality of Rotterdam adopted sustainability as one of the strongest municipal priorities, enforcing it also in its City Vision Program, in the Urban Development Framework and the Port Vision 2030. Rotterdam developed a set of actions to defense itself from water and from climate changes, for this reason the city is considered one of the safest cities in the world; for example in case of a problem of sea level it is possible to close and regulate the *Maes-*

lant dam and can be controlled the flooding in the more internal part of the dyke; in case of strong precipitation there is a system of storages that could help the city to prevent floods and to have negative effects on the drainage system. All this actions are well explained in the Rotterdam's climate adaptation strategy that is a book of actions based on urban design, collaborative methods and social and political regulations; this strategy is based on some actions to optimize the water defense system; improvement of resilience through adaptive measures to be implemented throughout the urban environment; on the combined action and agreed with all urban stakeholders considering climate adaptation as a strategy that can innovate the city, making it more interesting and innovative. The strategy gives close attention to some key actions such as safe, flood-proof construction, floating buildings such as the Rijnhaven project, or water-based public spaces that increase the resilience of the system.

The creation of a waterproof city requires individual approaches to the problem and intensive cooperation between water boards, the ministry, the municipality, urban developers, private companies, housing corporations and above all the direct involvement of the inhabitants of the city. It is absolutely essential that everyone does their part to implement the strategy defined for the creation of a resilient city. The climate strategy includes actions on buildings, landscape, mobility, infrastructures, environment; i.e. the areas of water accumulation within the city must also be strengthened, increasing the canal section, by implementing new channels and small lakes for the stagnation of water; there is the need to strengthen the blue lines within the city and connect them, in a reticular perspective, to the urban water system. In addition, the blue corridors also have another important function, that of an attractive space for sociality and leisure; measures to make buildings more resistant to heat include the use of white and green roofs, the installation of easy-to-open windows, awnings, blackout screens and the design of the interior distribution of housing in such a way that the bedrooms they are located on the lower floors and on the north sides of the buildings. The strategy promotes some actions able to achieve tangible result involving community; it promotes the increase of land permeability through encouraging residents to plant more flowers, shrubs and trees near their homes removing tiles from the garden enforcing the private space's permeability; the planting of trees, plants and flowers is particularly encouraged in the district of Oude Noorden, Nieuwe Westen/Middelland, Tarwewijk, Bloemhof and Hillesluis, combining, where is possible, this with measures to contain storm water runoff in incidences of extreme rainfall; the strategy encourages the introduction of lush greenery and a healthy cover of vegetation along the river banks of the New Meuse River, along the New Waterway, the Rotte and the Schie, creating an attractive and pleasant green corridor; it encourages the addition of green elements to existing facilities, such as green car parking sites; stressing the importance to develop wall gardens, or vertical gardens, not only brighten up the streets but also prevent the wall from warming up too much during extremely hot days.

3. Collaborative design and participatory aspects in the climate management

The creation of a waterproof city requires individual approaches to the problem and intensive cooperation between water boards, the ministry, the municipality, urban developers, private companies, housing corporations and above all the direct involvement of the inhabitants of the city. It is absolutely essential that everyone does their part to implement the strategy defined for the creation of a resilient city.

Rotterdam encourages the involvement of its inhabitants; for this reason Municipality promote some urban vision that aims the citizens' cooperation; CityLab010 is a municipal program encouraging the people of Rotterdam to participate in the Rotterdam Program on Sustainability and Climate Change as well as in other policies; the Air Quality City Lab is another example concerning this. Municipality needs to join forces and is in search of citizens' cooperation; Rotterdam needs to work with the people, business owners, the provincial authorities, central government, and all kinds of other (research and educational) institutions; commitment is required at various levels.

Rotterdammer have been adapting their city to the ever-changing delta for centuries. Rotterdam has a strong relationship with water, the whole city is surrounded by water that comes from the sea, from the river, from precipitation and from groundwater. This is the main reason because the city is one

of the more vulnerable city to the consequences of climate change. Municipality needs to join forces and is in search of citizens' cooperation; Rotterdam needs to work hand in hand with the people, business owners, the provincial authorities, central government, and all kinds of other (research and educational) institutions; commitment is required at various levels.
For this reason, stakeholders from all relevant sectors are involved in elaborating response and implementing actions; as part of the Delta Program 'Spatial Adaptation' in 2015 an engagement program has been set up to stimulate regional and local policy makers, institutes and businesses to create climate proof and water resilient cities by 2020. Encompassing different scales and a wide variety of actors, integrating climate-proofing in urban development is a complex challenge. Central government and the provincial and municipal authorities each have their own responsibilities in climateproofing urban areas, while many private parties (housing corporations, companies and private citizens) play a part in urban development.
The Rotterdam Climate Strategy is characterized by a strong interaction between different levels of government; in the strategy are involved, with a key role, the municipality, the economic firms, the water boards that are responsible of water management but, first of all, the citizens that live in the city; the citizens' role is very important and strategic for the whole climate vision; for example is important the dissemination of the climate key action, in particular the part of actions that regards the younger population; the school is very important, because is the first place where the children have the presentation of the problem of resilience. Since the first school class, the Dutch children are informed about the main risks of their nation and about the main actions to develop to preserve their environment free from emergency risks; for this reason the Dutch children are more sensitive to environment and sustainability and become also territorial sentinels inside their families and their districts; children and inhabitants have an active role in conforming the city that resist and cope to climate changes and in transforming the city; everyone is deeply involved in making the city waterproof. In the climate strategy, the resilience is included in all levels of government with a deep collaboration through private and public customers; regarding to this, is important to underline the importance of urban design in the construction of a waterproof city with a deep and strong relationship between urbanism and architectural scale of intervention. In this way is simpler, for Dutch people, to link the adaptive measures to other spatial development projects in the city and to intelligently combine them with existing management and maintenance programs with an intensive cooperation with other partners who are active in the city. The general aim is to promote the creation of a waterproof city through joint responsibilities and smart management and urban governance.
Dutch people are agree that the climate change problems must be dealt with consciously and with the full participation of the population; there is a slogan that reads "United You'll Succeed, Divided You'll Fail" (Anten, 2017) and that stimulate and propagate a 'participation society' because, for Dutch inhabitants, people feel the responsibility to connect and care for others. From this point of view, and for the success of strategy, a good protection from flooding is a necessity and not a luxury.
For Rotterdam's inhabitants, there are some key actions that is important to implement following the climate strategy promoted by municipality of Rotterdam, such as the acknowledge of vulnerability and risks, the need of a strategic planning, the importance of the involvement of all sectors of governance (from national to municipal), the complete awareness of inhabitants and stakeholders, the importance on public space as resource in which develop a resilient urban design, the importance on building districts and on their architectural project and on their maintenance and updating, the need of a good dissemination program that regards science and education and the full engagement of the community. These are key goals for every strategy about climate adaptation and urban resilient strategy (www.rotterdamclimateinitiative.nl). The slogan that summarize this concept is "Turning a weakness into a strength", so "Rotterdammer" are developing an urban program that is inspired by the slogan to "give Welcome to the water".
Rotterdam is showing all over the world that promoting an effective climate strategy means involving all level of competence, promoting a smart governance able to achieve tha people's awareness. Only in this way is possible to form active communities able in the promotion of waterproof and sustainable city with a full sharing of strategical aims. In addition, as we just introduced, the Dutch are deeply aware of the environmental problems, because at school, from an early age, training courses are provided that update them on the risks and

the main techniques to preserve their nation, as for example, that of the polders. The education system, in this case, is one of the best in the world and aims to raise children's awareness so that they can refine their behavior with growth and be examples of best practices and smart communities.
For these reasons, Rotterdam is becoming resilient not just by fortifying its defenses to a changing climate and rising seas, but also by building a more cohesive and inclusive society; resilience thinking is being incorporated in the policymaking and initiatives across all domains of city government, including across social, physical and economic programs. Making the city resilient means, as shown in the Netherlands, anticipating environmental risks and to encompassing them within the planning domain. It also implies constructing an urban planning as a unitary design able to lead to tangible results and to the creation of a desirable, less vulnerable city for smart citizens (Moraci et al., 2018).

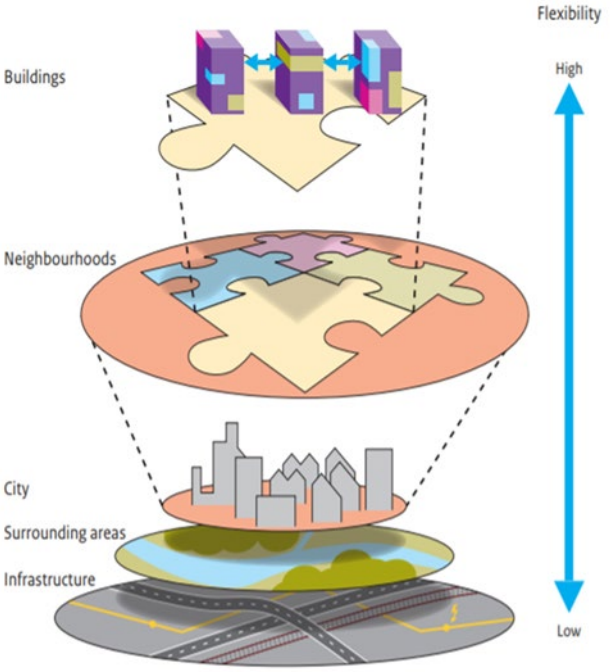

Figure 2: Various scales for adaptation measures within the urban environment. *Source: PBL Netherlands Environmental Assessment Agency.*

References

Anten, N. (2017). 5 Lessons The World Can Learn From Dutch Resilience. Retrieved from https://hyperloop-one.com/blog/5-lessons-world-can-learn-dutch-resilience

City of Rotterdam (2010). Deltas in Times of Climate Change, Rotterdam, 2010. Retrieved from http://www.climatedeltaconference2014.org/rotterdam/rotterdam.

City of Rotterdam (2014). Making sustainability a way of life for Rotterdam. Rotterdam Program on Sustainability and Climate Change 2015-2018. Retrieved from http://www.rotterdamclimateinitiative.nl.

City of Rotterdam (2013). Rotterdam Climate Change Adaptation Strategy, 2013. Retrieved from http://www.rotterdamclimateinitiative.nl.

City of Rotterdam (2010). Rotterdam, city with a future. How to build a child friendly city. Retrieved from http://www.robedrijf.nl.

City of Rotterdam (2016). Rotterdam resilient strategy. Ready for the 21st Century. Retrieved from http://www.100resilientcities.org/wp.../strategy-resilient-rotterdam.pdf

City of Rotterdam (2008). Rotterdam Urban Vision: Spatial Development Strategy 2030. Retrieved from http://ec.europa.eu/.../citiesoftomorrow/citiesoftomorrow_final.pdf.

Delta Commissie (2008). Working together with water. A living land builds for its future, Hollandia Printing, The Netherlands. Retrieved from http://www.deltacommissie.com/doc/deltareport_full.pdf.

Errigo, M. F. (2018). The Adapting city. Resilience through water design in Rotterdam. *TeMA Journal of Land Use, Mobility and Environment, 11*(1), 51-64. doi: 10.6092/1970-9870/5402

Galderisi, A., & Ferrara, F.F. (2012). Enhancing Urban Resilience In Face Of Climate Change. *TeMa, Journal of Land*

Use, Mobility and Environment, 5(2), 69-88. doi: 10.6092/1970-9870/936

Kimmelman, M. (2017). The Dutch Have Solutions to Rising Seas. The World Is Watching. The New York Times, June 15, 2017. Retrieved from https://www.nytimes.com/interactive/2017/06/15/world/europe/climate-change-rotterdam.html.

Legambiente (2016). The Italian cities to the challenge of climate - change impacts and adaptation policies, Retrieved from http://www.ecolifestyles.eu/en/news/italian-cities-challenge-climate-presentation-dossier-tuesday-february-9-2016-rome.

Moraci, F., Errigo, M., Fazia, C., Burgio, G., & Foresta, S. (2018). Making less vulnerable cities: resilience as a new paradigm of smart planning. *Sustainability, 10*(3), 755. doi: 10.3390/su10030755

Moraci, F., & Fazia, C. (2013). Le città smart e le sfide della sostenibilità. *Tema. Journal Of Land Use, Mobility And Environment, 6*(1), 35-45. doi: 10.6092/1970-9870/1459

PBL (2008). The Netherlands in a Sustainable World. Poverty, Climate and Biodiversity. Second Sustainability Outlook, Bilthoven: PBL Netherlands Environmental Assessment Agency.

PBL (2009). Roadmap to a climate-proof Netherlands, PBL publication number 500078003, The Hague/Bilthoven: PBL Netherlands Environmental Assessment Agency.

PBL (2010). Adaptatiestrategie voor een klimaatbestendige natuur, PBL publication number 500078002, The Hague/Bilthoven: PBL Netherlands Environmental Assessment Agency.

PBL (2011). Een delta in beweging. Bouwstenen voor een klimaatbestendige ontwikkeling van Nederland, PBL publication number 50019301, The Hague: PBL Netherlands Environmental Assessment Agency

Rijkswaterstaat (2011). Water Management in The Netherlands, Den Haag, February 2011. Retrieved from https://staticresources.rijkswaterstaat.nl.

Rockefeller Foundation (2015). Retrieved from http://www.100resilientcities.org/cities#/-_/.