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Dutch Delta Resiliency by Societal Learning Introducing the Intertwined Process of Daily Practice and Theory Development

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Abstract: The Wester coastal Delta zone of the Netherlands is the relatively more crowded area of the country where ten of the seventeen million people live. The governmental prognosis is that this number of people will increase steadily in the coming decennia, unless the threat of climate-change seawater level rising. This is the picture in more Delta zones globally what makes the topic of resiliency for these delta-areas of importance. Approaches of resiliency are often dominated by governmental rescue planning and believe in technology solutions, while in the process the behaviour of people can make the difference in overcoming climate-change impact disasters. In the struggle against high water storming and flooding, the Dutch people prove this by developing societal resilient behaviour in a broad spectrum of activities. Post-PhD research on Dutch resilient behaviour in the in 1016-flooded Zaanstreek-Waterland area near the city of Amsterdam confirms that. Recently research by questionnaire among citizens in this region shows that people have favour for shared responsibility with government and related professional organizations. The Dutch examples of societal resiliency carried by people also show a action-learning perspective intertwined with governmental contingency planning. Therewith the Dutch practice shows a positive cross-fertilization of practice and knowledge development.

Keywords: water-resilience; climate-change; action-learning; and resident-empowerment

1. Dutch practice of Climate-change 'Water Resilience' [1] (Sanders, 2018)

An Old Dutch saying tells 'God created the world, but the Dutch created the Netherlands', unless the fact that in the past the Western part of the country counted flooding regularly. History tells us about the highlights; how the severe storms of 1421 and 1675 for instance braked through dunes and dikes by which layers of peat poured into the sea disturbing the landscape creating open water areas in the countryside, with new threats for the people. Unless these water areas were made dry in later decennia, creating 'polders', in more recent times the floods of 1916 and the last flood of 1953 unexpectedly again set large polder land areas under water (Aten, 2009). The most severe floods though stimulated the Dutch to start defence planning, as these were:

- The 'Saint Nicolas' flooding of 1196 in the Northwestern part of the country, near the city of Alkmaar, by seawater braking through the dunes using an old gully. The villages in the area decided to build a new dike for protection and they divided the work. The effect was the creation of the first Water-authority in the Netherlands by Count Willem I in 1214.
- The 'Saint Elisabeth' flooding of 1421 resulted in sea-dikes breaking in the Southwestern and Northwestern row of dunes resulting in the seawater finding its way to the land. Almost thirty villages flooded and 2.000 residents did not survive.

[1] The former RRAU18 post-PhD congress paper on resilience among residents of the Zaanstreek-Waterland area is used for the content of the chapters 1 to 4 [Sanders 2018].

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- The flooding of 1916 resulted in sea-dikes and river-dikes succumbed to damage because of the combination of a severe storm and heavy rainfall. The most affected was the 'Waterland' area North of Amsterdam, which flooded completely. There were only three casualties.
- The flooding of 1953, caused by breaking of dikes along the whole Dutch coastal line from South to North, resulted in severe damage to villages, infrastructure, and the water defence system; in addition to the severe damage, 1836 people died. This disaster motivated the decision of the national government to build a complete new water defence system to defence the Western Delta called the 'Delta-works' [Dutch: 'Deltawerken'].

The Dutch learned from these accidents and every disaster was followed-up by new and better delta defence water resistant constructions(Aten and Wieringa, 2015). With the 'Delta Plan' developed after the flood of 1953 the country should be defended against storms and high tide combinations, whereby the dikes were upgraded to what is called the delta-level related to a chance of exceeding of 'one in a million years'

In 2016 the EO local television broadcast organization presented a drama series in the Netherlands concerning 'What would happen when the dikes break' [Dutch; Als de dijken breken'] by Johan Nijhuis creator and Hans Herbots cineaste. This series played on the growing interest among the Dutch people for the topic of seawater raise dangers as a result of climate-change, and included a call to the national government for better information concerning the personal risks of people and their houses. The result was that the national governmental organization for water defence called 'Rijkswaterstaat' consulted experts, started-up informational processes, and opened a website by which every household could review what the current risks are and how far their house lays below seawater level [www.overstroomik.nl]. In addition, a report on the risks of flooding for common people came available (Vergouwe, 2016). The maps out of this report show the threats of climate-change for the Netherlands coming from the rising see level and heavy rainfall both. Concerning the rainfall, the increasing intensity of rainfall will not only increase the water influx from the East, but also the 'polders' maintenance will the suffer difficulties with pumping capacities, see figure 1.

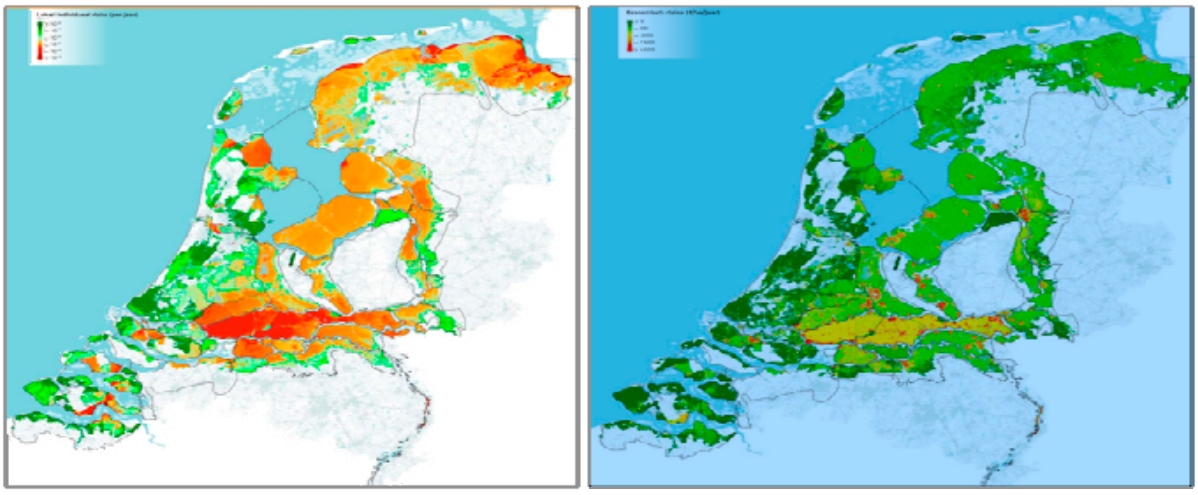

Figure 1. Showing flooding [left] en economic effects of flooding risks [right] (Vergouwe, 2016).

This www.overstroomik.nl website of the 'Rijkswaterstaat' department features the opinions of specialists to explain the current situation to the Dutch people to address their role and responsibilities too, accompanied by information what they could do themselves for reducing their risks: building housing different, more green gardening for water storage inside cities and showing interest for civilian movements and organizations that are related to water safety programming.

The forecast for the Netherlands is that climate-change will make this situation worse in the coming decennia, the seawater level will rise and storms will become more severe, because large areas of the Netherlands are situated below sea level in the past. Today it is up to 6,7 meters minus NAP near the city of Rotterdam at 'Zuidplaspolder' [NAP the general sea-level of the North Sea].

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For the Dutch situation every structural seawater-level rise can be far-reaching and will influence the circumstances of the people and their land, whereby the national and global debate on sea-water-level raise development (IPCC, 2007) (UN, 2015) (Delta-commission, 2017) (Deltares, 2018) undoubtedly influences the feelings and worrying of the people.

That's why a former post-PhD research focussed on the resiliency of the people behaviour in such flood disaster situations, research done in the Zaanstreek-Waterland area situated adjacent to Amsterdam a 100 years after the 1916 flooding (Sanders, 2018). This area, however, concerns a rural area in the situation of nowadays that most people live in cities increasingly. Which implicitly makes it important for a total picture to expand this research into the city. For the new added research the research question remains unchanged:

How do people act resilient, in a context of governmental disaster management?

The answer on this research question is sought in the combining of both research results by; presenting the Dutch resiliency developed attitude first [chapter 2] with working-out a definition for 'water resilience' [chapter 3], with subsequent the presentation of these research results [chapters 5, 6 and 7], for working-out conclusions and thoughts [chapters 8 and 9].

2. Dutch Practice of Action-Learning Resiliency Developments

New circumstances have challenged the Dutch people develop resilient behaviour in recent years, climate change not only water related mostly. This development makes it important for government and the people themselves to understand their resilient behaviour better. These other circumstances therewith influence the context the Dutch people are living in nowadays, what makes it worthwhile searching for patterns in these developments, that are:

- The Northwest of the Netherlands is suffering by mild earthquakes caused as the result of many decennia of emptying the gas fields (Van der Voort and Vanclay, 2015). Since the first 1986 earthquake [Richter 3.0] the total of 1269 [until November 2018] seismologic incidents took place.[2] A 2014 focus-group research proved that 60% of the area residents accepts this calmly, and for 20% decreased confidence in government (SPG, 2014).
- In the Northwest of the country milder seismologic turbulences are felt, caused by emptying oil-bearing layers in the last century; in the villages Anna Paulowna 2015 [Richter 1.5 and Warder 2018 [Richter 2.5]. Unless the villagers experienced little of this, local government because of the Groningen experience started up a network of measuring points.
- Heavy clustered rainfall and longer periods of dry weather due to climate change show to be increasingly of negative influence on the Dutch agricultural sector, and do cause inconveniences in the cities as flooded tunnels too.[3]
- The great rivers flowing from Germany into the Netherlands have disturbing periods of very low and very high water due to melting of the glaciers in the Alps (Bresser et al., 2005) (Vellinga et al., 2014), causing inconvenience for shipping and nearby housing. This encouraged the development of floating housing in the river flood plain areas, and in 2007 an investing program for giving these river in the Netherlands more space was started by government.
- Near the coast the hinterland suffers of salinization during periods of prolonged drought by seepage through the dunes because of the extra water-level differences (Van Bakel et al., 2009), what effects agricultural production of potatoes and flower bulbs two major export product of the Netherlands. Branch associations [KAVB and LTO] started discussion with their member in recent years, to mobilize awareness under the agricultural enterprises and for pressuring government to take reducing measures.

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[2] https://www.nam.nl/feiten-en-cijfers/aardbevingen.html

[3] https://www.knmi.nl/kennis-en-datacentrum/uitleg/regenintensiteit

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These examples show resiliency developments in the Netherlands whereby area residents and government cooperate together, in every situation in a different equilibrium, the government often takes the initiative, but citizens and citizen organizations also take the initiative, or a combined, start-up, start-up. Evidently, this combination delivers positive results, in two indexes scoring resilienness Dutch cities are on the top of these lists; The 'Sustainable Cities Water Index' identifying cities harnesses water assets for their long term advantage; 1. Rotterdam, 2. Copenhagen, 3. Amsterdam.[4]

3. 'Water Resilience' Defined

'Climate Resilience', which includes 'Water resilience', has been given a number of expressions depending on the focus chosen, by people related to climate-change. Resilience focuses on the ability to handle, as a society, mobilizing the capacity to adapt to extreme undesirable changing circumstances (Nelson et al., 2007). Concerning the far-reaching circumstances of climate-change, which can be severe storms, severe rainfall, seawater rising, loss of bio-diversity, and economic recession; many of these climate change examples are water related.

Adaptation to such extreme external stimuli and stress to Nelson should be seen as a system wide result from which the social component and social actors behaviour could be made particular; see the cycle of 'Adaptedness and resilience' figure 2. Nelson sketches the slight differences between adaptation and resilience. Resilience concerns the power of people to learn and to develop resilience capacity more than adaptation (Berkhout et al., 2006). Resilience therefore is a process of development making the system of adaptation stronger by every new experience (Walker et al., 2002).

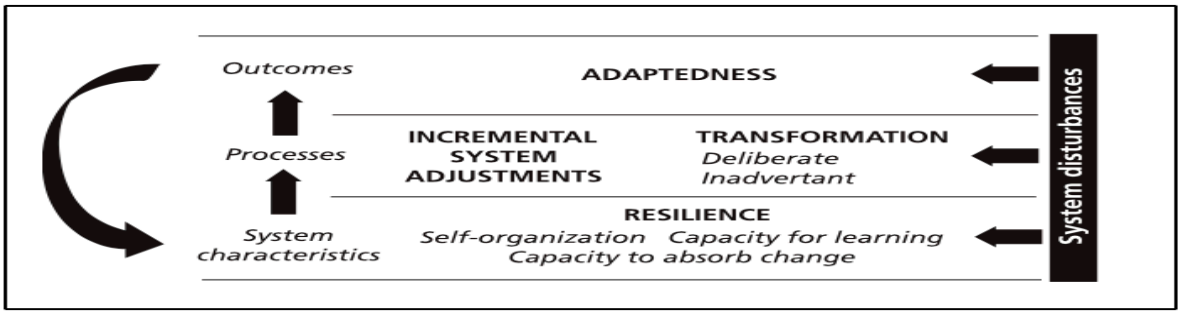

Figure 2. Showing the cycle of 'Adaptedness to Resilience' (Nelson et al., 2007).

According to Nelson, the resilience approach is unfortunately narrowed down to mainly the technological and governmental policy approach (Holling, 1973). Resilience though should be seen as an ecological reaction that cannot be considered void of peoples' action and behaviour (Nelson et al., 2007). Searching for resilience requires exploring and defining variables to create vulnerable preconditions and action-prospects for the time an impact takes place (Tompkins and Adger, 2004).

The understanding of 'Climate resilience' has developed in the past four decades along with the understanding of climate-change (Martin-Breen and Anderies, 2011). Originally in the sixties of the past century resilience became ecologically related and initially outlined as 'the capacity for ecological systems to persist and absorb changes'. By which ecological systems are described as from nature searching for the equilibrium towards some stable prior point under all circumstances (Holling, 1973). In the years after these ecological systems were seen less stable and functioning in a dynamic surrounding by adaptive management and environmentally limited resources (Holling, 1973). In the seventies the resilience phenomenon became connected to social science in a more evolutionary approach and transformed in the eighties to a reacting system approach through

[4] https://www.arcadis.com/en/global/our-perspectives/which-cities-are-best-placed-to-harness-water-for-future-success-/

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which external stresses could be offended. In the nineties when the issue of global-warming emerged resilience became related to climate-change (Pelling, 2010). Resilience related to climate-change water flooding became an important new issue of growing attention from the beginning of the twenty-first century. The extreme flooding of New Orleans, New York are examples of that (Sebastian et al., 2017).

4. Dutch 'Water Resilience' by People's Behaviour

Taking responsibility has always been a part of the mentality only the incentives have changed and become more urgent due to climate-change developments. (Wiering and Winnubst, 2017). Dutch experts with knowledge of this new defence systems today advise globally to make flood defence barriers in the USA, India and South America concerning several cities over the last years. Remarkably some of these cities managed to recover much faster then the others unless nothing profound was done yet. The city of New York for example recovered in 2012 from the Sandy hurricane in only a number of weeks while New Orleans is still starting up the recovery of the Katrina hurricane from 2005. The difference should possibly be the behaviour of the residents, how they took initiative and started-up cleaning and recovery tasks. This likely proves that the action prospects of the people does make the difference to make cities resilient for water flood disasters not just technology and governmental ruling alone (Chamlee-Wright and Storr, 2011).

Recently in 2017, Delft University of Technology in a 'Hacketon' session of researchers and 80 students discussed the tropical hurricane ' Harvey' that hit Houston Texas USA on August 17th 2017. In a four-day period the areas received more than a 1,000 mm of rain as the system slowly meandered over eastern Texas and adjacent waters, causing catastrophic flooding, with peak accumulations of 1,539 mm with made Harvey the wettest tropical cyclone on record in the United States. The resulting floods inundated hundreds of thousands of homes, displaced more than 30,000 people, and prompted more than 17,000 rescues'. One of the conclusions generated by 3D mapping analyses studying the flooded area and the city development of Houston over the last decennia found that new housing built in recent decennia's replaced former 'swamp' water storage areas that surrounded the city. Since 2001 over a period of 15 years the Houston had grown 23% without taking into account new water collection facilities (Sebastian et al., 2017). The residents of Houston showed the self-reliance of concerned residents. Volunteer firemen, neighbourhood's brigades, individual residents, and others mobilized themselves by successfully rescuing area residents and managing the reconstruction afterwards.

Comparing the disastrous flood hurricane effects of 'Katrina' New Orleans August 29th 2005, 'Sandy' New York October 30th 2012 and 'Harvey' Houston August 17th, these severe USA hurricanes of the 21-century show remarkable differences in reconstruction speediness', see figure 3. Unless 'Sandy' hit New York enormously by which 650.000 houses became uninhabitable and downtown Manhattan became flooded, the city recovered very fast after the hurricane. After only a number of days Manhattan was again in business. In the surrounding areas people left their houses to other places making place for new housing developments. The New York city council asked Henk Ovink from the Netherlands to be their special advisory to take the damage as a change for building a better city back, for transforming New York to a resilient region (Ovink, 2014). Houston the young the damage to the city is, already making recovering progress as well. New Orleans pitiful for the residents is still starting-up the recovery from the 'Katrina' hurricane of 2005 years longer ago. As Henk Ovink wrote in his report to the New York council, what the city needs is 'Working together to build a more resilient region'. Like the Houston residents after 'Harvey' showed, the mobilization of the people makes the difference.

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Figure 3. USA hurricanes left to right: Sandy, Sandy, Katrina, Harvey [source: Wikipedia].

Europe has laid in the shadow zone of these hurricanes in the past decennia. It was in autumn 2017 that the first Atlantic hurricane in 100 years reached the coast of Ireland. It was on the 17th of October 2017 that 'Ophelia' hit the mainland. It became the first time that Ireland needed a national storm alert. 120.000 houses lost electric power and three people were killed by the storm. According to 'The New York Times' the latest comparable storms were in 1893 and 1961. According to Ovink, Europe will become more vulnerable to hurricanes as a result of climate-change in the coming years. However, it will not be the storms but, the water nuisance from heavy rainfall and seawater rice that will cause the damage and threat (Ovink, 2014).

Surprisingly in the reports of these hurricane disasters little information is given about the role of residents in the recovering of the cities concerned. Their contribution is mentioned as important and indispensable in many of the witness reports and related research. It becomes unclear what the role of residents is in overcoming climate-change disasters, how these are mobilized, and what their motivation factors are. Because climate-change disasters are predicted to increase in intensity and frequency, the importance of fulfilling these knowledge gaps is obligatory. Therefore a comparative case in the Netherlands was used because the Netherlands has a history of struggling with water disasters since its existence. Additionally, there is conformity of the lack of knowledge with the Dutch research on the theme of resident-initiative and resident responsibility. Research done recently concerning sustainable city refurbishing and reintroducing neighbourhood responsibility group programs could be used as the 'body of knowledge' for this new research on 'Water resilience' (Sanders, 2014) (Sanders and Van Timmeren, 2017a) (Sanders and Van Timmeren, 2017b).

5. Exploring the 'Zaanstreek-Waterland' Societal Resiliency

In 2016, research was done that focused on the water-consciousness and self-reliance of the Dutch people in the Northwestern part of the Dutch Delta area where relatively the majority of the countrywide flooding took place in the past. The most recent flooding, the one of 1916 [see figure 4 for an impression], is interesting because this area is since 1916 a safety area in which all cities and civilian organizations worked together, including a large number of volunteers.

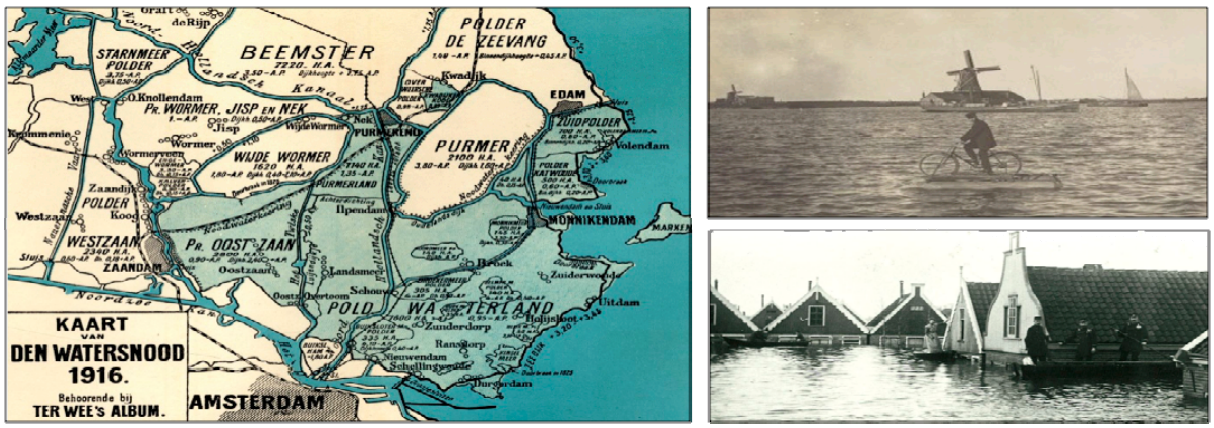

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Figure 4. Impressions of 1916 'Zaanstreek-Waterland' flooding (Aten and Wieringa, 2015).

The 1916 Zaanstreek-Waterland' area flooding, what happened and why, and its effect on present safety in the region is badly documented according to Aten and Wierenga (Aten and Wieringa, 2015). Looking back at the symbiotic cooperation of the people in the region and the local municipalities have remarkable importance in minimizing the number of casualties, the reoccupation of the people, and the help during this disaster. The 'Zaanstreek-Waterland' safety region still has large numbers of volunteers in the fire brigade, health care and other civilian supported organizations like welfare and animal-ambulance work sectors.

The security region of 'Zaanstreek-Waterland' (www.veiligheidsregiozaanstreekwaterland.nl) is an independent organization in which seven municipalities in this region have supervision. This security region finds its historic existence in the flooding of January 14th 1916, when almost the entire region. This incident created a feeling of mutual responsibility between the municipalities, related organizations, and civilians to manage safety and a diversity of tasks together. The mission statement of this security region still addressed these responsibilities in 2017: managing integral security, ready for disasters and crises, working together with police, and working together with civilians in self-reliance. The security region is active in case of fire, disasters, and crisis, has an emergency and coordination room and facilitates medical help in the region included ambulance help.

The present situation makes the civilian history of interest in relation to resilience capacity of regions to research the dynamics of this cooperation, what is remarkably distinctive. That's why for this area Dutch Officials, volunteers and residents were interviewed on location in a focus group Living-Lab setting to clearly distinguish what the important factors of resiliency for the area are. The invited interviewees were: one or two mayors, representatives of the volunteer fire brigade, the regional police, ambulance, water authority with two civilians and other dedicated residents. Based on this focus group session the following general conclusions are generated by this research:

- The role of volunteering to manage disasters was diminished in the last century due to city development, where people know each other less than compared to the agricultural areas and the little villages where most people lived before. This resulted in governmental authorities gaining responsibility and taking over the mayor role of managing safety for the people, residents, and people living in the surrounding areas.
- Since the flood of 1953 the Netherlands manages severe disasters by dividing roles by which people and professionals work on the different scales of the village or the neighbourhood and the city or a region respectively. The speculation is that in the case of severe disasters people can act faster to save others personally, and to help older and less able people. The official authorities on the other hand can focus on hospitals and other vulnerable places and begin recovery plans that include refugees.
- Wealth and long periods of safety can decrease the basic attitude of people taking responsibility when disasters take place because they are acclimated to a situation where the government has the responsibility. To be ready for severe disasters, based on the predictions of climate change, its important to activate people structurally in better times. Officials should not argue this behaviour as it diminishes the role of common people in case of severe disasters because these are needed to overcome disasters.
- Common people, residents, and people in the agricultural areas can be taught to learn and prepare themselves for volunteering in case of severe disasters by involving them in minor disturbances and giving them feedback on the results. Official authorities can learn additional information from previous severe disaster recoveries in other countries, the hurricane disasters in the USA for example.
- From the 1916 'Zaanstreek-Waterland' and other flooding recapitulations [Chapters 3 and 5] it becomes clear that the cooperation and tuning of civilian initiatives and government ruling in case of emergencies depends more on the values and choices of individual people, residents, and civil servants, than crisis planning and hierarchies. Crisis planning becomes stronger and

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more effective when the situation becomes clear to official authorities at helicopter level and when police and/or military forces arrive at the area of damage.

6. Resilience of Citizens, by 'Zaanstad Research Questionnaire

In spring 2018 a compact questionnaire is launched to the citizens of Zaanstad, the larger of the two cities in the Zaanstreek-Waterland region. Reason for this questionnaire was to research the resilience among the citizens for danger of flooding.

Awareness of the questionnaire for stimulating participation was taken care of by the local radio station and the local newspaper. By QR code participation was made easy to stimulate a large sample for the research, see figure 5. Chosen was for simple questions only to be answered by YES, NO or DON'T KNOW to facilitate the accuracy of the results. Nevertheless, the result was a low turnout, only 40 participants filled in the questionnaire, which is very little given the number of 80.000 households in the Zaanstad city. A second limitation of the research is that the composition of the participants is not representative in comparison with the local population, most of the participants were older then 60 years of age [70% instead of 22,5%] and none were young and lesser of middle age [zero instead of 22,5% and 30% instead of 50%] [According to CBS 2017 national statistics], see table 5. Therewith this research can only be seen as one of exploratory nature.

Table 5. The questionnaire participation presented in age categories.

Questionnaire participation	<20	20-60	>60
* Divided in age categories [%]	0,0	30,77	69,23

With the results of the questionnaire can though be concluded that all the questions show a remarkable clear result, all questions resulted in a preference of more then 60% for one out of the three possible answers, what somewhat compensates for the low turnout, see table 6.

Table 6. The questionnaire questions presented with results.

Question topics	YES	NO	DONT KNOW
1. Awareness of the risk that dikes can break	72,5	25,0	2,5
2. Confidence is the construction of dikes	67,5	22,5	10,0
3. Following governmental instructions by flooding	60,0	12,5	27,5
4, Rescuing neighbours instead of fleeing, by flooding	62,5	15	22,5
5. Taken precautionary measures for flood emergencies	30,0	70,0	0,0

Analysing the questionnaire outcome there could be concluded:

- Most of the citizens of Zaanstad are aware of the risk that dikes protecting their living area could break [72,55 out of 100%] although most of them have confidence in the construction of these dikes and their safety [67,5% out of 100%].
- Most of the Zaanstad citizens will follow the instructions given by governmental organizations in case of flooding [60% out of 100%] although they will rescue neighbours instead of running for the flooding if asked for, what seems to expose a dilemma for these citizens. Taking the order of the questions asked into account, in that case, it is reasonable to conclude based of these outcomes; that citizens will first rescue neighbours before they follow the instructions government.
- An interesting part of the citizen populations reacted positively that they have taken precautions for flood emergencies, having food supplies and a flashlight in stock [30% out of 100%].

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In general from this questionnaire can be concluded, under the emphasis of the limiting factors mentioned, that most of the citizens of the Dutch city Zaanstad are aware of the danger and local risks of flooding, that an interesting part of the populations have taken precautions, and that they follow instruction of government loyally, after they have take care of neighbours that need that.

7. Dutch Resilient Behaviour of Citizens, Conclusions and Lessons Learned

By comparing the resilience research results of Zaanstad with the of the former wider Zaanstreek-Waterland area research (Sanders, 2018), then it stands out that there is less difference between the people living in the countryside or the citizens living in the city nearby; 1.they are aware of the risks of flooding, 2. They rely on governmental instructions, and 3. They are willing to take responsibility for neighbours and other people nearby that need help in case of such emergencies.

The 2018 focus group session with representatives of the 'Zaanstreek-Waterland' safety area confirmed though that the contribution of official authority, people, and civilians in case of emergencies differs based on the scale of focus and the quickness of taking action. The extent, to which this also applies to the city and the citizens their behaviour, has not been investigated with the Zaanstad questionnaire research. There could be suggested that where population density in cities is greater the communication among and the support to people there will be able to develop more quickly then in the countryside. On the other hand the density of cities can cause people to be overlooked and auxiliaries to run into obstructions in streets. For substantive conclusions on this point its is necessary and advised to cities that the local control room teams become involved and interviewed.

The Zaanstreek-Waterland research resulted with the conclusion that residents and people living in the farmland areas to overcome severe disasters yet to come, can learn from less severe disturbances on two levels: 1. Learning to take action and volunteer on small scale in their living area by socially warning others and becoming prepared themselves, and 2. That taking civilian initiatives in case of emergencies is important in the first hours and days after a disaster takes place because the official authorities can not handle that fast giving support to all the people in their area. The governmental first focus is taking away the threat, the evacuation of less mobile people, such as hospitals and houses for elderly, and organizing refugees. This too is not researched for the urban situation of Zaanstad. Nevertheless, I can be accepted in a safe manner that in cities this will not be different.

Based on both research concerning the resilience by flooding in the situation of the Zaanstad city and the Zaanstreek-Waterland region, the message to conclude is; civilians and professionals from government and other authorities can work together successfully in case of severe disasters as long they know and accept their own role, and work on different scales and time schedules. Because besides government the people living are aware of the danger and an interesting percentage of them take precautions. Sharing experiences from overcoming less severe disturbances will help to bring these skills and motivations into practice to both civilians and professionals. This will make the Netherlands resilient for the coming future, in cities and in the countryside.

9. Dutch Resiliency Prospects Coupled to New Research Initiatives

In The Netherlands the four Universities of Technology in 2018 started a combined research program on resilience coupled to climate-change called DeSIRE [Designing Systems for informed Resilience Research] under management of the new 4TU-RE Research Center.[5] These Dutch four Universities of Technology [in Delft, Eindhoven, Twente and Wageningen] had not worked together in such an important program before, what shows the urgency in the Netherlands to work on

[5] www.4tu.nl/resilience

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combining practice, innovation and theory forming. Smaller programs have started too, like 'SOS Waterfront' for exchanging knowledge and vision on water related resilience between professionals of Universities in Europe. This program more then DeSIRE program focuses on the behaviour of area residents and citizens similar to the research done in the Zaanstreek-Waterland region.

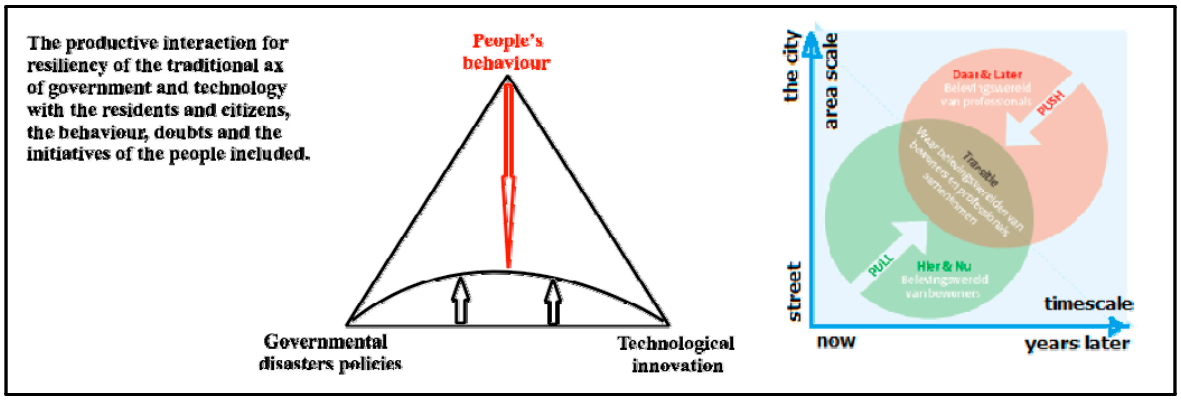

Figure 7. The resilient interaction of; government, technical professionals and residents.

These research programs differ in their focus, some take the interaction of government and technical professionals central, while for others the behaviour of residents is the starting point. From the research done in the Zaanstreek-Waterland area is concluded that the one approach cannot be seen separately from the other. As given a picture left in figure 7; these relations form a triangle, by which the collaboration between government and technical professionals has to seek alignment with the residents living in the areas for which resilient results should be developed. PhD research has proved that residents think short term attached to a small territory, while professionals think long term for large territories, what makes that a productive interaction asked for mutual respect and empathy for creating results, as pictures right in figure 7 (Sanders, 2014). Both insights confirm each other, that resilience for an area askes cooperation of all parties involved, each from their own strength without giving priority to the one or the other. Research proves to that this cooperation does not happen automatically, there are stimulating and frustrating conditions to be recognized. Therefor further research area, culture and situational coupled is recommended, that theory and practice come together for developing resiliency where needed.

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