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A Decision-Support Tool for Assessing Areas Facing Drought: A Case Study of Living Lab Schouwen-Duiveland, Zeeland, The Netherlands.

"Primary focus on stakeholder theory and analysis"

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Abstract

In order to streamline decision-making processes regarding areas facing drought a decision-support tool is proposed by the author. This decision-making tool combines 1) vulnerability assessment; 2) stakeholder analysis; 3) a recommendation on adaptation, mitigation and resilience-building measures against drought; and 4) a repeating element aimed at stakeholder involvement and collaboration into one broad and stepwise process. These aspects served as a foundation of the research performed. The developed decision-support tool was tested in the case study area of the island of Schouwen-Duiveland in the Netherlands. Empirical evidence was collected in this area for step 2: the stakeholder analysis. This stakeholder analysis was performed in three steps. 1) Stakeholder identification was done by contacting organisations through the network organisation Living Lab Schouwen-Duiveland. Contacted organisations, and individuals within those organisations, who were either affected by and/or interested in addressing drought on the island were asked to participate in a questionnaire, a subsequent interview and a workshop. 42 contacts were approached, of which 24 sent back the questionnaire and of those 15 were interviewed. Thus 24 initial stakeholders were identified who provided 139 additional contacts. These were then divided into 8 sectors related to the issue. 2) Stakeholder categorisation took these results and categorised the stakeholders using the 'Rings of Involvement to Drought' method developed by the author. The method uses 3 rings and 4 quadrants to indicate the level of involvement to drought as well as characterisation of the stakeholders: Policy-making, Executive power, Advice & Consultancy, and implementation & suppliers. These divisions were chosen to unravel the many stakeholders as efficiently as possible. 3) Stakeholder interrelationships were visualised using the stakeholder's relations to their contacts. These results displayed 16 organisations, 24 initial stakeholders, their 58 individual contacts, 27 organisational contacts and 16 groups/ projects/ programmes into a circular dendrogram. The stakeholder analysis made it clear that decision-making processes can be streamlined by uncovering the network surrounding drought as it makes communication between stakeholders more efficient. Further research should aim at testing the vulnerability assessment and the adaptation, mitigation and resilience-building measures steps of the developed decision-making tool.

Keywords: Drought, Decision-support tool, decision-making, Stakeholder, Schouwen-Duiveland, Netherlands, Climate Change

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List of Abbreviations

1) **LAB**	Living Lab Schouwen-Duiveland
2) **DST**	Decision-support tool
3) **IPCC**	Intergovernmental Panel on Climate Change
4) **KNMI**	Royal Dutch Meteorological institute
5) **EC**	European Commission
6) **ENRD**	European Network for Rural Development
7) **ENRM**	Environmental and Natural Resource Management
8) **SNA**	Social Network Analysis

Terminology

Often used words by the author that may need further clarification.

1) Local scale :	The local scale is used for small areas; usually for a city or municipality
2) Regional scale :	The regional scale is used for larger areas; a region or province. The Island of Schouwen-Duiveland is both a municipality and region
3) Province :	After the national government, the second tier of government in the Dutch constitution; an intermediary between the two other tiers
4) Municipality :	After the national and provincial government, the third tier of government in the Dutch constitution
5) Waterboards:	A public body that has the task of regulating water management in specific regions in the Netherlands; the term also indicates regions over which that body has control
6) Initial Stakeholder:	The 24 stakeholders related to drought on the island of Schouwen-Duiveland that participated in the research
7) Contacts :	The 139 contacts related to drought on the island of Schouwen-Duiveland provided by the initial stakeholders
8) Core partners of LAB:	The initiators and core team of LAB who are also part of the initial stakeholders

1. Introduction

The following chapter introduces the reader to the study process. The problem statement, the research aim and scope, as well as research questions and objectives are outlined in the following sections.

1.1 Problem Orientation

Drought is one of many natural hazards exacerbated by climate change (Shukla et al., 2019) Governments and local communities alike have to adapt to environmental and societal stresses that drought brings, but often there are no clear regional pathways of how to deal with the changes (Ribeiro et al., 2009). Climate pathways and decision-making tools are abundant but they mainly focus on one assessment aspect (e.g. climate impacts, vulnerability) and on national and larger scales. Take for instance the work from Field et al. (2014) which outlines several scenarios or climate pathways for the world to slow down the climate change. However, local individuals, organisations and governments mainly in developing countries are limited in their adaptation capabilities due to income, education, health, security, political power, or access to technology (Denton et al., 2014). Climate scenarios such as the IPCC's and climate adaptation plans made by countries might take general and global information on environmental stresses into account but often there is a lack of focus on regional events (Römisch, 2009). Above all, local stakeholders are often left out of the larger conversations regarding regions that they have their livelihoods in (Phillipson et al., 2012). Without the input of those affected and/or interested parties much information can be skipped over or lost altogether. Using the stakeholder involvement approach local stakeholders affected by and/or interested in addressing drought can be brought together into transparent organisations (EC & ENRD, 2015). By acknowledging the issue, the author of this thesis proposes an integrated decision-support tool (DST) for these specific situations where climate impacts are apparent and one of the following is the case: no climate adaptation plans are available and/or no stakeholders are known. The DST would be integrated in the sense that both data from scientific literature, and local and national stakeholders should be used to gain a full picture of the climate vulnerability, parties affected by and/or interested in addressing drought, and what can be done in terms of prevention or adaptation.

The case study for this thesis has been chosen in the Netherlands as it is a country that has had a long history of water management and thus is an exemplary study region to bring to discussion. Furthermore, the author is from the country and thus knows the customs. For centuries it has been Dutch practice to get rid of superfluous water during floods or high rainfall.

However, in the last years there have been increasing concerns about drought during the summer months. Those Dutch regions which are mainly dependent on rainfall suffer more from drought than those with access to other fresh water sources such as rivers and lakes (KNMI, 2021a). The way of addressing drought in the Netherlands is partially dependent on how various sectors use the fresh water. As stated by the Royal Dutch Meteorological institute (KNMI, 2021a), drought is exacerbated by climate change which means that long-term solutions should be found to limit the effect it can have. The island of Schouwen-Duiveland is one of the regions, where the effects of drought could have been seen in the past few years. The island struggles between a surplus of fresh water in winter and a lack of fresh water in summer. This difference is due to the huge differences in the amount of rainfall in the winter and summer months. Furthermore, it can be a challenge to bring together all the related information and knowledge such as vulnerable parties and stakeholders interested in addressing the issue. Connecting the affected and interested parties is important for useful cooperation. A disconnect between stakeholders can indeed be a limiting factor to the effectiveness of progress towards addressing the problem of drought (Esmail et al., 2015).

1.2 Research aim and scope

The study focuses on streamlining the decision-making process, with emphasis on stakeholder cooperation, regarding drought on the island of Schouwen-Duiveland in The Netherlands.

1.2.1 Research Questions

Main research question*: Which are the main elements of a decision-support tool that contribute to more focussed stakeholder collaboration in a place-based manner?*

Sub Questions:

1. *What is the importance of a decision-support tool in regards to drought management?*
2. *How can the effects of drought be identified and analysed in general, according to vulnerability assessments?*
3. *What are the proposed measures against drought in the case study area of Schouwen-Duiveland?*
4. *How can stakeholders be identified, categorized and interlinked, according to stakeholder theory?*

This study will give insight into the drought issues of the island of Schouwen-Duiveland; mainly focussing on the stakeholder network. It will highlight the knowledge gap between top-down (government) and bottom-up (community) approaches in drought management as

identified by the stakeholder analysis. In this way the proposed DST can support decision-makers to fill in those gaps and improve stakeholder cooperation. This is especially significant for those stakeholders whose livelihoods are threatened by drought.

1.2.2 General Objectives

1. To explain the role of the DST regarding drought on Schouwen-Duiveland.
2. To identify the stakeholder network in Schouwen-Duiveland related to drought by means of a stakeholder analysis with the help of the network organization LAB.
3. To categorize those identified stakeholders as affected by and/or interested in addressing the issue of drought.
4. To document the interrelationships of the stakeholders of LAB related to the issue of drought.

1.2.3 Specific objectives

1. To get acquainted with the stakeholders affected by and/or interested in addressing the drought issue on Schouwen-Duiveland.
2. To perform a stakeholder analysis and collaborate with these stakeholders using a questionnaire, interviews and a workshop.
3. To visualize the outcomes of the questionnaire, interviews and stakeholder workshop using methodologies of the stakeholder theory.
4. To compare the categorization of stakeholders involved from the author's and stakeholders perspective.
5. To explain how the DST can support local governments and communities in better cooperation between them.
6. To recommend how the DST can also be used in other geographical areas.
7. To test and validate the DST on the case study area of Schouwen-Duiveland.

2. State of the Art

This chapter provides an overview of existing literature regarding conceptual frameworks and decision-support tools; vulnerability assessments; available stakeholder theory methods; and adaptation, mitigation and resilience-building measures against drought. This structure was chosen based on the structure of the developed DST.

2.1 Significance of decision-support tools and frameworks

In environmental sciences and related fields, conceptual frameworks are often used to streamline and visualize a step-by-step assessment process related to specific topics such as climate change impacts and risk assessments. In general, conceptual frameworks are used to identify research variables and clarify the relationships among those variables (McGaghie et al., 2001).

Similar to conceptual frameworks are DSTs which add the ability to aid and support decision-makers in making more informed judgements and decisions (Perimenis et al., 2011). DSTs can contribute to analysing the decision environment by looking at various elements such as climatic effects, vulnerabilities and stakeholders. They also aid in visualizing the assessment process which outlines clear goals. Last, they contribute to the cooperation of parties involved.

Conceptual frameworks and DSTs in environmental sciences are mainly used to assess and/ or evaluate areas facing a specific issue. By personal communication with the LAB it came forward that frameworks and tools are often quite technical and might not be always user-friendly to decision-makers. For this reason a DST focusing on drought has to be broad, yet still specific enough to be useful. This is the gap in knowledge that this thesis aims to address.

Various authors (Sesana et al., 2020); (Füssel & Klein, 2006); (Dolan & Walker, 2006); (Duzgun & Lacasse, 2005) show that the frameworks and tools often focus on issues on the national or other broader scale, while there is less focus on the regional and local scale. In this chapter, the gaps in several tools and frameworks will be inspected. Furthermore, it will be explained how elements from these frameworks can be used and modified for the regional/local drought case study. The basis of this thesis is the development of a DST that can help with the analysis of areas prone to environmental stresses such as drought. The DST also aims to streamline and visualize assessments processes and therefore can use the conceptual frameworks discussed as examples.

The following subchapters of the state of the art are there to state which assessments are important and why there is a focus on them. In short, these are vulnerability-, stakeholder-, and

adaptation/ mitigation measure-assessments as well as the need of a repeating element in the DST.

2.2 Relevant frameworks for this thesis

The inspiration for a DST that assesses areas threatened by climate phenomena such as drought came from the article '*An integrated approach for assessing the vulnerability of World Heritage Sites to climate change impacts*' by Sesana et al. (2020). In this article, the authors propose a conceptual framework on impacts of climate change on world heritage sites. In the conceptual framework by Sesana et al. (2020), the impacts of climate change are assessed based on national/ regional scale and on a local scale. The vulnerabilities towards climate change impacts of the affected and interested stakeholders are studied on a local scale by interviews and workshops. This local stakeholder study, in contrast with more top-down oriented studies, can provide insights on climate impacts on a much smaller scale. People who have lived in a region all their life might notice changes happening more than models can tell.

The 5-step process of Sesana et al. (2020) starts with understanding the value of the site. These values are then placed in their social and environmental contexts respectively. The second step is to assess the impacts of climate change by analysing data based on the exposure and sensitivity. This data comes from climate projections, literature research and expert consultations. The third step is to assess the impacts of climate change on the local level. This is done by consulting with experts and interviewing the local affected and/or interested stakeholders. The data gathering of the previous steps culminates in assessing the vulnerability by means of the qualitative method. Finally, the authors make a recommendation that this process should be repeated when the opportunity presents itself as systems are dynamic; especially in regards to climate change and adaptive capacity.

A second example of a qualitative assessment framework is that of Füssel & Klein (2006) who explain the main concepts and relationships which any impact assessment should have. Their conceptual framework for impact assessment has all the basic elements needed to explain the pathways that need to be taken when assessing the vulnerability to climate change. The qualitative assessment framework shows that emissions and concentrations of greenhouse gasses are mitigated if possible. If not they inflict change upon the climate system. The degree and nature of this exposure to climatic variations together with the sensitivity to climatic stimuli cause climate change impacts. This is a simple framework that broadly shows how a climate system is interconnected.

Another theoretical framework comes from Dolan & Walker (2006) who, still in the field of vulnerability, present a way of assessing adaptive capacity in coastal communities to climate change. It is presented as a starting point for a bottom-up approach to impact assessments. Their methodology aims to provide valuable insights into local responses against climate change.

The insights gained from this theoretical framework are that it is important to combine top-down and bottom-up perspectives to gain a fuller picture of climate impacts and adaptive capacity. Every layer from individual to global scale can provide new information as well as having different coping mechanisms. It also showcases in a clear scheme what combination of processes leads to a clear climate vulnerability framework.

The integrated vulnerability framework of Dolan & Walker (2006) shows in detail how interconnected a climate system is. From the climate variability and climate change influencing the whole system, to the indicators of vulnerability impacting the biophysical and human environment and levels of society. It shows there are plenty of factors driving the assessment and plenty more impacted by it. A model more focused on assessing the risks comes from Duzgun & Lacasse (2005), who combine hazard assessment and vulnerability assessment to create a risk assessment. The hazard assessment in this case is the numerical modelling with sensitivity analyses, whereas vulnerability assessments focus more on the magnitude, scale and element of risk derived from the sensitivity analysis. The risk assessment combines the two and evaluates risk based on the acceptability and tolerability criteria. The authors emphasize that there are no generally accepted models for vulnerability assessments and therefore they proposed one in their framework. The main concept that can be taken from the analysis of these frameworks in that they always include a clear pathway and process outline.

2.3 Significance of Vulnerability Assessments

The field of vulnerability and climate vulnerability assessments has become quite important especially in this day and age. Nowadays, the climate change affects areas that before were not subject to climate-change-induced hazards. Some of the natural hazards that are exacerbated by climate change are drought, floods, wildfires, typhoons, increased weather variability and intensity, etc. (Field et al., 2014). In the IPCC's 3rd assessment report, McCarthy et al. (2001) defined vulnerability as "*the degree to which systems are susceptible to cope with the adverse effects of climate change"*. This includes the aforementioned increase in climate variability and extremes.

Vulnerability is a combination of three indicators: exposure, sensitivity and adaptive capacity, which can all be measured to an extent. Some examples of vulnerability assessment methods related to the topic of climate change are in the works of Balica et al. (2012) who used the concept to create a flood vulnerability index for coastal cities; Sesana et al. (2020) who performed an assessment to vulnerability on world heritage sites; and Mallari & Ezra (2016) who assessed climate change vulnerability of the agricultural sector.

The common feature of the abovementioned researches is the use of a qualitative assessment. There are two types of Vulnerability assessments (Giordano, 2014). First, the descriptive qualitative assessment which aims to gather information that can easily be measured or translated into numbers. As examples we can take the stakeholder involvement, meetings, interviews and questionnaires. The second type of vulnerability assessment is the quantitative assessment which uses indicators, indices and maps to express the results in numbers. An example of a quantitative assessment can be found in the work of Metzger et al. (2008). This thesis uses the qualitative vulnerability assessment for its DST, as methods such as a questionnaire and interviews will be used. These methods help gaining local input and are quite valuable to determine vulnerability indicators such as those from the climate vulnerability index website: https://cvi-heritage.org/.

To measure the vulnerability of an area one needs to measure the exposure, sensitivity (potential impact) and adaptive capacity. With a high potential impact the vulnerability also increases; a higher adaptive capacity will decrease the vulnerability (Jol & Füssel, 2012). This can be determined by using indicators for specific sectors. For instance, exposure is measured by current climate conditions, changing climate conditions as well as the intensity of climate conditions (Giordano, 2014). Taking the biodiversity of an area as an example, the sensitivity can be measured by looking at the species with a small environmental tolerance or species that

are dependent on specific environmental triggers. Similar indicator measurements can be done for the issues the agricultural sector is facing due to drought. The magnitude of exposure together with sensitivity combine into the potential impacts of climate change. It is to be said that climate impacts can have both beneficial and harmful impacts on the area. For instance, with higher levels or CO_2 in the atmosphere farming efficiency goes up due to an increased grow rate. However, this is in stark contrast to the negative impacts extreme weather events caused by climate change can have on agriculture (Stoorvogel, 2009). The adaptive capacity can be measured by the systems present in the area that make the adaptation more or less possible. For instance, well organized communities, governments, or well managed ecosystems. This can all be influenced by the resources available to improve the adaptive capacity.

2.4 Significance of Stakeholder theory

This thesis focuses mainly on the significance of stakeholder theory for the developed DST as empirical data was gathered and research was done on this step alone. Existing theories and methods are described and several of them are later used in the Methods and Results chapters.

2.4.1 History of Stakeholder theory

There are many definitions of what stakeholder theory, stakeholder management or stakeholder models and frameworks is/are. The general consensus is that 'Strategic Management: A stakeholder Approach' (Freeman, 1984) is the most cited research done on the topic. Freeman did not coin the term 'stakeholder', however, he was the first to develop the Stakeholder concept as we know it today. In his work he differentiates from previous management practices of companies to only please shareholder's interest. His work puts forward the need to incorporate other internal and external forces.

"A stakeholder is any group or individual who can affect or is affected by the achievements of the firm's objectives" (Freeman, 1984).

After Freeman's work various books and articles followed. In regards to all previously mentioned work done on the topic it has to be said that the concept of stakeholder theory and its subsequent forms is differently defined by every author and has therefore no fixed framework or model (Donaldson & Preston, 1995). For example, Mitchell et al. (1997) argues in their work '*Towards a theory of stakeholder identification and salience'* that there are three attributes that can be assigned to stakeholders: power, legitimacy and urgency. By combining these attributes a stakeholder typology can be created. Another example is the convergent stakeholder theory which aims to combine instrumental, normative and descriptive approaches under one general approach (Jones & Wicks, 1999). This work was highly debated by Freeman (1999) who argued that instead of convergence there should be more divergence, asking for more specialized approaches instead of one that covers all situations.

Consequentially, discussions arose on why to distinguish between different stakeholders. This can be seen in the work of Friedman & Miles (2002) who suggest a model that helps with stakeholder configuration and how relations between them change over time. It is also an example of a model that does not only look at the organization's point of view but also takes other stakeholders into account. The 'actor-oriented approach' by Biggs & Matsaert (2004) looks at mapping the relationships and information flows. In their article, Biggs & Matsaert (2004) use this approach for natural resource innovation systems and describe a set of tools,

such as the Actor-Linkage-Matrix and -Map. More recent examples of stakeholder theory are those such as Yang (2014) who discusses that multi-stakeholder analyses in urban planning are more often used and highlights the importance of rationalistic and empirical perspectives. Again, no single one stakeholder method is determined to be the most effective and approaching the issue from different angles seems the most useful. Last, an important stakeholder theory is that of the Environmental and natural resource management (ENRM) perspective. In the work of Colvin et al. (2020), the challenges of translating stakeholder theory from business management to ENRM are described. In the context of ENRM the stakeholder power is decentralised in contrast to the traditional business-centred perspective where the power is centralised around the company. In contrast to that, the decision-making power in ENRM is given to the most powerful stakeholders (e.g. government or powerful organisations) resulting in those powerful stakeholders' viewpoints being given more privilege than those of the stakeholders with less power.

In this thesis, the topic of drought impact is put in the centre of attention identifying, categorizing and finding relations with stakeholders. This method is used because a stakeholder analysis from the point of view of a firm would inevitably prioritize some stakeholders over the others. This is counterproductive as no such prioritization is wanted here. Therefore, the ENRS method is used to categorize stakeholders based on their own affectedness to drought.

Various stakeholder identification, categorization and interrelationship methods are discussed in the next section, of which one method or several parts of the existing methods will be used for this thesis. The schematic representation of rationale, typology and methods for stakeholder analysis by Reed et al. (2009) will be used to explain the methods in existing literature. The basis of the stakeholder theory is the research method or rationale which can be descriptive, normative or instrumental in nature. The descriptive method is in essence a first step for both normative and instrumental research methods. Normative methods are those with an emphasis on legitimacy of stakeholder involvement and the power it gives to decision-making processes. Instrumental methods are more used to nudge and manage behaviour of stakeholders to achieve a certain goal (Reed et al., 2009).

2.4.2 Identification - methods in existing literature

The first step of the stakeholder analysis process is to identify clear boundaries. What is the scope of the area and who are the stakeholders included? Reed et al. (2009) states that stakeholder identification methods can be performed through Focus groups, Semi-structured Interviews and Snowball sampling. Focus groups are the method that seeks the most stakeholder participation. Workshops and interviews provide a bottom-up perspective on the issue at hand and every stakeholder can voice their concerns. Semi-structured interviews are already by nature less participatory but still provide insights and clarity. Snowball sampling asks stakeholders to forward an interview or questionnaire to their contacts which leads to larger sample size, but may be less participatory. It can also prove to be non-representative for the initial issue.

The identification of initial stakeholders can also be challenging. The concept of initial stakeholders was adapted for the purpose of this thesis as defined in terminology. It can occur that a stakeholder analysis is performed from a top-down perspective which may lead to a limited scope (Fraser et al., 2006). This is why the participatory stakeholder analysis practices exist. To include as many parties as possible for clarity's sake. A useful method for identifying stakeholders and their position in regards to the issue is the Rainbow diagram (Chevalier & Buckles, 2008). In this diagram stakeholders are positioned based on whether they are affected by or affecting a problem or action. It is advised to let the stakeholders position themselves in the diagram. It is possible to include only a sample of the stakeholders or all of them. This may depend on the scope of the analysis.

An example of a stakeholder identification performed is in the work of Elbakidze et al. (2012), who used the methods mentioned in this subchapter in order to divide their stakeholders into variables which were based on their specific context.

2.4.3 Categorisation - methods in existing literature

Reed et al. (2009) argued that there are two approaches to stakeholder differentiation; the Analytical categorization (top-down) and the reconstructive categorization (bottom-up). **Analytical categorizations methods** are based in scientific research with emphasis on observations of the issues at hand (Hare & Pahl-Wostl, 2002). The most often used methods make use of matrices and Venn diagrams. The first example of such methods are **Interest-influence matrices** or the **Power-Legitimacy-Urgency visualization** (Mitchell et al., 1997). However, the issue with categorizing stakeholders according to these matrices is that one can

fall into the 'usual suspect trap'; meaning that there might be stakeholders not included in decision-making processes because they have less power or they do not seem relevant by other parties. This means that the analyst likely already know beforehand what the outcome of the analysis will be: an under-represented network.

Radical transactiveness (Hart & Sharma, 2004) is a method to overcome this trap by having a two-way discussion with stakeholders close and far from the issue. This is mostly done to prevent under-represented stakeholders from groups that could assert more power together.

Reconstructive categorizations are more participation-oriented wherein stakeholder can position themselves in the issue, which reflects reality more (Hare & Pahl-Wostl, 2002). Some methods include **Stakeholder-led stakeholder categorization** e.g. in the form of card-sorting processes. Stakeholders are asked to sort cards of every stakeholder on an issue into groups accordingly. In this way every stakeholder's perspective as well as the linkages can be seen. This also includes the **Q methodology** developed by the psychologist William Stephenson in 1935 (Lee, 2017) which is used when not all (individual) stakeholders can be reached and thus stakeholders are grouped (e.g. governments, communities, research institutions, etc.). This is quite helpful in the case of environmental management where an issue such as drought can be too big to include every individual. **Strategic perspective analysis** (Dale & Lane, 1994) is a way of comparing the goals of all stakeholders, which is useful especially when there are knowledge institutes and governments involved.

2.4.4 Interrelationships - methods in existing literature

The methods used to find linkages within and outside the stakeholder network are Actor-linkage matrices, Social network analyses and Knowledge mapping (Reed et al., 2009). **Actor-linkage matrices** set stakeholders in rows so as to better visualize if they are connected to each other (Biggs & Matsaert, 1999).

Social network analyses (SNAs) (Wasserman et al., 1994) are used to visualize the linkages of stakeholders in a web. In this way one can observe the links that are missing to fill in gaps, the strength of existing links and what kind of relationship there is between stakeholders. The SNA is especially helpful in environmental management to identify and visualize conflicts but also opportunities to share knowledge between stakeholders.

Last, there is **Knowledge mapping** which is used mainly in firms for improving innovation and competitive advantages (Cole, 1998). Reed et al. (2009) argue that it is a static method which can be improved when combined with SNAs that can help to visualise analysis results.

Combining the knowledge mapping method with SNA not only answers the question of "who knows who" but also "who knows what". An example of the performed stakeholder interrelationships analysis comes from the work of Prell et al. (2009) who created eight categories of stakeholders in order to find the linkages between them.

2.4.5 Convergent stakeholder theory

Even though not used for this research, convergent stakeholder theory needs to be mentioned. It is based on the idea of combining a social science and normative method of stakeholder analysis (Jones & Wicks, 1999). The aim of the convergent method is to identify and categorize stakeholders in a standardised way, which would make it easier for managers and policy makers to perform these analyses. However, in reality, stakeholders are not all the same for all contexts and cannot thus always be classified in the same way. Freeman (1999) was an opponent of this idea saying that more specialized approaches should be used instead of a "one that suits all" approach. This thesis has therefore not used the convergent stakeholder theory but a divergent approach.

2.5 Significance of Climate adaptation, mitigation and resilience-building measures

According to the climate scenarios of the Royal Dutch Weather service (KNMI, 2021b), Dutch summers will be wetter, warmer and in the summer more often dry. Sea levels have already increased by 20cm in the last century and will continue to rise by 26 to 82cm in the next one. It is also expected that some weather extremes such as heat waves and heavy precipitation will occur more often by 2050. Precipitation extremes, drought, heat and salinization are new upcoming issues. The effects of climate change will already be experienced before 2050. Examples of effects of climate change on the agricultural sector are the reduced crop yields and/or loss of quality of the agricultural product due to precipitation, storm, hail, softened soil due to water, and the long term drought period in the areas that don't have much availability of fresh water. Hail, storms and lightning strikes can also damage some means of production such as greenhouses and stables. Furthermore, it will be harder to anticipate these higher weather extremes (KNMI, 2021b).

The Dutch National Climate Adaptation Strategy (NAS) highlights 9 sectors that will be affected by climate change and presents impacts, opportunities and threats for them. These sectors are: Water and Space, Nature, Agriculture, Greenhouse and fish farming, Health, Recreation and Tourism, Infrastructure (roads, rails, water and air travel), Energy, IT and telecom, Security. The NAS does this for many phenomena such as the climate getting warmer,

wetter, dryer and rising sea levels. For the purpose of this thesis the trend of drought presented by KNMI (2021a) is used. Using these climate scenarios and adaptation strategies on a regional scale can help to mitigate some of the effects of climate change or adapt to them to achieve the new normal (Meijs et al., 2016).

The importance of resilience-building has to be pointed out as well. According to Norris et al. (2008), resilience is the "*capacity for successful adaptation in the face of disturbance, stress, or adversity*". It is one thing for a system, community or individual to be able to adapt to changing conditions, but it should also be able to recover quickly from a disaster when the stress becomes too great. Examples of resilience-building measures are public policy programs; local initiatives (Aldrich, 2012); functional, accountable and inclusive levels of governments and institutions (Tortajada et al., 2017).

Scoping down from the Dutch national level to the Province of Zeeland where the island of Schouwen-Duiveland is located, local plans and strategies are developed. Two important documents for the province of Zeeland are the 'Climate Adaptation Strategy Zeeland 2021-2026' (Pijpelink et al., 2020) and the 'Zeeland Delta plan fresh water' (Provincie Zeeland, 2020) where the climatic problems and vulnerabilities are explained on the provincial scale.

These documents build on the work done on measures to combat climate change by the province of Zeeland and its municipalities and waterboards. Four important climatic effects are highlighted in the Climate Adaptation Strategy Zeeland: superfluous water, drought, heat and flooding. The regional and local approaches are focussed on broad themes of measures taken against the negative climatic effects. This is because the Climate Adaptation Strategy Zeeland is not a document from one government agency, but rather a supporting tool that every governing body in Zeeland can translate into their own policies. This loose strategy gives those governing bodies more freedom to focus on their own specific ambitions, priorities and local situations. In response, the knowledge gained on a local level can be shared with the regional adaptation strategy and thus learning from practice can be established. Documents like these are important, since they provide information on the current state of climatic issues and the measures that can be taken against them.

Examples of measures taken against drought on Schouwen-Duiveland		
Sector	**Climatic problem**	**Measure**
Agriculture	Water system	Aquifers, water storage in tanks,
Agriculture	Soil System	Good water holding soils, organic substance, etc.
Agriculture	Crops and cultivation systems	Resilient and resistant plants and cultivation systems, etc.
Agriculture	Livestock farming	Relieve heat stress, animal health, etc.
Nature management	Displacement of Species	Creation of robust ecosystems, greening of urban and agricultural space, etc.
Nature management	Drought in nature	Link with the agricultural sector, maintain water levels and aquifers, buffer zones, shift in function of area.
Urban Use	Vitality of greenery due to heat stress	cooling effects of urban greenery on urban green, sportsfields, etc.
Urban Use	Extinguishing water	Adapt surface water system, adapted water level management, emergency supply from extinguishing ponds and basins.
Urban Use	Drink water supply	Efficient drink water use, awareness, water buffers, etc.
Urban Use	Sports fields	Building of fresh water basin under sports field during construction.
Policy-making	Supporting instruments	Regional approach, knowledge and innovation, risk management
All	Fresh water supply	External supply of fresh water from Volkerak-Zoommeer or Schelde-Rijn Channel.

Table 1: Examples of measures taken against drought on Schouwen-Duiveland (sources from: Actieprogramma klimaatadaptatie landbouw, klimaatverandering Zeeuwse risico's in beeld (Zeeuwse Gemeenten et al., 2020), stakeholder interviews performed in this thesis)

3. Methods and Data

This chapter provides information on the case study area, the way how the data was collected, and the methods used for the analysis of the data as discussed in the State of the Art chapter.

3.1 The study area: Schouwen-Duiveland

The following subchapter will present the challenges and threats as well as general information on the case study area of the island of Schouwen-Duiveland.

3.1.1 Challenges and threats to the island regarding drought

The study area is situated in the Netherlands on the island of Schouwen-Duiveland (Figure 2). Trends show that climate change will lead to an increase in temperatures which will impact the nature as well as the society. Freshwater will be less available due to global warming and natural hazards such as floods, drought and landslides will become more frequent. Another phenomena is the sea level rise which will significantly affect coastal areas (EC, 2017). When looking more specifically on the climate information about this region, the KNMI proposes 14 climate scenarios and how to cope with those (KNMI, 2015). The general changes that will occur are increasing temperatures which will lead to milder winters and hotter summers. The volume of precipitation in the winter months will increase, as well as the intensity and frequency of extreme precipitation events such as hails and thunderstorm throughout the year. The intensity od extreme rainfall will increase also in summer, which will most likely lead to landslides and pluvial floods as the dry land will have problems to infiltrate the vast amounts of water. The sea level is predicted to rise, as well as the pace of the sea level rise under different scenarios. While some of the KNMI's climate scenarios predict even more changes than described here, some of them, in contrast, predict less changes. The differences between scenarios are dependent mainly on the global temperature.

As an island, Schouwen-Duiveland is particularly vulnerable to the effects of climate change (Nurse et al., 2014; Municipality of Schouwen-Duiveland, 2018). The land behind the dams and dikes is mostly below the sea level, which is an issue with sea-level rise. Water defences will have to be re-evaluated and strengthened. Salt water intrusion will also increase which will impact the fresh water supplies. An increase in heavier and more frequent precipitation can harm the crops and overload the water discharge system. On the other hand, higher temperatures will mean more frequent and longer droughts, which will have an impact on the water supply on the island and thus the sectors dependent on it; drinking water, agriculture, nature, tourism, urban areas, etc... With all these climate impacts combined, it is evident that the island of

Schouwen-Duiveland will be facing quite a challenge in the coming years and has to prepare to upcoming changes.

Focusing on the drought, Schouwen-Duiveland is heavily dependent on rainfall in winter to replenish its water supplies. Winters are usually so wet that most of this water is discharged into the sea, otherwise the land will flood and crops will wash away. In summer there is a need to retain the fresh water, otherwise the land will dry out and crops will not germinate. Equilibrium is needed so that fresh water is always available regardless of the season. Therein lies the issue; too much water in winter, and not enough in summer. The Netherlands has a tradition of the constant fear of too much water and therefore the common practice is to get the water out to the sea as fast as possible, not thinking of how it might be needed the next summer (Rijkswaterstaat, 2020).

There are three ways of gaining access to fresh water in the Netherlands: through rivers, rainfall and groundwater. The water is used by several sectors such as those mentioned before: drinking water, agriculture, nature conservation, shipping, recreation and cooling water for the industrial and energy sector (Rijkswaterstaat, 2021). The Netherlands is divided in 'high' and 'low' Netherlands when talking about fresh water availability. 'High' Netherlands is composed of the high eastern sand ground and some other areas such as islands near the coast and is heavily dependent on the rainfall and the groundwater supplies, as no fresh water can be additionally supplied to the area. This means that the drought has harsher impacts here than in the 'low' Netherlands. During droughts, the measures are implemented against the unsustainable water use. 'Low' Netherlands does have access to fresh water supplies from the rivers and lakes, and thus during a drought those supplies can be used and the freshwater can be pushed up to the areas that need it. In case there is not enough water available for all sectors then a prioritization system is used which ranks the sectors on the basis of their importance. The most priority is given to safety and vulnerable nature, then the utilities such as drinking water, then small scale high-end use, and lastly other sectors. This means that on Schouwen-Duiveland, which has no direct access to river water, the agricultural sector, urban use, and non-vulnerable nature may receive less fresh water or can be even entirely disconnected from the water supply during a severe drought.

This would have various impacts on the sectors dependent on fresh water on Schouwen-Duiveland. Affected parties may have to invest in water management and adaptation, mitigation and resilience-building measures against drought.

A potential impact is that the agricultural sector may be forced to stop watering their crops with shower irrigation. The lack of proper water supply will lead to crops drying out and dying and therefore harming a good harvest. This is what happened during the drought of 2018, which was particularly harmful (Kramer et al., 2019). In that year 607mm of rain fell, which is 240mm lower than the average. It was one of the 5 driest years in history. If the droughts occur more frequently and last longer, those situations will become more normal in the years to come.

Another example of potentially affected sector is the nature conservation which will have to deal with the effects of drought such as wildfires and soil erosion. Without proper water distribution the nature areas will become vulnerable to these kinds of hazards in summer.

Examples of measures as well as proposed measures taken against drought on the island of Schouwen-Duiveland are presented in Table 1. Measures are linked to the sectors to which they provide help against drought. It is to be said that there are many more measures, but these are the ones most used on Schouwen-Duiveland.

Last, it is important to be aware of all the groups working independently in the area. It might be a challenge to identify and link the stakeholders, which would provide the clarity needed to share valuable knowledge and work together to tackle drought on the island.

3.1.2 What is the Living Lab Schouwen-Duiveland?

The network organization LAB consists of the municipality Schouwen-Duiveland, waterboard Scheldestromen, Provincial board of Zeeland, Erasmus University/ERBS/GovernEUR in Rotterdam, Delta Platform – Centre of Expertise Water & Climate, HZ University of Applied Sciences, HAS college, Scalda college and Pontes Pieter Zeeman. Together they are looking for solutions for societal problems in the fields of water, food, education and governance. As stated on the LAB website: *https://livinglabschouwen-duiveland.nl/,* they experiment together with knowledge institutions and put the gained knowledge into practice in the region. This is achieved by working together with educational institutions, businesses, governments, research institutes and inhabitants. Similarly, the Agrarians Schouwen-Duiveland (ASD), the Dutch Agrarian association (ZLTO), Deltares, Acacia Water and KWR Water are as well involved. The LAB connects students with Schouwen-Duiveland and the businesses there. Their goal (appendix 3) as stated on their website is to work on innovative solutions in practice and to test these moving towards a circular economy on the island. Innovative solutions that are found on Schouwen-Duiveland can also offer perspective for other coastal areas, governments and educational institutions.

Living Labs are an upcoming concept in the Netherlands that instead of theory places more of a focus on the practical part of innovation (Maas et al., 2017). They are initiatives where civilians, knowledge institutes, businesses and governments work together to come up with innovative solutions to societies' more complex problems of this time; Such as climate change and social injustice. Living Labs are characterized by their involvement with citizens which identifies them as *citizen-public-private partnership* (C3P) or *public-private-people-partnerships* (PPPP) by the European commission. In 2017, there were around 90 such initiatives in the Netherlands. It's an experimental, learning approach in a concrete setting.

LAB provided contact information on the initial stakeholders for the stakeholder analysis and the opportunity to hold the stakeholder workshop later during the research. Stakeholders were identified and contacted through the core partners and coordinators of the LAB.

3.1.3 The Island of Schouwen-Duiveland

Schouwen-Duiveland is an island and municipality in the Province of Zeeland in the Netherlands. In August of 2020 34,012 inhabitants were living on the island (OiN, 2020). As stated by the website of the municipality of Schouwen-Duiveland: https://www.schouwen-duiveland.nl/, its surface area reaches 488.94 km2 of which 257.87km2 consists of the North Sea, Oosterschelde estuary and Grevelingen lake. The island is connected to the mainland by 2 dams, 1 storm surge barrier and 1 bridge. The island is very flat and mostly below sea level. The highest point is the 'Kop van Schouwen'; a 42 meter high dune. The whole island is enclosed by either dams and/or dunes. Schouwen-Duiveland is surrounded by the North Sea in the north, the Eastern Scheldt estuary on the south and the salty Grevelingen Lake on the north-east. This lake is the largest saltwater lake in Europe. The island is located in the Dutch Southwest Delta which comprises the islands of Zeeland and South-Holland, Zeeuws-Vlaanderen and West-Brabant with all waters included. In ecological terms the area is important for resting- and foraging for migratory birds and as access for migratory fish to the river Rhine, Maas and Scheldt, as well as breeding- and growing areas for sea fish. The delta is economically important because it is situated between the harbours of Rotterdam and Antwerp and as such is known as the Port to Western Europe (Zuidwestelijke Delta, 2014).

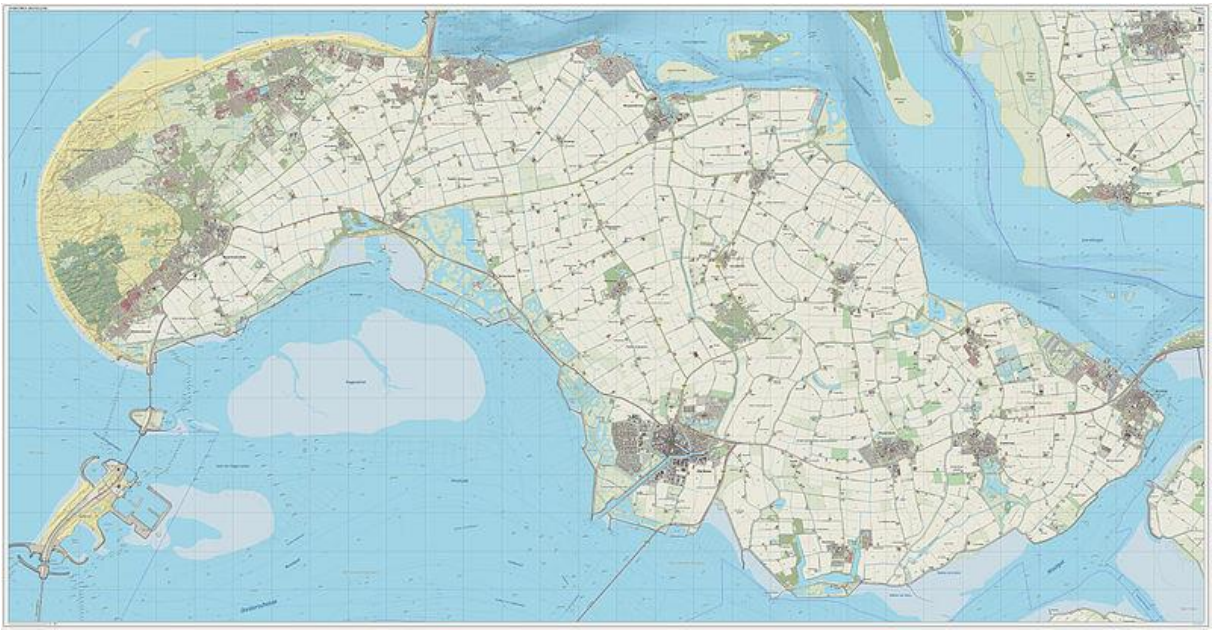

*Figure 1: Municipal/ topographical map of the island of Schouwen-Duiveland. *Open source and Compiled from open geo data. (van Aalst, 2014)*

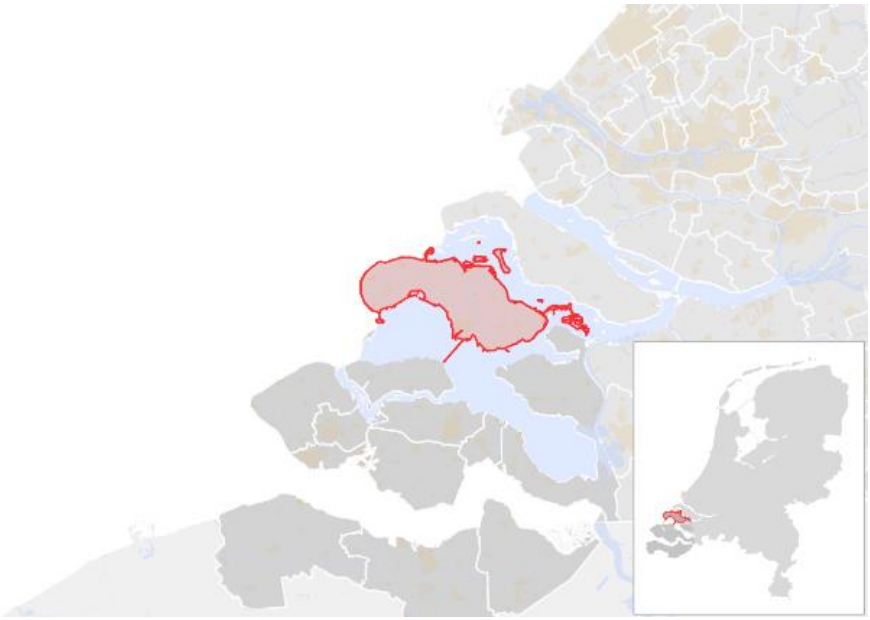

*Figure 2: Location of the municipality of Schouwen-Duiveland in the Netherlands *Open source if cited as follows (Centraal Bureau voor de Statistiek & Topografische Dienst Kadaster, 2015)*

*Figure 3: Zelandicarum insularum exactissima et nova descriptio. Map of Zeeland 1542-1546 *Open source (van Deventer, 1542-1546)*

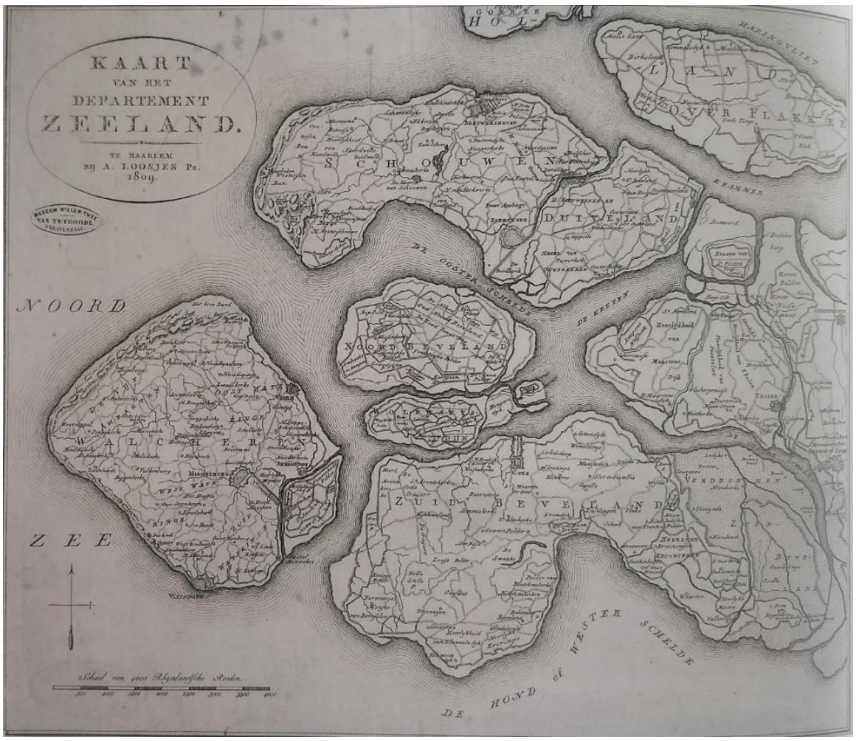

*Figure 4: Map of the department Zeeland, 1809; Copper engraving from A. Loosje Pzn *Source granted by author (Kuipers & Swiers, 2005)*

Schouwen-Duiveland as a part of the South-western Delta of the Netherlands has changed a lot over the centuries. Figure 3 shows, that in 1573 the islands were mostly still surrounded by the sea. The area had an estuarine and dynamic nature where the sea dictated most of the ecological but also economic processes. There are records of the frequent flooding of the area and thus islands disappearing. In time reclamation of sea and tidal flats was performed which created new land. This dynamic nature remained up until the Big flood of 1953 (Kuipers & Swiers, 2005) during which 1836 people died in the Netherlands. After the flood, efforts were made to make the area safe, which gave rise to the Delta works that can be seen connecting and protecting the islands today.

This loss of the dynamic nature of the area has had many positive benefits especially to the safety of the population and economy. However, the biodiversity has been greatly reduced. On top of that, due to natural (natural subsidence) but also human processes (peat mining, discharge systems) the ground has been subsiding over the centuries (Natuurinformatie, 2014). This subsidence mostly occurs in clay rich areas which Schouwen-Duiveland mostly consists of. This leads to more salt water intrusion which negatively impacts farmlands and lowers and dangerously harms productivity of crops. Drought exacerbates this even more as there is less fresh water behind the dikes to halt salt water intrusion.

3.2 Data collection: questionnaire and interviews

In order to test one part of the DST a stakeholder analysis was performed with the help of the LAB. In the next section it is explained how the stakeholder analysis was conducted on the issue of drought on the island of Schouwen-Duiveland. The next section also explains how the stakeholders in the area were identified and how the contact was made.

Acknowledging the lack of pre-existent information, the cooperation with LAB was initiated in order to make use of their network and thus identify initial stakeholders. All stakeholders that participated in the research were divided in sectors related to the issue of drought. These are: Governance & Managers; Drinking Water; Urban Use; Agriculture; Nature Management; Private Research; Public Research; Independent Consultancy & Advice; Recreation & Tourism; and Industry and Energy. The last two were not included in the research as they were more involved on the national scale. The following methods were used to get into contact and gather information.

3.2.1 Questionnaire

First, a questionnaire (Appendix 1) was prepared and sent by email to the key partners of the LAB, as well as to other key contacts as designated by the coordinator of LAB.

During the research, more stakeholders joined in and all were either affected by or interested in addressing drought in the study area. The questionnaire was sent by email to 42 contacts, with the seal of approval of the coordinator of LAB, with instructions to answer the questions and return the questionnaire. This was done to give the stakeholders a first glance at the questions before the next step of the process, which was the performance of semi-structured interviews. Out of those 42 contacts, 8 said they were not closely related to the drought topic, 3 were not interested in the research and 5 did not reply. Finally, in total 24 answered questionnaires were received. This made a total response rate of 57%.

3.2.2Interviews

After stakeholders had filled in the questionnaire and sent it back, a call was made to dive deeper into the questions. This was done by semi-structured interviews performed via phone- or electronic video call. The stakeholders that did not return the answered questionnaire yet were also contacted and asked again if they would want to participate in this research. In most cases the interviews provided the necessary additional information needed to perform the data analysis. The interviews were in average 20-25 minutes long with the upper and lower extremes being 15 minutes and 45 minutes. The duration of the interview depended on the information the stakeholder could provide. The interviews were audio-recorded and transcribed afterwards. Out of the 24 people who filled in the questionnaire 15 were interviewed using an online platform such as *Google Meets* or *Zoom*.

3.2.3Workshops

Thanks to the collaboration with LAB the author was able to join one monthly meeting where the progress was discussed between the LAB and their core partners. The gained material from this workshop served as a part of the analysis and as a state of the research for the partners. The workshop was done in order to let the stakeholders participate and cooperate more in the research. This workshop was held online in early December 2020 and 16 core partners of LAB participated. The state of the research was presented, preliminary results were discussed and an

interactive part was performed through the website *Miro*. This workshop had two major objectives: First, to observe whether two stakeholder categorization methods: the stakeholder power-legitimacy-urgency method and the stakeholder axis method were adequate for this research; and second, to showcase a newly developed stakeholder categorization method and discuss whether this method would be more adequate than the two methods mentioned before. The outcome of this workshop is explained further in the Results chapter. There was time for discussion among the participants and researchers and the workshop lasted for one and a half hours.

3.3 Data Analysis

The personal data collected for this thesis were treated and analysed correctly and names were coded to maintain privacy of the people involved in the research. The collected data from the questionnaire and interviews were organized in Excel files. The data were then used to continue the stakeholder analysis. The stakeholder analysis was performed in three steps: 1) stakeholder identification, 2) stakeholder categorisation and 3) stakeholder interrelationships.

3.3.1 Stakeholder Identification

As part of the stakeholder analysis, the identification was performed on the parties affected by and/or interested in addressing drought on the island of Schouwen-Duiveland. Two questions from the questionnaire directly supplied these results:

1) *Do you have (functional) contacts who are also involved in this drought problem, if so what are the contacts within your network that are influential and important? [Name, Contact person, Position and institute / organization]?*

2) *Do you have an overview of other organizations, institutions and people who are dealing with the drought problem? If so, do you think your network is working properly and if not, do you need a better functioning network?*

The data on initial stakeholders, their organisations and contacts related to drought on the island were organized in Excel files with corresponding sectors affected by and/or interested in addressing drought. Subsequently, a simple histogram was used to visualize the range of initial stakeholders, sectors reached, not yet reached and contacts provided. This was the simplest and most efficient visualizing method as the other methods specialize either in the business perspective or social perspective and not the environmental perspective that was researched here.

3.3.2 Stakeholder Categorisation

As part of the stakeholder analysis, the categorisation was done on identified stakeholders on the island of Schouwen-Duiveland. At the start of the research two categorization methods were observed whether or not yet could be used in this research's context. One was the Power-Legitimacy-Urgency Venn-diagram method (Mitchell et al., 1997). The other was a stakeholder axis method, developed and provided by LAB and its partner the Erasmus University ERBS GovernEUR. This stakeholder axis method consists of Innovation & Development vs. Conservation & Management on the y-axis and Nature & Landscape vs. Society & Culture on the x-axis. See the Terminology for the interpretation of these terms for this research.

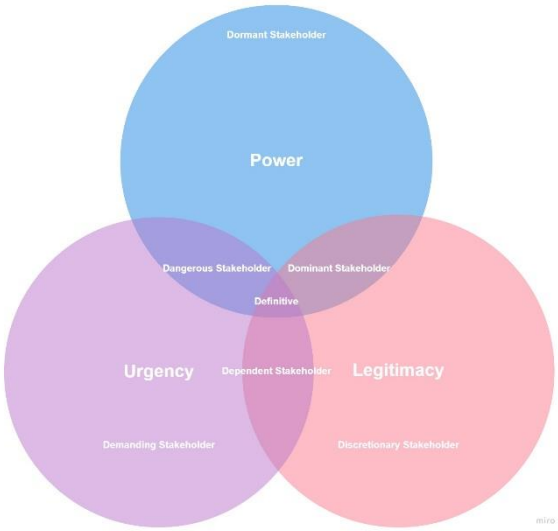

Figure 6: Stakeholder Typology: One, Two, or Three Attributes Present (Mitchell et al., 1997). Recreated by: J.S.

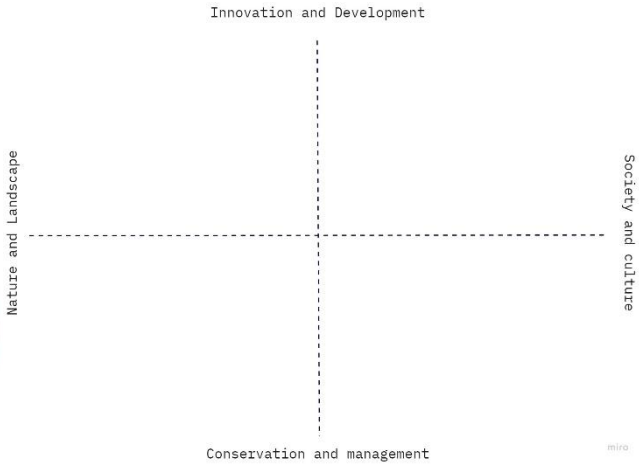

Figure 5: Stakeholder axis, credit to Erasmus University ERBS GovernEUR, 2020. Recreated by J.S.

Later on in the research it was found that the method from Mitchell et al. (1997) and the stakeholder axis method were not adequate for this context and thus a new method was developed in which these stakeholders would be more easily categorised. This alternative method is the *Rings of involvement* method and is a combination of the *rainbow diagram* (Chevalier & Buckles, 2008) and the *Rings of influence*, or the Factor-C online tool by the online management company *Publiec*.

3.3.3 Stakeholder Interrelationships

As part of the stakeholder analysis, the interrelationships between identified and categorised stakeholders were visualised. This method helps to find and visualise commonalities between the stakeholders. The relations of the initial stakeholders with their contacts were visualised using a social network visualiser in the shape of a dendrogram. This method was useful to

untangle the network regarding drought on Schouwen-Duiveland, because it shows the initial stakeholders, their organisations, contacts and in which sector regarding drought they mostly operate. The data from the questionnaire and interviews were used as a base for the dendrogram which is presented in the results chapter. The individual stakeholders within these organizations are visualized by their function instead of their names for privacy reasons.

3.4 Ethics Statement

The participants in the stakeholder research gave informed written consent. On the first page of the questionnaire, before any questions were asked, participants were informed that their answers will only be used for the purposes of the stakeholder analysis and this thesis and that their data be kept private. Consent from the coordinator of LAB was also given to contact the partners in their network under LAB's name. This statement is in accordance with the European Privacy law (Article 7 EU GDPR "Conditions and consent").

4. Results

In this chapter, the results of the research are presented and discussed. First, the results of the stakeholder analysis are presented, followed by the results on the DST regarding drought. Although only step two of the DST (the stakeholder analysis) was tested in this thesis it provided some rudimentary information on step one, three and four.

4.1 Stakeholder Analysis: Identification

The 24 initial stakeholders provided the research with 58 contacts with name, organisation and function, 27 contacts with organisation but no name and function, and 16 groups, consortia, programmes and projects which do not fall in any of the other categories. During the questionnaire and interview phase, the same names and organisations came up multiple times per different initial stakeholder. That is why out of the 139 contacts provided by the 24 initial stakeholders only 101 were unique contacts. Figure 7 presents the core findings of the stakeholder identification; the frequency of stakeholders represented per sectors affected by and/or interested in addressing drought on Schouwen-Duiveland. These sectors were: Governance & managers; Drinking water; Urban Use; Agriculture; Nature Management; Private research; Public research; Independent consultancy & Advice; Recreation & Tourism; and Industry and Energy. The identification showed that most initial stakeholders were from the Governance and Management; Public research and Private research sectors. Sectors with less initial stakeholders identified included Agriculture, Urban use and Independent consultancy. The sectors where most contacts were identified were the Agriculture; Urban use; Private research; Governance and Management and Public research. Sectors with fewer contacts identified include Drinking water; Nature conservation and Independent consultancy and Advice. There were no initial stakeholders, nor contacts identified in the Recreation and Tourism; and Industry and Energy sectors.

The label *reached* refers to those initial stakeholders identified that the author was able to contact and who participated in the research. The label *not yet reached* were the initial stakeholders identified that could either not be contacted, or were too busy during the data gathering phase of the research to participate. The label *contacts identified* refers to the contacts related to drought on the island that were identified using the questionnaire and interviews with the initial stakeholders.

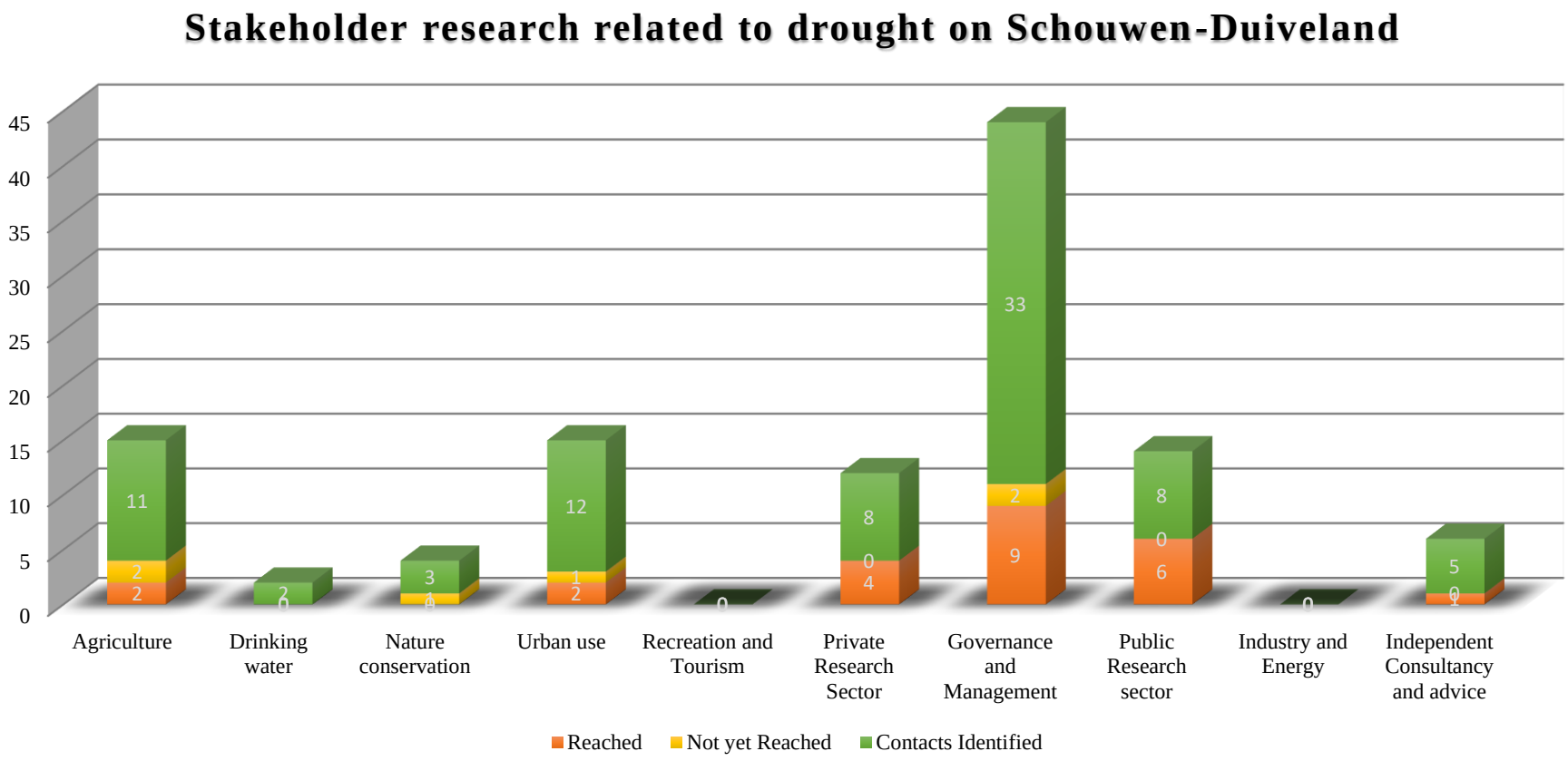

Figure 7: Stakeholder research, Identification of stakeholder related to drought on Schouwen-Duiveland, Created by JS, (2020)

In an interview with a representative of the Waterboard Scheldestromen it was made clear that they have a division in how drought is addressed. On the one hand, they identify the actual drought which is the most common in the summer months and search for solutions on how to cope with it. On the other hand, they identify fresh water availability in general. Both these nuances may have different measures offered as solutions. Other areas may benefit from different distinctions, but for the island of Schouwen-Duiveland this nuance was proposed.

> A stakeholder representative of Waterboard Scheldestromen (governance and management sector) during an interview:
>
> "*We at the waterboard make the distinction between drought and fresh water availability, because drought is in essence freely translated as the lack of water. And fresh water availability takes that one step further and says something about the salinity of that water. But if you look at drought measures then you can sometimes also take those with salt water. If you look at drought, one of the effects can for instance be subsidence of the soil and subsidence damage in houses. That can perfectly be prevented with salt water too. That nevertheless leads to other problems. And that is why there is a nuance difference between drought and fresh water availability".*

It is worth mentioning that in the LAB stakeholder analysis most of the stakeholders already knew largely who was involved in the drought issue. This was already made clear in the early stages of the research, where it was said that the stakeholder network surrounding drought was so big that the LAB and other institutions found it difficult to oversee it. However, it was not clear who exactly was working on what issues regarding drought and in what projects/ consortia/ work groups stakeholders were involved. It was made clear that the network that the existing network was formed coincidentally, which makes the stakeholders involved uneasy. A clear documentation and/or stakeholder database aims to reduce this unease.

A stakeholder representative of the municipality of Schouwen-Duiveland (governance and management sector):

> *"Now you are still dependent on coincidence. Your network is very often decided by the people that you know and that you work with. And for those it is also often searching… …of how many organizations and instances are working on drought. … … So yes I become confused sometimes and I know stuff accidentally, but the fact that it is accidental always makes me a little uneasy".*

4.2 Stakeholder Analysis: Categorisation

The second step in the stakeholder analysis was to research how the initial stakeholders and their contacts could be positioned within the drought problem on Schouwen-Duiveland. Early in the research, the Power-Legitimacy-Urgency diagram by Mitchell et al.(1997), as well as the stakeholder axis were proposed as methods. As discussed in the Methods chapter, both methods have their place in the stakeholder theory and are useful in specific situations, such as business administration. Both methods were found useful for starting the dialogue with the core partners of LAB, which was done during the stakeholder workshop. It opened the floor to discussion and limited miscommunication between the core partners, because when they positioned themselves on the places in the diagrams where they knew they and their colleagues stood. The results of the stakeholder workshop are presented in Appendix 2. However, in the context of this research it was found that these two methods are less useful and an alternative method was used that fitted the context of this research better.

4.2.1 Results of the Stakeholder Workshop

The stakeholder workshop was held in order to find out which of the stakeholder categorisation methods suited the research the best. Sixteen core partners of LAB were asked to participate. First, the diagram (see Figure 12 in appendix 2) was filled in with the 24 initial stakeholders, which included the 16 core partners. This exercise was performed to initiate the discussion regarding different perspectives among the core partners and the author. During the workshop, these diagrams were presented and initial stakeholders were jointly positioned on the diagrams. At the end, two versions of the diagrams were created; one from the author's perspective and one from the core partners of LAB's perspective (Figure 13 in Appendix 2). Not all core partners were present during this segment of the workshop and thus not all of them were positioned on the diagrams. The same technique was used for the stakeholder axis where stakeholders were positioned based on the Innovation and development vs. Conservation and management on the y-axis; and the Nature and landscape vs. Society and culture on the x-axis (Figure 14-15 in Appendix 2).

The categorising of the stakeholders prior to the workshop (i.e. by the author) was done in order to later compare the viewpoints to the viewpoints of the stakeholders. It was assumed, that the author may have viewed the organisations, their goals and ambitions differently than the organisations themselves. The stakeholders were mostly sided towards the legitimacy circle indicating that all parties have legitimate concerns and ambitions to do something about the drought on Schouwen-Duiveland (Appendix 2). Some stakeholders overlapped with the

urgency circle which meant that they were the parties most impacted by the drought, or the ones wanting to do something about drought fast. Then there were stakeholders that overlapped with the power circle and were thus the parties with the most power to make actual progress on addressing the drought issue. They were the ones pulling projects and offering funding to those in need due to the drought. Finally, there were the definitive stakeholders, occupying the centre of the diagram. These were the parties that are at the centre of the drought issue and display most of the before mentioned qualities.

As for the stakeholder axis, the author categorised most of the stakeholders on the Innovation and development; and Society and culture side of the axis; as most of the parties are government agencies and public/private research institutes. As such, they strive for innovation and development and their motivations are mostly societal. Government agencies were put in the centre as they should strive to find a balance between all viewpoints. Nature organisations were put on the side of Nature and landscape; and Conservation and management.

When categorising the stakeholders together with the core partners, the workshop outcomes were slightly different in terms of positioning. It was found that positioning the core partners on the diagrams (Figure 12 & 14 in Appendix 2) depended on what role the person held within their organisation. The core partners agreed that the goals and the ambition of an organisation as a whole may not be the same as those of the stakeholder's function dictates and that their position can change depending on their function. For example, the municipality of Schouwen-Duiveland as a governing agency has a multitude of issues to take care of which usually puts it in a central position. However, a stakeholder from the municipality may have a function that allows him/her to be closer to the issue (drought) and thus have a different position within the stakeholder diagram and axis.

Overall, the results of the stakeholder categorisation from the authors' viewpoint and the stakeholder viewpoint coincide, but there are some differences. As expected, the municipality of Schouwen-Duiveland held a central position (Figure 15 in Appendix 2), but their stakeholders spread out over the y-axis based on their function within the organisation. An outlier was the Provincial board of Zeeland which was expected to be Innovation- and development-focussed, but was moved by the core partner to Conservation and management. The reason was that the Provincial board used to be a knowledge institute for the whole province, but over time took more of a conservationist stance. Currently, the Provincial board

is more a top-down governing agency with a focus on governance and the maintenance and management of the projects that are brought to their attention.

At the conclusion of the workshop these points were discussed and it was made clear that these methods of stakeholder categorisation are useful when it comes to discussing the stakeholder network and smoothing out any misunderstandings that may exist. However, these stakeholders were already acquainted with each other and so a better way of categorising was needed. Rounding down in the workshop the categorisation method 'The Rings of Involvement' was discussed. In that same workshop the 'Rings of involvement' method was introduced as can be seen in Figure 8.

4.2.2 The Rings of Involvement

Based on the information gained from the stakeholder workshop, the categorisation method **Rings of Involvement** was developed, which presents the initial stakeholders and their contacts together with their organisations. These are then subdivided in three rings and four quadrants. The three rings indicate the level of involvement towards drought. The smallest ring is occupied by the people and organisations directly affected by drought. The middle ring is made up of the parties interested in addressing the drought problem. The outer ring consists of the stakeholder contacts related to drought that were uncovered during the stakeholder analysis. Finally, the method categorises stakeholders further by dividing them into four quadrants: Policy-making, Executive power, Advice & Consultancy, and Implementation & suppliers. The aim of this method was to categorise the various stakeholders in order to find out their relation to drought on Schouwen-Duiveland.

First and foremost, with the **Rings of Involvement** method it is possible to depict the level of affectedness towards drought. The circles indicate whether a stakeholder is affected by drought, interested in addressing the drought and which are the contacts of the initial stakeholders. This way, the aspects such as urgency and interest towards the drought issue can be visualised. The outermost ring is the largest as there are all the contacts provided by the initial stakeholders. Only a short version of their function is presented for privacy reasons. Contacts in this ring can 'drift' towards the middle ring as they become more interested in addressing drought. This 'drifting' has not been researched as of yet, but is shown by one single arrow in the graph.

The stakeholders were further subdivided into the quadrants. Most stakeholder and their contacts were spread out over the Policy-making and Advice & Consultancy quadrants. Policy-making represents all the government agencies, the policy officers and government projects and

consortia. Advice & Consultancy represents the public and private research institutes, advice bureaus and aligned projects. Executive power stands for the directors and other powerful positions that have the power to drive change. The last quadrant is Implementation & Suppliers which stand for all the companies with practical knowledge and working on alleviating the drought issue.

The use of this method is to see in one glance which stakeholders are in which situation regarding drought. The method can also be expanded by adding arrows indicating stakeholders moving further in or out the rings which would mean that their affectedness by drought changes.

A side note is that there are several extra contacts displayed on the Rings of Involvement than in the stakeholder identification. These ‘extra’ contacts are derived from the website of LAB and only fill in the Executive power quadrant more. This choice was made mainly to provide a discussion material for the stakeholder workshop.

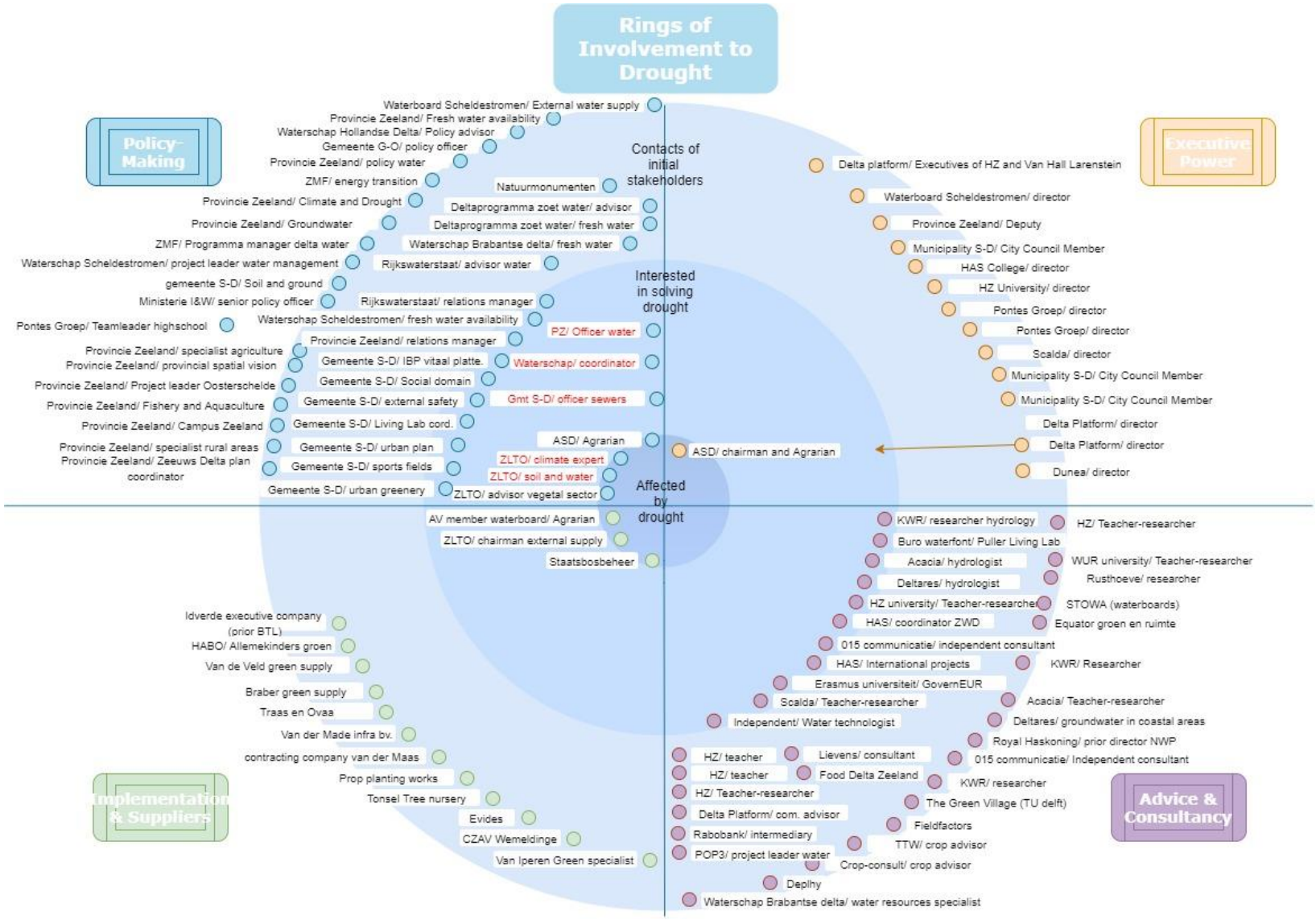

Figure 8: Rings of involvement, adapted from Rijkswaterstaat's 'Rings of influence' and Chevalier & Buckles 2008 Rainbow Diagram. Created by: J.S. (2021)

4.3 Stakeholder Analysis: Interrelationships

The Interrelationships part of the stakeholder analysis was performed in two major steps; first, to put all the initial stakeholders and their contacts in an Excel file and second, to visualise the relationships concerning drought on Schouwen-Duiveland in a clear way using the website: app.rawgraphs.io. Figure 9 indicates the preliminary SNA where only the core organisations of LAB are shown. Figure 9 was used as the basis for the main SNA in Figure 10 which visualises the organisations of the initial stakeholders, their contacts and in which sector they are the most characterised by. To properly analyse and draw conclusions on the relations in the network a circular dendrogram was used.

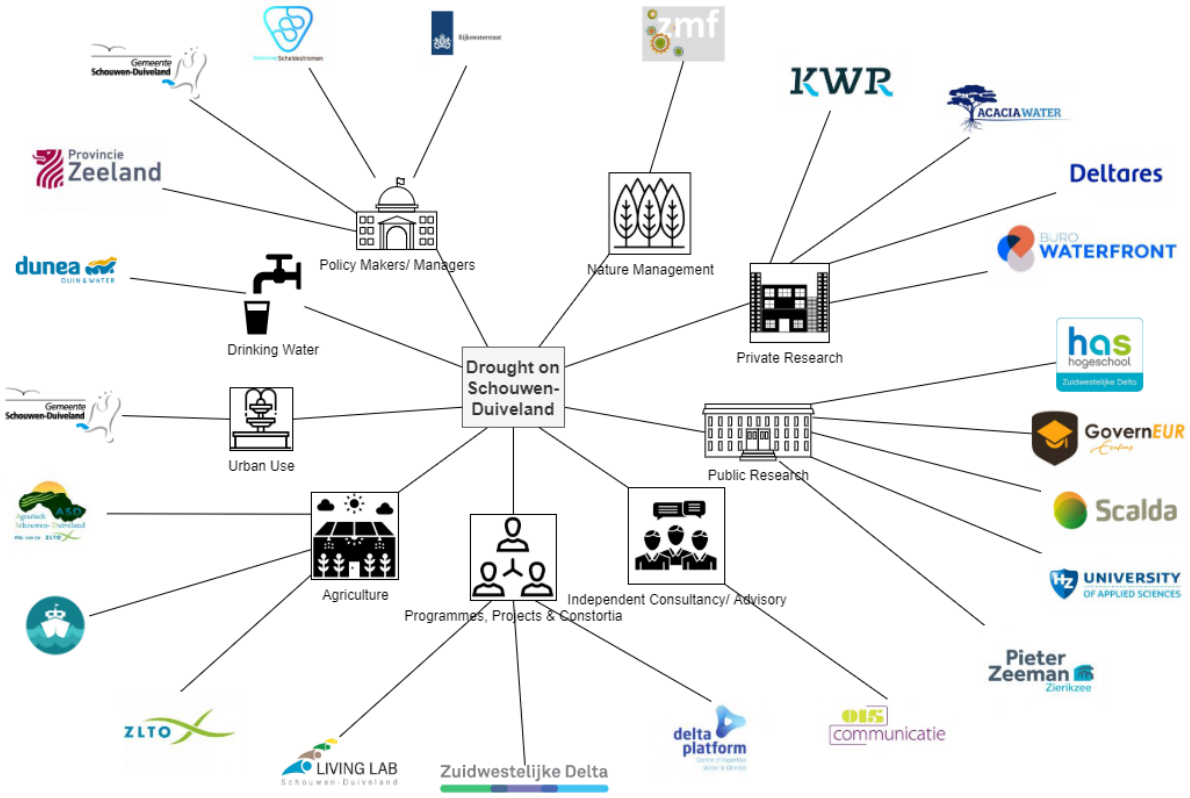

Figure 9: Example of a SNA displaying only the core organisations. Credit: J.S (2020)

Table 2: Initial stakeholder information

Nr.	Organisation	Organisation Code	Name (contacts)	Stakeholder Code	Function of stakeholder (related to drought)	Sector	Sector Code	Contacts in a row	Contacts Code	Contact sector code
1	Municipality of Schouwen-Duiveland	O1	[private]	LL1	Municipal official and project leader of Living Lab Schouwen-Duiveland	Governance and management	SE1	[private]	IC18	SE1

Table 3: Individual contacts (where a name and organisation were provided)

Nr.	Name	Organization	Function of stakeholder (related to drought)	Sector	Code
1	[private]	Dunea	General Director of drink water company	Drinking water	IC1

Table 4: Organisational contacts (where only an organisation, but no name or function was provided)

Nr.	Organization	Function of stakeholder (related to drought)	Sector	Code
1	Evides	Drink water company	Drinking water	OC1

Table 5: Groups, consortia, programmes and projects (that don't fit neatly in with the other two categories)

Nr.	Organization/ Project	Function of stakeholder	Sector	Code
1	Municipality of Schouwen-Duiveland/Regionaal "groen" overleg	Regional "green" meeting with neighbouring municipalities and direct contact with managers of sports fields.	Urban Use	G1

Table 6: Summary of code for interrelations dendrogram (J.S, 2021)

Summary of code for interrelations dendrogram							
Code (O)	**Organisation of initial stakeholder**		**Code (LL)**	**Initial stakeholder part of Living Lab**		**Code (NL)**	**Initial stakeholder not part of Living Lab**
O1	Municipality of Schouwen-Duiveland		**LL1**	Municipal official and project leader of Living Lab Schouwen-Duiveland		**NL1**	Teamleader highschool/gymnasium
O2	HAS University of Applied Sciences		**LL2**	Official and substantive expert		**NL2**	Business Advisor in the vegetal sector at ZLTO
O3	HZ University of applied Sciences		**LL3**	Strategic Policy official on Social Domain		**NL3**	Project leader soil and water
O4	Erasmus University/ ERBS/ GovernEUR		**LL4**	Involved in Core Team Living Lab and in Core Team IBP- Vital Countryside		**NL4**	Water Technologist
O5	Pontes Groep, Locatie Pieter Zeeman		**LL5**	Policy officer space and environment/ Urban planner		**NL5**	Policy Officer Public Green and Landscape
O6	Water Board Scheldestromen		**LL6**	Project Coordinator Zuidwestelijke Delta with a focus on Communication / HAS International projects		**NL6**	Officer maintenance sports fields
O7	Provincial Board of Zeeland		**LL7**	Teacher and Researcher			
O8	Scalda College/ Groen college		**LL8**	Researcher at GovernEUR			
O9	Agrarians Schouwen-Duiveland, Department of ZLTO		**LL9**	Policy advisor fresh water availability			
O10	KWR Water		**LL10**	Relations Manager/ officer in municipal plans			
O11	Deltares		**LL11**	College teacher			
O12	Acacia Water		**LL12**	Chairman of ASD/ Department of ZLTO			
O13	Buro Waterfront		**LL13**	Researcher (Eco) Hydrology			
O14	015 communicatie		**LL14**	Hydrogeologist			
O15	Rijkswaterstaat		**LL15**	Expert/hydrologist			
O16	Independent Water technologist		**LL16**	Independent Advisor and puller Living Lab.			
			LL17	Communications Advisor Living Lab Schouwen-Duiveland			
			LL18	Relations manager			

Table 6 presents the codes of the organisations of initial stakeholders, initial stakeholders part of the Living Lab and initial stakeholders not part of the Living Lab. These codes are then used in the SNA (Figure 10).

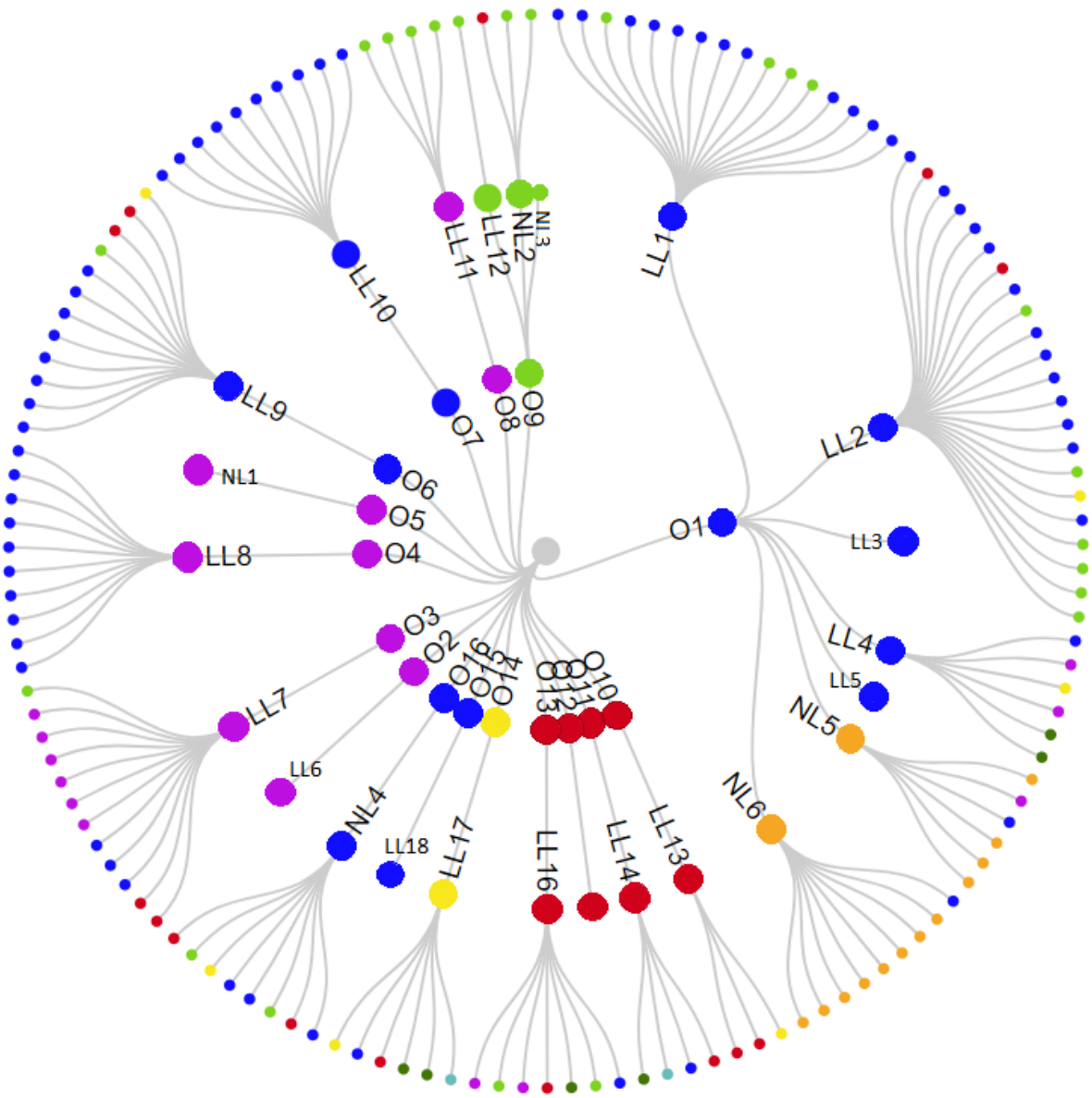

Figure 10: Stakeholder Interrelationships regarding drought on Schouwen-Duiveland (made in: rawgraphs.io, edited by: J.S (2021)) The dendrogram was built using the stakeholder identification step and Tables 2-5 give examples of the labels that were used.*

The coloured dots in Figure 10 refer to the sectors related to drought in Table 7. Figure 10 visualizes the network related to drought on Schouwen-Duiveland. It can be seen that there are 16 organisations, 24 initial stakeholders, their 58 individual contacts, 27 organisational contacts and 16 groups/consortia/projects following the drought issue which is positioned in the middle.

These are then assigned the colour code depending on to which of the 8 sectors influenced by drought on Schouwen-Duiveland they belong, as seen in Table 7. It can be seen that 9-24 initial stakeholders had mostly (60%) contact within their own sector (LL1; LL2; NL5; NL6; LL13; LL9; LL10; LL12; NL2). Furthermore, it is visible that mostly governmental agencies and the agriculture sector have this tendency to provide contacts in their own sector. 8-24 initial stakeholders had a mixed network (LL4; LL14; LL16; LL17; NL4; LL7; LL8; LL11) where mostly the private research; public research; and consultancy and advise sectors are represented. 7-24 initial stakeholders provided no contacts (LL3; LL5; LL15; LL18; LL6; NL1; NL3). Note that stakeholders with the code LL still maintain contact with the other LL stakeholders even if not displayed in Figure 10. 139 contacts are displayed in Figure 10, because several contacts had been mentioned in interviews and the questionnaire multiple times.

Table 7: Sectors where initial stakeholders and their contacts are mostly affiliated with.

Sectors related to drought	Code	Colour
Governance and management	SE1	Dark Blue
Public research	SE2	Purple
Private research	SE3	Red
Drinking water	SE4	Light Blue
Urban Use	SE5	Orange
Agriculture	SE6	Light Green
Nature Management	SE7	Dark Green
Independent Consultancy & advisory	SE8	Yellow

4.4 The development of the Decision-support tool

The DST for assessing areas facing drought was developed based on several conceptual frameworks presented in the State of the Art chapter. The vulnerability assessment framework by Sesana et al. (2020) gave the idea for a step-wise process of assessing the vulnerabilities to climatic effects. It also stressed the importance of having both top-down and bottom-up perspectives in its stakeholder analysis as both local scale and national/regional scale look at the context in different ways. Their idea to have a repeating element in the conceptual framework was also added into this thesis' DST. Instead of cultural heritage the DST would be focussed on drought. Based on the conceptual framework from Sesana et al. (2020) step 1)vulnerability assessment, and step 2) stakeholder analysis, were added to the DST. Step 3) an adaptation, mitigation and resilience-building measures recommendation, was added to give the DST a practical element. The results from the stakeholder analysis performed within this thesis were used as a base for the addition of the three aspects of the stakeholder networks assessment: identification, categorisation and interrelationships. Thus, following this process the DST for the assessment of areas facing drought was developed (Figure 11).

The DST for the assessment of drought should be used as follows. Step 1: The climatic impact and vulnerabilities of the area that suffers from the phenomenon of drought should be assessed in order to become acquainted with the issue. Step 2: The stakeholder network regarding drought should be assessed in order to involve and collaborate with the stakeholders affected by and/or interested in addressing drought. As seen by the arrow going from step 2 back to step 1 (Figure 11), the newly identified stakeholders in this step could provide new insights into the vulnerability assessment. Step 3: A recommendation on drought adaptation, mitigation and resilience-building measures should be created in order to make practical use of the information and knowledge acquired in the previous two steps. Step 4: The entire step-wise process should be repeated in order to keep the information and knowledge acquired up-to-date.

The practical applications of the DST on the island of Schouwen-Duiveland are explained in the discussion chapter.

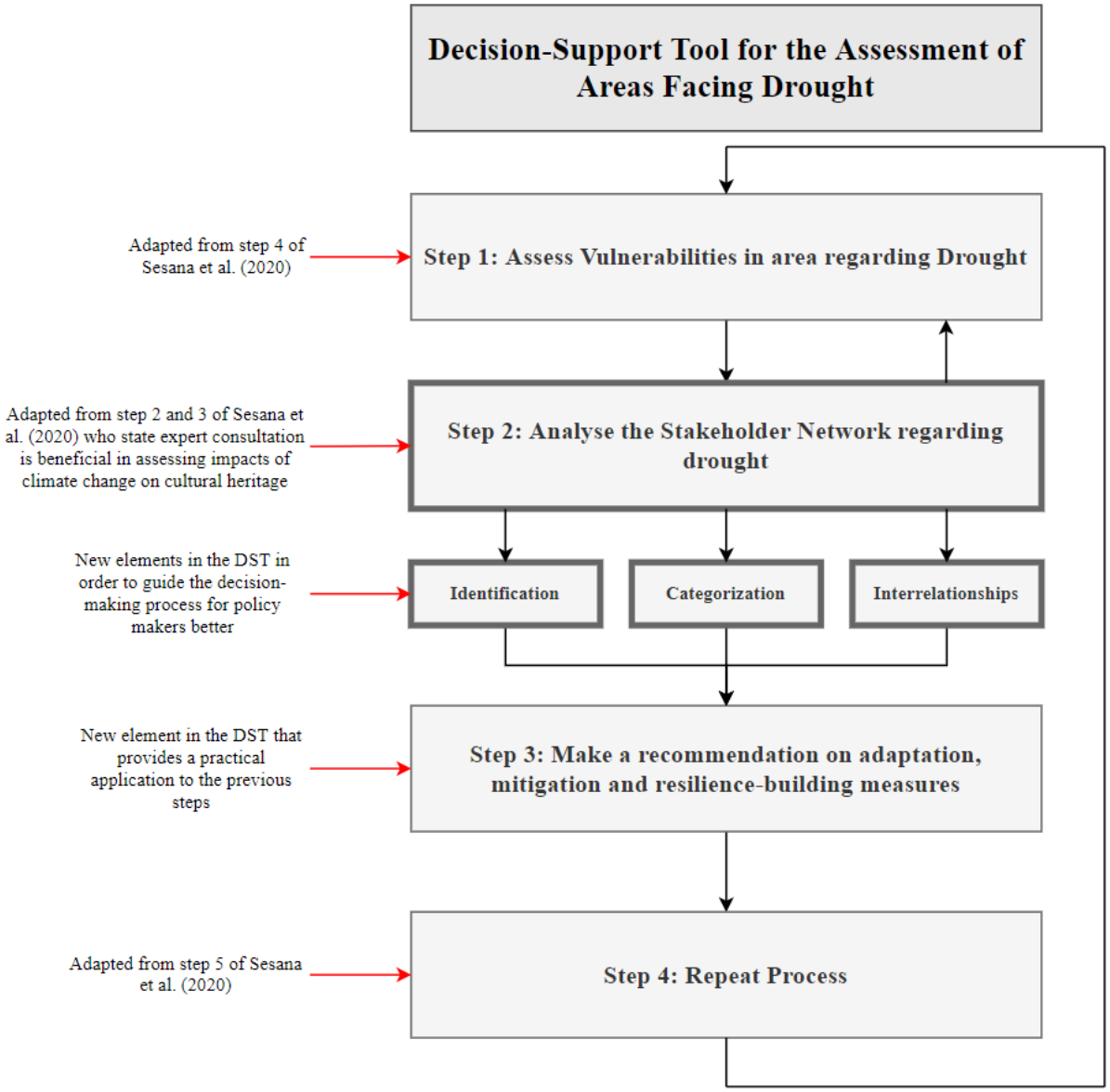

Figure 11: Decision-Support Tool for the Assessment of areas facing drought. Modified from: (Sesana et al., 2020). Created by: J.S. (2021)

5. Discussion

In this chapter the main findings of the research are reiterated and discussed. Comparisons are drawn with other authors' work. At the end of the chapter the limitations and recommendations on future findings are presented.

5.1 Revisiting the research problem

The research problem approached in this thesis stated that there is a lack of interdisciplinary approach regarding area assessment on drought, and therefore a DST should be developed. The aim of the research is to streamline a suggested model of the decision-making process, with an emphasis on stakeholder cooperation, regarding drought on the island of Schouwen-Duiveland in The Netherlands. This thesis aims to address especially the situations where climate impacts such as drought are evident and one of the following is the case: no climate adaptation plans are available and/or no stakeholders are known. To guide the research, a main research question was formulated: *Which are the main elements of a decision-support tool that contribute to more focussed stakeholder collaboration in a place-based manner?* The research question was answered using several sub questions.

The author based his DST on the elements as follows: First, vulnerability assessment, which assesses the impact and consequences of drought on several sectors on the study area. Second, the stakeholder engagement that brings together the parties affected by and/or interested in addressing the drought problem for more efficient collaboration. Third, a recommendation on adaptation, mitigation, and resilience-building measures, which aims to use the information and stakeholder network from the two previous steps to develop a useful strategy against drought. And fourth, repetition of the entire process so that all information and knowledge gained can stay up-to-date for present and future use. The combination of these steps in a DST regarding drought is important in order to streamline the decision-making process for policy-makers and research institutions; and to gain information, create knowledge and share that knowledge with the stakeholders within as well as outside of the stakeholder network. This thesis focussed on the step 2 of the DST - the stakeholder engagement/collaboration, which was executed by means of a stakeholder analysis. The stakeholder analysis was approached through identifying, categorising and interlinking stakeholders. It was found that using these methods the stakeholder network regarding drought on Schouwen-Duiveland could be mapped adequately.

5.2 Summary and review of findings: Decision-support tool

A DST for assessing areas facing drought was developed. It combined the steps of 1) vulnerability assessment; 2) stakeholder analysis; 3) adaptation, mitigation and resilience-building recommendation; and 4) the need for a process repetition. The stakeholder analysis performed in this thesis aimed to test step 2 of the tool on the case study area of Schouwen-Duiveland. The steps of the DST were developed by reviewing the existing literature, mainly that of Sesana et al. (2020).

5.2.1 Step 1: Assessing the vulnerabilities of an area regarding drought

The DST in Figure 11 visualizes the process a decision-maker can take to in order to gain clarity on an area facing drought. The process starts with researching the climatic impacts and resulting vulnerabilities related to drought in the area. On the island of Schouwen-Duiveland these vulnerabilities affect various sectors as identified in the Results chapter. Therefore, the first step is also scoping down the drought issue, because drought as a phenomenon can also be divided further as described in the Stakeholder Identification subchapter of the Results. This division of drought as a phenomenon may impact the choice of the adaptation and/or mitigation measures. When the type of drought is identified, the decision-maker can determine which sectors are being affected. In this research, the following sectors were identified as being affected by and/or interested in addressing drought on Schouwen-Duiveland: Agriculture, Drinking water, Nature conservation, Urban use, Recreation & Tourism, Private research, Public research, Policy and management, Industry & Energy, and Independent consultancy & Advice. The choice of the sectors identified was based on the Dutch water prioritization of fresh water (Rijkswaterstaat, 2021) with the addition of interested sectors. The identified sectors are not expected to be facing the same issues regarding drought. Some sectors such as energy and industry may not be as much affected by drought in general but more by the lack of fresh water availability; while others such as agriculture are facing issues on both fronts. In the stakeholder analysis performed in this thesis the emphasis was mainly on drought in general, but still keeping fresh water availability in mind.

5.2.2 Step 2: Analysis of the stakeholder network regarding drought

Step 2 consists of three sub-steps: stakeholder identification, stakeholder categorisation and stakeholder interrelationships as also described and performed in the Methods and Results chapters. These steps together comprise the stakeholder analysis.

This step aims to guide the decision-maker in assessing the stakeholder network related to drought. The information gathered during the vulnerability assessment prevent the decision-

maker from coming across as uninformed and may make the whole process more streamlined, which may prove helpful when talking to the stakeholders. It is the assumption of the author that this step should be performed before the step of adaptation, mitigation and resilience-building measures recommendation. The author suspects, that some stakeholders might provide valuable information on the topic which could be of use in the next step.

Uncovering of the stakeholder network regarding drought is important for several reasons. One is that there may be a lot of valuable information and knowledge scattered across various individuals, communities and organizations. According to LAB, the efficiency of decision-making regarding drought would increase if the information and knowledge gained from the stakeholders would not be lost again. Another reason is to find out what the motivating factors are for stakeholders to find solutions to drought and in what affected sectors is that motivation present. A consequential reason to uncover the stakeholder network may be to connect these stakeholders to ensure that all parties can have an equal say in the matter. Individuals that have a small chance of being heard can unite to increase their potency. This may improve the cooperation between the various layers of society. A network organization such as the LAB can be established to provide a platform on which the stakeholders can interact.

5.2.2.1 Identification of stakeholders

The stakeholder identification showed that most initial stakeholders were from the Governance and management; Public research; and Private research sectors. The sectors with less initial stakeholders identified included Agriculture, Urban use and Independent consultancy. The sectors where most contacts were identified were the Agriculture; Urban use; Private research; Governance and management and Public research. Sectors with lower numbers of contacts identified include Drinking water; Nature conservation and Independent consultancy and Advice. There were no initial stakeholders, nor contacts identified in the sectors Recreation and Tourism; and Industry and Energy.

Most of the initial stakeholders came from the LAB. The initial stakeholders in the Governance and management; Public research and Private research sectors are so prevalent, because many of them are also core partners of LAB which is where the research data originated from. Another influencing factor is the focus of LAB as a network organisation which strives to combine knowledge from different fields. The governmental and research sectors are therefore in the spotlight as they are the ones that bring that knowledge. The initial stakeholders from the other sectors are there to bring local knowledge to the Table, as well as a line of communication between the local and municipal level so that more voices can be heard. The high amount of

contacts for the governance and management indicates that various levels of government in the Netherlands are working on addressing the drought issue in Schouwen-Duiveland and other municipalities in the province of Zeeland. The contacts provided for the other sectors are mostly even, with the exception of Agriculture and Urban use sectors, where high amount of contacts was identified. This suggests that those sectors are also heavily involved in drought on the island and may either be underrepresented or not yet wholly approached by LAB as they were still expanding their network. The numbers of contacts for the sectors of Drinking water and Nature conservation were small because of the lack of contacts for those sectors in the LAB network. During the conversations with the stakeholders it was observed, that even though the initial stakeholders had no contacts in those sectors, many of them still stressed the importance of including those sectors into the debate because of their direct exposure to either drought or lack of freshwater. No contacts were identified in the Industry and Energy sector, because they operate mainly on a national level. The Recreation and Tourism sector was identified as being affected by drought, but no mention of contacting them was made by any of the stakeholders. It can be assumed that LAB was not ready to expand their network to that sector yet. The assumption based on the stakeholder analysis is that with one foot in the door, or one contact in the sector, more contacts could have been identified in the sectors that lack representation.

The results of the stakeholder identification are in line with other similar studies such as Elbakidze et al. (2012). In their study they divided stakeholders into three categories, which they call “variables” .Those variables were based on the specific context of the study. Subsequently, the authors made further subdivisions in those variables. First, they divided the stakeholders based on their rights to use natural resources. This variable can be equated to the stakeholders in this thesis being affected and/or interested in addressing drought. Second, they divided their stakeholders based on what sector they belonged to; these were the civil sector, private sector and public sector. Here the comparison can be made with the 10 sectors chosen in this thesis. The third variable they used was the geographical scope of the stakeholders’ activities. In this thesis, this part is already covered by the scope of the research, the island of Schouwen-Duiveland. From the comparison of the two works it can be seen that the broad identification method from Elbakidze et al. (2012) makes sense in a wider spatial context, but not in the context of this thesis. The stakeholders connected to the drought problem on Schouwen-Duiveland are more diverse, which asks for more specification of the sectors in which the stakeholders should be identified. Identification of stakeholders based on only three

sectors to cover the drought problem would bring too general results and would not provide sufficient insight into the stakeholder network.

5.2.2.2 Categorisation of stakeholders

The stakeholders and their contacts were then categorised using the developed rings of influence method (Figure 8). This method showed that most initial stakeholder and their contacts reside in the policy-making quarter and advice & consultancy quarter. Least represented are the executive power and implementation & suppliers quarters. Eight initial stakeholders and contacts are directly affected by drought; 24 are interested in addressing drought; and the rest are contacts of the initial stakeholders who could become stakeholders if further assessed.

The use of this categorisation method was to visualise what relations the initial stakeholders and their contacts have with drought on Schouwen-Duiveland. The policy-making quadrant includes all the government agencies, its policy officers and government projects and consortia. Being the quadrant with the most parties this suggests that the solutions to the drought problem are heavily influenced by the government. It also suggests that the Netherlands has many levels of government (national level, provincial level, municipal level, water boards, state forestry) which all have drought on their agenda and work to address it in their own way. The advice & consultancy quadrant represents the public and private research institutes, advice bureaus and aligned projects. The large number of parties in this quadrant suggests a large base for public and private research on drought in the case study area as well as advisory and consultancy agencies providing their expertise (communication, civil engineering, economics). There are not only universities and companies from Zeeland but also outside of it suggesting that the issue and the need of addressing it is crossing the provincial and municipal borders. The executive power quadrant stands for directors/presidents of organisations and other powerful positions who have the power to drive change. Regarding drought, this power can be used to hear out the organisations such as LAB and bring the information provided by them to 'higher places' such as the national government, sparking debate and action. The executive power contacts presented in Figure 8 are derived from the core partner organisations of LAB. The implementation & suppliers quadrant stand for all the companies with practical knowledge and working on alleviating the drought issue. This quadrant mostly comprises of greenery suppliers for urban use but also local farmers. Unlike the regional and national farmer associations, Local farmers are not represented often in Figure 8 as it was outside of the scope of the thesis. There are currently not many affected parties represented in the Figure in comparison with the amount of

interested parties. This may suggest that there are not many parties affected by the issue, however, this impression can be caused by the lack of representation of farmers who are directly affected by drought, as mentioned before.

The results of the stakeholder categorisation suggested a network dominated by the stakeholders from the policy-making and consultancy & advisory quadrants and their contacts. It also indicated that the power-legitimacy-urgency categorisation tool by Mitchell et al. (1997) was not appropriate for the context of this thesis. The urgency to solve drought, which in the categorisation tool from Mitchell et al. (1997) is defined as: "*the degree to which stakeholders claim call for immediate action*", is implied in the context of this thesis. The legitimacy of stakeholders to lay claim to the issue of drought is as well out of place in this context, as Mitchell et al. (1997) defines legitimacy as: *"a generalised perception or assumption that actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, definitions".* Furthermore, the definition of power as stated by Mitchell et al. (1997) is: "*a relationship among social actors in which one social actor, A, can get another social actor, B, to do something that B would not have otherwise done"*. The power of stakeholders to solve the drought issue in this case study could be disputed between the government and local communities banding together. For the above-mentioned reasons it can be argued that the business perspective of stakeholder categorisation cannot be applied on this thesis and that is why the ENRM perspective was chosen. In the ENRM perspective an environmental issue stands in the centre of attention, which lends itself better to the context of this thesis.

5.2.2.3 Interrelationships between stakeholders

The interrelationships between the 24 initial stakeholders and their 139 contacts were visualised in a SNA. 16 organisations, 24 initial stakeholders, their 58 individual contacts, 27 organisational contacts and 16 groups/consortia/projects were displayed and colour coded per sector influenced by drought. The visualisation showed that 9-24 initial stakeholders had mostly (60%) contact within their own sector, 8-24 initial stakeholders had a mixed network and 7-24 initial stakeholders provided no contacts.

It can be assumed, that the function held by the stakeholder most likely influences the structure of their contacts. Stakeholders involved from public-private research or consultancy appear to have more diverse contacts than the ones from the governmental or agricultural areas. It is precisely this combination of diverse and specific contacts that is important to build and maintain a holistic network. The 7-24 initial stakeholders did not provide any contacts in the

research phase. However, 5-7 of them are part of the core team of LAB and thus maintain relations with them on that level. There are 2 initial stakeholders that did not provide any contacts and were not aligned to LAB, which may suggest a lack of knowledge on the topic or a misinterpretation of the question when asked in the research phase. Several of the 139 contacts displayed in Figure 10 were mentioned multiple times, which may be an indication that those contacts could be particularly prevalent in the drought issue on Schouwen-Duiveland and could potentially be valuable (information, knowledge, experience) stakeholders. It could also indicate that those particular contacts work on the same drought issue, but their involvement has not been communicated sufficiently. If so, those contacts may need to be included into the network for that reason to avoid double work or miscommunication.

The results from the stakeholder interrelationships were reached in similar manner as in the work of Prell et al. (2009). There are several similarities and differences that can be discussed. In both their work and this thesis a SNA is used to visualise the links between the stakeholders and their contacts. However, Prell et al. (2009) did not perform the stakeholder categorisation step the same way as it was done in this thesis. However, the stakeholder categories in the work of Prell et al. (2009) were very similar to the sectors of the stakeholder identification in this thesis. This suggests that depending on the context of the research the stakeholder categorisation step may not be needed in order to perform a SNA. The fact that the stakeholder identification was used to perform the stakeholder interrelationships step rather than the stakeholder categorisation seems to supports this claim. The SNA used by Prell et al. (2009) visualises the links and the frequency of communication between all stakeholders and subsequently measures which stakeholders are the most central in the network. The similarity to this thesis can be found in the fact that this method shows which stakeholders are the most central in the network. All the links between the stakeholders and contacts were not visualised in this thesis' SNA for the sake of its clarity. The focus in this thesis rested on the links between initial stakeholders and their contacts. The links between the contacts were ignored, since that lies out of the scope of this research. A feature added in this thesis that is not in the work of Prell et al. (2009) is the visualisation of the sectors influenced by drought on Schouwen-Duiveland. This feature would also not be clear if all links between contacts were visualised.

5.2.3 Step 3: Make a recommendation on adaptation, mitigation and resilience-building measures.

Step 3 of the DST is a recommendation of measures that can be used against drought. In step 1 preliminary research was done to uncover the vulnerabilities to drought. In the current step the

vulnerabilities combined with the information provided by the stakeholders should already provide a good basis for a recommendation of the measures against drought. More thorough literature research should complement the ideas presented by the stakeholders for a broader database of available types of measures. Different sectors may take wildly different measures into consideration. It is a task of the decision-maker to provide a thorough recommendation of all possible adaptation, mitigation and resilience-building measures that can be used against drought. This recommendation can be subsequently presented to the network organization and discussed with the affected stakeholders to identify which measures fit their needs the most. The overall trend in the frameworks presented in the state of the art chapter is that there is often no practical follow-up after the vulnerabilities and stakeholder networks are assessed. In the work of Lim et al. (2004) it is stated that there should be a follow-up. This step would force decision-makers to use the data from the previous steps to come up with practical adaptation plans for drought. It can be challenging for policy-makers to use raw data that often requires scientific expertise in the field to be interpreted properly. Providing this practical output of the DST in the form of recommendations would make the uptake of the produced scientific knowledge easier.

5.2.4 Step 4: Repeat process

The final step of the DST is in essence the need to repeat the entire process. The researches within LAB are usually performed only once and they are repeated only when the need arises (mostly many years later). This consensus may be a liability, since in this time gap many factors regarding the drought phenomenon can change. More threatening impacts and vulnerabilities may appear and the stakeholder network may evolve, leading to gaps in knowledge distribution. It is therefore suggested to keep step one, two and three of the DST up-to-date constantly. It can be seen in Figure 11 that the entire process of the DST is linear up to the fourth step. Then the tool becomes repeating in order to reduce uncertainty over time. In this manner the DST fits the description of an adaptive management tool (Murphy & Weiland, 2014). The adaptive management cycle visualises a circular process that takes the information and knowledge gained in the process to capture and share it before reiterating the process. The DST repeats itself in a similar manner. The repeating of the entire process after step 3 should be performed as transparently as possible towards the stakeholders. It should as well reflect on the findings of the steps in order to come to new insights. Additional stakeholders may also be identified and included. This involvement and collaboration with identified stakeholders aims to gain and maintain knowledge on drought vulnerabilities and the suitable measures to address the

phenomenon. The DST is also repeated after step 2. The reason of the repeating after the stakeholder analysis is because the knowledge gained from stakeholders (local, regional, national) can be used to assess the vulnerabilities to drought again. This process can be repeated as many times as there are new stakeholders identified.

The DST was developed in order to provide broad and clear pathways for decision-makers to understand areas facing drought; the people affected by and/or interested in addressing drought in those areas; and how to adapt to or mitigate the damage done to various sectors affected by drought. The decision-makers in question could be, but are not limited to, policy makers from all levels of government, knowledge institutes such as universities or private research institutes.

Hemmati (2002) States that interest is the defining aspect of stakeholders, however those with the power to influence decisions may not have interest themselves (Reed et al., 2009). It may be a challenge to always engage stakeholders without issues. Examples of possible problems that can occur with stakeholder engagement are: conflict of interest, lack of capacity, stakeholder fatigue (Filho and Brandli, 2016)

The results of the DST suggest major correlations with various works presented in the State of the art chapter. As the DST was developed based on the work of Sesana et al. (2020) their claims that the assessment of vulnerabilities was aided by the perceptions of local stakeholders coincides with the findings of this thesis. Stakeholder involvement and collaboration appears to provide essential information regarding the issue of drought on Schouwen-Duiveland. It can also be argued that the lack of stakeholder involvement and collaboration could be a barrier in effective addressing of the issue.

5.3 Limitations

Several limitations were identified during the research. It was challenging to contact all the relevant stakeholders and gather useful information for the stakeholder analysis. Many identified stakeholders were not interested or busy with their own work and even the interested stakeholders were sometimes not able to provide all the necessary information they were asked for. Various identified stakeholders and sectors were not approached in this research. One such group were the farmers on the island of Schouwen-Duiveland. It was decided early on in the research that interviewing all the farmers would make the volume of the task too great and thus it is outside of the scope of this thesis. Nevertheless, 3 conversations with farmers were held but they were not followed by any subsequent interviews. This was caused by the harvesting season which kept the farmers busy, as well as the Covid-19 pandemic which prevented the author from being on the island in person and put more pressure on the execution of the interviews. It is important to note that in case of the inclusion of local farmers in the research the balance of the sectors in the stakeholder identification would have turned out differently as the Agricultural sector would have a higher number of stakeholders. Now it seems that there is a disconnect between the local farmers and the government, which is not the case. The local farmers are represented by the national and regional farmer association as seen in the results of the Stakeholder Identification subchapter. Other sectors not approached in the research were the Industry and Energy sector and the Recreation and Tourism sector. Both sectors were decided to be left out of the research because LAB, which was in the centre of the stakeholder network, was not ready for expanding their network in those directions yet. The Nature conservation sector was only slightly touched upon in this research for the same reasons. However, this sector later became part of the expanded network of LAB.

It is important to stress out that the stakeholder analysis is the only one step out of four of the DST which was tested within this thesis. The DST provides decision-makers with a broad, yet specific enough process to assess areas facing drought. However, the other three steps should be tested in future research so that the DST can provide full support to decision-makers.

5.4 Recommendation on future research

Some unexpected findings arose during the course of the research. The methods seen in this thesis were not the ones initially planned, but are the result of changes happening over time to make the methods fit the context better. The articles found in later stages of the research and discussed in the Discussion chapter provided new insights into how other authors tackle stakeholder engagement and stakeholder analyses. Methods similar to those discussed in the Discussion chapter could be used in future research to expand the visualisation of a stakeholder network. This expanded visualisation could cover more aspects of the stakeholder network (e.g. type of relationship, frequency of contact), which could provide deeper insight to the ways how to involve those stakeholders that are interested in addressing the issue. Future research should also include a continuation of testing the other steps of the DST in order to make the tool more robust for the use by decision-makers. An important recommendation is to continuously update the stakeholder analysis. The aim is to create a living document that is kept up to date so that the information and knowledge is not lost. Last but not least, this decision-making tool is focussing on the drought issue in the context of Dutch culture. Further research could reveal whether the DST works in other areas and cultures in which drought occurs, and perhaps if the tool could be used in relation to other climate related issues.

6. Conclusions

The research aimed to develop a decision-support tool (DST) for assessing areas facing drought. The research was performed, with the help of the network organisation LAB, on the island of Schouwen-Duiveland in the Netherlands where drought has become an increasing issue over the last years. Through the literature research and stakeholder involvement it became clear that the DST can provide help to decision-makers in assessing the vulnerabilities to drought, the stakeholder network affected and/or interested in addressing drought, and the adaptation, mitigation and resilience-building measures against drought. The results indicate that the stakeholder network surrounding the drought problem on Schouwen-Duiveland can be efficiently mapped using the identification, categorisation and interlinking methods found in stakeholder theory literature. The results also proved that stakeholder engagement and involvement is vital for the successful performance of the stakeholder analysis.

As defined in the problem statement, there are often no clear guidelines or pathways for the assessment of areas facing drought on a local level. This research aimed to overcome that limitation by developing the DST that would give decision-makers the opportunity to fill in the gaps regarding the assessment of drought and improve stakeholder cooperation. This is how the gap in knowledge was tackled. The results obtained by the testing of the DST on the case study in this thesis also indicate that the areas facing drought can be efficiently assessed through a structured approach. The testing of the DST resulted mainly in the stakeholder analysis which provided valuable insights for LAB.

Based on these conclusions, it is clear that the stakeholder analysis step provided useful insights for assessing areas facing drought on Schouwen-Duiveland. Further research can include the testing of the vulnerability assessment; adaptation, mitigation, and resilience-building; and repeat process steps. It can also further assess whether the inclusion of all these steps will make the assessment process more efficient or not.

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Appendix 1 Stakeholder Questionnaire

Vragenlijst Stakeholders Thema Droogte voor het Living Lab Schouwen-Duiveland

Over het Onderzoek

Beste deelnemers, mijn naam is Joost Swiers uit Middelburg, Zeeland. Ik studeer voor mijn Master duurzame ontwikkeling aan de Universiteit van Venetië. Hiervoor studeerde ik Deltamanagement aan de Hogeschool Zeeland in Vlissingen. In Venetië ben ik veel bezig met wat klimaatverandering doet met de wereld en wat de effecten daarvan zijn op lokaal niveau. Voor mijn afstudeeronderzoek ben ik bezig met de risico's op natuurrampen. Daar zijn er veel van en daarom heb ik voor de problematiek van droogte gekozen. Schouwen-Duiveland kampt hiermee en zodoende doe ik mijn onderzoek op het eiland. Het is daarnaast ook erg leuk en interessant om in mijn eigen provincie een onderzoek als dit te doen.

Om er achter te komen en meer duidelijkheid te scheppen van hoe droogte een gebied als Schouwen-Duiveland aantast en wat de mogelijkheden zijn voor duurzame ontwikkeling heb ik een model en een aanpak bedacht. Dit wordt in drie stappen gedaan.

*1) De **kwetsbaarheid** van een gebied bekijken. Dit stelt mij in staat de problematiek beter te leren kennen.*

*2) De **belanghebbenden** in het gebied in kaart brengen en samen brengen. Dit zorgt er voor dat er een netwerk kan worden opgebouwd en koppelingen gemaakt kunnen worden tussen belanghebbenden. Zo kan ook kennis gedeeld worden.*

*3) De **maatregelen** tegen risico's op natuurrampen onderzoeken. Dit stelt mij in staat om toepasselijke oplossingen te vinden voor de problematiek in het gebied.*

Deze resultaten stellen mij in staat om mijn model en aanpak te testen en andere onderzoekers en managers kunnen hiermee verder werken.

Over de Vragenlijst

Beste deelnemers, bij voorbaat dank voor het invullen van deze vragenlijst. Dit onderzoek wordt gebruikt om directe en indirecte stakeholders in kaart te brengen die betrokken zijn bij de droogteproblematiek op Schouwen-Duiveland. Het nut van een stakeholder netwerk opzetten is dat er zo meer duidelijkheid geschapen wordt wie waar mee bezig is om dubbel werk en miscommunicatie te voorkomen. Daarnaast geeft het een kans om nieuwe verbindingen te leggen en kennis te delen.
U wordt eerst gevraagd naar uw betrokkenheid bij de droogteproblematiek in Schouwen-Duiveland en dan wordt u gevraagd naar uw contacten die ook betrokken zijn en degene daarvan die interesse tonen. Als laatste wordt u gevraagd over het functioneren van een goed stakeholder netwerk.

Uw antwoorden worden alleen voor dit onderzoek gebruikt onder de privacywet. (Artikel 7 van de EU-AVG "Voorwaarden voor toestemming").

Ik ga akkoord dat de persoonlijke informatie die ik in deze enquête invul, gebruikt mag worden voor de doeleinden beschreven in de privacy melding.

Vul een kruisje in het vakje hier onder in als u akkoord gaat.

1. Vanuit welke functie bent u betrokken bij de droogteproblematiek op Schouwen-Duiveland?

2. Heeft u (functionele) contacten die ook betrokken zijn bij deze droogteproblematiek, zo ja wat zijn de contacten binnen uw netwerk die hier op van invloed en van belang zijn? [Naam, Contactpersoon, Functie en instituut/ organisatie] ? Contacten die (relevante) kennis dragen zijn ook welkom.

3. Bent u op de hoogte van de organisatie Living Lab Schouwen-Duiveland en waar zij zich mee bezig houden en zo ja op welke wijze (waarbij of hoe of rond welk thema bent u betrokken)?

4. Bent u ook op de hoogte van of betrokken bij droogteproblematiek buiten Schouwen-Duiveland, en zo ja op welke manier bent u daarbij betrokken?

5. Heeft u zicht op andere organisaties, instellingen en personen die zich met de droogteproblematiek bezighouden. Zo ja, vind u dat uw netwerk goed werkt en zo nee, heeft u behoefte aan een beter functionerend netwerk?

6. Wat zijn uw doelen, ambities en oplossingen voor de droogteproblematiek in Schouwen-Duiveland? (persoonlijk en organisatie)

Appendix 2 Stakeholder Workshop

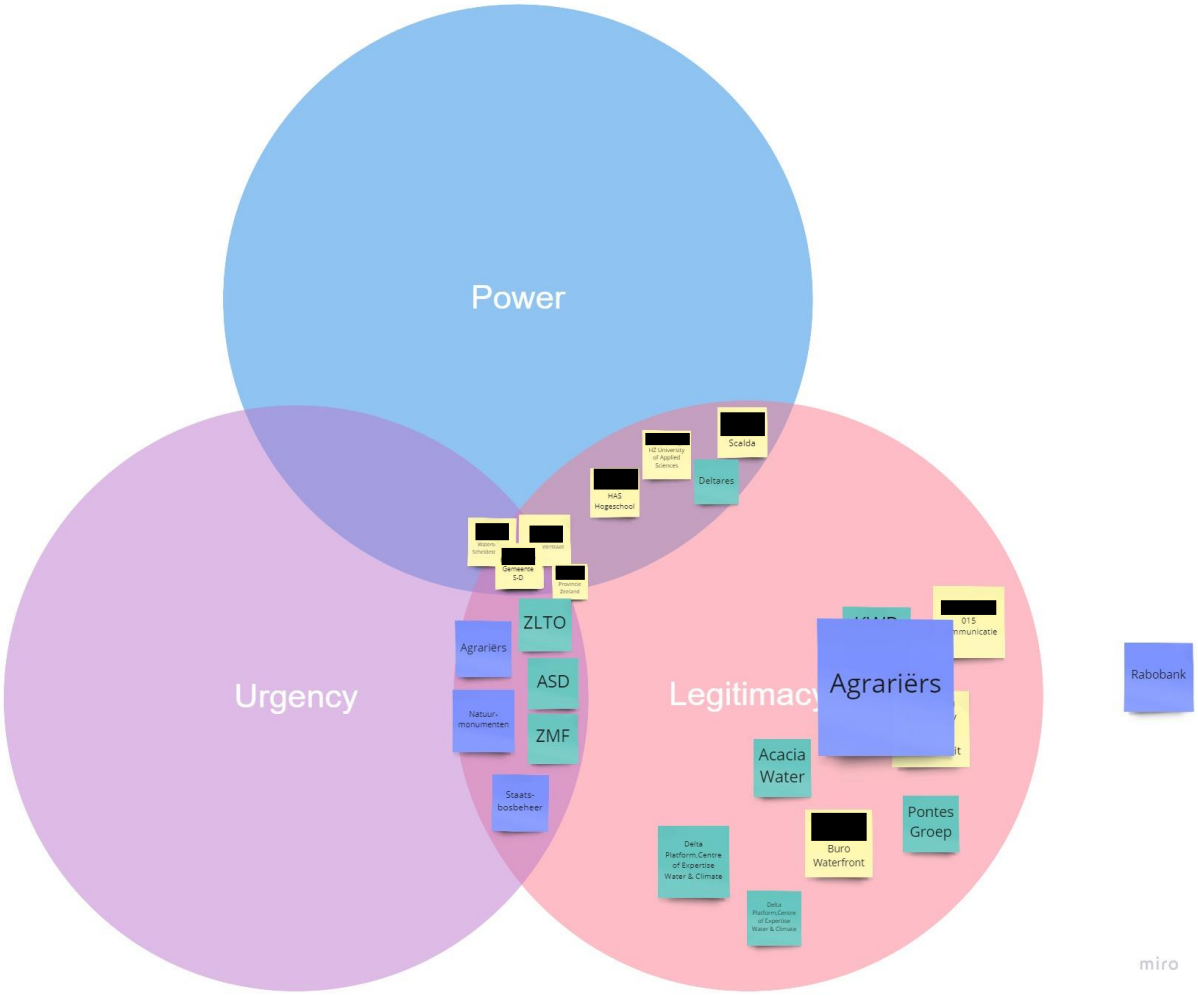

Figure 12: Stakeholder Workshop Power-Legitimacy-Urgency diagram (author's viewpoint), filled in by J.S (outsider view), Created in Miro (2020).

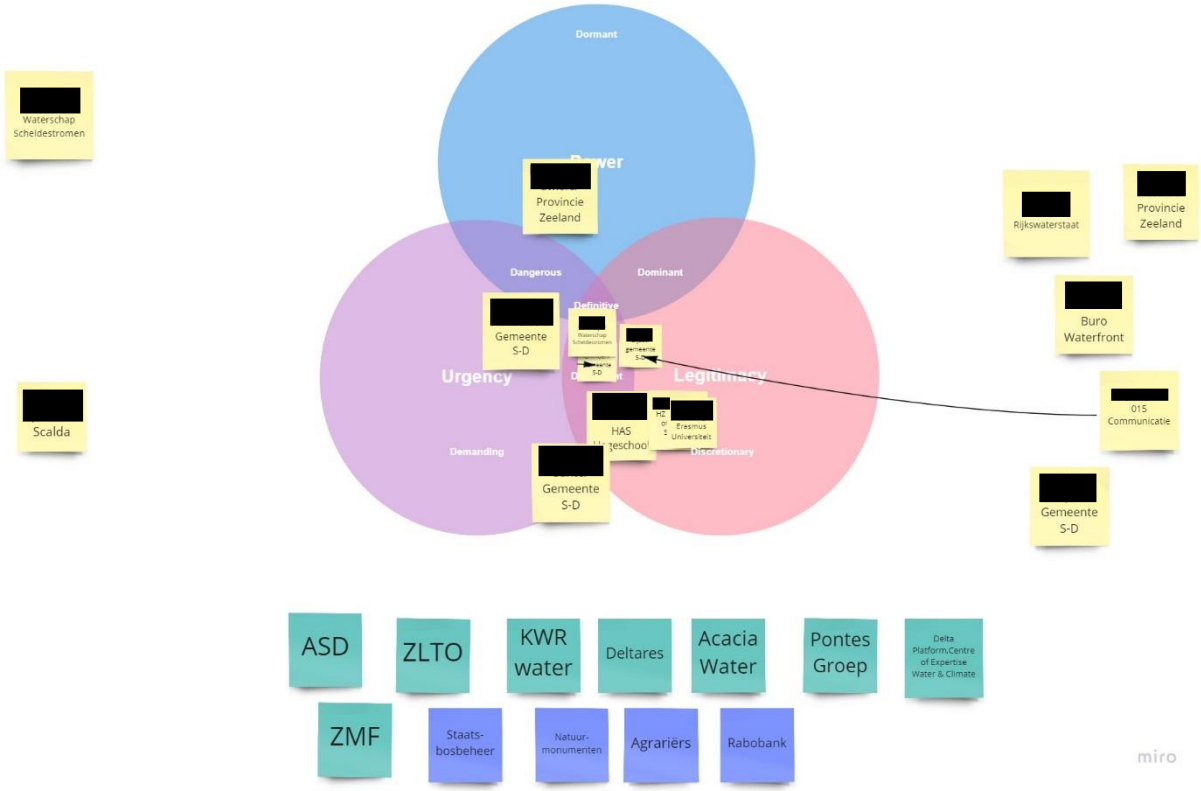

Figure 13: Stakeholder Workshop Power-Legitimacy-Urgency diagram, filled in by core partners Living Lab Schouwen-Duiveland (stakeholder's viewpoint), Created in Miro (2020).

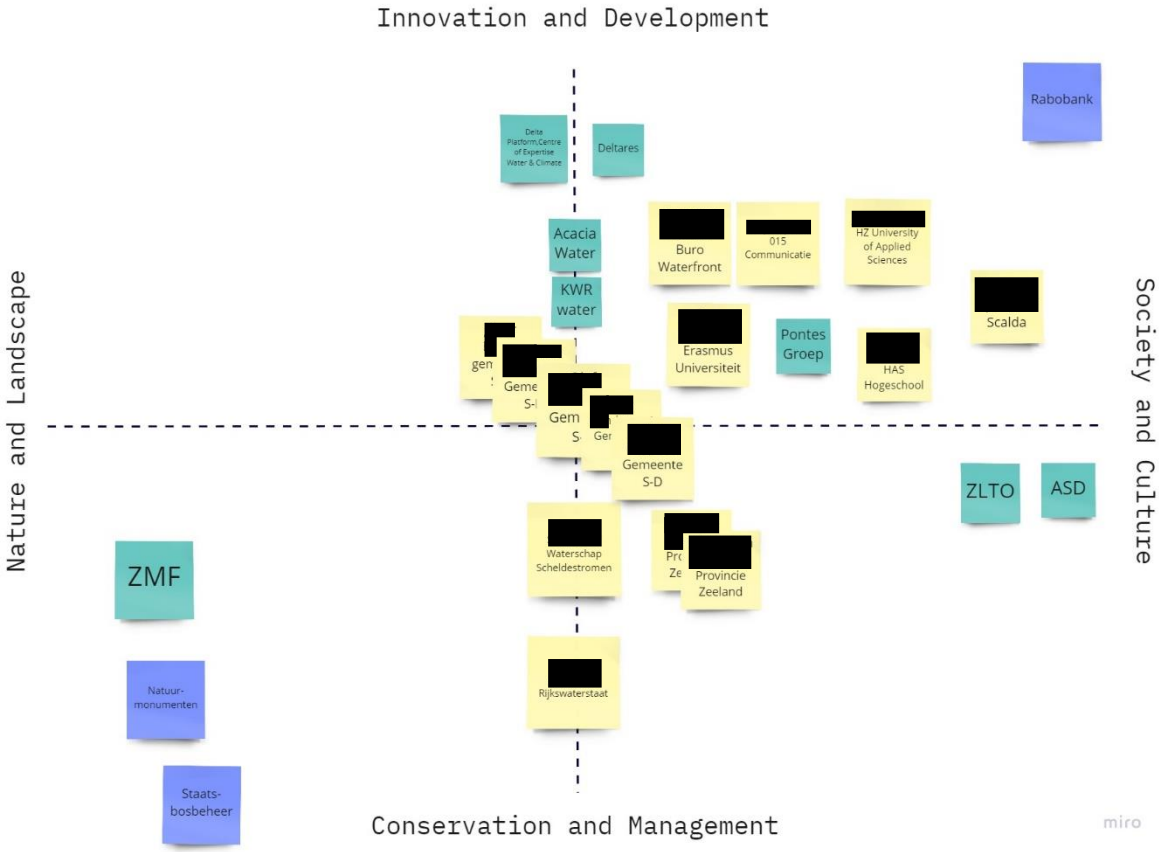

Figure 14: Stakeholder Workshop/ stakeholder axis (author's viewpoint) , filled in by J.S (Outsider view), Created in Miro (2020).

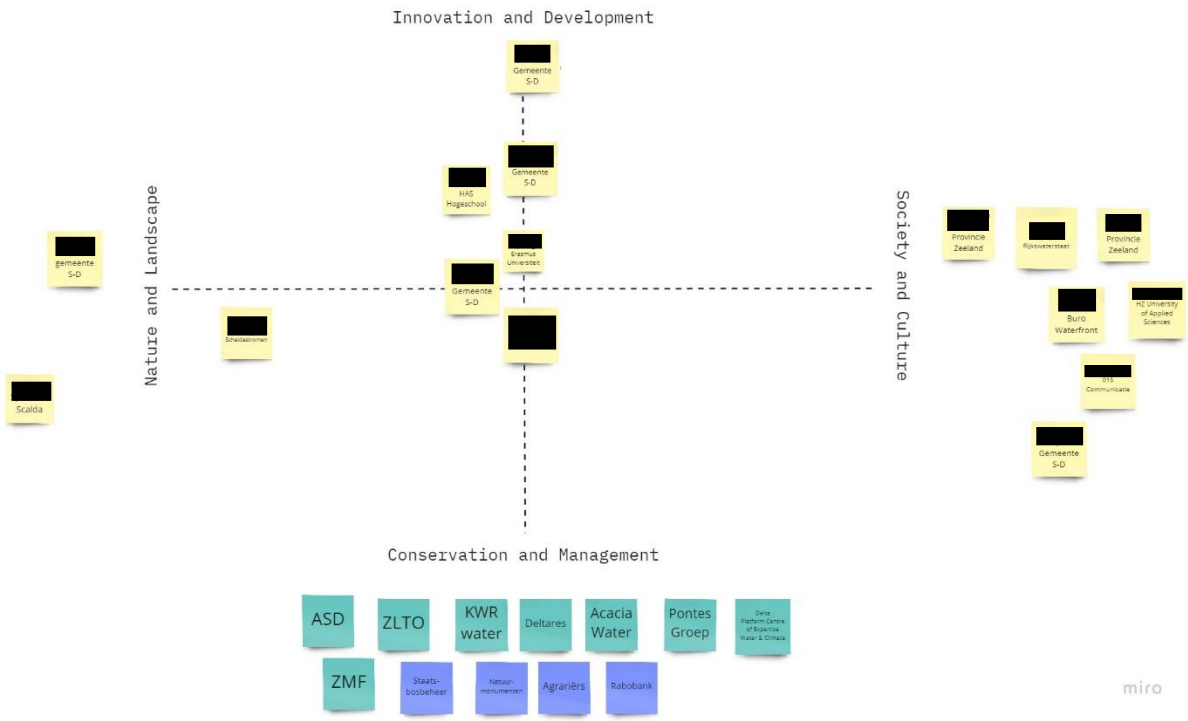

Figure 15: Stakeholder Workshop/ stakeholder axis, filled in by core partners Living Lab Schouwen-Duiveland (stakeholder's viewpoint), Created in Miro (2020).

Appendix 3 Extra information about Living Lab Schouwen-Duiveland

Ambitions

- Search for the enlargement of fresh water availability and innovations for sustainable water supply; Find answers for drought and salinization of agricultural grounds by means of alternative fresh, salt and mixed crops on the land.
- Develop ecologically responsible seaweed- and outside of the dike food production in the Eastern Scheldt estuary and the Grevelingen lake that also offers opportunities for water safety and recreational use.
- Develop and test new methods for connected governance (impulses for a quicker and supported decision-making by governments).
- Develop Schouwen-Duiveland as an innovative island for a resilient and adaptive delta.

Research themes

- Fresh, salt and mixed crops and fresh water supply for agriculture on the land.
- Food production (seaweed and algae) outside of the dikes in the water.
- Connected governance, governmental innovation and connectedness.
- Educational innovation, connecting cross- and practice oriented education.

Source: https://livinglabschouwen-duiveland.nl/