Water Stress Governance in the Dutch Delta:

Assessing the different stakeholder frames and -responses on the island of Schouwen-Duiveland, the Netherlands

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"The issues we face are so big and the targets are so challenging that we cannot do it alone. When you look at any issue, such as food or water scarcity, it is very clear that no individual institution, government, or company can provide the solution."

- **Paul Polman, former CEO Unilever**

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Figure on the front: arial picture of Schouwen-Duiveland (retrieved April 2022 from https://www.zeeland.com/nl-nl/visit/eilanden/schouwen-duiveland)

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For now, enjoy the read!

Abstract

Evidence from climate adaptation case studies across the globe suggest that complex climate change adaptation challenges are often unjustly addressed through merely technical analysis. This may hamper the actual implementation of climate adaptive measures. In this case-study, I examined how six different stakeholder groups, on the island of Schouwen-Duiveland, were framing- and responding to water stress. By means of qualitative data analysis of 21 stakeholder interviews, I quantified how the multiple stakeholder' frames- and responses were aligned with each other. Results showed that all stakeholder groups mostly framed water stress as a complex challenge (characterized by flux and unpredictability, many competing ideas, and multiple unknown system dynamics). However, half of the stakeholder groups (the waterboard, the province and external experts) responded with merely a technical analysis of water stress. Together with other academic literature, results of this study point out the need for a more holistic view of water stress. In this, specific attention should be paid to adjusting the leadership style to match changing governance contexts.

Key words: water stress, climate change adaptation, stakeholder groups, framing, governance response, leadership styles, Cynefin framework, Schouwen-Duiveland

Abbreviations used:

ASD	Agrarisch Schouwen-Duiveland (*Agricultural Schouwen-Duiveland, the local farmers union*)
RQ	Research question
SD	Schouwen-Duiveland
ZLTO	*Zuidelijke Land- en Tuinbouw Organisatie* *(Southern Agriculture and Horticulture organisation)*
ZDZW	Zeeuws Delta Plan Zoet Water *(A Delta Plan on the scale of the province of Zeeland to address fresh water availability)*
ZMF	Zeeuwse Milieu Federatie *(An umbrella organisation for different nature organisations in Zeeland)*

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1. Introduction

As a result of climate change, more extreme weather events are expected (IPCC, 2014). The severity of these extreme weather events is depending on the geographical location and socioeconomic characteristics. For the Netherlands, it is likely that the frequency of dry periods during the summer months will increase (KNMI, 2014). For the Province of Zeeland, which is located in the South East of the Netherlands (see figure 1), these dry periods can be especially problematic because of the limited availability of fresh water in the province. Therefore, this research focused on water stress in Zeeland, and more specifically it focused on the most northern island of the province, named Schouwen-Duiveland (hereafter named SD), see the red arrow figure 1.

Figure 1: Province of Zeeland (De Louw et al. 2011)

In SD, the challenge of water stress is especially urgent because it has the deepest polders of Zeeland (up to 2 metre below sea level), which results in high salinisation rates (> 0.5mm/day) (De Louw *et al.*, 2011). These high salinisation rates, negatively influence the water quality, resulting in limited fresh water availability. This poses a serious threat to the long-term agricultural production and fresh water nature areas on the island, since these are mostly dependent on sufficient fresh water supply.

In this research water stress is defined both in terms of water quality as water quantity (Van Vliet et al., 2017). Since SD is located in a delta region, there mostly is enough water. However, the quality of this water may be insufficient during dry periods.

1.1 Background

In order to have a basic understanding of how water stress affects SD, first, the bio-physical challenges the province of Zeeland is facing will be elaborated upon. Second, several governance challenges surrounding water stress will be highlighted.

Bio-physical challenges

First, it is important to understand the biophysical characteristics of the Province since these influence the SD's vulnerability to water stress. The province of Zeeland is closely located to the sea (see figure 1 and 2) and contains several brackish lakes surrounding the peninsula's (see figure 3). Because of its saltiness, water from these lakes is not suitable for agricultural- and domestic use. This makes the province dependent on other water sources for its fresh water supply.

Figure 2: Major Rivers in the Netherlands (Klijn et al., 2018)

As can be seen in figure 2, there are multiple rivers that contain fresh water that reach the sea just above the Province of Zeeland. Diverting from these rivers, there is an extensive freshwater distribution network which can supply fresh water to most parts of the Netherlands (Klijn et al., 2018). However, not all regions of Zeeland are connected to this fresh water distribution network. The Islands of Walcheren (orange), Noord-Beveland (green), Schouwen-Duiveland (red) and a part of Zuid-Beveland (purple) are not connected to this fresh water distribution network, see figure 3 (Deltares, 2015)).

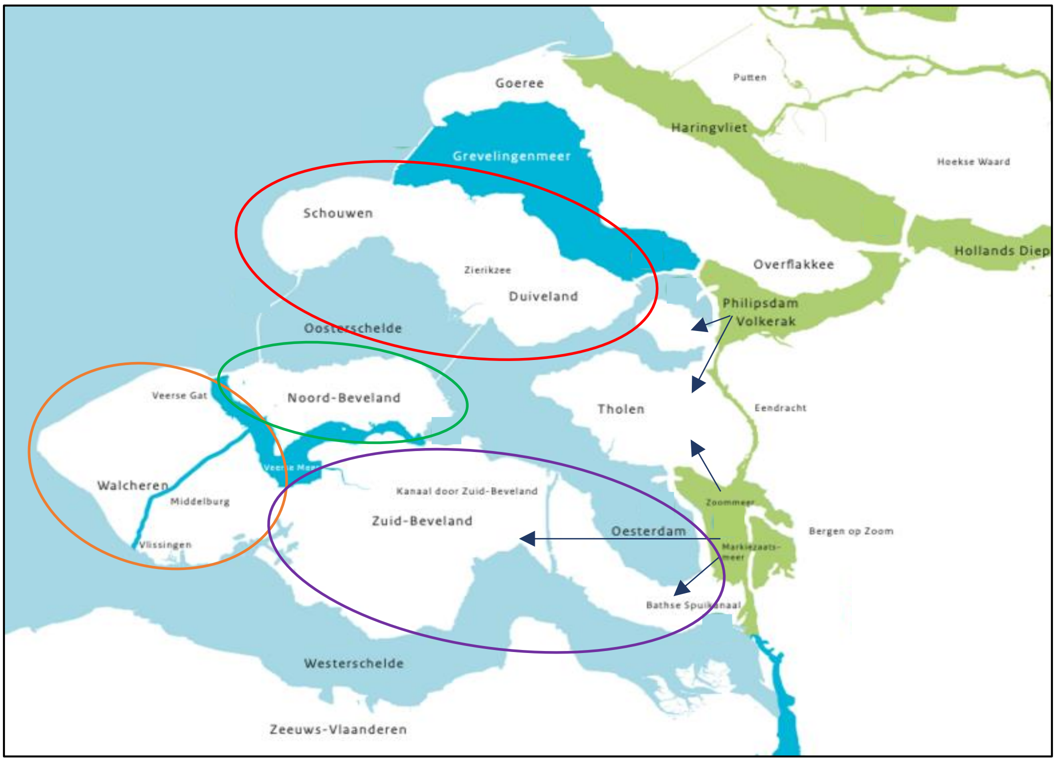

Figure 3: Overview of fresh- & saline water bodies in Zeeland: The light green colour represents fresh water bodies. The dark-blue colour represents saline water bodies, without tidal fluctuations. The light-blue colour represents saline water bodies, with tidal fluctuations. The islands are highlighted with circles: Schouwen-Duiveland (red), Noord-Beveland (dark green), Walcheren (orange), Zuid-Beveland (purple).The arrows indicate distribution of fresh water to regions in the province of Zeeland. (Deltares, 2015).

Thus, with mostly salt and brackish water surrounding the province and limited fresh water supply from rivers, ground water extractions are an option for fresh water supply. However, in comparison with Dutch provinces located more inland, Zeeland also has limited possibilities for ground water extractions. This is due to salt water intrusion[1]. Since most of the Land is located closely to sea and elevation is relatively low, salt sea water gets the possibility seep under the dikes into the polders. As a result, groundwater, ditches and other surface water bodies often contain brackish or saline water. This process is visually illustrated in figure 4. The spatial variation of seepage and infiltration in the province can be seen in figure 5. Here, areas which have a lot of seepage often also correspond with the lower areas. As a result of saltwater intrusion, surface water and water in the subsoil often contain higher sodium chloride concentrations (Geijzendorffer *et al.*, 2011; Kroes and Supit, 2011). This can be seen in figure 6 and 7. (Salt water corresponds with high chloride values (Barlow and Reichard, 2010). As a result of sea level rise, the rate of salt water intrusion is even expected to increase (Oude Essink et al., 2010).

[1] Salt water intrusion is a natural process in Deltaic areas (Custodio, 2010; Post and Abarca, 2010; Tully *et al.*, 2019). In years with average precipitation, this is not a threat, since vegetation gets enough fresh water supply via rainfall and fresh water lenses in the subsoil. However, salt water intrusion becomes problematic in the case a precipitation shortage occurs like in Zeeland in 2018. Therefore, scholars already argued that areas like Zeeland, with shallow fresh water lenses are very vulnerable to changing precipitation patterns and rising sea levels, enhance seepage (Maas, 2007; De Louw *et al.*, 2011). In the light of climate change

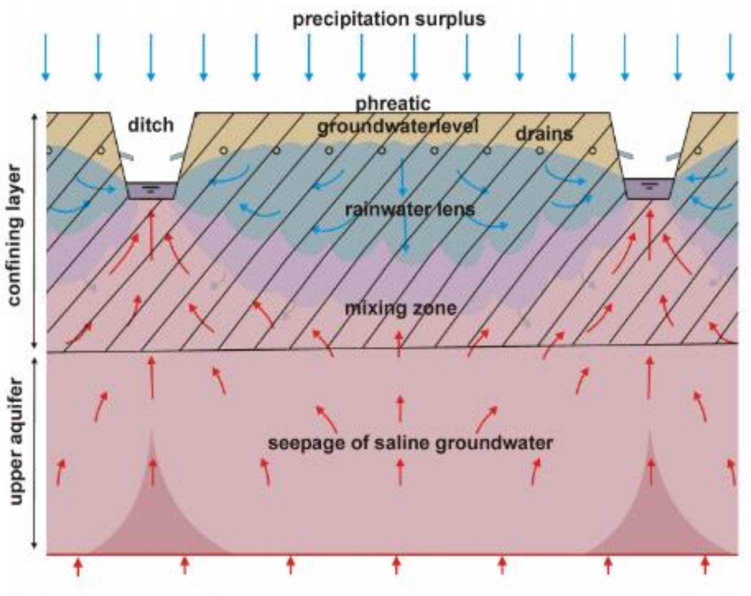

Figure 4: Visualization of saline groundwater seepage (De Louw et al. 2011)

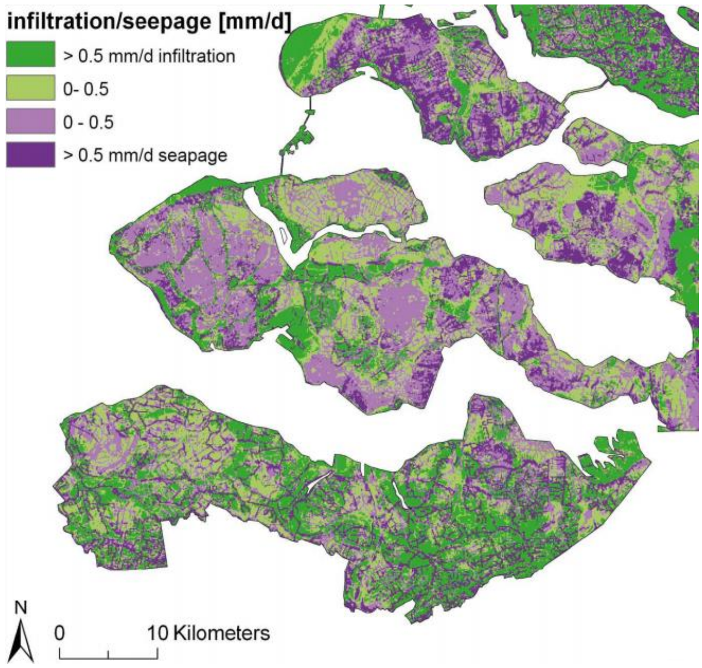

Figure 5: Infiltration and seepage rates in mm/day (De Louw et al. 2011)

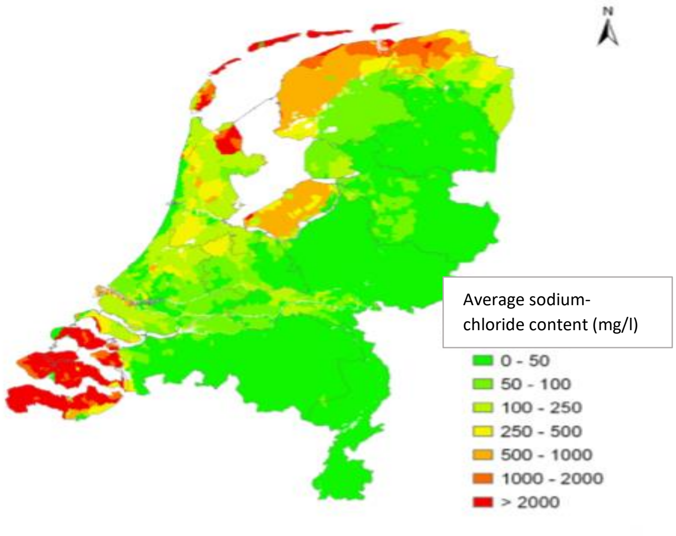

Figure 6: The average chloride-concentration in the surface-water in July, expressed in mg/litre (Geijzendorffer et al., 2011)

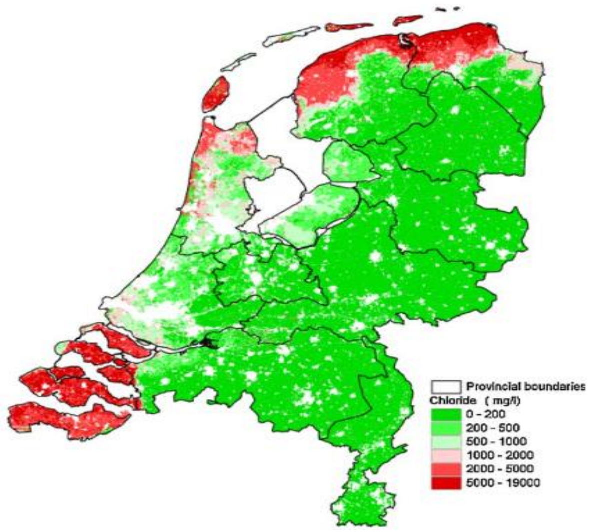

Figure 7: Spatial distribution of salinity (Cl-) concentration (mg/l) in the subsoil of the Netherlands (Kroes & Supit, 2011)

So, because of 1) the salt/brackish surface water surrounding the Province, 2) limited fresh water supply from the rivers and 3) limited fresh groundwater availability, Zeeland is mostly dependent on rainfall for its fresh water supply (Waterboard Scheldestromen, 2022). In years with average precipitation, fresh water availability most likely will not be a problem, since there is a precipitation surplus. In these years there will be enough water for domestic, recreational and agricultural purposes. However, due to the increased likeliness of dry summer periods combined with sea level rise which leads to increased salinization rates, more frequent periods of water stress are to be expected (KNMI, 2014).

To illustrate, the recent years of 2018 and 2020, already have been very dry (see figure 8). Of these years, 2018 has been the most severe, mostly affecting the agricultural sector. The subsequent years (2019 and 2020) also have been exceptionally dry (KNMI, 2021). According to the Waterboard of Zeeland, *Waterboard Scheldestromen*, the precipitation shortage in 2018 was between the 300 and 400 mm (Waterboard Scheldestromen, 2018). These water shortages have led to economic damage in the agricultural sector. To illustrate, onion yields decreased with 70% and potato yields with 20% in 2018 (Van Hussen *et al.*, 2019, page 14).

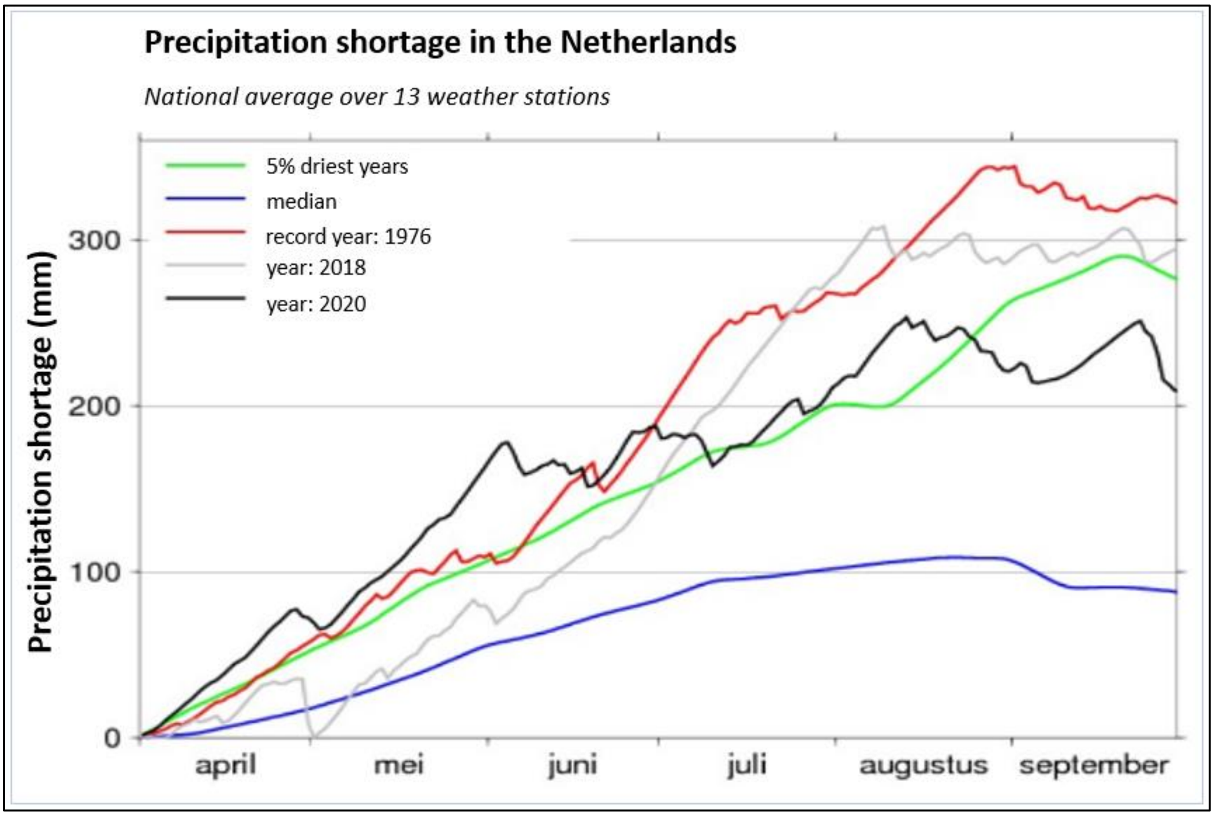

Figure 8: Precipitation shortage in the Netherlands (KNMI, 2020)

Governance challenges

Next to these biophysical challenges, there are also multiple governance challenges. In the section below these will be highlighted. First, several governance initiatives are illustrated which are already taking place. Second, the challenge of 'framing' water stress is explained and why this is important for water stress governance in SD.

(I) On a national level, there is the *National Delta Program Fresh Water.* This program entails set of measures aimed to ensure the fresh water availability throughout the Netherlands till 2050. As reaction to the dry years of 2018 – 2020, the Dutch government decided to make an extra 100 million euro available in summer 2020 for second phase of the program. The first phase (2015-2021) already entailed 400 million euro. With the extra funds, there will become another 800 million euro available for the second phase of the program from 2021 onwards for nation-wide adaptation (Dutch Delta Programme, 2020). (II) On a provincial level, the Province of Zeeland also formulated a provincial delta plan sweet water (ZDZW), where mostly technical measures were listed, which farmers could use to increase their resiliency to water stress (Province of Zeeland, 2021). Also the regional waterboard, Waterboard Scheldestromen, made a one-off investment of 100.000 euro in order to find more short-and long-term solutions regarding water stress in the future, as reaction to the recent dry years (Waterboard Scheldestromen, 2019). (III) On the level of the municipality, the municipality of SD, is facilitating and initiating various (pilot) projects and information exchange, mostly aimed at decreasing farmers vulnerability to water stress (Personal communication 2021). (IV) On a local level, depending on their location, farmers are participating in various (pilot) projects of the municipality, and uniting by labour unions which advocate for sufficient fresh water, even by means of an external fresh water pipeline towards the island (ZLTO, 2021; De Puupe, 2022).

All the above mentioned responses show that the challenge of water stress is seen as urgent challenge by the different actors. However, mostly likely all these different actors also have different ways how they frame water stress, which subsequently influences their response to water stress. For example, in SD (a part of) the agricultural sector sees the long-term future of agriculture threatened. Therefore they are advocating for an external fresh water pipeline to the island, otherwise not all farmers might be able to "run profitable agricultural companies" anymore (De Puupe, 2022). Nature organisations, mainly see the nature values threatened, and mention that recent dry years also highlight a "structural problem": In wet periods too much fresh water is drained, while in dry periods there is competition about this fresh water (Natuurmonumenten and Prinsen, 2020). The municipality of SD also frames water stress as a threat to the open landscape, because if agriculture disappears the open landscapes would also disappear, this will threaten the tourist industry on the island (Municipality of SD, 2011). So this already illustrates some of the different stakeholder frames at play.

In academic literature scholars argue that they way how stakeholders 'frame' may have "far reaching implications for the shape and success of adaptation projects" (Dewulf, 2013). Here framing is defined as "*the process by which issues, decisions, or events acquire different meanings from different perspectives*" (Dewulf, 2013, page 322). The Royal Commision on Environmental Pollution mention framing as *'perhaps the most challenging aspect of building adaptive capacity'* (Royal Commision on Environmental Pollution, 2010, page 76). A specific frame of a stakeholder may not determine what happens next, but the stakeholder who is able to set the agenda, steers the discussion in a certain direction (Dewulf, 2013). By framing, "*implicitly or explicitly, particular interests are advocated or undermined, power positions are maintained or challenged and particular actors are included or excluded from policy debates"* (Mary Pettenger, 2007; Dewulf, 2013, page 332).

Moreover, evidence from other case studies shows that complex climate adaptation challenges, like water stress, are often addressed through merely technical analysis (Finger, 1994; Pfeffer and Sutton, 2000; Kollmuss and Agyeman, 2002; Simmons and Volk, 2002; Leiserowitz et al., 2005; Fazey *et al.*, 2010; McKenzie-Mohr, 2011; Vignola *et al.*, 2017). These scholars argue that for successful adaptation to climate change, next to this technical focus, also more attention should be paid to the behavioural- and process oriented challenges. This merely technical framing may hamper the actual implementation of climate adaptive measures (Measham *et al.*, 2011; Termeer *et al.*, 2011; Meijerink and Stiller, 2013).

Concludingly, both paragraphs above as illustrated above are governance challenges which require tuning and alignment, among the different stakeholders (Levin et al. 2021; McDonnel et al. 2019). For the SD-case it is yet unknown how stakeholders frame and respond to water stress. Therefore an assessment of stakeholder frames and responses to water stress is needed. This could fungate as a first step in aligning stakeholders frames and responses towards water stress.

1.2 Knowledge gap

The knowledge gap of this research was two-fold. Firstly, it was unclear how stakeholders in SD were framing water stress. This is important to know since the way stakeholders frame water stress, has implications for the governance response needed (Snowden and Boone, 2007; Dewulf, 2013). Secondly, it was unclear whether stakeholders' governance response was aligned with their framing.

My hypothesis was that the water stress challenges in SD were mostly framed as a complex challenge (characterized by multiple interests and knowledge references and deep uncertainties) by the different stakeholders. However, my assumption was that stakeholders were mostly responding with mere technical analysis of water stress (Fazey *et al.*, 2010; Vignola *et al.*, 2017). This is interesting since a complex challenge like water stress, would demand a more 'probing' governance response, and increased levels of interaction and communication among actors (Snowden and Boone, 2007). In order to verify whether this hypothesis is true, this research was executed.

1.3 Objective of this research

The objective of this research is two-fold. First, it is to assess the different stakeholder frames and responses to water stress. Second, it is to assess how these frames and response are aligned with each other.

By doing so, this research could help decision makers in SD, to identify potential mismatches between stakeholders framing and actual responses to water stress.

1.4 Research questions

Main research question:

How are stakeholders framing and responding to water stress in Schouwen-Duiveland, and how is this framing and response aligned with each other?

Sub research questions:

1. *Who are the main stakeholders in water stress governance in Schouwen-Duiveland?*
2. *How are the main stakeholders framing the causes and problems related to water stress?*
3. *How are stakeholders responding to the causes and problems related to water stress?*
4. *What is the complexity-level of stakeholders' framing- and response to water stress, according to the Cynefin framework?*

1.5 Reading guide

This thesis report consists of seven chapters. The introduction chapter, which you just read, serves as an introduction where the challenge of water stress is introduced, afterwards the knowledge gap, objective and research questions were mentioned. The theory and concepts chapter, presents the theoretical framework and concepts used in this research. The methodology chapter presents the method of data collection and data analysis. The results chapter highlights the involved stakeholder groups in water stress governance, and their main ways of framing and responding towards water stress in SD. Also, the study results are linked to the conceptual framework used. The discussion chapter discusses the study limitations and the results. Also, it compares the study results with other relevant academic research. The conclusion chapter restates the key findings and answers the main research question. In the recommendations chapter, several recommendations for the municipality of SD are listed. Afterwards the references and several appendices (including a summary in Dutch) are listed.

2. Theory and Concepts

2.1 Definition water stress & governance

Since this research is about the governance of water stress, it is good to define wat is meant by 'water stress' and what is meant by 'governance'.

For the term 'water stress', the definition as defined by the European Environment Agency (EEA) will be used (Felberg et al., 1999, page 155):

In this research **water stress** is defined as an event ***"when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use. Water stress causes deterioration of fresh water resources in terms of quantity (aquifer over-exploitation, dry rivers, etc.) and quality (eutrophication, organic matter pollution, saline intrusion, etc.)".***

Important to note that water stress is defined both in terms of water quality and water quantity (Felberg et al., 1999; Van Vliet et al., 2017). Also, in most of the cases, water stress is relative to human needs. In the SD-case mostly human activity will determine the water demand (e.g. in unpopulated desert places there is not necessarily water stress).

To illustrate water stress with some pratical examples: SD farmers may have enough water in the ditches around their plots, but if the water is too saline for agricultural use, this still is considered as water stress since the quality of the water is insufficient. Also, if there is a precipitation surplus, but water intensive crops like onions still require more water, this also is considered as water stress.

Second, the term governance was defined.

In this research **governance** was defined as: "***the act of governing resources and environments, and the ensemble of organizations, institutional frameworks, norms and practices, operating across multiple spatial scales, through which such governing occurs"*** (Perreault, 2014, page 236-237)**.**

Thus in this research (obviously) the 'resource' is water and the 'environment' is the island of SD.

2.2 Complexity science

The conceptual framework, which will be presented in in subchapter 2.3, stems form complexity science. In order to have a basic understanding of complexity science, this chapter will provide an overview of complexity science. Complexity science is more a way of thinking about the world, rather than a new way of working (Snowden and Boone, 2007). One could see it as the frame, or the lens, by which systems are studied. Complexity science "*studies how a large collection of components … can spontaneously self-organize to exhibit non-trivial global structures and behaviours at larger scales, often without external intervention, central authorities or leaders"* (De Domenico and Sayama, 2019). The benefit of complexity science is that it can help leaders to make sense of systems fraught by uncertainties and multiple simultaneous-occurring-interactions. Often this is referred to as a 'complex adaptive system'. Water stress on the island of SD could be seen as such a 'complex adaptive system'.

In the table below the six characteristics of complex adaptive systems are highlighted (Snowden and Boone, 2007, page 3). In the right column of the table the characteristic are tailored to the case of water stress in SD.

Table 1: Characteristics of complex adaptive systems

	Characteristics of a complex adaptive system (Snowden and Boone, 2007)	Examples tailored to the case of water stress in SD
1	*"It involves large numbers of interacting elements."*	Many different stakeholders constantly interacting with each other (e.g. farmers – waterboard about water level in the ditches, or municipality – province about funding for climate adaptive projects)
2	*"The interactions are nonlinear, and minor changes can produce disproportionately major consequences."*	Small changes like stricter regulations on fertilizer use, may cause farmers to shift from cultivation of water intensive crops like onions, to less water demanding crops like wheat. This may have major consequences on the total water demand if done over the whole island.
3	*"The system is dynamic, the whole is greater than the sum of its parts, and solutions can't be imposed; rather, they arise from the circumstances. This is frequently referred to as emergence."*	If small partnership between farmers arise in collectively storing fresh water in basins. When effective other farmers across the island are likely to adopt this way of working.
4	*"The system has a history, and the past is integrated with the present; the elements evolve with one another and with the environment; and evolution is irreversible."*	For centuries the focus in water management on SD has been on drainage. Mostly, the threat has been too much water instead of too little. This influences willingness of stakeholders in participating in projects related to water stress. Also stakeholders have an history in interacting with each other. For example farmers and waterboard have had a long history in managing water levels together.
5	*"Though a complex system may, in retrospect, appear to be ordered and predictable, hindsight does not lead to foresight because the external conditions and systems constantly change."*	Global food prices can fluctuate caused by external conditions. An example is the war between Russia and Ukraine, which increased global wheat prices, which may increase SD farmers willingness to plant more wheat, which subsequently influences the water demand on SD.
6	*"Unlike in ordered systems (where the system constrains the agents), or chaotic systems (where there are no constraints), in a complex system the agents and the system constrain one another, especially over time. This means that we cannot fully forecast or predict what will happen."*	Perhaps in 50 years the market of sea-based food has grown till such extent, that it is more profitable for SD farmers to produce sea-based food instead of traditional crops. This will place the challenge of water stress in another perspective. However changes like this cannot be fully predicted on foresight.

Another well known example of a complex adaptive system is a flock of birds, if you were to fly to the centre of the flock avoid collusion and match speed, the flock is likely to adapt. Within complexity science, this flock of birds would be considered as a complex adaptive system (Snowden and Boone, 2007).

This way of thinking can also be helpful for the case of water stress governance in SD, since water stress governance by its very nature involves uncertainties, many interacting elements and wide stakeholder involvement (McDonnel *et al.*, 2020). Also here we cannot always fully predict what will happen in the future. In the SD case there are multiple interacting stakeholders (municipality, agricultural sector, waterboard etc.) whom are all being affected by water stress. By seeing these different stakeholders and the challenges as one complex adaptive system, the interconnectedness in the system and the system-behaviour will probably be highlighted.

2.3 Cynefin framework

A helpful framework for analysing complex adaptive systems is the *Cynefin Framework*. This framework was used for the data analysis in this research. Complex adaptive system, like explained above, can take different shapes and forms. Each complex adaptive system has a certain level of complexity. To understand the level of complexity present, the Cynefin framework is useful. The strength of the Cynefin framework is that it helps executives to determine the level of complexity in which they are operating (also known as the 'operative context'). Subsequently, the framework also helps executives to adopt a leadership style, which matches the complexity level they are facing (Snowden et al. 2007). Leaders who have to make decisions, while dealing with a lot of uncertainty will find this framework especially useful (Snowden et al. 2007). Therefore, it was used and applied on the case study of water stress in SD. Hopefully, the study results will provide some relevant insights for leaders in SD.

Originally, the framework was developed for a more corporate business environment. However, it has been widely applied by leaders across various domains (Snowden and Boone, 2007). For example, the U.S. Defence Agency has applied it to combat terrorism, provincial governments in Canada have used it for engaging employees in policy making, and recently it was used by the European commission on managing uncertainty and complexity during the recent COVID-19 pandemic (Snowden and Boone, 2007; Snowden and Rancati, 2021). In this research, instead of a cooperate business environment, the framework was applied in a more environmental governance environment.

The framework consists of five operative contexts. These are: 1) *simple,* 2) *complicated,* 3) *complex,* 4) *chaotic* and 5) *disorder* (Snowden et al. 2007). See figure 9. This research focused on the first four operative contexts. Here, an operative context is defined as the context in which the leader has to operate – each operative context requires a certain leadership style. Among the four operative contexts a distinction is to be made between ordered and unordered. '*Simple*' and '*complicated*' contexts assume an ordered world where there are clear cause-and-effect relationships, and right answers can be determined based on facts. On the contrary, '*complex*' and '*chaotic'* contexts assume an unordered world. This means that there are no clear cause and effect relationships, and the way forward should be determined based on emerging patterns. Ordered contexts represent fact-based management. Unordered contexts represent pattern based management. (Snowden and Boone, 2007)

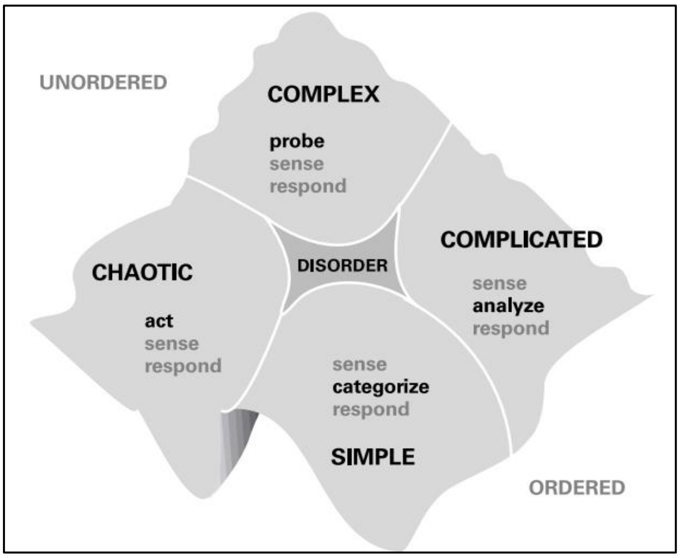

Figure 9: Different operative contexts - with appropriate governance responses - Cynefin Framework (Snowden and Boone, 2007)

Below the four operative contexts are explained in separately.

1) Simple contexts are often characterized by clear cause-and-effect relationships. The right answers for problems are often self-evident. Also, all parties involved share the same understanding of the problem that needs to be solved. This operative context is the realm of 'known knowns'. The appropriate governance response to problems in this operative context requires a straightforward management approach. Because of the shared understanding and the subsequent management approach needed, simple contexts are also known as the domain of the best practice (Snowden and Boone, 2007). Executives in this operative context should *sense*, *categorize* and then *respond*. Emphasis is on categorising. (Snowden et al. 2007) Tailored to the context of SD, a simple governance approach could be, 'there is no fresh water, let's construct an external fresh water pipe line'. Straight forward management approach to solve the problem.

2) Complicated contexts, in contrast to simple contexts, may contain multiple right answers to occurring problems. Though there is a relationship between cause and effect, it is not immediately apparent to everyone. Therefore, this operative context is characterized by 'known unknowns'. An example could be new methods for groundwater storage. The challenge is clear, but experts like hydrologists and geomorphologists are needed to determine exact locations and methods where this is possible. (Second example could be problems in the engine of a F1 car, the engine itself highly complicated, but with expert knowledge of F1 mechanics, problems in the engine can be solved.) Leaders operating in complicated contexts, should *sense*, *analyse*, *respond*. Emphasis is on analysing. (Snowden et al. 2007) Tailored to the context of SD, a complicated governance approach could be, 'we don't fully understand the fresh and saline water flows in the underground yet, let's do more research'. If more research is done, then appropriate solutions can be developed.

3) Complex contexts, don't provide right answers on a problem on forehand. Only on hindsight 'right' answers or patterns can be determined. Whereas in the complicated domain 'right' answers (which is a little subjective..) can be found by expert diagnosis (remember the ordered world), complex problems do not provide these 'right' answers on forehand (remember a unordered world). Therefore, complex contexts are characterized by 'unknown unknows'. On forehand you do not know how a system will react, because of its complexity. Leaders who are operating in this context should therefore allow patterns to emergence. Often this is done by increased levels of interaction and communication among actors. By doing so leaders can discover along the way what works and what does not work. The appropriate governance response in this domain is to *probe*, then *sense* and then *respond*. Emphasis is on probing. (Snowden et al. 2007) Complex contexts could also be seen as the domain of the 'wicked problems' (Rittel and Webber, 1973). Tailored to the context of SD water stress could be considered as a complex challenge because of the multiple biophysical- and governance challenges simultaneously affecting the stakeholders involved. Also, most system behaviour cannot be predicted on forehand (e.g. many SD farmers are producing for the global food market which is subject to unpredictable changes like a COVID-19 pandemic, war and other crisis. This can impact water demand.) This makes the system complex as well. In this case the appropriate governance response would be to increase levels of interaction and communication among actors and create environments were patterns can emerge (Snowden and Boone, 2007).

4) Chaotic contexts, are characterized by turbulence and chaos. There is little time to think, and many decisions need to be made. With the time available, there is no point in looking for clear

cause-and-effect relationships. Therefore, searching for right answers or patterns on forehand in this operative context is pointless. Examples of chaotic operative contexts would be crises like a major dike breach. The governance response in these contexts should not be to discover patterns, but rather to 'stench the bleeding'. Leaders should firstly *act* then *sense* and then *respond*. Emphasis is on acting. (Snowden et al. 2007) Tailored to the context of SD, a chaotic operative context would occur when there is a 'crisis' situation where there is an extensive period of water stress and decisions should be made on which functions on the island do receive water and which do not.

Lastly, it is important to note that water stress, likely has certain aspects which fall in one operative context, while other aspects will fall in another operative context. This is also the reason why the lines in figure 9 are bent and not straight. Most challenges do not completely fall in one context.

In table 2 below an overview is given on the different operative contexts and their needed responses. The four rows represent the 4 different operative contexts. The first column highlights characteristics of each operative context. The second column elaborates on the appropriate governance response. The third column highlights danger signals (or pitfalls) executives often tend to fall in to. The fourth column subsequently mentions tips for executives to prevent falling in these pitfalls.

Table 2: A leaders guide for managing different operative contexts (Snowden et al. 2007, page 7) – blue elements added by the researcher

Decisions in Multiple Contexts: A Leader's Guide

Effective leaders learn to shift their decision-making styles to match changing business environments. Simple, complicated, complex, and chaotic contexts each call for different managerial responses. By correctly identifying the governing context, staying aware of danger signals, and avoiding inappropriate reactions, managers can lead effectively in a variety of situations.

	THE CONTEXT'S CHARACTERISTICS	THE LEADER'S JOB	DANGER SIGNALS	RESPONSE TO DANGER SIGNALS
SIMPLE	Repeating patterns and consistent events Clear cause-and-effect relationships evident to everyone; right answer exists Known knowns Fact-based management	Sense, categorize, respond Ensure that proper processes are in place Delegate Use best practices Communicate in clear, direct ways Understand that extensive interactive communication may not be necessary	Complacency and comfort Desire to make complex problems simple Entrained thinking No challenge of received wisdom Overreliance on best practice if context shifts	Create communication channels to challenge orthodoxy Stay connected without micromanaging Don't assume things are simple Recognize both the value and the limitations of best practice
COMPLICATED	Expert diagnosis required Cause-and-effect relationships discoverable but not immediately apparent to everyone; more than one right answer possible Known unknowns Fact-based management	Sense, analyze, respond Create panels of experts Listen to conflicting advice	Experts overconfident in their own solutions or in the efficacy of past solutions Analysis paralysis Expert panels Viewpoints of nonexperts excluded	Encourage external and internal stakeholders to challenge expert opinions to combat entrained thinking Use experiments and games to force people to think outside the familiar
COMPLEX	Flux and unpredictability No right answers; emergent instructive patterns Unknown unknowns Many competing ideas A need for creative and innovative approaches Pattern-based leadership	Probe, sense, respond Create environments and experiments that allow patterns to emerge Increase levels of interaction and communication Use methods that can help generate ideas: Open up discussion (as through large group methods); set barriers; stimulate attractors; encourage dissent and diversity; and manage starting conditions and monitor for emergence	Temptation to fall back into habitual, command-and-control mode Temptation to look for facts rather than allowing patterns to emerge Desire for accelerated resolution of problems or exploitation of opportunities	Be patient and allow time for reflection Use approaches that encourage interaction so patterns can emerge
CHAOTIC	High turbulence No clear cause-and-effect relationships, so no point in looking for right answers Unknowables Many decisions to make and no time to think High tension Pattern-based leadership	Act, sense, respond Look for what works instead of seeking right answers Take immediate action to reestablish order (command and control) Provide clear, direct communication	Applying a command-and-control approach longer than needed "Cult of the leader" Missed opportunity for innovation Chaos unabated	Set up mechanisms (such as parallel teams) to take advantage of opportunities afforded by a chaotic environment Encourage advisers to challenge your point of view once the crisis has abated Work to shift the context from chaotic to complex

framing *response*

Now the question arises, in which operative context(s) are SD stakeholders mainly framing water stress? And in which operative context(s) are the different stakeholder groups mainly responding? And most important, does their framing align with their response?

As referred to before, appropriately dealing with water stress is a hugely complex undertaking due to large uncertainties, different stakeholders, the far reaching consequences of water stress and the other biophysical and governance challenges mentioned previously (McDonnel *et al.*, 2020). Therefore, it is to be expected that water stress mostly can be considered a complex challenge, and should also be addressed in that operative context. However, whether this is actually happening should be assed.

Currently, stakeholders are acting in multiple ways. (e.g. the province came with a delta plan, the municipality is facilitating and initiating multiple pilot projects, where farmers are taking action themselves etc.) However, while multiple developments to deal with water stress are taking place, it is unclear yet in what operative context(s) stakeholders framing are responding. The operative context in which stakeholders are responding is important to know, since the Cynefin framework argues, that different contexts requires different leadership styles (Snowden and Boone, 2007).

My hypothesis is that stakeholders on SD, according to the Cynefin framework, are mostly framing water stress a complex challenge. However, my hypothesis is that most measures currently taken are mainly corresponding with the *complicated* domain. This is interesting since a *complex* operative context would require a more ‘probing’ governance response, instead of a mostly ‘analysing’ governance response. In order to verify whether this hypothesis is true, this research needs to be done. Results of this research could be relevant for adopting different leadership styles which might be needed.

3. Methodology

In this chapter the method for data collection and analysis are described and justified. First, the data collection is explained by highlighting which stakeholder groups were identified and how this data was collected from the stakeholders. Second, the method of data analysis is explained by highlighting was coded.

The data to answer the research questions was gathered by conducting 21 interviews with key stakeholders, and review of relevant policy documents. After the interviews, the interviews were transcribed and coded. On basis of code frequency, and the content of the answers, research questions were answered. Also, telling quotes were used in the results section to illustrate a point.

3.1 Data collection

21 interviews were executed with interviewees from six main stakeholder groups. These six main stakeholder groups were identified and selected, on basis foreknowledge of the researcher with the case study, literature review of relevant policy documents, information retrieved during 1on1 conversations with the project leader of the Living Lab SD. This project leader was involved in multiple projects related to water stress on SD and could easily provide me with contact details of interviewees. Therefore, the methods of data collection could be classified as 'snowball sampling' and 'convenience sampling' (Farrokhi and Mahmoudi-Hamidabad, 2012; Kumar, 2019). The stakeholder groups were selected, either since they were directly affected by water stress, or they were involved in the execution (pilot) projects related to water stress, or they were involved in the funding of (pilot) projects related to water stress. The six stakeholder groups which were interviewed, are presented in the table below. Also the roles of the interviewees within the stakeholder groups are presented.

Table 3: Stakeholder groups and interviewees which were interviewed during research

Stakeholder Group:	**1. Municipality of Schouwen-Duiveland**	**2. Waterboard Scheldestromen**	**3. The Province of Zeeland**	**4. Agricultural Sector**	**5. Nature organisations**	**6. External Advisors and Experts**
Role of interviewees within their organisation:	1. Policy advisor 2. Project leader 3. Alterman (wethouder) 4. Spatial planner	5. Hydrologist 6. Hydrologist 7. Field supervisor 8. Former Advisor	9. Policy advisor 10. Policy advisor	11. Representative ZLTO 12. Farmer 13. Farmer 14. Farmer 15. Farmer	16. Representative ZMF 17. Public relations manager & field supervisor Natuurmonumenten	18. Consultant Deltares 19. Consultant KWR 20. Consultant Buro Waterfront 21. Governance expert

Out of these six stakeholder groups, the first three stakeholder groups are especially relevant for this research, since these are government bodies which have authority and budget to formulate and execute policy on water stress. From each stakeholder group I executed at least two interviews to prevent bias from just one interview. Also, within each stakeholder group, interviewees with different types of roles were interviewed in order to get a comprehensive understanding. For example, for the municipality, I also decided to interview an alterman (*wethouder*), to increase my understanding on how the topic of water stress was embedded politically. For the waterboard and nature organisations, I also interviewed an field supervisor (*opzichter),* since these interviewees had a lot of direct contact with farmers, and local knowledge of the study area.

Also, this field supervisor also provided me with several contacts form the agricultural which I could interview ('snowball sampling') (Kumar, 2019). For the agricultural sector, I tried to spatially separate the interview locations with farmers in order to get a comprehensive understanding of the entire study area. The approximate locations of the farmer interviews are presented in figure 10.

Figure 10: Approximate interview locations farmers *(source: maps.google.com)*

The 'external advisors and experts' group mostly consisted out of consultants from knowledge institutes who were advising government bodies. Since this group had a influential role in advising they were included in this research as one stakeholder group.

Hereafter, stakeholders will only be referred to with name of that stakeholder group. This is done in order to safeguard stakeholders anonymity. (For example, an interview with and interviewee from the waterboard will be referred to as "*Interviewee4_Waterboard".* Here the number four is randomly chosen, and is not necessarily the fourth person in the list.)

The interviews were held in a semi-structured format (Adams, 2015; McIntosh and Morse, 2015). This meant, that depending on the answers given by stakeholders, possible follow up questions were asked. In total the interviews lasted about 45 minutes per interview. With consent of the interviewees the interviews were recorded. Twelve of the twenty one interviews were held in person and recorded via a mobile phone. Nine of the twenty one interviews were held online and recoded via Microsoft teams.

In Annex E – Interview questionsthe asked interview questions and (possible) follow-up questions are listed. Also the corresponding RQ's to which the interview questions are referring to are listed in the third and fourth column of Annex E – Interview questions. The interview questions were designed to correspond with certain parts of the Cynefin framework, these parts are listed on the right side of the column (Snowden and Boone, 2007). RQs one, two and three, were answered by executing the interviews. RQ four, was answered after further data analysis.

3.3 Data analysis

Interviews were recorded, with consent of the interviewees, and were consequently transcribed into separate Microsoft Word documents. These documents were imported into the qualitative data analysis software 'ATLAS.ti 9 Windows' and ordered per stakeholder group. Afterwards, all documents were coded, based on characteristics of the Cynefin framework. The original Cynefin framework, as presented in chapter 2 '*Theory and Concepts*', was operationalized to fit the context of water stress governance in SD. This operationalized Cynefin framework is presented in table 4 below. Here the original Cynefin 'context characteristics' and 'leaders job' are displayed in grey (Snowden and Boone, 2007). The operationalized 'context characteristics' and 'leaders job' are displayed in green. In this way, the researcher had a clear indication of what kind of characteristics to search for in the text, in order to assign a code.

Table 4: Operationalized Cynefin Framework

Operative context:	**Context characteristics (1):**	**Context characteristics (1)** – tailored to Zeeland:	**The Leader's Job (2):**	**The Leaders Job (2)** – tailored to Zeeland:
'SIMPLE' (A)	***A.1.1:*** *'Repeating patterns and consistent events'* ***A.1.2:*** *'Clear cause-and-effect relationships evident to everyone; right answer exists'* ***A.1.3:*** *'Known knowns'* ***A.1.4:***	**A.1.1:** Water stress is described as a phenomenon with a repeating pattern with consistent characteristics. **A.1.2:** Water stress is described as a phenomenon with clear cause and effect relationships, evident to everyone. Also the right solution to water stress exists. **A.1.3:** The cause-, mechanisms-, and solutions to water stress are clearly mentioned. **A.1.4:**	***A.2.1:*** *'Sense, categorize, respond'* ***A.2.2:*** *'Ensure that proper processes are in place'* ***A.2.3:*** *'Delegate'* ***A.2.4:*** *'Use best practices'* ***A.2.5:***	**A.2.1:** A governance response is described with firstly a "*sensing*"- then an "*categorizing*"- and lastly a "*responding*" character. The emphasis is on categorising. **A.2.2:** Proper processes/procedures to deal with water stress are mentioned. **A.2.3:** Delegating is mentioned as means to cope with water stress. **A.2.4:** Several 'best practices' to deal with water stress are mentioned.

	'Fact-based management'	Water stress is described as a challenge where "right" governance responses, can be determined based on facts.	*'Communicate in clear, direct ways'* ***A.2.6:*** *'Understand that extensive interactive communication may not be necessary'*	**A.2.5:** A governance response is described where there is clear and direct communication on what to do in case of water stress. **A.2.6:** Extensive & interactive communication on the topic of water stress is described as not necessary.
'COMPLICATED' (B)	***B.1.1:*** *'expert diagnosis required'* ***B.1.2:*** *Cause-and-effect relationships discoverable but not immediately apparent to everyone; more than one right answer possible'* ***B.1.3:*** *'Known unknowns'* ***B.1.4:*** *'Fact-based management'*	**B.1.1:** Expert diagnosis is described as means to solve a problem. Here experts are defined as: hydrologists, geomorphologists, civil engineers & social scientists. The experts do research on water stress (-related topics). **B.1.2:** A problem perception of water stress is described which calls for research to discover the "cause-and-effect" relationship. Multiple strategies to deal with the cause are possible. **B.1.3:** There is mentioned in which area there are unknowns. These "unknowns" can be determined by analysis of that area. **B.1.4:** Water stress is described as a challenge where "right" answers, can be determined mostly based on facts.	**B.2.1:** *'Sense, analyse, respond'* **B.2.2:** *'Create panels of experts'* **B.2.3:** *'Listen to conflicting advice'*	**B.2.1:** A governance response is described with firstly a "*sensing"*- then an *"analysing"*- and lastly a *"responding"* character. The emphasis is on analysing. **B.2.2:** 'Expert panel creation' is mentioned. Here experts are defined as: hydrologists, geomorphologists, civil engineers & social scientists. **B.2.3:** Policy makers are described which listen to conflicting advice(s) on the topic of water stress.
'COMPLEX' (C)	**C.1.1:** *'Flux and unpredictability'*	**C.1.1:** Water stress is described as a challenge in which there is a lot of "flux and unpredictability".	**C.2.1:** *'Probe, sense, respond'*	**C.2.1:** A governance response is described with firstly a "*probing"*- then an "sen*sing"*- and lastly a *"responding"* character. The emphasis is on the probing. Here probing is defined as:

	C.1.2: *'No right answers; emergent instructive patterns'* **C.1.3:** *'Unknown unknowns'* **C.1.4:** *'Many competing ideas'*	**C.1.2:** Water stress is described as a challenge for which there is no single perfect solution. Secondly, emergent and instructive patterns are described. These can be instructive in new policy formulation. **C.1.3:** Water stress is described as a challenge in which there are multiple unknown system dynamics (see conceptual chapter on CAS). **C.1.4:** The management of water stress is described as a 'wicked problem' in which there are many different and competing ideas on how to deal with water stress.	**C.2.2:** *'Create environments and experiments that allow patterns to emerge'*	Searching into the right course of action, by creating safe-to-fail experiments as if with a probe. **C.2.2:** The creation of environments and experiments that allow patterns to emerge are described. Here environments could be seen as actual physical spaces (like a plot to run experiments) as well figurative/metaphorical spaces (like a building stronger relationships among stakeholders). Experiments are defined as safe-to-fail experiments in relation to water stress. The created environments and experiments are used to "probe" what the right course of action ought to be.
	C.1.5: *'A need for creative and innovative approaches'* **C.1.6** *'Pattern-based leadership'*	**C.1.5:** A need for creative and innovative approaches is expressed. **C.1.6:** The management of water stress is described as a challenge which requires 'pattern-based-leadership'. Meaning: the leadership is based on certain patterns unfolding during (or after) water stress.	**C.2.3:** *'Increase levels of interaction and communication'* **C.2.4:** *'Use methods that can help generate ideas: Open up discussion (as through large group methods); set barriers; stimulate attractors; encourage dissent and diversity; and manage starting conditions and monitor for emergence'*	**C.2.3:** A governance response is described in which there are "increased levels of interaction and communication" among stakeholders affected by water stress in Zeeland. **C.2.4:** Methods are described that can help generate ideas. These are: "Open up discussion (as through large group methods); set barriers; stimulate attractors; encourage dissent and diversity; and manage starting conditions and monitor for emergence". An elaboration on each of these methods can be found in Annex F – Tools for Managing in a complex context. If the data corresponds with these characteristics of Annex F – Tools for Managing in a complex context, it may be used for coding.

Explanation table:

As can be seen each characteristic has a corresponding 'code', like A.1.1, A.1.2, A.1.3. etc.

- The first letter stands for the corresponding 'operative context': **A** for '*simple*'-, **B** for '*complicated*'- & **C** for *'complex' domain*.
- The first number stands for the corresponding column: **1** for '*context characteristics*' & **2** for the '*leaders' job'*
- The last number stands for the sequence: **1** for the first, **2** for the second, **3** for the third, etc.

The codes, as described in the green columns, were added as individual codes in Atlas.ti and used for the coding.

After all documents were coded, the code frequency could be assessed. Here a distinction was made between stakeholders' problem perception (*the context characteristics*), and stakeholders' response (*the leaders job*). In addition, a distinction was made per operative context (simple, complicated, complex). In this way the complexity level of stakeholders framing- and response could be determined, which answered RQ four.

The image below summarizes the methodology in one image:

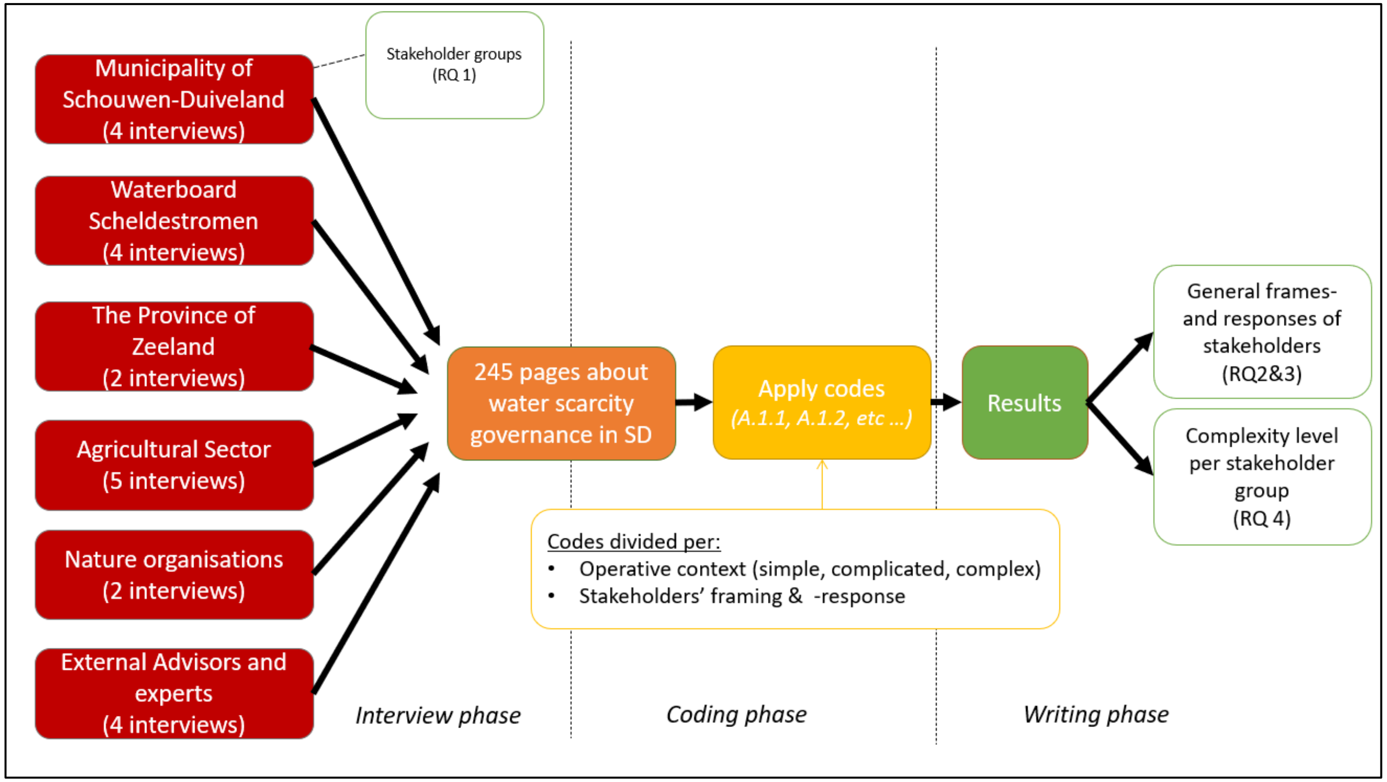

Figure 1: Methodology

Next to the coding, several policy documents were assed. The municipality provided me with multiple policy documents and evaluation reports of water projects. Also, the one of the experts provided me several advice reports published by the governance task force. These documents were not used for the coding analysis, but were read by the researcher to understand the multiple pilot projects taking place, and increased his understanding of the case study.

4. Results

The results chapter is divided in four sub-chapters. Each sub-chapter answers one of the research questions in chronological order. Sub-chapter 4.1 introduces the main stakeholder groups and their role in water stress governance, thereby answering RQ1. Sub-chapter 4.2 shows stakeholders' problem perception, thereby answering RQ2. Sub-chapter 4.3 shows how stakeholders response to water stress, thereby answering RQ3. In sub-chapter 4.4, the Cynefin framework is applied on stakeholders' problem perception- and response to water stress, this answers RQ4.

4.1 Main stakeholders (RQ1)

This sub-chapter answers RQ1 "*Who are the main stakeholders in water stress governance in Schouwen-Duiveland?"*

This research identified six main stakeholder groups in the water stress governance on SD. These are in random order: 1) The agricultural sector, 2) Nature organisations, 3) The municipality of SD, 4) Waterboard Scheldestromen, 5) The Province of Zeeland and 6) External advisors & experts. In the section below each stakeholder group is briefly introduced and how water stress affects them:

1. Agricultural sector

The agricultural sector has been affected directly by water stress in recent years. Water stress mostly resulted in lower yields, (and in some cases also loss in revenues, since prices also fluctuate based on supply) (Van Hussen *et al.*, 2019, page 14). Compared to surrounding islands who do have fresh water supply, many farmers on SD, saw their long-term competitive position under threat. The extent that agricultural companies are affected differs. This largely depends on the soil type, type of crop, and location in the water system. However, some famers still saw flooding as a bigger threat that water stress.

2. Nature organisations

Nature areas have been affected in both terms of water quantity and water quality (mainly salt water intrusion). There are several nature areas, of which most are located on the south- and west side of the Island. Several (protected) species had difficulties during dry years, such as the Natterjack Toad which needs fresh water and shore birds where the breeding season failed two years in a row. To deal with water stress, nature organizations are mostly in contact with the province on several nature restoration projects. Most projects are aimed to make nature areas more resilient to water stress.

3. Municipality of SD

The municipality itself is not directly affected by waters scarcity, in the sense that the people working for the municipality still have enough water. However, if the agricultural sector would disappear, the municipality will lose one of its main economic drivers. This will also affect the spatial design of the island, this may make the island less attractive for tourists. Therefore, the municipality wants to ensure the long term economic viability of the island. They do this by playing initiating and facilitating role in the network organisation named; '*Living Lab Schouwen-Duiveland'*. This is a network organisation, aimed at creating innovative solutions in the area of water, food and climate. Here multiple solutions are being developed for mainly the agricultural sector to become more resilient to water stress.

4. Waterboard Scheldestromen

Waterboard Scheldestromen is the waterboard for the entire delta region of Zeeland. Formulating a governance response to deal with water stress is not a core task of the waterboard. Traditionally, the waterboard is mostly focused in the dealing with a surplus of water, not a lack of it. This is partly reflected in the major programs the water board works: Planvorming Wateropgve (PWO) &

Waterbeheer 21e Eeuw (WB21). The PWO is a legally binding document, which determines the water levels of the ditches throughout the year. The WB21 entails a set of requirements the waterboard should adhere to, in order to prevent flooding/inundation. To become more resilient against water stress the waterboard tries to maintain higher water levels, where possible.

5. *The Province of Zeeland*

Like the municipality, the Province is not directly affected by water stress, in the sense that there still is enough drinking water. However, the agricultural sector is a relatively big sector in the province, and this sector is directly affected by water stress. This resulted in increased political pressure by agricultural lobby organisations and municipalities do something about water stress. Therefore, the province wants to ensure a more robust fresh water situation. This is reflected in the formation of the ZDZW and the budgets made available to address water stress. The ZDZW is a provincial plan to ensure Zeeland has a 'robust fresh water situation by 2050' (ZDZW 2021).

6. *External advisors & experts*

The stakeholder group of external advisors and experts plays an important role in water stress governance, since they are advising and developing potential new solutions. Most of them are involved in the pilot projects connected to the Living Lab Schouwen Duiveland. Some of the knowledge institutes involved are: Deltares, KWR, Acacia Water and the Erasmus University of Rotterdam.

In table 5 below each main stakeholder group is mentioned, and their role in water stress governance.

Table 5: Key stakeholder groups and their role in water stress governance

Stakeholder group	# Interviews	Role in water stress governance
Agricultural sector	5	• Advocating for the construction of an external fresh water pipe line towards the island and/or other local solutions for water stress • Exercising political pressure that solutions will be provided quickly
Nature organisations	2	• limited role, since most pilot projects are aimed at the agricultural sector. • Keen for more collaboration between nature – agriculture • Responsible for nature areas located on the west and south side of the island • Involved in nature restoration projects, initiated by the province
Municipality of SD	4	• Safeguarded funding for climate adaptation projects • Initiating and facilitating role within the network organisation living lab SD, where multiple stakeholders work on innovative solutions to deal with water stress
Waterboard Scheldestromen	4	• Responsible for water levels in ditches • Responsible for sustainable use fresh ground water lenses

		• Increased effort in monitoring behaviour fresh water lenses
Province of Zeeland	2	• Distributes budgets for funding • Initiator of the *Zeeland Delta Plan Freshwater,* (a provincial plan to make Zeeland resilient to future water stress)
External advisors & experts	4	• Advising on new water storage techniques and governance arrangements • Knowledge development (e.g. testing new storage techniques)

Next to these six main stakeholder groups, there are three other stakeholder groups which need to be mentioned briefly. These were 1) The tourist industry, 2) Inhabitants of SD, 3) Evides (drinking water company). These stakeholders were not interviewed during this research, since their role in water stress governance was limited or to limit the extensiveness of this research. A short introduction of these stakeholder groups and more detailed reasoning why they were not included in this research, are mentioned in **Annex D**.

4.2 Stakeholders' framing (RQ2)

This sub-chapter answers RQ2: "*How are the main stakeholders framing the causes and problems related to water stress?*"

This is done by highlighting four dominant views of how stakeholders' framed water stress. In short these are summarized in the table below, together with the corresponding stakeholder groups where this dominant view was mainly present. After the table, each dominant view will be discussed in more detail.

Table 6: Stakeholders' framing of water stress

Stakeholders' framing of Water stress	
Dominant views:	***Stakeholder group where this view was mainly present:***
1. Threat to agricultural competitiveness	• Agricultural sector • Municipality of SD • Province of Zeeland
2. Threat to agriculture, but also nature values	• Nature organisations • External experts group
3. Flooding is a bigger challenge	• Agricultural sector • Waterboard
4. Complex problem interlinked with other societal & global changes	• Agriculture • Nature organisations • Municipality • Waterboard • Province of Zeeland

1. Water stress threatens the agricultural competitiveness of the island

A first dominant view, is that water stress threatens the long term future of agriculture on the island. This view was mainly present during the stakeholder interviews with the agricultural sector, the municipality and the province. The dry years of 2018-2020 reduced the yields of agricultural companies, depending on crop type and moment of harvest. Agricultural entrepreneurs on SD mentioned that their yields were less, compared to other entrepreneurs surrounding SD. Contrary to SD, these entrepreneurs did have external fresh water supply. As a result the competitive position of SD farmers is under threat. To illustrate this point with quotes:

"The topic of water stress is very alive, there is a strong sense, and that's a little hypothetical, that the future is at stake. That's for sure. … I know another farmer on SD who has a relatively small agricultural company in terms of arable land. So they see their chance of survival … in the cultivation of a more intensive crop. About the last three years he said: 'I worked very hard, but earned nothing'. With his current cultivation plan, he won't manage. … So the future of these companies is at stake. This sounds a bit pathetic, but this is how it is." [2] – Interviewee2_agriculture

An employee from the municipality mentioned that they also became more aware of this long term future threat, during climate stress tests which were executed in 2017-2018:

"The starting signal was the realization of those climate stress tests and the conversations with farmers, in which they mentioned that things were deteriorating, that yields were decreasing in comparison with the region. Then we are talking about Goerree-Overflakkee, Tholen and the Bevelanden, where they did have fresh water. We got signals: 'Our revenues are declining, while costs are not decreasing'. So eventually you are farming backwards." [3] – Interviewee2_Municipality

Lastly, one of the external experts who had a lot of contact with farmers mentioned:

"In the field labs you actually see two main groups. There is a group which says: I'm affected by water stress, and as a result my competitive position is under pressure. So we need to do something about this in the long run, otherwise we won't make it. and there is another group which says, all fine, but the risk of flooding is bigger." [4] – Interviewee1_Ext.experts

To conclude, a first dominant view was that water stress was framed as a threat to the long term future of agriculture of the island.

2. Water stress not only affects agriculture, but also nature

A second dominant view of water stress, came from interviewees from the nature organisations. This view was mainly present during the stakeholder interviews with the nature organisations, and the external experts group. Contrary to the first view, where emphasis was put on water stress as an economic threat, nature organisations argued that water stress should be seen as a more holistic threat. Beside the impact of water stress on the agricultural sector, great impact is seen on the nature values across the island (interviewee 1 & 2_nature). In their view water stress, should be seen as a broader problem, than solely something which influences the agricultural viability of the area. To illustrate this with a quote:

"There is still talk about the construction of a pipeline … And this doesn't only relate to SD, but we (as nature organisations) strongly got the impression with the ZDZW, that from the start onwards, the

, it is realis
tic to expect
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focus has been: how can we technically ensure that we maintain what we have now. So that we can continue as it is now. However, this (Zeeland) has always been a dynamic area. And for a while we could go on, or we could do as we have done. But now the disadvantages of our way of working are becoming clear. And then you should actually start responding to what has changed, and will change. Which is land subsidence, possibly soon sea level rise, changing climate. And then you can think about constructing a fresh water pipe line. But for me that feels as a belated execution. Of course you can continue for a while as we are doing now, but you will get stuck somewhere. And in the meantime nature values, but also salinization rates and quality of the space you use for different purposes also deteriorates. So it's, very much a tunnel vision. But you have to look at the bigger picture. And that's what I fear with that clinging to those technical measures." – Interviewee1_Nature[5]

Also, both interviewees from nature organisations currently missed the integrality between nature and agriculture in developing solutions to water stress.

3. Water stress is a challenge, but flooding is a bigger challenge

A third dominant view, was that water stress was seen as threat, but the risk of flooding/inundation was even considered a bigger threat. This view came from the agricultural sector and the waterboard. As stated in the introduction, climate change is likely to increase the frequency and severity of dry spells in the Netherlands. However it is also expected to become wetter. Moreover, recent years already have shown an increase in extreme rainfall. Farmers in SD are very aware of these changes over the last decades, as illustrated in the following quote, by a farmer who lived his whole live on SD:

"Last season (summer 2021) *was characterised by extreme rain showers … We were standing in the barn there. Over a period of half an hour, 52 mm of rain. The gutters overflowed and it ran under the ditch right into the barn. And those weather extremes, when you're 20, you think yes this must be, but I am 63, I experienced it differently. As a small child on a birthday … I remember family talking: 'boy, it rained hard'. And then it came out, '25 mm'. Yes…. We say, 25 mm, that is nothing, now 40, 50 mm is also included. Because that's what we had here this summer. A few showers, 30, 40, 50 mm at once…*[6]*" – Inteviewee1_Agriculture*

So next to water stress, the extremeness of precipitation events has increased over the last decades. By several farmers, mainly farmers located at the tail of a water system, which are often the lower parts, the fear of flooding was considered as a bigger problem, than water stress. As one farmer illustrated:

"A farmer at the end of the water system, is more sensitive to flooding. So that farmer is mostly concerned with the risk of too much water. And understandably. So that person also made the remark, and rightly so: 'when everything floods, you have nothing at all, when you have drought you maybe will have damage to your crops.' That's how it is for him. So it differs per individual, depending on your circumstances." [7]*– Inteviewee2_Agriculture*

Several farmers who had experienced flooding, only wanted to continue with the field lab experiments, if first the challenge of flooding was dealt with (Interviewee1_Ext.experts). This dominant view illustrates the balance between water stress and water surplus. Moreover, in the interviews with the waterboard interviewees indicated that the waterboard has to put a big effort in

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making the entire water system of Zeeland resilient to flooding (Interviewee2&3_Waterboard). Therefore, there was limited capacity left to extensively deal with water stress.

To conclude this section, mainly stakeholders from the waterboard and agricultural sector viewed flooding as an equal (or even bigger) threat than water stress. This is important to note, since this influences the urgency for stakeholders to deal with water stress.

4. Water stress is seen as a complex problem, which is also interlinked with other global and societal changes

The fourth and last dominant view was that water stress was mostly seen as a complex or wicked problem; wat especially made it complex according to interviewees were the linkages with other major global and societal changes. This view was present during interviews with the agricultural sector, nature organisations, municipality and the waterboard. According to the interviews a few examples are 1) fluctuations on the global food market, 2) stricter European regulations on use of fertilizer and pesticides, and 3) reactive attitude on the urgency of water stress. These three examples, can have an influence on the water demand of the island. This is shown, with quotes in the three separate paragraphs below.

A first example, illustrated fluctuations on the global food market. Interviewees mentioned that farmer revenues fluctuated as a result of a fluctuating world economy. One farmer mentioned that before Covid-19 pandemic he used to get around 19ct. for his potatoes, at the beginning or corona many public events like sports and festivals got cancelled, resulting in less people wanting to eat fries. Therefore, the maximum price this farmer could get for his potatoes dropped from 19ct/kg to 3ct/kg. This is concerning the global potato market, concerning the wheat market another interviewee (intv1_waterboard) mentioned:

"But also if you look at how corona has kicked the world economy upside down, last year a farmer almost didn't get anything for it's wheat. And now he can buy a complete new tractor from it. That's so unpredictable. You just don't know. That's entrepreneurship."[8]

(Not to even mention the recent war in Ukraine, which is also a war between two of the biggest wheat exporters in the world (FAO, 2022). It's likely to expect that wheat prices even will further rise (FAO, 2022). So, all these different fluctuations influenced (or, are influencing) farmers crop choice. This can mean that farmers switch from crops with a high water demand, like onions, to crops with a lower water demand, like wheat. Or the other way around. In this way the global food market influences the water demand on SD.

A second example, illustrates how (European) regulations are putting the cultivation of water-demanding crops, like onions, under pressure. Interviewee1_agriculture mentioned:

"For me personally I don't need extra fresh water, because in two years, we won't have the cultivation of onions here anymore …. These new Green Deal regulations of minister Timmermans will force us to use less fertilizer and pesticides. And well, the first crop that will go out, will be onions … Crops for a combine, wheat, cereals, all the combine crops so to say … There we have enough pesticides for… that we can still cultivate. And you don't need fresh water for that."[9]

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So, here again a fluctuation is presented, in the form of regulations, which could influence water demand of the island. And more importantly, this influenced the view of water stress for this farmer.

A third example, was the reactive attitude on the urgency of water stress. This reactive attitude was especially present in provincial politics. Interviewees from the province and the municipality indicated that especially political pressure significantly increased after the dry years of 2018, 2019, 2020. While it decreased again afterwards. To illustrate with quotes:

"You can see that the questions from society are strongly driven by the current situation. Four years ago, I think 2017, there was also a question from the national government to map out the fresh water situation and see what is going on. Then we did a round through Zeeland and asked who needed fresh water. And actually, almost nowhere there was a need for more fresh water. Then the story was: 'Yes, maybe the neighbour, but I'm fine'. And if you do that same round three years later, the picture is completely different. And this year again (which was a wet year) *there is totally no need for extra fresh water, so it is very difficult in that regard."* [10] *– Interviewee1_Province*.

A second interviewee of the province mentioned that water policy advisors at the province were already working on the topic of water stress.

However, *"on top of that came the year of 2018, and following dry years. On an official level, that didn't change a lot for us. But, politically it changed a lot."* [11]*– Interviewee2_Province*

Thus, this reactive attitude and thus the urgency to do something about water stress, very much increased or decreased depending on the current fresh water situation.

To conclude, interviewees viewed water stress as a complex problem, which was interlinked with other global and societal changes. In their view water stress could not be seen as a challenge on its own, but water stress ought to be seen as a complex problem (or 'wicked' problem), which is also linked to other major processes like 1) fluctuations in the global food market, 2) European regulations and 3) a reactive attitude on the urgency of water stress.

This previous chapter 4.2, about *stakeholders' framing,* started with the question (RQ2): "*How are the main stakeholders framing the causes and problems related to water stress?"* The chapter has attempted to provide an answer by highlighting the most four dominant views of water stress, which were present among stakeholders. In sum water stress mainly was viewed as:

1. a threat to the agricultural competitiveness of the island
2. a threat to agriculture, but also to the nature values of the island
3. a threat, but flooding remains a bigger threat
4. a complex problem which is interlinked with multiple other societal and global changes

considered.

[11] Quote 27:11 & Quote 27:15

4.3 Stakeholders' response (RQ3)

This sub-chapter answers RQ3: "*How are stakeholders* <u>*responding*</u> *to the causes and problems related to water stress?"*

This is done by highlighting five dominant responses of how stakeholders responded to water stress. These are summarized in the table below, together with the corresponding stakeholder groups in which this response was mainly present. After the table, each dominant response will be discussed in more detail.

Table 7: Stakeholders' Response to Water stress

Stakeholders' Response to Water stress	
Dominant Responses:	***Stakeholder group where this response was mainly present:***
1. Use of 'best' practices	• Agricultural sector • (Municipality of SD) • (Waterboard) • Nature organisations
2. More technical analysis of the water system	• Waterboard • Ext. experts
3. Development of new technical solutions	• Ext. experts • Province of Zeeland
4. Increased political pressure	• Agricultural sector • Municipality • Province of Zeeland
5. Increased levels of interaction and communication	• Municipality

1. Use of 'best practices'

On a local scale, multiple farmers fell back to the use of best practices – here best practices are defined as straight forward management approaches, which are often clear to everyone (Snowden and Boone, 2007). For example, farmers changed their land use practices. Two of the four farmers mentioned that they started with non-inversion tillage (in Dutch: niet-kerende grondbewerking). This was done in order to increase the humus content in the soil. Soils with more humus content can retain more moisture (Eldor, 2015). Also, multiple farmers placed self-made weirs to conserve fresh water which was running downstream. Thirdly, one farmer who was interviewed constructed his own vertical drains to infiltrate fresh water during wetter periods. Fourthly, some famers even transported fresh water by trucks and ships to their plots during dry spells.

Next to the agricultural sector, the municipality and waterboard also stimulated changes in land-use practices like non-inversion tillage. The municipality facilitates 'soil & water' coaches, which farmers can make use of for advice on improving the soil quality and water retention capacity of their soil. The waterboard, offers farmers the possibility to place weirs in the secondary and tertiary ditches on their land. Officially, they have apply for a permit for this, but also farmers were interviewed who did this without a permit.

Lastly, nature organisations placed pumps close to the boarders of their nature areas which could be used for flooding the nature area, in periods of water stress. In this way, there would be enough food like worms available for offshore birds during the breeding season.

Next to the multiple 'best' practices which were applied, more analysis on the water system was done, this is the second dominant response.

2. More technical analysis of the water system

Secondly, stakeholders responded by further technically analysing the water system. Originally, the polders of SD were constructed with the aim to discharge water quickly. However, the behaviour of the water system during periods of water stress is not fully known yet. For example, until recently the amount of fresh water available in the soil was unclear (Delsman *et al.*, 2018), also the influence of brackish ditches which cross fresh water lenses is not fully known yet (Personal communication Interviewee2_Ext.expers, November 4th 2021). Therefore, more analysis is done to gain understanding on how the water system behaves in periods of water stress.

A first example is that the waterboard is constructing a new monitoring network to measure the volumes of fresh water lenses in the ground.

"It's not that we are doing nothing (about water stress) … we are currently constructing a ***monitoring*** *network, to see how the volumes of fresh water lenses are changing. This way we can get a better understanding of the amount of fresh water that we have in the soil. Also, what can we do with this water? And how can be use it in a sustainable way? So these things are taking place. But if you really talk about whether we are formulating a complete drought policy… That's on the list."* [12] – Interviewee 3_Waterboard

A second example of further technical analysis done, is in the two main programs where the waterboard works: Plan Vorming Wateropgave (PWO) and Waterbeheer 21e eeuws (WB21). Here analysis is done to see whether higher water levels can be maintained, without having the risk of flooding. See quotes:

"There are several areas where we do ***research*** *if we can increase the water levels. And then actually the question is; how much can we increase the water levels, before we exceed the WB21 inundation norms."* [13] – Interviewee 3_Waterboard

"The easiest thing we can do, is to steer with the water levels. … So now that we know that this can happen (a drought like in 2018, 2019, 2020), we ***monitor*** *the groundwater levels more extensively. When we see a dry period coming, or when it is already here, we can anticipate by setting up higher water levels. Even within the PWO, we can fluctuate the water levels within a range of 10cm, which is considered safe."* [14] – Interviewee 4_Waterboard

A third example of more analysis is in the project '*Natuurlijk Zoet'* (translated: *Natural Sweet).* This was a participatory monitoring project where twenty farmers measured the salinity content of the

[12] Quote 36:14
[13] Quote 36:16
[14] Quote 42:17

ditches surrounding their plots over a period of two years (2019-2021). This project was done in collaboration with multiple stakeholder groups: The agricultural sector, Acacia water (from the ext. experts group), the municipality, the waterboard and the province of Zeeland.

To conclude, on multiple levels stakeholders increased analysis of the behaviour of the water system (the waterboard by constructing the new monitoring network and analysing whether higher water levels are possible, and other stakeholder groups by participating in the project *Natuurlijk Zoet*).

3. Development of new technical solutions

A third dominant response, was the development of new technical solutions to water stress. Two groups we identified. Firstly, the development of new water storage techniques in the underground. Secondly, the implementation of water efficient irrigation techniques. These examples will be highlighted in the two separate paragraphs below:

New water storage techniques were being developed and tested by means of pilot projects. The type of water storage technique depended on the underground (e.g. clay layers, sandy soil etc.). Most techniques were designed to prevent that salt/brackish water from the underground mingles with the fresh water from the sky. This way, fresh water could be stored and used for irrigation during periods of water stress. The techniques were developed by Deltares, Acacia Water and KWR, and funded by the municipality and the province of Zeeland. The waterboard was not involved intensively.

Also, implementation of more efficient irrigation techniques was encouraged (ZDZW, 2021, page 28). The Province of Zeeland acknowledged that efficient water use for irrigation did not play a big role yet. However, in order to maintain the fresh water resources sustainably, the province "urgently recommended", efficient water use (ZDZW, 2021, page 28). Also, the province wanted to continue with pilots for efficient irrigation methods, knowledge development and financial support for investments farmers make related to efficient irrigation techniques. A point for critical reflection on the ZDZW, came from one of the interviewees who mentioned:

"The ZDZW is, in my view, a summation of techniques. That's it. That is not a delta plan. A delta plan is, you have a problem, and you have solutions, and this is the plan how we will come there. … So you should focus on what is the problem, and where are we going? And then you will see, that especially on SD, there will be areas where agriculture won't be possible anymore. … Seepage is so strong there, it's a really deep polder. … we could continue for a while, but at a certain point, then it will stop. … So we can better start quantifying the problem, what would this mean for the local economy? – Interviewee2_Waterboard [15]

To conclude this section, multiple technical solutions (new water storage techniques & water saving irrigation methods) were implemented to better deal with water stress. Multiple solutions were still in ir development or pilot phase.

4. Increased political pressure

A fourth dominant response of stakeholders towards water stress was increased political pressure to do something about water stress. This increased political pressure was mainly expressed in three different ways: 1) The agricultural sector had a powerful lobby group which was advocating the construction of a fresh water pipeline from the (fresh water) Schelde-Rijn Canal towards SD. 2) Within the municipality of SD and from the municipality towards the province, feasibility studies about the external pipe line were advocated as well as the urgent need that solutions should be found for water

[15] Quote 35:16 & quote 35:15

stress. Otherwise, in the long term, *"agriculture at SD may not have a future anymore"* [16] (Intv1_Municipality). 3) On a provincial scale, from the province of Zeeland towards the national government, the urgency of the problem was expressed, as well the urgent need for funding to cope with these changes. These three separate ways in how political pressure was expressed are discussed in separate paragraphs below.

The political pressure from the agricultural sector to construct a fresh water pipeline towards the island, was expressed by a small lobby group named: *Stichting the 'Puupe'* (Zeeuws dialect for '*pipe*'). In their view, the supply of external fresh water is needed in order to continue with agriculture on SD (De Puupe, 2022). Moreover, last ten years yields on SD decreased compared to areas where there is fresh water (De Puupe, 2022). According to them, the agricultural competitiveness of SD farmers towards other Dutch- and international farmers will further decline if nothing happens. Therefore, an external fresh water pipe line is needed. The municipality also wanted to research whether this option is feasible for SD.

Therefore, the municipality of SD also advocated towards the province that independent research should be done to the possible construction of this pipe line. However, research by an independent consultancy showed that for now the costs for construction does not live up to the potential benefits (expressed in revenues for agriculture). The municipality did not completely agree with the way how this analysis was executed, in their view benefits of an external pipeline will be more than solely agricultural revenues (Intv2&4_municipality). Therefore, the municipality would be in favour of a societal cost-benefit analysis were the broader benefits to the society of SD are quantified. For now, the municipality keeps the option of an external pipe on the table, as one of the potential solutions towards water stress.

Lastly, on a provincial scale, from the municipality and the province towards the national government, there is also a political lobby. To clarify, every few years there is national funding available for climate adaption. For most of these funding budgets, the province of Zeeland decides how these budgets will be allocated throughout the province (*Intv2_Province; Intv2_Municipality; Intv4_Municipality)*. What makes it difficult for Zeeland, is that the province has relatively big climate adaptation challenges (like water stress, but also sea level rise), while there are not that many inhabitants in the province. However, the distribution of state funds is also dependent on the total amount of inhabitants. Therefore, according to Intv2_municipality the province of Zeeland is not considered a 'rich' province. However, the climate adaptation challenges like water stress are very urgent. Therefore, multiple interviewees stressed the importance of more clearly advocating this message towards the national government (*Intv2_Municipality; Intv2_Province; Intv2_Waterboard).*

5. Increased levels of interaction and communication

A fifth dominant response towards water stress was increased levels of interaction and communication. Most of this was initiated and facilitated during events of the Living Lab SD, which is a network organisation initiated by the municipality of SD. At the Living Lab SD, different types of organisations are involved like governments, knowledge institutes and also the agricultural sector itself. The aim of the living lab is to develop *"innovative solutions for complex challenges in the area of water, food, education and governance"* (Living Lab SD, 2022). The reason why the living lab

[16] Quote 29:25

contributed towards increased levels of interaction and communication was mainly because of two reasons:

Firstly, the structure of the Living Lab was very much horizontal between different organisations. A network structure. In this way, knowledge exchange between organisations could go quite quickly. Also, it offered a platform to communicate with different organisations simultaneously, instead of solely between two or three organisations per time. This could help in creating a more shared problem perception and also potential solutions towards water stress which are developed collaboratively.

Secondly, the living lab hosted multiple information evenings where farmers could get information on dealing with water stress, and potential solutions, which are being developed together. Moreover, farmers could also give practical input for the knowledge institutes which could be incorporated in the pilot projects again. About these information evenings one farmer mentioned: *"if there hadn't been the living lab, then I would not have met these 20 other colleagues, who also have interest for the topic. So the municipality simply played a good role in this. Absolutely."* [17] - Interviewee3_Agriculture.

So in conclusion, this section showed that the network structure and the information evenings of the living lab fungated as a platform for increased levels of interaction and communication between the different stakeholders.

To recall, this chapter 4.3 about stakeholders' response started with the question (RQ3): "*How are stakeholders <u>responding</u> to the causes and problems related to water stress?"* The chapter presented the five most dominant responses of stakeholders towards water stress. These were:

1. Change in land use practices
2. More intense analysis of the water system
3. Development of new technical solutions
4. Increased political pressure
5. Increased levels of interaction and communication

So far, all the stakeholder groups are known (RQ1, chapter 4.1), the stakeholders framing- (RQ2, chapter 4.2) and the stakeholders' response (RQ3, chapter 4.3). Now the interesting question is to see how stakeholders' framing and response are aligned with each other, and where there are similarities & differences. For this the Cynefin framework will be applied on stakeholders framing- and response. This will be done in the following chapter 4.4.

4.4 Comparing stakeholders' framing and response (RQ4)

This sub-chapter will answer RQ4: "*What is the complexity-level of stakeholders' framing- and response to water stress, according to the Cynefin framework?"*

Also this chapter will answer the last part of the main RQ: "*How are stakeholders framing and responding to water stress in Schouwen-Duiveland, <u>and how is this framing and response aligned with each other</u>?"* In order to do so, the Cynefin framework, was applied on the SD-case.

The chapter is structured as follows: Firstly, the overall (coding) results of stakeholders' problem perception and -response are presented. Secondly, stakeholders' problem perception and response are connected, such that similarities and differences in problem perception and response are highlighted. Thirdly and lastly, the section will summarize the key findings from the coding analysis.

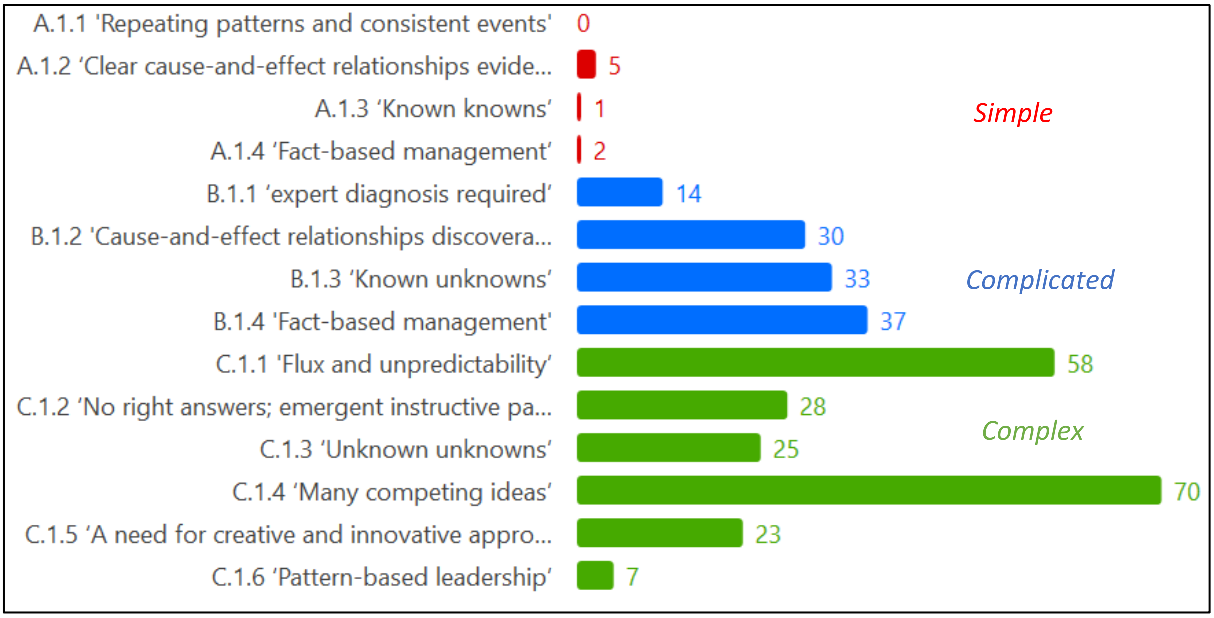
[17] Quote 37:29

Coding results stakeholder's problem perception- and response

As explained in the methodology chapter, the Cynefin framework consists of four different domains. Each domain has its own context characteristics, which requires its own management style (also known as "*The Leader's Job*"). In this research, the *context characteristics* relate to how stakeholders perceived water stress in SD. The *management style* relates to how stakeholders responded to water stress. Both stakeholders' problem perception and response had specific characteristics which were used for coding (see the green table in the methodology chapter). The coding results are presented below.

Table 8 presents the total amount of codes, placed during all 21 stakeholder interviews which relates to stakeholders' problem perception of water stress.

Table 8: Stakeholders' problem perception of water stress, according to Cynefin framework



Explanation table: *On the left side of the table the code names are listed (for the elaborate code name description see table 4 page 16-18 in the methodology chapter). In the middle the bar indicates the frequency a code was given. The colours indicate the domain with which the code corresponds (simple domain = red, complicated domain = blue, complex domain = green).*

A first finding is that stakeholders viewed water stress mostly as a complex challenge, since most codes corresponded with this domain. Secondly, also relatively many codes correspond with the complicated domain. Interviews showed that problems relating to technical aspects of the water system were mostly perceived as *complicated*, while problems relating to social interactions among stakeholders, or uncertain future scenarios where more seen as *complex.* As one interviewee mentioned:

"The technical aspects, those are complicated, that is fine. But it is complex, since you have different future scenario's which are unsure. So that will make it more complex. And also because you need, yet unknown, funding sources." [18] *– Interviewee 2_Waterboard*

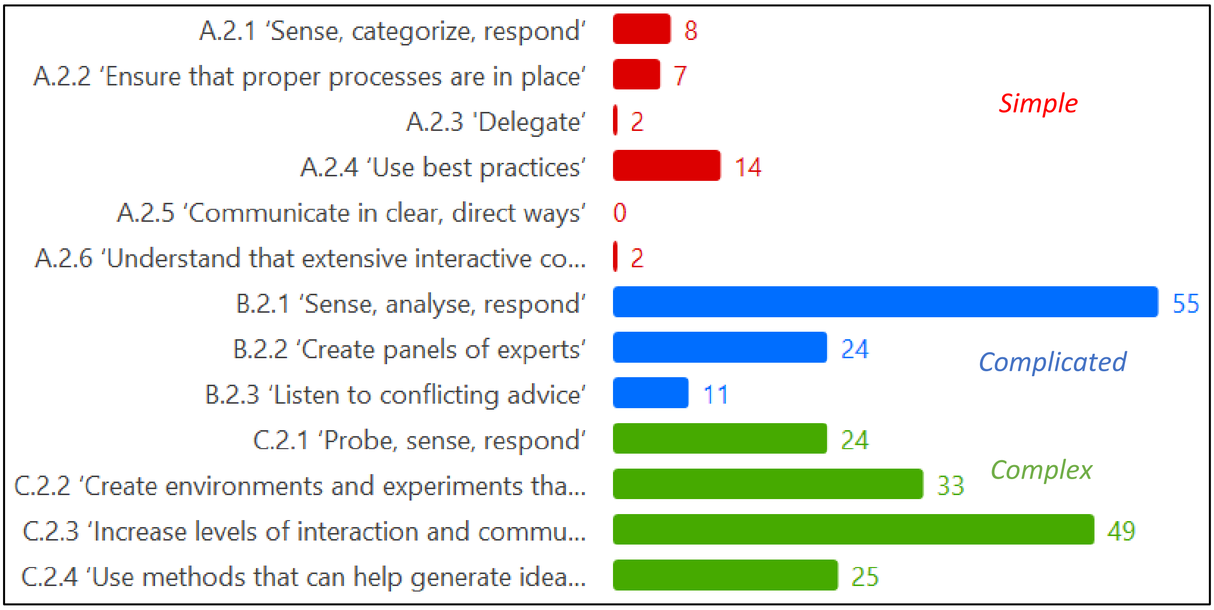
To illustrate this difference. Some examples which were related to a *complicated* problem perception

[18] Quote 35:22

were: unclarity on salinity context in the ditches, insufficient knowledge on ground water flows and unclarity on the feasibility of underground water storage techniques. These were considered as complicated, since these implied 'known unknowns' where 'cause-and-effect relationships are discoverable'. Some examples which were related to a *complex* problem perception were: Conflicting views among actors on how to deal with water stress, uncertain future scenario's, and uncertainty on funding. These were considered *complex* since problems like these are fraught with 'flux and unpredictability', 'unknown' system dynamics and often entails 'many competing views' on how to deal with them.

Based on a problem perception, which had most codes in the complex domain, also a governance response with most codes in the complex domain would be expected. However, in contrast to the problem perception, there are relatively many codes in the complicated domain as well. This is shown in the table below which presents the total amount of codes, placed during all 21 stakeholder interviews, relating to stakeholders' governance response to water stress.

Table 9: Stakeholders' response to water stress, according to Cynefin framework



Explanation table: *On the left side of the table the code names are listed (for the elaborate code name description see table 4 page 16-18 in the methodology chapter). In the middle the bar indicates the frequency a code was given. The colours indicate the domain with which the code corresponds (simple domain = red, complicated domain = blue, complex domain = green).*

A first important observation is that that the general response of stakeholders to water stress was mostly in the complex domain (131 codes[19]), however, this was followed by relatively many codes in the complicated domain (90 codes[20]). This meant that predominantly two ways of dealing with water stress were in place. First, a complex response, which was characterized by adaptive learning, experimentation, and high levels of interaction and communication between the different stakeholders. Second, a complicated response, which was characterized by a more fact-based management approach and a more traditional command-and-control management style.

[19] 24+33+49+25= 131 codes

[20] 55+24+11= 90 codes

A second important observation to highlight was the difference between code B.2.1 and code C.2.1. Here a governance response is described with emphasis on - 'sense, analyse, respond' (B.2.1) or 'probe, sense, respond' (C.2.1). During the interviews, stakeholders described a complicated governance response, with emphasis on *sense, analyse, respond* more than twice as much (55 times), as a complex governance response, which had an emphasis on *probe, sense, respond* (24 times). The finding from this is that apparently, in the current governance responses present, there is more emphasis on analysing water stress – which assumes right solutions can be fettered out by fact based management – than on a probing management approach. The high emphasis on analysing could be explained by the different types of research carried out during several pilot projects and the emphasis on research and monitoring within the waterboard.

A third and general observation is that despite the overall problem perception which had almost no codes in the simple domain, the overall governance response did have several codes in the simple domain. This means that though water stress was not perceived as a challenge where the right answers are evident to everyone, some stakeholders did respond in this leadership style by using straightforward management practices. This was mainly the case for the agricultural sector.

More can be said about table 8 & 9 above, however, these tables contain the total amount of codes which are not separated per stakeholder group yet. In order to draw more precise conclusions per stakeholder group, it is valuable to divide the codes per separate stakeholder groups and then compare the problem perception and response. In this way similarities and differences can be highlighted per individual stakeholder group. This will be done in the following section.

Complexity level of stakeholders framing- and response

This section presents the complexity level of stakeholders' problem perception and governance response per individual stakeholder group, which answers RQ4[21]. Secondly, similarities and differences in stakeholders problem perception and response are highlighted, which answers the second part of the main RQ[22].

[21] RQ4: "*What is the complexity-level of stakeholders' framing- and response to water stress, according to the Cynefin framework?"*

[22] Main RQ: "*How are stakeholders framing and responding to water stress in Schouwen-Duiveland, <u>and how is this framing and response aligned with each other</u>?"*

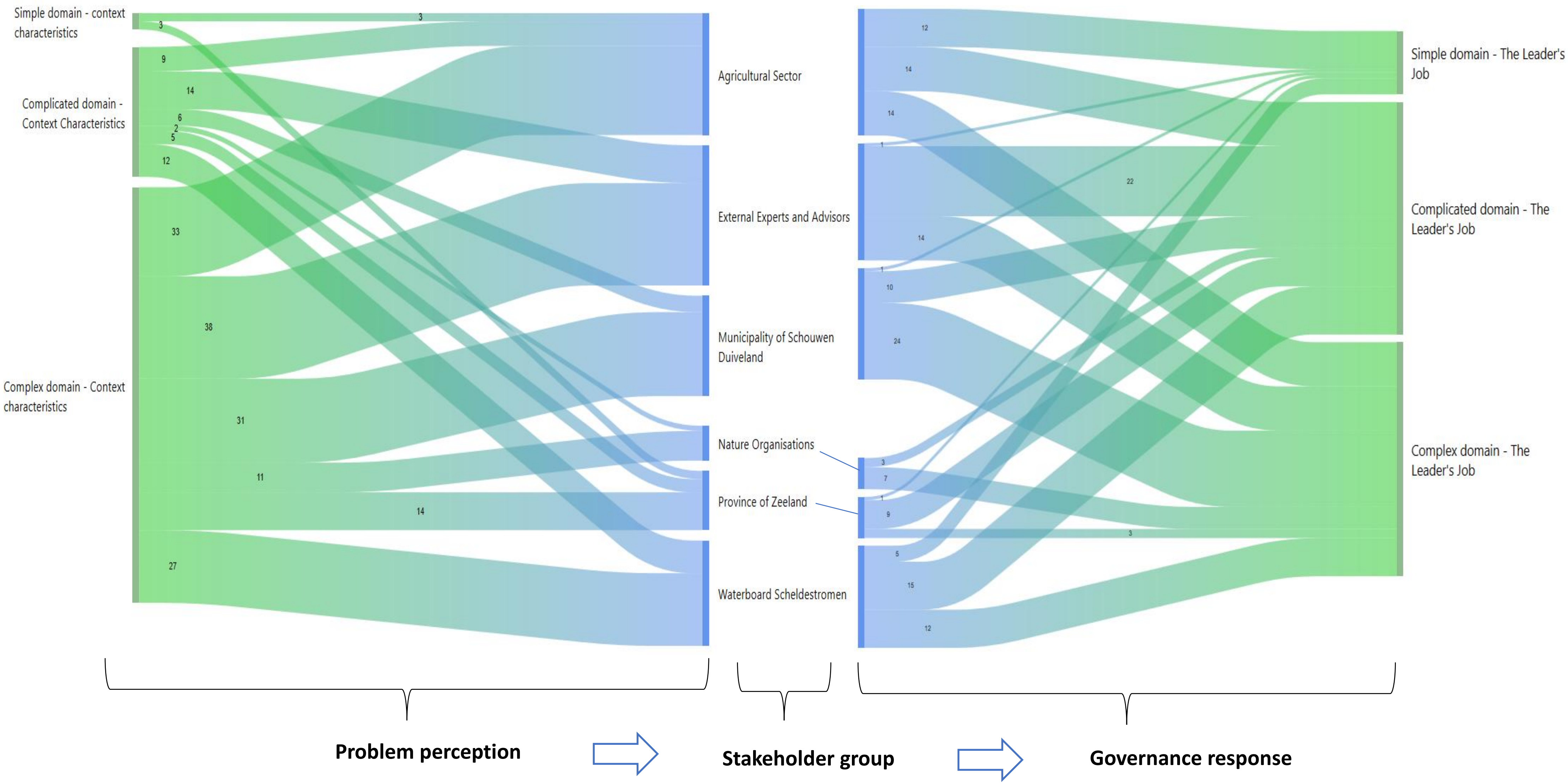


Figure 2: Problem perception- and governance response to water stress per stakeholder group

Explanation figure: Left side represents problem perception, in the middle each stakeholder group is listed, the right side represents governance response. The coloured bars connect stakeholder's problem perception- with their governance response. The thickness of each line indicates the frequency a code was placed, (# codes can also be red inside each line). So the thicker the line, the stronger the relationship between that stakeholder group and that domain/complexity level. The arrows below the figure indicate how stakeholders go from problem perception to governance response.

(For a view of the same figure, but then separated per individual stakeholder group see Annex B. Also, the individual coding results per stakeholder group are included in Annex C.)

Results show that all six stakeholder groups mostly perceived water stress as a *complex* challenge. The complexity level of stakeholders framing (RQ4) was thus mostly *complex.* This means that all stakeholder groups mostly perceived water stress as a challenge which is characterized by flux and unpredictability, many competing ideas, and multiple unknown system dynamics. This will be illustrated with some examples below: In the answers of all stakeholders, 'flux and unpredictability', often related to uncertain future scenario's, especially if and how agriculture would remain feasible in the long term future on SD[23]. Furthermore, 'flux and unpredictability' related to other societal and global changes in the global food market, this mostly came from the agricultural sector[24]. The 'many competing ideas' related to competing views among farmers on the desirable water level in the ditches[25]. Also, on a more holistic level, 'many competing ideas' related to different views on what should be the best way forward to deal with water stress. In this there were two main groups to be distinguished: one group mostly represented by the agricultural sector, who found that quick solutions for the agriculture sector should be found. A second group, mostly represented by nature organisations and some of the external experts, who also stressed the importance of having a long term vision for SD. According to them *"implicitly, the starting point is a bit, we want to remain agriculturally competitive. And for some parts of SD, you can of course ask yourself, is that a realistic picture?"[26].* Therefore, this group stressed the importance of formulating a clearer long term vision. After a clearer long term vision, farmers could also be offered perspective, and if needed other economic activities could be developed collaboratively (e.g. development of mini-campings, management of nature areas, cultivating crops more resistant towards water stress etc.). The 'multiple unknown system dynamics', mainly referred to an uncertain global food market and uncertainty on what would happen if an external pipe line were to be constructed and how the economy of SD would adapt to this.

Contrary to the mostly *complex* problem perception, the governance response was almost equally divided between the *complicated* and the *complex* domain. Thus the complexity level of stakeholders response was both *complicated* and *complex* (RQ4). Analysis of the individual stakeholder groups showed that governance response differed per stakeholder group. To specify, 1) the municipality and the nature organisations mostly responded in the *complex* domain. 2) The waterboard, the external experts group and the Province of Zeeland mostly responded in the *complicated* domain. 3) The agricultural sector responded almost equally in both the *simple, complicated,* and *complex* domain. In the three paragraphs below the main reasons for this will be explained.

The municipality and the nature organisations mostly responded in the *complex* domain. The main reason why the municipality mostly responded in the *complex* domain, was because they played an important role in facilitating and initiating the network organisation, Living Lab SD, where different stakeholders were connected to each other and multiple solutions towards water stress were developed. By doing so, an environment was created where there was knowledge exchange and multiple experiments could be developed. The main reason why nature organisations mostly responded in the complex domain was because they intensified their interaction and communication with other stakeholders. On a provincial scale, ZMF and Natuurmonumenten participated in the formation of the ZDZW. Also the ZMF is participating in the multistakeholder partnership *Regioteam*

[23] also see first dominant view chapter 4.2
[24] see fourth dominant view chapter 4.2
[25] see third dominant view chapter 4.2
[26] Quote 41:11 – Interviewee 4_Ext.experts

Zuidewestelijke Delta, a regional multi-stakeholder partnership. Also, on a local scale the ZMF was participating in the network organisation Living lab SD and Natuurmonumenten was involved in various nature restoration projects initiated by the Province of Zeeland, on different parts of SD.

The Waterboard Scheldestromen, the Province of Zeeland and the external experts group mostly responded in the *complicated* domain. The reason why the waterboard mostly responded in the *complicated* domain was because it mainly was involved in technical analysis of the water system. Mostly, it had been analysed whether higher water levels could be maintained throughout the year. Furthermore, the waterboard started with the construction of the monitoring network to continuously measure the volumes of the fresh water lenses in the underground. In both examples there was emphasis on technical analysis, which corresponds with the *complicated* domain. The reason why the Province of Zeeland and the external experts group also mostly corresponded with the complicated domain was because they both were involved in the development of new water storage techniques on SD. The Province of Zeeland was mostly involved by means of funding, and advocation mostly technical measures in the ZDZW. Most of the interviewees from the external experts group, were involved since they were technical experts testing the feasibility of these new water storage techniques in SD.

The agricultural sector responded almost equally in the *simple-, complicated-* and *complex* domain. The reason for this was because farmers both need immediate short term solutions, while also needing long-term solutions. Coding results showed that most codes associated with the simple domain related to immediate 'best' practices farmers executed on their own land like placement of weirs, non-inversion tillage or the transportation of fresh water to their land by truck or boat[27]. Coding results related to a *complicated* response corresponded with the participation in the various pilot projects where potential new water storage techniques for the underground were tested. This can be considered more are as a *complicated* governance response, since the emphasis was on analysing[28]. Coding results related to a *complex* response corresponded with the participation of multiple farmers in the networking events of the Living lab SD[29].

To conclude, this chapter started with RQ4: *"What is the complexity-level of stakeholders' framing- and response to water stress, according to the Cynefin framework?"* and the main RQ: "*How are stakeholders framing and responding to water stress in Schouwen-Duiveland, and how is this framing and response aligned with each other?"* Results showed that all stakeholder groups mostly perceived water stress as a complex challenge. However, the response to water stress differed per individual stakeholder group. Three of the six stakeholder groups (the waterboard, the Province and the external experts group), responded mostly in the *complicated* domain, meaning water stress was mostly addressed through technical analysis. Two out of six (municipality and nature organisations), responded mostly in the complex domain. Lasty, one stakeholder group (agricultural sector), responded almost equal over the simple-, complicated and complex domain.

[27] Also see first dominant response chapter 4.3
[28] Also see third dominant response chapter 4.3
[29] Also see fifth dominant response chapter 4.3

5. Discussion

This chapter is structured as follows: Firstly, the key findings are compared with other relevant academic literature in the field of water stress, climate adaptation and multi-stakeholder collaboration. Secondly, the study limitations are highlighted. Thirdly, recommendations for future research are mentioned.

In 5.1, the comparison of the key findings with academic literature is done in decreasing order of importance.

5.1 Comparison of key findings with academic literature

The key findings of this research showed that, though the overall problem perception was complex, half of the stakeholder groups responded with a mainly technical analysis of the problem. In other climate change adaptation challenges across the globe, similar responses of stakeholders are observed. Vignola et al., 2017 in their article "Leadership for moving the climate change adaptation agenda from planning to action", mention that often "*complex problems, as well as correspondent solutions of many adaptation initiatives are often addressed through technical analysis…".* However, in order to adequately deal with the inherent 'wicked' nature of climate adaptation challenges, scholars argue that a "*paradigm shift is needed from a large reliance on technical knowledge and solutions towards a more comprehensive approach paying more attention to behavioural challenges"* (Finger, 1994; Pfeffer and Sutton, 2000; Kollmuss and Agyeman, 2002; Simmons and Volk, 2002; Leiserowitz, Kates and Parris, 2005; Fazey *et al.*, 2010; McKenzie-Mohr, 2011; Bisaro and Hinkel, 2016; Vignola *et al.*, 2017). In this research, I showed that the Cynefin framework, though originally developed for a more cooperate business environment, can also be applied in an environmental governance context, and thus can be used to "pay more attention to these behavioural challenges" in climate adaptation since it identifies different ways how a leader should behave, depending on the context.

Moreover, Vignola et al. 2017 suggest that, different leadership styles might be needed, to move from the planning to action phase in climate adaptation. What is particularly interesting in the case of SD, is that stakeholders are indeed trying to move from the planning to action phase, since there are multiple pilot projects taking place, with the aim of being scaled-up potentially (see results: Living Lab SD, page 20). When comparing my research with the research done by Vignola et al. 2017, I would argue that stakeholders are partly moving from a challenge which is mostly complicated (e.g. developing a better comprehension of the water system, and development of innovative water storage techniques), towards a challenge which will become more complex (e.g. with scaling up pilot projects more stakeholders will get involved, more competing ideas, long-term uncertainty how the agricultural will develop in general). Therefore, I argue a mostly a complex 'leadership style' is needed, where there is a 'probing' governance response, increased levels of interaction and communication and creation of environments which allow patterns to emerge (Snowden and Boone, 2007). When seeing the SD case through the lens of Vignola et al. 2017 in article*,* I would argue that the SD case is currently moving from the 'planning' phase to the 'managing' phase in the adaptation cycle (Fazey *et al.*, 2010; Vignola *et al.*, 2017, figure 1 page 86). Therefore, mostly 'coaching' leadership style might be needed (see table 1 page 85 inVignola *et al.*, 2017).

A second point for discussion is the 'increased political pressure' which was mentioned on page 29-30, as the fourth main governance response. Here the water stress issue was mainly framed as a threat for the agricultural sector, therefore an external fresh water pipeline is needed (De Puupe, 2022). Partly, this is of course a very valid point since Zeeland mainly is an agricultural province, and water stress indeed threatens the long term viability of many agricultural companies on the island. However, one could question whether this way of framing fully includes the complexity of water stress. Scholars in climate change adaptation argue that certain ways of framing are very important in steering the debate in a certain direction (Dewulf, 2013). To illustrate; *"A particular of framing does not determine what happens next, but whoever is able to set the terms of the debate steers the debate in a certain direction … implicitly or explicitly, particular interests are advocated or undermined, power positions are maintained or challenged and particular actors are included or excluded from policy debates"* (Pettenger, 2007; Dewulf, 2013, page 322). By framing water stress mainly as a threat to agriculture, other stakeholders could be left out. In this study, interviewees from the nature organisations confirmed this point, as illustrated in the results section (see second dominant view of water stress, page 23-24). Here both interviewees argued that instead of maintaining what is present, the focus should rather be on the bigger picture, incorporating the long term future of Zeeland and SD[30]. This also links with 'danger signals' as identified by Snowden and Boone 2007, where they highlight that leaders sometimes wrongly have the 'desire to make complex problems simple' and have an 'overreliance on best practice if the context shifts'(Snowden and Boone, 2007, page 7). In this SD case this would be to solve this climate adaptation challenge of water stress, by constructing a fresh water pipe line.

A third point of academic reflection, is on technological lock-ins as described by Wesselink 2007. The SD case showed that there is discussion on the possibility of a fresh water pipe line, as illustrated above, but also other development of new water storage techniques. While assessing the various options which could be implemented, leaders should be aware of not creating a system, which enhances a technological 'lock-in' (Wesselink, 2007, page 4). This means, that a (water) system is created which has it's own built in vulnerabilities and also leaves little room to go back again (locked-in). For example, when a fresh water pipe line is constructed, agricultural companies will adapt their business plans to the extra availability of fresh water. In a climate which is likely to become more dry during the summer periods (KNMI, 2014), one could argue whether this is desirable on the long-term.

A fourth point of academic reflection, is a critical nuance on how the Cynefin framework was used in this research. Implicitly, I started this study with a more 'black and white' idea of 'right' and 'wrong' governance responses. As stated in my hypothesis, I assumed that most stakeholders would perceive water stress as a mostly complex problem, while the response of stakeholders was expected to be mostly complicated. This way of thinking, on hindsight, may have been a bit too rigid. Scholars carefully note, that a problem may be complex for example, however certain parts of it can be simple or complicated (e.g. research on fresh water lenses, or setting out a survey) (Brouwer *et al.*, 2019). These are 'simple' actions of a problem which may be 'complex' when seen as a whole. This is an important distinction to make within each challenge. Actually, this not classifying a challenge as solely this or that domain, but rather seeing challenges with a "prevalent" context, is the reason why the lines are presented as bended lines instead of rigid lines, see figure 9 theory and concepts chapter (Snowden and Boone, 2007, page 4). This realisation of assessing "prevalent" contexts, rather then rigid contexts, is important when taking into consideration the results of this research.

A fifth point of discussion, is the fifth dominant governance response: "Increased levels of interaction and communication" (chapter 4.3). In academic literature, scholars argue that the chance of success in adequately dealing with water stress, also very much depends on the extent to which institutions are able to facilitate information exchange and foster collaboration between actors, especially at a local level (Engle, 2013; Gutiérrez *et al.*, 2014; Baudoin *et al.*, 2017; Vignola *et al.*, 2018). Moreover, recently scholars pointed out '*coordination'* among actors, and collaborative '*learning'* as two of the

[30] And of course this is difficult, since you have to make choices, while dealing with many uncertainties.

five key elements for measuring governance capacity (van Popering-Verkerk *et al.*, 2022). In this regard, this study found that the network organisation of the Living Lab SD played a very useful role in facilitating this information exchange and collaborative learning. On basis of the 21 stakeholder interviews (out of which most interviewee were very positive about the role the living lab was playing) and academic literature, I would suggest to continue with the efforts of the Living Lab SD. Specifically, events which are aimed at facilitating this information exchange and collaborative learning between stakeholders. Perhaps, there is a nice challenge for the Living lab in getting a better understanding of opportunities and synergies present between nature organisations and the agricultural sector.

5.2 Study limitations

This study had several limitations. The three limitations which, according to me, were the most important to take into account are presented in the section below.

Firstly, a careful reader may already have noticed this, there is a difference in the total amount of codes between the coloured Sankey diagrams (figure 1, page 33 & figures in Annex B) and the tables with the total amount of codes listed per domain (table 8 and 9 & table in Annex C). The reason for this, is the way the codes are counted in the data analysis software *Atlas.ti*: For the Sankey diagrams multiple codes which corresponded with the same text selection were counted as a one code. While, with the tables, codes corresponding with the same text selection were counted as separate codes. In order to align both ways of counting, I have put extensive effort in trying to solve this issue, however, it did not seem possible within the functions of Atlas.ti. For the main findings of this research it does not affect the outcome: (In both cases stakeholders prevalent problem perception remained complex and the prevalent governance response of most stakeholder groups remained complicated). However, when assessing the results as presented in the Sankey diagrams, the reader should be aware of this way of coding. If the reader wants to compare individual codes, the reader should rather use the tables as presented in Annex C instead of the Sankey diagrams. (Since individual codes corresponding with the same text selection are not merged there.)

Secondly, a point of weakness in this research was that all coding data was retrieved via the execution of interviews. Though 21 interviews were executed and of each stakeholder group at minimum two participants were interviewed, this way of data collection may be a bit one-sided. For example the person interviewed may have had a certain view, which was not completely representative for the entire stakeholder group. For a stronger validity of the results it would have been better to also include policy documents and a questionnaire with practitioners in or next to the coding analysis. In this way there would be a strong triangulation, which would increase the validity of the results. In this study within the time period of half year, I did not have the time to do so, next to the 21 interviews executed. Though I have to admit several policy documents were assessed, but not used in the coding analysis. Mostly these policy documents helped in the researchers' comprehension of the case.

Thirdly and lastly, the Cyenfin framework actually entails five different domains (there are also the domains of *'disorder'* and *'chaotic'*). Due to time limitations I chose not to focus on the chaotic domain in this research. However, in practice I think water stress, especially during long lasting dry spells, potentially can become chaotic. Then the governance response should rather shift to 'act, sense, respond' with emphasis on acting immediately. This was left out during this research, but for an even more comprehensive assessment of water stress governance on SD, I would recommend to also take this domain of 'chaos' and 'disorder' into consideration.

5.3 Recommendations for further research

In academic literature the Cynefin framework has not yet been widely applied on environmental case studies. In that sense, this type of research in which the Cynefin framework was applied on a water stress governance case is relatively new, and perhaps has not even been done before. This study tried to operationalize the Cynefin framework to adapt it to the water stress governance case of SD (see table 4 page 16-18 in the methodology chapter). However, especially in managing complex environmental challenges, the Cynefin framework provides some guide lines, but these still remain quite general (e.g. "open up discussion", see Annex F). My recommendation for further research would be to see where these Cynefin guidelines could be made more specific for an environment governance context. A first suggestion could be to include the concept of value focused thinking as presented by McDaniels and Trousdale 1999 as a more specific guideline which could be used as tool for managing complex contexts (McDaniels and Trousdale, 1999).

A Second recommendation for if this research were to be executed again, is to also include the 'danger signals' of the Cynefin framework as presented in table 2 of the theory chapter (Snowden and Boone, 2007). Though, it is difficult to measure (e.g. how to you measure "temptation to fall back in habitual, command and control mode"?), it may be very relevant for policy makers to identify these danger signals, since after they are identified measures can be taken to prevent them.

A last recommendation, if this research were to be executed again, would be to change interview question five which was asked during the stakeholders interviews ('*If you look to other stakeholders how are they reacting to water stress? Are these measures individual- or collective- measures?').* At the beginning of this research I had the implicit assumption that individual measures would correspond mostly with a complicated governance response, while collective measures would correspond with a complex governance response. However, in practice this does not have to be the case. You can respond in a complicated manner, while doing this very collectively (for example, setting up monitoring project together with different actors). Therefore I would not state it as 'individual' and 'collective' on hindsight.

6. Conclusion

In this study, I examined how six key stakeholder groups, on the island of Schouwen-Duiveland, were framing and responding to water stress. After identifying stakeholders' main frames and responses, I quantified how these were aligned with each other. My hypothesis was that stakeholders mainly would frame water stress as a complex challenge (characterized by flux and unpredictability, many competing ideas, and multiple unknown system dynamics), while stakeholders merely would respond with technical analysis. After executing 21 stakeholder interviews and reading policy documents, my qualitative data analysis concluded that indeed all stakeholder groups mainly framed water stress as a complex challenge. However, the governance response differed, depending on the stakeholder group. Half of the stakeholder groups (the waterboard, the province and external experts) indeed responded with mostly technical analysis. Two of the six stakeholder groups (municipality, nature organisations) had a complex governance response (characterized by experimenting and increased levels of interaction). Lastly, the agricultural sector responded to water stress in an almost equally divided governance response over the simple, complicated, and complex domain (meaning that they took immediate short-term local measures, like the placement of weirs and non-inversion tillage, but they also participated in various research projects to new water storage techniques, and increased their levels of interaction and communication, to develop long-term strategies).

Findings from other climate adaptation case studies across the globe also show that complex climate adaptation challenges are often addressed through technical analysis. This research, underlines these findings. Scholars argue that to effective deal with climate adaptation challenges, different leadership styles might be needed, depending on the phase in the adaptation cycle. This study contributes to the existing literature by showing how the Cynefin framework, which was originally developed for a more corporate business environment, also can be applied on an environmental governance case study and can help practitioners in determining a matching leadership style.

When assessing the quantified problem perception and response of stakeholders, the reader should be aware, that two different ways of counting were in place during this research. Therefore, attention should rather be on the relative frequency of codes, than on absolute numbers. Regardless, results of this study point out the need for a more holistic view of water stress. In this, specific attention should be paid in adjusting the leadership style to match the changing governance environments, rather than focussing on mere technical analysis of water stress.

7. Recommendations for the municipality of Schouwen-Duiveland

Below several recommendations are listed for the municipality of SD, to take into consideration while planning and developing measures to make SD more climate adaptive:

1. I would recommend to make a careful distinction between the technical aspects of your climate adaptive projects (like the research to new water storage techniques and projects like '*natuurlijk zoet*'), and the more process oriented and behavioural aspects (e.g. how to involve farmers more? How to foster more collaboration between the different stakeholders? etc.) For the latter, different leadership styles might be needed.

   Then of course the questions arises, which leadership style do we need now? It is difficult to give one general answer to this since the appropriate leadership style depends on the context/phase of the project and the stakeholders involved. However, below some are 'tools' listed which could help in determining the right leadership styles:

   - **The Cynefin framework** (which was used in this research), see table page 12 of this document, or the attachment in the email for whole article, or this link.

     This framework can helps in separating the different aspects of your climate adaptation challenges into the different contexts (simple, complicated, complex, chaotic). Results of this study showed that water stress governance was mostly perceived as a 'complex' challenge. Therefore, I would recommend to also mostly use a complex leadership style (which you are also doing partly with the living lab SD, see point 2). Here focus is on 'probing' (In Dutch: gaandeweg leren, uitproberen, kijken wat werkt en niet werkt), *creation of environments and experiments where patterns can emerge (like the field lab-experiments), Increased levels of interaction and communication (like the information evenings).*

   - The **Leadership for moving the climate change adaptation agenda from planning to action** article (Vignola *et al.*, 2017). See attachment of the email for the article, or use this link.

     The article explains why many climate change adaptation projects fail to go from planning to actual implementation. Multiple leadership styles are listed in table 1. I would recommend to adopt a mostly 'coaching' leadership style. In table 2 several leadership challenges are listed per stage of climate change adaptation. Here I would focus on the challenges listed when going from the 'planning' to the 'managing' phase, since you are also trying to go from a pilot phase to wider implementation on SD.

   - **The Multi Stakeholder Partnership guide** (Brouwer *et al.*, 2019) (link 1, link 2)

     This guide could be used as a more generic guide for different phases of the multi-stakeholder processes. I would recommend to pay specific attention the first principle 'embrace systemic change'.

2. Parts of the living lab, like the field labs and the information evenings, where there is a lot of interaction and communication are very good, keep these! They are good, since they correspond with a 'complex' leadership style (see comment above on Cynefin framework). Suggestion would be to see where there can be more interaction and communication between nature organisations and agriculture, since interviewees from nature organisation

missed a bit the intergrality between nature and agriculture (see results, second dominant frame).

3. The focus on multiple type of solutions, and learning by doing is good! (e.g different storage solutions, and solutions on different scales). This is because a complex context requires a more probing response.

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*Note: References of particular interest are highlighted **bold***

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Annex A – Nederlandse samenvatting

Voor u ligt een beknopte samenvatting met de hoofdpunten uit het onderzoek zoals hierboven beschreven. Wilt u bij specifieke hoofdstukken een uitgebreidere analyse? Dan verwijs ik u door naar de Engelse hoofdstukken van het daadwerkelijk onderzoek. Onder elke kop zijn de paginanummers in *schuingedrukte letters* weergegeven.

1. Introductie

Voor de volledige versie zie pagina 1 – 6.

Een zeer waarschijnlijk gevolg van klimaatverandering in Nederland, is dat droge periodes gedurende de zomermaanden gaan toenemen in aantal en in intensiteit. Voor een kustprovincie als Zeeland, is dit vooral problematisch omdat er 1) veelal zout water rondom de provincie is, 2) er weinig tot geen aanvoer is van zoet water is en 3) er maar beperkte hoeveelheid zoet water in de ondergrond is opgeslagen. Dit kan leiden tot periodes van wat in dit onderzoek '*waterstress'* wordt genoemd (zie definitie in hoofdstuk hieronder). Een eiland waar deze problematiek met name nijpend is, is het eiland van Schouwen-Duiveland. Vergeleken met de andere eilanden in Zeeland heeft Schouwen-Duiveland relatief gezien de diepste polders (t/m 2 meter onder zeeniveau) en geen aanvoer van zoet water. Daarom zal dit onderzoek zich specifiek richten op Schouwen-Duiveland.

Naast de boven beschreven fysieke uitdagingen, zijn er ook verschillende bestuurlijke uitdagingen in het beheren van waterstress. Resultaten van andere klimaatadaptatiestudies over de wereld laten zien dat de manier waarop verschillende stakeholdergroepen hun uitdagingen 'framen' veel invloed heeft op hoe er vervolgens gehandeld wordt op dat probleem. Door een bepaalde manier van 'framen' kunnen bijvoorbeeld verschillende belangen en/of stakeholders worden voorgetrokken of juist worden buitengesloten. Ook blijkt dat veel complexe klimaatadaptieprojecten, tot nu toe vooral technische worden aangevlogen. Dit kan daadwerkelijke implementatie in de weg staan. Academici in klimaatadaptatie betogen, dat er naast een technische aanpak ook veel aandacht moet zijn voor de meer procesmatige en bestuurlijke aspecten van klimaatadaptatie om tot succesvolle implementatie te komen.

Voor het eiland van Schouwen-Duiveland is het tot nu toe nog onduidelijk hoe de verschillende stakeholdergroepen waterstress 'framen' en hoe ze reageren op waterstress. Dit brengt ons tot de onderzoeksvragen van dit onderzoek:

Hoofdvraag:

Hoe 'framen'- en reageren de verschillende stakeholders in Schouwen-Duiveland (op) waterstress, en hoe verhouden de verschillende 'frames' en reacties zich tot elkaar?

Sub-vragen

1. Wie zijn de belangrijkste stakeholders in het beheer van waterstress op Schouwen-Duiveland?

2. Hoe 'framen' de belangrijkste stakeholders de oorzaken en de gevolgen van waterstress?

3. Hoe reageren de belangrijkste stakeholders op de oorzaken en gevolgen van waterstress?

4. Wat is het niveau van complexiteit in stakeholder 'frames' en reacties, volgens het Cynefin-raamwerk?

Voor ik het onderzoek startte, was mijn hypothese dat stakeholders in Schouwen-Duiveland waterstress vooral zouden framen als een complex probleem (gekarakteriseerd door verschillende soms tegenstrijdige belangen, verschillende referentiekaders en veel onzekerheden). Maar dat stakeholders veelal zouden reageren met een veelal technische aanpak van waterstress.

2. Theorie en conceptueel raamwerk

Voor de volledige versie zie pagina 7 – 15.

In dit onderzoek is waterstress gedefinieerd als een gebeurtenis '*waar de vraag naar water de beschikbare hoeveelheid overstijgt gedurende een bepaalde periode OF wanneer beperkte waterkwaliteit het gebruik ervan beperkt. Water stress veroorzaakt achteruitgang van de zoetwatervoorraden in termen van kwantiteit en kwaliteit'*. (Zie pagina 7 voor exacte Engelse definitie).

Daarnaast is governance gedefinieerd als '*de handeling van het beheren van (natuurlijke) hulpbronnen en plaatsen, en het geheel van organisaties, institutionele kaders, normen en gewoontes, opererend over meerdere ruimtelijke schalen, waardoor dergelijk bestuur plaatsvindt'*. (Zie pagina 7 voor exacte Engelse definitie).

Voor dit onderzoek werd gebruik gemaakt van het 'Cynefin-raamwerk'. Dit is een conceptueel raamwerk wat vooral nuttig is voor leiders die te maken hebben met problemen die verschillende managementstijlen vergen. Het raamwerk maakt onderscheid tussen vier verschillende domeinen. Dit zijn het 1) simpele domein, 2) het gecompliceerde domein, 3) het complexe domein, 4) het chaotische domein. De hoofgedachte is dat elke domein om zijn eigen soort managementstijl vraagt.

Het simpele domein is het domein met problemen die een recht-toe-recht-aan managementstijl vragen. Problemen in dit domein hebben een duidelijke oorzaak-gevolg relatie waardoor het voor iedereen duidelijk is wat er moet gebeuren. Een voorbeeld zou kunnen zijn: het slootpeil is te laag, dus wordt er een stuw geplaatst.

Het gecompliceerde domein is het domein van problemen die wel een oorzaak gevolg relatie hebben, maar die niet gelijk duidelijk is. Daarom is onderzoek nodig om de oorzaak gevolg-relatie vast te stellen. Een voorbeeld zou kunnen zijn: het is niet precies duidelijk welke sloten zoet en zout zijn, daarom worden er veel metingen en analyse gedaan om vast te stellen welke sloten zoet en welke zout zijn, en hoe dit door het jaar heen veranderd. Door uitvoerig onderzoek wordt de oorzaak-gevolg relatie duidelijk en de aanpak die hierbij nodig is.

Het complexe domein is het domein van de 'wicked problems'. Dit zijn complexe problemen waar niemand van tevoren precies weet hoe het werkt en vaak verschillende stakeholders ook verschillende ideeën hebben over wat nou eigenlijk het probleem is. Waar je bij gecompliceerde problemen na analyse kan bepalen wat de juiste aanpak is, kan dat bij complexe problemen niet. Alleen achteraf kan je duidelijk zien wat werkt en wat niet werkt. Complexe problemen zijn gekarakteriseerd door hoge mate van onvoorspelbaarheid-, complexiteit- en veel verschillende soms concurrerende ideeën over wat het juiste plan van aanpak is. De 'juiste' aanpak voor complexe problemen richt zich op proberen, kijken wat werkt en niet werkt, en veel interactie tussen de verschillende stakeholders. Een voorbeeld van een complex probleem zou kunnen zijn: Hoe maken we Schouwen-Duiveland in 2050 bestendig tegen klimaatverandering?

Het chaotische domein is in deze studie buiten beschouwing gelaten. Maar voorbeelden van chaotische problemen zijn bijvoorbeeld crisissituaties zoals een dijkdoorbraak. De juiste aanpak voor dit soort problemen kenmerkt zich vooral door snel te handelen.

Voor een uitgebreide tabel met de verschillende domeinen en de juiste bijbehorende managementstijlen, zie tabel 2 pagina 12.

3. Methodologie

Voor de volledige versie zie pagina 14 – 20.

Data verzameling

De data voor deze studie is verzameld door interviews te houden met zes verschillende stakeholdergroepen die betrokken waren bij het beheer of de 'governance' van waterstress op Schouwen-Duiveland. Deze stakeholdergroepen zijn in willekeurige volgorde: 1) de Gemeente Schouwen-Duiveland, 2) Waterschap Scheldestromen, 3) De Provincie Zeeland, 4) de agrarische sector, 5) natuurorganisaties, 6) externe adviseurs en experts betrokken bij de verschillende pilotprojecten op Schouwen-Duiveland. Van elke stakeholdergroep zijn er minstens twee personen geïnterviewd (zie tabel 3, blz. 14 voor hun precieze rollen). In totaal zijn er 21 verschillende interviews gehouden. De vragen die gesteld zijn tijdens de interviews zijn weergegeven in annex E.

Data analyse

Alle 21 interviews zijn uitgetypt en vervolgens gecodeerd met de data-analyse-software Atlas.ti. Het coderen is gedaan op basis van de karakteristieken van drie verschillende domeinen van het Cynefin-raamwerk. Hierin is specifiek onderscheid gemaakt in hoe de verschillende stakeholders waterstress framen en hoe ze op waterstress reageren. Voor de operationalisatie-tabel met exacte codes die zijn gebruikt, zie pagina 16-18 tabel 4.

Door de uitgeschreven interviews op deze manier te coderen, kon precies worden gezien in welk(e) domein(en) stakeholders waterstress framen en in welk(e) domein(en) stakeholders reageerden op waterstress.

4. Resultaten

Voor de volledige versie zie pagina 21 – 39.

<u>Vraag 1: Wie zijn de belangrijkste stakeholders in het beheer van waterstress op Schouwen-Duiveland?</u>

In dit onderzoek zijn zes stakeholdergroepen geïdentificeerd, dit zijn in willekeurige volgorde: 1) de agrarische sector, 2) natuurorganisaties, 3) gemeente Schouwen-Duiveland, 4) Waterschap Scheldestromen, 5) Provincie Zeeland, 6) externe adviseurs en experts betrokken bij de verschillende (pilot) projecten. Hun rol in waterstress is omschreven op blz. 21-23. Daarnaast zijn er drie andere stakeholdergroepen (toerisme sector, inwoners van Schouwen-Duiveland, drinkwaterbedrijf Evides), die indirect wel relevant werden geacht, maar verder buiten beschouwing zijn gelaten in dit onderzoek. Uitleg en reden hiervoor is omschreven in annex D.

<u>Vraag 2: Hoe 'framen' de belangrijkste stakeholders de oorzaken en de gevolgen van waterstress?</u>

Uit de 21 interviews kwamen er vier dominante manieren naar voren hoe stakeholders waterstress framen. Dit waren:

1) Waterstress is een bedreiging voor de agrarische concurrentiepositie van het eiland.
2) Waterstress is een bedreiging voor de agrarische sector, maar ook een bedreiging voor de natuurwaarden op het eiland.
3) Waterstress is een probleem, maar het risico op overstromingen is een groter probleem.
4) Waterstress is een complex probleem wat ook direct verbonden is met andere maatschappelijke en globale vraagstukken.

Voor een uitgebreidere toelichting en de bijbehorende stakeholdergroepen per dominante 'framing' zie tabel 6, blz. 23 en de sectie daaronder.

Vraag 3: Hoe reageren de belangrijkste stakeholders op de oorzaken en gevolgen van waterstress?

Uit de 21 interviews kwamen er 5 dominante manier naar voren hoe stakeholders reageerden op waterstress. Dit waren:

1) Het gebruik van 'best practices'[31].

   Voorbeelden waren, niet-kerende grondbewerking, plaatsen van stuwtjes in de sloot en het plaatsen van dompelpompen.

2) Meer technische analyse van het watersysteem.

   Voorbeelden waren, constructie van een nieuw monitornetwerk om veranderingen in het volume van de zoetwaterbellen te meten door het waterschap, programma's zoals de PWO van het waterschap, en onderzoeksprojecten zoals Natuurlijk Zoet.

3) Ontwikkeling van nieuwe technische oplossingen.

   Voorbeelden waren de ontwikkeling van nieuwe technieken voor zoetwateropslag in de bodem (zie projecten Living Lab), het optimaliseren van efficiëntere irrigatietechnieken (zie ZDZW, pagina 28)

4) Verhoogde politieke druk om iets aan waterstress te doen.

   Voorbeelden waren 1) de lobby voor externe zoetwater aanvoer door stichting de Puupe, 2) lobby voor zoetwateroplossingen van de gemeente SD naar de provincie toe en 3) politieke druk (nu nog in beperkte mate) vanuit Provincie Zeeland richting de nationale overheid.

5) Meer interactie en communicatie rondom het onderwerp waterstress.

   Voorbeelden waren de informatieavonden georganiseerd door het Living Lab en de horizontale netwerkstructuur van het Living Lab waardoor verschillende stakeholders snel informatie konden uitwisselen.

Voor een uitgebreidere toelichting en de bijbehorende stakeholdergroepen per dominante reactie van stakeholders op waterstress zie tabel 7, blz. 28 en de sectie daaronder.

Vraag 4: Wat is het niveau van complexiteit in stakeholder 'frames' en reacties, volgens het Cynefin-raamwerk?

Deze resultaten zijn visueel weergegeven in figuur 2, blz. 36. Hieronder volgt een toelichting op dat figuur.

Uit het coderen van de interviews bleek dat alle stakeholdergroepen waterstress hoofdzakelijk als een complex probleem zagen (gekarakteriseerd door verschillende soms tegenstrijdige belangen, verschillende referentiekaders en veel onzekerheden). De reacties van stakeholders op waterstress verschilde per stakeholdergroep. De helft van de stakeholdergroepen (waterschap, provincie, externe adviseurs en experts) reageerden vooral op waterstress als een gecompliceerd probleem (waarin veel

[31] Met 'best practices' worden recht-toe-recht aan management handelingen bedoeld, waarvan het duidelijk is dat ze in het verleden effectief zijn gebleken (Snowden and Boone, 2007). Voorbeelden in de casus van waterstress op Schouwen-Duiveland zijn, niet-kerende grondbewerking, plaatsen van stuwtjes in de sloot en het plaatsen van dompelpompen.

nadruk ligt op technische analyse van het watersysteem). Twee van de zes stakeholdergroepen (gemeente SD en natuurorganisaties) reageerden vooral op waterstress als een complex probleem (hierin was veel nadruk op uitproberen wat werkt, en veel interactie en communicatie tussen de verschillende stakeholders). De agrarische sector reageerde op waterschaarste bijna gelijk verdeeld over het simpele-, gecompliceerde- en complexe domein. Een verklaring hiervoor is dat er zowel snelle korte-termijn (het plaatsen van stuwen) als wel lange-termijn oplossingen (participatie in de fieldlabs en onderzoek naar nieuwe zoetwateropslag technieken) nodig waren voor deze sector.

5. Discussie & Conclusie

Voor de volledige versie zie pagina 39 – 43.

De resultaten van deze studie lieten ziet dat hoewel het probleem van waterstress vooral werd gezien als een complex probleem, de reactie van de helft van de stakeholdergroepen vooral gecompliceerd was. Dit betekent dat er veel nadruk was op technische analyse van waterstress. In andere klimaatadaptatiestudies over de wereld zien we vergelijkbare resultaten. Academici betogen dat om tot succesvolle implementatie van klimaat-adaptieve projecten te komen er naast nadruk op technische analyse meer ruimte moet komen voor de meer procesmatige en bestuurlijke kanten van klimaatadaptatie. Hiervoor zijn verschillende leiderschapsstijlen nodig, afhankelijk van de lokale context.

Het Cynefin-raamwerk zoals gepresenteerd op pagina 11 van dit onderzoek, zou een mogelijk handvat kunnen bieden in het vaststellen van de juiste leiderschapsstijl. Een andere suggestie zouden de verschillende leiderschapsstijlen kunnen zijn zoals gepresenteerd door Vignola et al. 2017 (zie referenties en/of de link op pagina 44 voor het artikel).

Een ander punt van discussie wat naar voren kwam in de resultaten van deze studie en in andere klimaatadaptatiestudies is het punt van 'framing'. Andere academici hebben laten zien dat een door een probleem op een bepaalde manier te framen de discussie in een bepaalde richting geduwd kan worden. Impliciet of expliciet kunnen daardoor bepaalde belangen behartigd- of juist ondermijnd worden en kunnen bepaalde stakeholdergroepen betrokken- of juist uitgesloten worden. De interviews met natuurorganisaties in deze studie bevestigden dit punt. Door waterstress vooral als een bedreiging voor de agrarische concurrentiepositie van het eiland te framen, voelde deze stakeholdergroep zich soms buitengesloten en/of had moeite aan de beleidstafel aan te schuiven. Natuurorganisaties onderstreepten het belang van een langetermijnvisie voor Schouwen-Duiveland die breder was dan alleen een agrarisch concurrerend eiland blijven.

Net als elk onderzoek, had dit onderzoek ook een aantal beperkingen. In het kort waren dat de manier hoe de codes zijn opgeteld en de manier van data verzameling wat in deze studie alleen door interviews was.

Voor de volledige discussie en conclusie, met aanbevelingen voor vervolgonderzoek zie pagina 39-43.

6. Aanbevelingen voor de gemeente Schouwen-Duiveland

Voor de volledige versie zie pagina 44 – 45.

Naast de leerpunten uit dit onderzoek, zijn een ook een aantal aspecten in het beheer van waterstress wat al erg goed was. In het kort zijn dat mogelijkheid voor veel interactie en communicatie tussen de verschillende stakeholdergroepen binnen het Living Lab Schouwen-Duiveland (door o.a. de informatieavonden en de horizontale netwerkstructuur van de netwerkorganisatie). Dit is belangrijk omdat dit volgens het Cynefin-raamwerk nodig is in het aanvliegen van complexe vraagstukken. Daarnaast werd er binnen het Living lab ingezet op verschillende oplossingsrichtingen om op die manier uit te proberen wat werkt en wat niet werkt. Deze ‘uitproberende’ (of trail-and-error) houding is goed, omdat juist deze houding nodig is voor complexe problemen zoals waterstress waarin je van tevoren niet alle oorzaak-gevolg relaties kan bepalen.

Een aanbeveling (die wellicht zou passen binnen het werkveld van de governance- taskforce?) zou zijn om nog scherper te krijgen welke verschillende leiderschapsstijlen er nodig zijn om van de ‘pilot- en planningsfase’ naar de daadwerkelijke implementatie van klimaat-adaptieve projecten te komen. Een aantal suggesties inclusief hyperlinks, zijn hiervoor op pagina 44-45 genoemd.

Annex B – Dominant domains per stakeholder group

The figures below show the same result as *figure 1* in the results chapter. However, for readability the same figures are presented here, only now the results are shown per individual stakeholder group. Within each figure the stakeholder group is listed in the middle of the figure and above each figure.

Agricultural sector

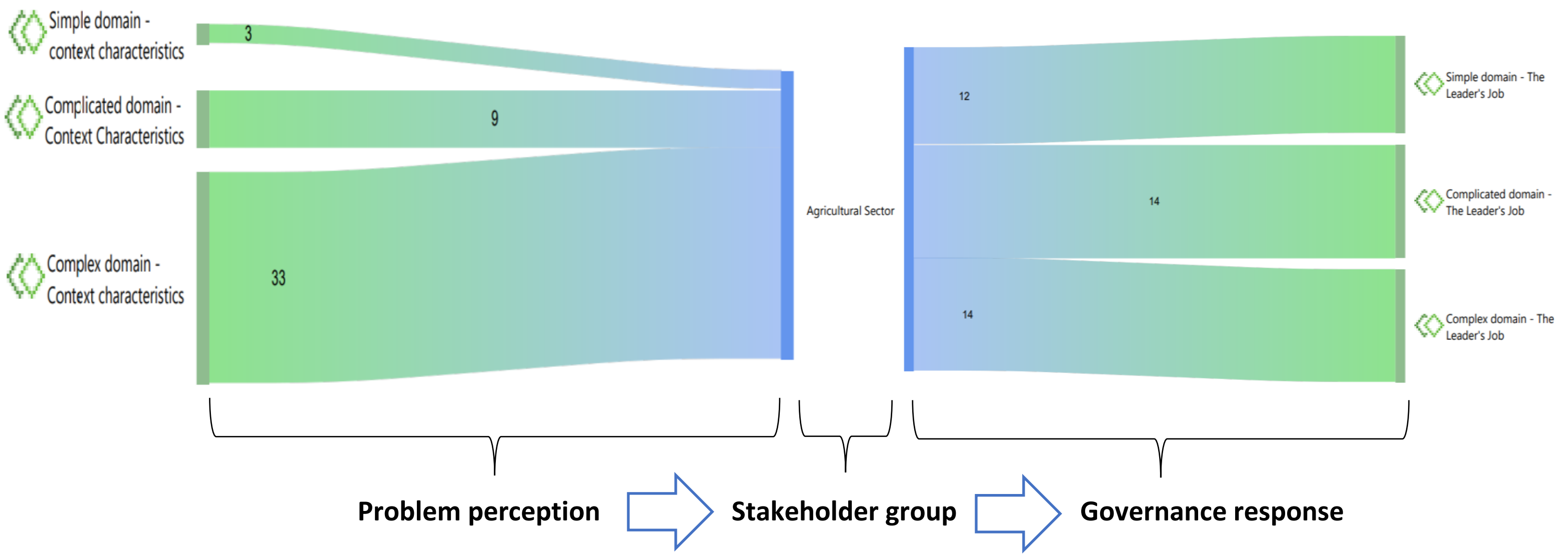

Figure 3: Agricultural sector: problem perception and response to water stress

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External experts and advisors group

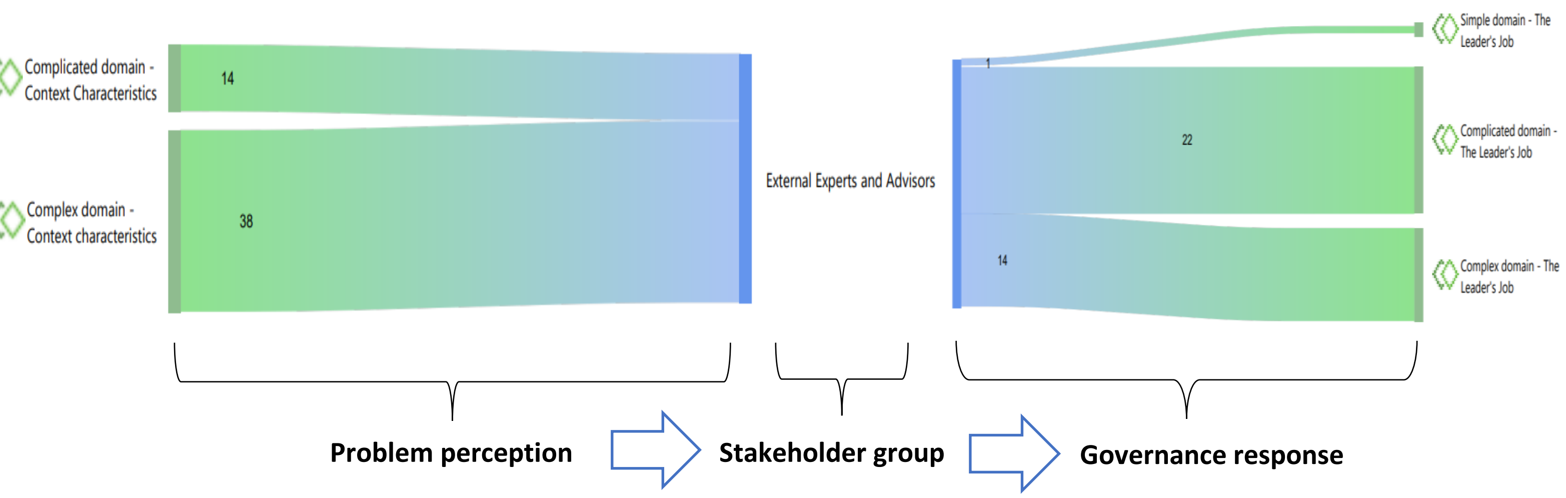

Figure 4: Ext. advisors and experts: problem perception and response to water stress

The Municipality of Schouwen-Duiveland

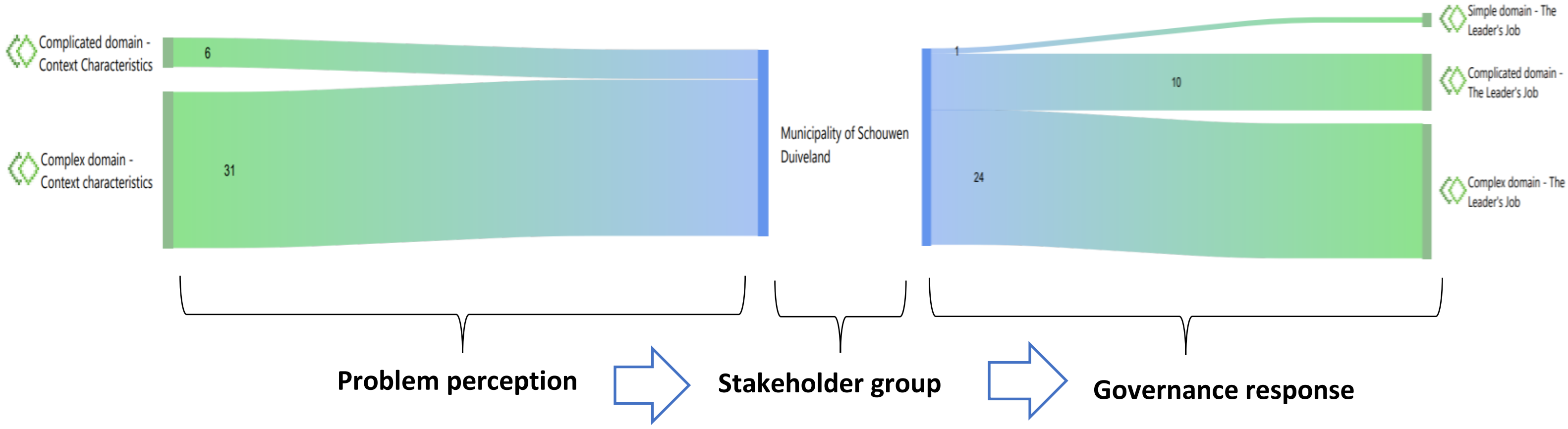

Figure 5: The Municipality of Schouwen-Duiveland: problem perception and response to water stress

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Nature organisations

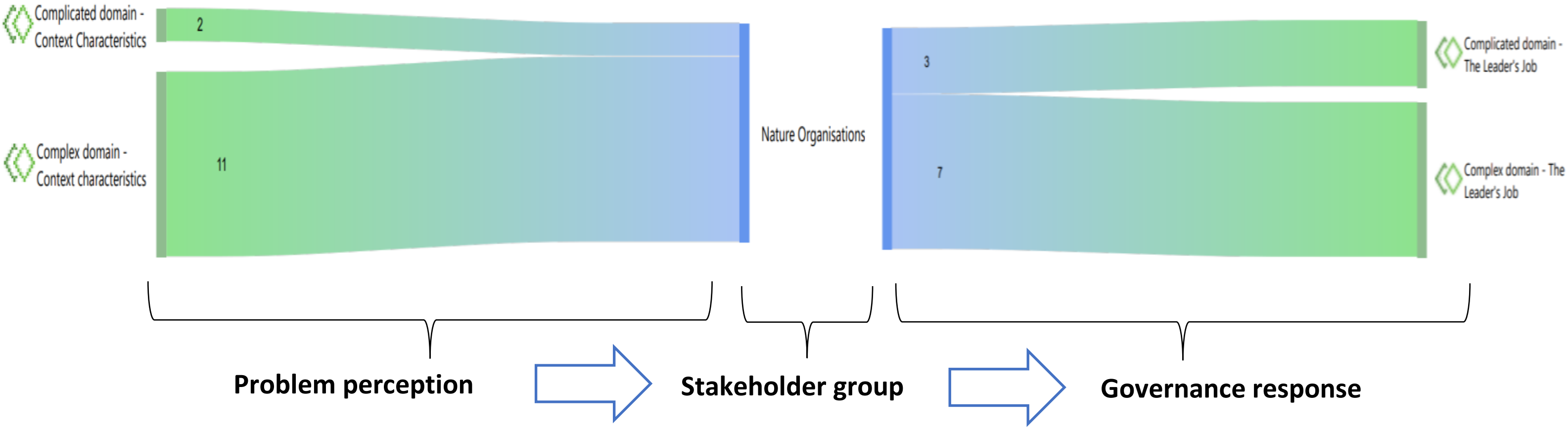

Figure 6: Nature organisations: problem perception and response to water stress

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The Province of Zeeland

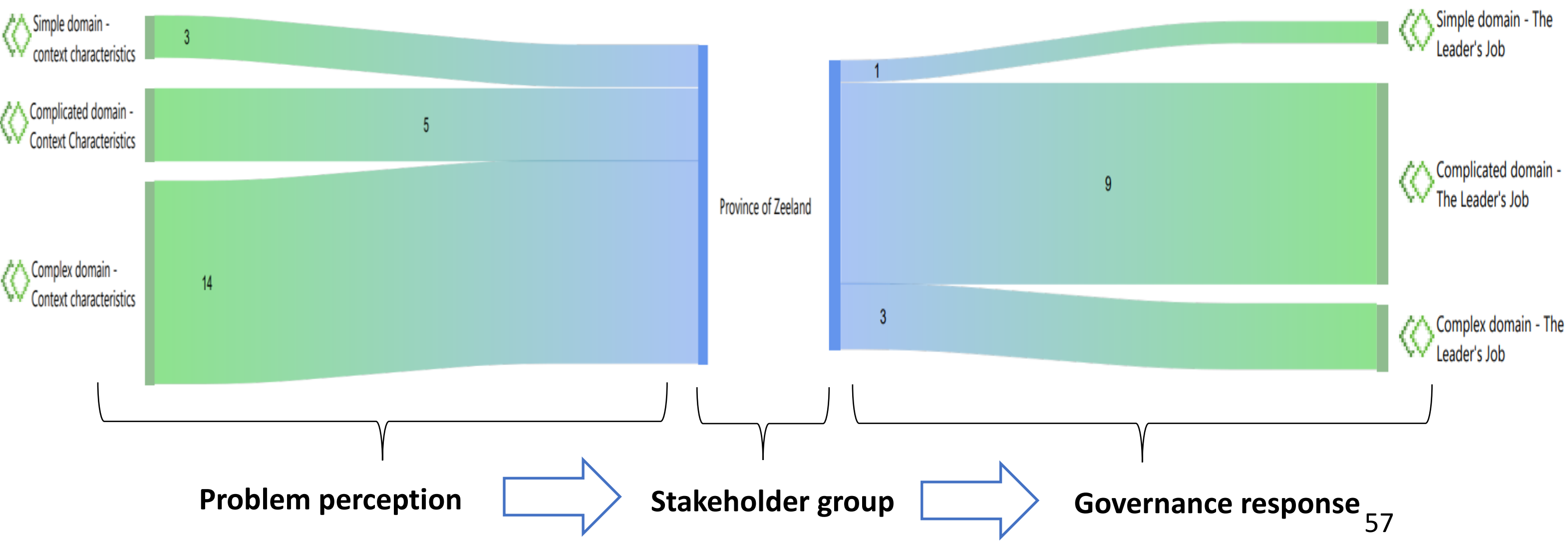

Figure 7: The Province of Zeeland: problem perception and response to water stress

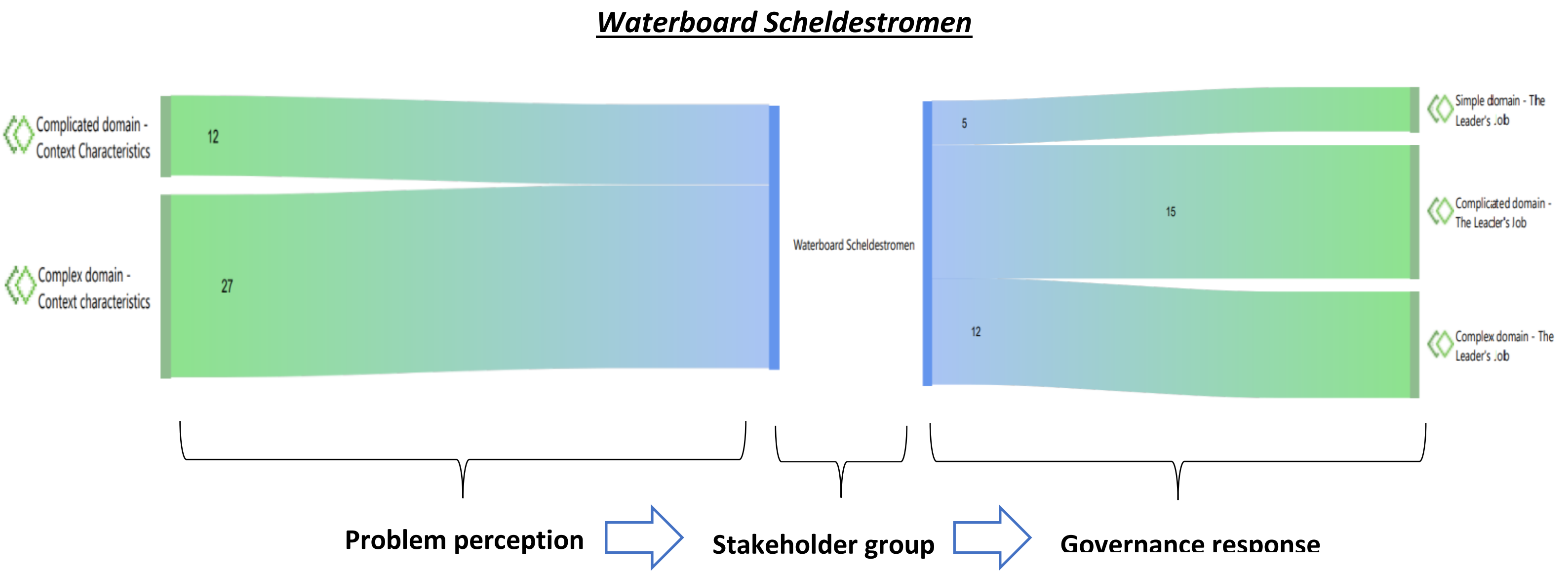

Figure 8: Waterboard Scheldestromen: problem perception and response to water stress

Annex C – Table Cynefin characteristics per stakeholder group

			Agricultural Sector Gr=106; GS=5	External Experts and Advisors Gr=114; GS=4	Municipality of Schouwen Duiveland Gr=94; GS=4	Nature Organisations Gr=60; GS=2	Province of Zeeland Gr=47; GS=2	Waterboard Scheldestromen Gr=109; GS=4	Totals
Simple domain	context characteristics	• A.1.1 'Repeating patterns and consistent events' Gr=0	0	0	0	0	0	0	0
		• A.1.2 'Clear cause-and-effect relationships evident to everyone; right answer exists' Gr=5	3	0	0	0	2	0	5
		• A.1.3 'Known knowns' Gr=1	1	0	0	0	0	0	1
		• A.1.4 'Fact-based management' Gr=2	0	0	0	0	2	0	2
	governance response	• A.2.1 'Sense, categorize, respond' Gr=8	6	1	0	0	0	1	8
		• A.2.2 'Ensure that proper processes are in place' Gr=7	4	0	0	0	1	2	7
		• A.2.3 'Delegate' Gr=2	0	0	0	0	0	2	2
		• A.2.4 'Use best practices' Gr=14	10	1	1	0	1	1	14
		• A.2.5 'Communicate in clear, direct ways' Gr=0	0	0	0	0	0	0	0
		• A.2.6 'Understand that extensive interactive communication may not be necessary' Gr=2	1	0	0	0	0	1	2
Complicated domain	context characteristics	• B.1.1 'expert diagnosis required' Gr=14	1	6	1	0	4	2	14
		• B.1.2 'Cause-and-effect relationships discoverable but not immediately apparent to everyone; more than one right answer possible' Gr=30	4	12	3	2	3	6	30
		• B.1.3 'Known unknowns' Gr=33	6	12	4	1	3	7	33
		• B.1.4 'Fact-based management' Gr=37	7	11	6	1	5	7	37
	governance respon	• B.2.1 'Sense, analyse, respond' Gr=55	10	17	7	3	7	11	55
		• B.2.2 'Create panels of experts' Gr=24	4	9	5	1	2	3	24
		• B.2.3 'Listen to conflicting advice' Gr=11	1	2	0	0	4	4	11
Complex domain	context characteristics	• C.1.1 'Flux and unpredictability' Gr=58	16	13	12	2	6	9	58
		• C.1.2 'No right answers; emergent instructive patterns' Gr=28	11	5	5	1	2	4	28
		• C.1.3 'Unknown unknowns' Gr=25	4	4	8	0	5	4	25
		• C.1.4 'Many competing ideas' Gr=70	8	19	14	5	6	18	70
		• C.1.5 'A need for creative and innovative approaches' Gr=23	5	6	5	5	0	2	23
		• C.1.6 'Pattern-based leadership' Gr=7	2	4	0	1	0	0	7
	governance response	• C.2.1 'Probe, sense, respond' Gr=24	6	6	10	0	0	2	24
		• C.2.2 'Create environments and experiments that allow patterns to emerge' Gr=33	6	7	11	2	1	6	33
		• C.2.3 'Increase levels of interaction and communication' Gr=49	7	11	14	7	3	7	49
		• C.2.4 'Use methods that can help generate ideas: Open up discussion (as through large group methods); set barriers; stimulate attractors; encourage dissent and diversity; and manage starting conditions and monitor for emergence' Gr=25	2	8	5	1	2	7	25
		Totals	125	154	111	32	59	106	587

The table in Annex C above shows the results of all codes placed in the coding analysis of this research. On the left side of the table the self-made Cynefin code titles are listed, ordered by domain (simple, complicated, complex), respectively in the colours red, blue, green. On the top-side the different stakeholder groups are listed in the separate rows.

Annex D – Stakeholder groups not included in this research

Next to the stakeholder groups which were interviewed, there are also three other important stakeholder groups which were not interviewed. These are listed below, with a short argumentation why they have not been included in this research.

Tourist industry

The tourist industry consists of camping areas on the west part of the island, shops in cities like Zierikzee, and companies who offer recreational activities (e.g. sailing, kiting, etc). Several camping areas located in the west part of the island have conflicting stakes with the neighbouring nature areas: Camping areas prefer dry soils, while neighbouring nature areas with fresh-water-nature prefer wet soils (personal communication interviewee2_nature, 2021).

This stakeholder group was not included in this research to limit of the extensiveness of this study. Also, the role of the tourist industry in the governance of water scarcity is limited since they do not have any formal responsibilities in water stress governance.

Inhabitants of SD

The inhabitants of SD are not (yet) affected by water stress in their drinking water supply. This is because drinking water is distributed throughout the Island via a separate pipe network solely for drinking water purposes. However, water stress does affect the houses of inhabitants located in areas with peat soils. Here dry periods can lead to oxidation in peat soils, with soil compaction as a result. The extent of soil compaction on SD is not fully known yet. But this could become a more severe challenge if water stress intensifies in the future.

This stakeholder group was not included in this research since the drinking water supply is not under threat yet. Also current water stress governance is mostly aimed at the agricultural areas of the island.

Evides

Evides is the drinking water company situated in the dunes in the west part of the Island. Via a separate external fresh water pipeline, water from the Haringvliet, is infiltrated in the dunes. This water is used as drinking water after treatment. According to the multiple interviewees of the waterboard as much water is infiltrated as extracted from the dunes, which makes their water balanced closed.

This stakeholder group was not included in this research since the drinking water network can be seen as a separate and a closed water network, next to the network of ditches throughout the island.

Annex E – Interview questions

#Interview Question	Interview Question	Targeting Research Question		Possible Follow-up Questions	Related to which part of the Cynefin Framework?
1	*According to you, who are the main stakeholders involved in water stress governance in Zeeland? And why should these be considered as main-stakeholder?*	1.	*Who are the main stakeholders involved in water stress governance in the province of Zeeland?*	*What are their specific roles in the management of water stress?* *With which stakeholders do you have a lot of interaction? And with which ones not? Why is this?*	-
2	*How is water stress affecting you? And what are the most important causes of water stress according to you?*	2. & 4.	How are the main stakeholders framing the causes and the problems related to water stress? & *What is the complexity-level of stakeholders' framing- and response to water stress, according to the Cynefin framework?*	In your experience, could you explain what makes it difficult to deal with water stress?	*The Context Characteristics*
3	*How have you responded to the recent years with water stress (e.g. 2018, 2019, 2020)? And how are you planning to respond to water stress in the future?*	3. & 4.	*How are stakeholders responding to the causes and problems related to water stress?* & *What is the complexity-level of stakeholders' framing- and response to water stress,*	*In your eyes, what is the best way to deal with water stress?*	*The Leader's Job*

			according to the Cynefin framework?		
4	*How are people you know responding to water stress in Zeeland?*	3. & 4.	" & "	-	*The Leader's Job*
5	*If you look to other stakeholders (e.g. province, waterboard, farmers, nature organizations), how are they reacting to water stress? Are these measures individual- or collective- measures?*	3. & 4.	" & "	-	*The Leader's Job*
6	*Are there places or spaces in which you collectively with other stakeholders can interact and communicate on the topic of water stress? If yes, how is this being done? And what is discussed during these meetings?*	3. & 4.	" & "	Would you prefer meeting more or less with these other stakeholders? And why?	*The Leader's Job*
7	*According to you, what are strong- and what are weak points in the current response to water stress?*	2. & 3.	*How are the main stakeholders framing the causes and problems related to water scarcity?* & *How are stakeholders responding to the causes and problems related to water stress?*	-	*The Context Characteristics* & *The Leaders Job*
8	*Are there any other things you would like to add to this interview?*	-	-	-	-

Annex F – Tools for Managing in a complex context

Tools for Managing in a Complex Context, retrieved from Snowden & Boone 2007, page 6:

Tools for Managing in a Complex Context

Given the ambiguities of the complex domain, how can leaders lead effectively?

- **Open up the discussion.** Complex contexts require more interactive communication than any of the other domains. Large group methods (LGMs), for instance, are efficient approaches to initiating democratic, interactive, multidirectional discussion sessions. Here, people generate innovative ideas that help leaders with development and execution of complex decisions and strategies. For example, "positive deviance" is a type of LGM that allows people to discuss solutions that are already working within the organization itself, rather than looking to outside best practices for clues about how to proceed. The Plexus Institute used this approach to address the complex problem of hospital-acquired infections, resulting in behavior change that lowered the incidence by as much as 50%.
- **Set barriers.** Barriers limit or delineate behavior. Once the barriers are set, the system can self-regulate within those boundaries. The founders of eBay, for example, created barriers by establishing a simple set of rules. Among them are pay on time, deliver merchandise quickly, and provide full disclosure on the condition of the merchandise. Participants police themselves by rating one another on the quality of their behavior.
- **Stimulate attractors.** Attractors are phenomena that arise when small stimuli and probes (whether from leaders or others) resonate with people. As attractors gain momentum, they provide structure and coherence. EBay again provides an illustrative example. In 1995, founder Pierre Omidyar launched an offering called Auction Web on his personal website. His probe, the first item for sale, quickly morphed into eBay, a remarkable attractor for people who want to buy and sell things. Today, sellers on eBay continue to provide experimental probes that create attractors of various types. One such probe, selling a car on the site, resonated with buyers, and soon automobile sales became a popular attractor.
- **Encourage dissent and diversity.** Dissent and formal debate are valuable communication assets in complex contexts because they encourage the emergence of well-forged patterns and ideas. A "ritual dissent" approach, for instance, puts parallel teams to work on the same problem in a large group meeting environment. Each team appoints a spokesperson who moves from that team's table to another team's table. The spokesperson presents the first group's conclusions while the second group listens in silence. The spokesperson then turns around to face away from the second team, which rips into the presentation, no holds barred, while the spokesperson listens quietly. Each team's spokesperson visits other tables in turn; by the end of the session, all the ideas have been well dissected and honed. Taking turns listening in silence helps everyone understand the value of listening carefully, speaking openly, and not taking criticism personally.
- **Manage starting conditions and monitor for emergence.** Because outcomes are unpredictable in a complex context, leaders need to focus on creating an environment from which good things can emerge, rather than trying to bring about predetermined results and possibly missing opportunities that arise unexpectedly. Many years ago, for instance, 3M instituted a rule allowing its researchers to spend 15% of their time on any project that interested them. One result was a runaway success: the Post-it Note.

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