Unravelling Drought Resilience by means of Capital Domains, Generic Resilience Principles and Indicators at the Doesburger Eng, NL

Teun van der Werf
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Preface

The work you are about to read is the result of my thesis research, part of the MSc Environmental Sciences at Wageningen University. The work also marks the end of my connection with Wageningen, a journey that started in 2013. On that journey, I managed to build knowledge on an ever-expanding collection of interests.

So, why drought out of all options from that huge collection of interests? Why resilience? Why indicators? Stakeholder Participation? Plenty of reasons, and for each I could formulate a several page long answer. However, the short answer: all are important and all are intriguing.

Had I done the whole research on my own, it would have turned out disastrous (actually it would not have turned out yet). Therefore, I want to make some acknowledgements:

I would like to acknowledge the Doesburger Eng. It is a truly unspectacular, yet beautiful rural gem. I visited it the first time in March 2020, even though I had been living near it for several years. A shame. So, if you are near, please walk the following 'Klompenpad': *Doesburgermolenpad*.

I would like to acknowledge my supervisors Bas Amelung and Pieter van Oel. Our discussions, their reviews and answers to my questions were of great help throughout the research.

I would like to acknowledge all people that participated in the research through the fuzzy cognitive mapping, the surveys, giving expert judgement and brainstorming. These people are the land users of the Doesburger Eng, and all the knowledgeable individuals from Provincie Gelderland, Waterschap Vallei en Veluwe, STOWA, LTO, Collectief Veluwe, gemeente Ede, Wageningen UR, Deltares en KWR Water. I would like to thank Albert van Weerdenburg from Stichting Buurtschap Doesburgse Eng in particular for connecting me to the land users of the Doesburger Eng.

I would like to acknowledge some specific help: Gerben Mooiweer and George van Voorn for thinking along about the statistical tests and R codes, and the robustness analysis, respectively; Professor Rik Leemans, my brother Job and fellow student Iris for reviewing my drafts; the ESA secretariat for taking care of the bureaucratic part.

Finally, I would like to thank those that helped me on a personal level: Marleen, my family and friends, and my other fellow students. I want to thank them for the time we spend talking about my research, but more so for the time we spend talking about all other things that matter.

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Summary

A drought-resilient agricultural area persists and adapts to droughts. A detailed understanding of drought resilience guides drought-resilience improvements and research. The drought resilience of an agricultural area can be understood through a specific resilience attribute and indicator set (AIS). Resilience attributes are the distinct competences and conditions that affect resilience (e.g. farming experience or physical soil quality), and resilience indicators are measurable reflections of these resilience attributes (e.g. years of farming experience or infiltration capacity). Ideally, AISs are known for each individual agricultural area, but no single set has been established in The Netherlands.

Economic, human, institutional, natural, physical and social capital domains and generic resilience principles (GRPs) also affect drought resilience, albeit more abstractly than resilience attributes. The capital domains refer to the dimensions in which individuals or communities have assets and resources to sustain them. GRPs refer to different system qualities (i.e. consciousness, diversity, feedbacks, modularity, openness and reserves). Knowledge about such capital domains and GRPs is therefore likely useful to guide resilience decisions if the attributes are unknown. The relative importance of these capital domains and GRPs is poorly known in The Netherlands. I addressed this problem first.

To eventually establish drought-resilience AISs for all Dutch agricultural areas, AISs are ideally developed efficiently. A literature-based approach to indicators formulation requires less effort, but a participatory approach probably results in more useful indicators, which is then reflected in their validity, convenience and perceived legitimacy. Whether a literature-based or a participatory approach to the indicator formulation is most useful is unknown. I also addressed this problem.

I aimed to assess which capital domains and GRPs affect drought resilience most and how this is perceived by stakeholders by developing drought-resilience AIS. Additionally, I aimed to determine the differences in usability between a participatory and a literature-based approach by analysing the drought-resilience AIS's development.

My research was conducted at the Doesburger Eng, a Dutch drought-affected agricultural area. I combined a systematic literature review and participatory fuzzy cognitive mapping to formulate potential drought-resilience attributes indicators. These attributes and indicators were categorized as capital domains and GRP. The participating stakeholders (i.e. agricultural land users, policy officers and independent experts) assigned scores to attributes. This determined which attributes influence drought-resilience at the Doesburger Eng.

Over 200 drought-resilience attributes and 400 drought-resilience indicators were identified. 31 attributes and 33 related indicators were selected for the first Dutch drought-resilience AIS. These attributes and indicators relate to soil, irrigation, cooperation, attitudes, local knowledge and governmental support.

I statistically analysed the number of drought-resilience attributes in each category and the attributes' scores to determine the relative importance of each capital domain and GRP. Additionally, I analysed the scores to detect differences between the stakeholder groups. The results are relevant for the Doesburger Eng, and probably also for similar Dutch agricultural areas. However, further comparative research has to confirm this.

The natural and institutional domain were the most important, the social capital domain the least important. Consciousness and reserves were the most important GRPs. Although not fully

conclusive, diversity was the least important. Consciousness is ignored by some studies that apply GRPs. This is remarkable given its perceived importance.

My results support the hypothesis that not all capital domains and GRPs are equally important for drought resilience. Policy officers and land users did not differ significantly in their appreciation of the different categories, whereas these stakeholders appreciated social, economic and reserves attributes more than the experts.

I statistically compared the validity and convenience of the indicator formulation results, while I compared the legitimacy by an additional choice-experiment. The participatory approach was better than the literature-based approach for validity, but not for the convenience and legitimacy. One other study found the opposite for validity and convenience. That study aimed to formulate convenient indicators, while my study aimed to formulate valid indicators. So, depending on the goal, a participatory approach potentially creates more valid or more convenient indicators.

My research started to unravel drought resilience in The Netherlands. The findings give directions for research to further unravel drought resilience in The Netherlands and beyond. Moreover, my findings can likely assist Doesburger Eng practitioners, and probably also Dutch practitioners to effectively strengthen drought resilience.

1. Introduction

Drought is 'an exceptional lack of water compared to normal conditions' (van Loon et al., 2016). It is the natural hazard that causes globally most damage (Lesk et al., 2016; Mishra & Singh, 2010; Wilhite, 2000). Especially the agricultural sector is heavily impacted by drought (Lesk et al., 2016; Prins et al., 2018). The Netherlands do not frequently experience severe droughts (Prins et al., 2018). However, the most recent years (2018, 2019 and 2020) have been remarkably dry, resulting in water use restrictions (Huibers, 2020) and reduced yields (Everts, 2020). Future drought damage to the Dutch agricultural sector is foreseen and is likely to be aggravated by climate change (Polman et al., 2019).

Individuals, groups and whole sectors involved in agriculture attempt to become drought resilient to limit the damage from droughts (e.g. Rey et al., 2017). Drawing on the general resilience literature, I define drought resilience as *the capacity of a system to undergo drought and reorganize to undesirable changes, while maintaining its (desirable) functions* (Cutter et al., 2008; Folke et al., 2010; Gunderson & Holling, 2001; Simonovic & Arunkumar, 2016). I underlined two key parts of the definition that link to two dimensions of drought resilience: persistence and adaptability. Persistence is a systems' ability to undergo and cope with the disaster when it occurs (Folke et al., 2010). Adaptability is a systems' ability to adapt and reorganize to any change that will magnify the effects of a disaster, in this case drought (Folke et al., 2010). A system can take the form of a geographical area or a network (Carpenter et al., 2001; Rey et al., 2017; Tortajada et al., 2018). The more drought resilient a system is, the less it is affected by drought in the short (persistence) and long term (adaptability) (Tortajada et al., 2018).

1.1 Societal Problem: Application of the Drought Resilience concept in Practice

The resilience concept is regularly used in policy and research (De Bruin et al., 2017; Folke et al., 2010), because it captures both persistence and adaptability. Resilience is a versatile concept and this can be perceived as vague (e.g. De Bruin et al., 2017; Keating and Hanger-Kopp, 2020). Therefore, practical use of the concept requires a proper understanding of what entails and influences drought resilience in specific locations. Knowledge on what entails and influences drought resilience assists people and programs in allocating (often limited) resources to improve drought resilience. Consequently, the agricultural localities with the lowest drought resilience can be targeted. Additionally, within localities the weakest aspects of resilience can be targeted when they are identified. Resilience attributes and indicators can be studied to comprehend drought resilience (Meuwissen et al., 2019).

Resilience attributes are *individual and collective competences and the enabling (or constraining) conditions that enhance [...] resilience* (Meuwissen et al., 2019, p. 5). Farming experience, social cohesion and crop diversity are examples of resilience attributes.

In the environmental sciences, indicators are used for three functions: 1) as a way to measure, study and compare intangible phenomena, 2) as a 'barometer for trends' or 3) as an early warning to change (Kurtz et al., 2001; Moldan et al., 2012; Niemi & McDonald 2004). Resilience indicators express the conditions of resilience attributes, in line with the first function. An example of a resilience indicator is, related to the resilience attribute 'crop diversity', the number of crop species cultivated (Ciftcioglu, 2017).

The attribute and indicator set (AIS) that defines drought resilience in a particular system can be used to analyse resilience or to evaluate or formulate policies and measures. Drought-resilience AISs are different for each system (Carpenter et al., 2001; Meuwissen et al., 2019), depending on its characteristics. Resilience AISs have been established for different systems,

such as landscapes (Vallés-Planells et al., 2020), communities (Khatibi et al., 2019; Singh-Peterson & Underhill, 2017) and farm systems (Meuwissen et al., 2019). Moreover, drought-resilience AISs have been established for various locations, from counties in the US (e.g. Mihunov et al. 2018) to regions in Iran and China (Khatibi et al., 2019; Zhang et al., 2019). In The Netherlands, no drought-resilience AIS has been established thus far.

From a resilience perspective, drought is poorly studied in The Netherlands, despite the increased interest in drought research in recent dry years (STOWA, 2020). The current research efforts focus on the propagation, consequences and handling of drought, taking a meteorological or hydrological starting point (Philip et al., 2020; STOWA, 2020).

1.2 Knowledge Gaps

The lack of clearly defined drought-resilience attributes in The Netherlands is problematic, because it hampers effective strategies to increase drought resilience. Individual practitioners probably have an intuitive idea about relevant resilience attributes in their locality. However, a shared understanding among stakeholders of the relevant resilience attributes' importance is likely to 1) be more accurate (Rowe et al., 1991) and 2) be a strong starting point for decision-making beyond the individual level (Valkenburg, 1998). A 'drought-resilience monitor', which would display the relevant drought-resilience AISs per agricultural area, would help in making targeted improvements.

1.2.1 Resilience Aspects: Capital Domains and Generic Resilience Principles

Unfortunately, developing a drought-resilience AIS is challenging. Therefore, until such drought-resilience monitor exists, a more abstract approach than resilience attributes is needed to understand which aspects affect drought resilience. However, that approach should be more detailed than persistence and adaptability. A capital approach and a generic resilience approach are two distinctive and complementary ways to understand what influences resilience. Different capital domains and general resilience principles (GRPs) influence drought resilience. Capital domains (e.g. the natural or economic domain) refer to the dimensions in which people and communities can have assets (Gutierrez-Montes et al., 2009), whereas GRPs (e.g. diversity or openness) refer to qualities of a system (Meuwissen et al., 2019).

The capital approach is rooted in livelihood research (Bebbington, 1999; Ellis, 2000; Gutierrez-Montes et al,. 2009) and initially described the assets and resources (i.e. capital) that sustain people's livelihoods. Different types of assets are categorized in capital domains, which differ slightly depending on the author and study (c.f. Gutierrez-Montes et al,. 2009 and Cutter et al., 2014). Although the capital domains were initially used to categorize assets, also negative resilience attributes are categorized as capital domain. Cutter et al. (2014) have altered the capital approach to fit the resilience theory. I apply six capital domains: social, physical, institutional, economic and social (Ellis, 2000; Cutter., 2014). Table 1.1 summarizes the specific aspects those capital domains include. I based the descriptions mainly on Cutter et al. (2014). The respective capital domains might refer to slightly different aspects in other disciplines.

A capital domain framework based is commonly applied in resilience studies (e.g. Williges et al., 2017; Zhang et al., 2019). Capital domains are sometimes referred to as resilience types (Cutter et al. 2014), dimensions (Liu et al., 2016) or categories (Mihunov et al., 2018) in resilience studies. Most resilience and drought studies that applied a capital or similar framework have not compared the relative importance of the domains (e.g. Brewton et al., 2010; Miles, 2015; Li et al., 2016; Segnestam, 2009). The only identified study that did compare the relative importance of different capital domains for drought resilience was Jordaan

et al. (2018) in South Africa. Through a survey, they found that environmental (natural) and economic capital domain were perceived as most important.

Table 1.1: Overview of capital domains, adapted from Ellis (2000) and Cutter et al. (2014)

Resilience Dimension	Includes
Social	Social, community and demographic aspects
Physical	Infrastructural aspects and the built environment
Institutional	Governance, organizational, administrational and legal aspects
Economic	Economic, financial, market, and labour aspects
Natural	Agricultural and ecosystem (soil, water, biological) aspects
Human	Health and educational aspects, and individual skills and attitudes

GRPs are an alternative approach to view drought resilience and drought-resilience attributes. The approach distinguishes six types of GRPs: diversity, modularity, openness, tightness of feedbacks, system reserves and consciousness (Table 1.2) (Carpenter et al., 2012; Meuwissen et al., 2019; Resilience Alliance 2010). The Resilience Alliance (2010) and Meuwissen et al. (2019) consider five of these GRPs (all but consciousness). Carpenter et al. (2012) list three additional principles. I merge these principles (monitoring, leadership and trust), because they are relatively narrow resilience principles. I apply the term 'consciousness' to this novel GRP, because the three original GRPs are concerned with being aware of the threat/resilience and actively tackling/enhancing it.

GRPs have been applied in a few studies only. Studies that did apply GRPs to assess resilience have not paid attention to the relative importance of the different attributes (e.g. Nemec et al., 2014; Bouska et al., 2019).

Table 1.2: Overview of generic resilience principles, adapted from Carpenter et al. (2012)

Generic Resilience Principle	Description
Diversity	Existence of differences within system
Modularity	Internal connectivity of a system
Openness	Connectivity between systems
Tightness of feedbacks	Response to signals; speed of adaptation
System reserves	Resource stocks
Consciousness	Awareness and motivation to strengthen resilience. Includes monitoring, leadership and trust

The limited (capital domains) and non-existent (GRPs) evidence on the relative importance of categories forms a knowledge gap regarding drought resilience (in The Netherlands). Stakeholders probably have an intuitive idea about the relative importance of capital domains and GRPs. However, stakeholder groups plausibly disagree about the relative importance, because they hold contradicting views about the application of a resilience approach (Keating & Hanger-Kopp, 2020), and individuals differ in perspective on what influences resilience (Taysom & Crilly, 2017). Whether stakeholder groups differ in perspective on the relative importance of capital domains and GRPs forms another knowledge gap regarding drought resilience.

1.2.2 Attribute and Indicator Set Development

As stated at the end of Section 1.1., a drought-resilience monitor is desirable. Developing a drought-resilience monitor becomes feasible when AISs can be developed efficiently (i.e.

achieving usable results through limited effort). Understanding how to conduct efficient AIS development is therefore meaningful.

Indicator development is well covered in literature (e.g. Lupoli & Morse, 2015; Jónsson et al., 2016). Indicator development encompasses the following general steps. First (1) the topic and context are set. Second, (2) possible indicators are formulated, what results in an initial list of indicators. Then, (3) a selection is made from the initial list. That selection procedure results in a final set of indicators (Figure 1.1).

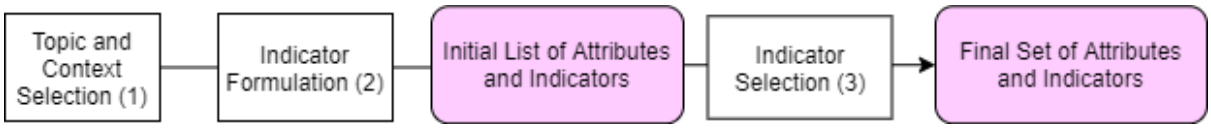


Figure 1.1: A simplified overview of indicator development, with steps (white rectangles) and products (pink. rounded rectangles). Based on Lupoli & Morse (2015); Jónsson et al. (2016) and Khatibi et al. (2019).

During each indicator development phase, a participatory or a literature-based (expert-based) approach can be applied. A literature-based approach requires limited effort (e.g. Brandt et al., 2013; Reed, 2008). Contrastingly, a participatory approach potentially yields more usable outcomes (e.g. Reed, 2008; Reed et al., 2008; Rosenström & Kyllönen, 2007; Wesselink et al., 2011). An outcome (here: an indicator) is useful when it is valid (i.e. it represents the actual situation), when it is convenient (i.e. easy to understand and apply) and when it is legitimate (i.e. accepted as decent by stakeholders) (Table 1.3).

Table 1.3: Overview of the main instrumental arguments (validity, convenience, legitimacy) in literature supporting participatory approaches. Based on Reed (2008), Reed et al. (2008), Wesselink et al. (2011) and Lyytimäki et al. (2018).

Argument type	**Argument**
Validity	Involvement of stakeholders with specific (local) knowledge will lead to outcomes that better reflect local realities.
Convenience	Involvement of users will lead to outcomes that can be applied more easily by more stakeholders
Legitimacy	Involvement of stakeholders will lead to better acceptance of outcomes by stakeholders and consequently to fewer future conflicts about the outcomes.

Despite the required effort, many indicator-development studies have selected indicators through a participatory approach, because its validity, convenience and legitimacy during the indicator selection have been demonstrated to be higher compared to a literature-based approach (e.g. Rosenström & Kyllönen, 2007; Lupoli & Morse, 2015; Jónsson et al., 2016; Lyytimäki et al., 2018). Only Reed et al. (2008) studied the outcomes' validity and convenience from a participatory approach during indicator formulation. They concluded that the participatory approach resulted in indicators that were more convenient and almost as valid as indicators from the literature. They did not study the legitimacy. Moreover, they formulated indicators as 'barometer of change', not to express resilience. Whether a participatory approach to resilience indicator formulation results in more valid, convenient and legitimate outcomes than a literature-based approach, is therefore unknown. This knowledge is crucial when deciding what approach to take during indicator formulation.

1.3 Problem Statement - Research Objectives - Research Questions

The lack of understanding about capital domains' and GRPs' role and relative importance to drought resilience restricts an evidence-based debate on priorities for drought-resilience investments and research in The Netherlands. Additionally, the lack of understanding the

instrumental advantages of a participatory approach over a literature-based approach during indicator formulation, restricts an informed decision on applying either approach.

To tackle these problems, my research objectives are to:

1. Evaluate which capital domains and GRPs are relatively more important in shaping drought resilience, and assess whether stakeholders perceive that relative importance differently; and
2. Evaluate whether a participatory approach is better than a literature-based approach for formulating valid, convenient and legitimate indicators.

These objectives are achieved through the development of a drought-resilience attribute and indicator set (AIS) for a specific agricultural area. The AIS development allows me to address the knowledge gaps simultaneously. The content (i.e. the outcomes of the indicator development) is analysed to target the first research objective. The process (i.e. the indicator development) is analysed to target the second research. Moreover, the AIS itself directly contributes to understand drought resilience in detail in that specific agricultural area.

Additionally, I aim to make recommendations based on my research findings to 1) drought-resilience practitioners and scholars regarding their general focus; 2) persons involved in indicator development regarding indicator formulation and 3) land users of the specific agricultural area regarding drought resilience.

The following two main research questions (RQs) and related sub research questions are addressed to realize the research objectives:

1. Which 'capital domains' and 'generic resilience principles' affect drought resilience relatively most in The Netherlands, and do land users, policy officers and experts agree about the relative effect?
    a) Which attributes, expressed through which indicators, can affect drought resilience?
    b) Which attributes, expressed through which indicators, affect drought resilience at a specific Dutch agricultural area?
    c) Drought-resilience attributes and indicators from which 'capital domains' and 'generic resilience principles' are the most frequently mentioned in literature and the most frequently mentioned and highest rated by land users, policy officers and experts?
    d) Drought-resilience attributes from which 'capital domains' and 'generic resilience principles' were differently scored by land users, policy officers and experts?

2. To what extent does a participatory approach to indicator formulation produce more usable outcomes than a literature-based approach, focusing on (a) validity, (b) convenience and (c) legitimacy?

1.4 Outline

The report consists of seven chapters. **Chapter 2** presents the methodology. The chapter starts with a description of the study area and stakeholders (2.1). The second section presents the stepwise methodological approach to all RQs (2.2). This stepwise approach is roughly divided in two parts, one for each main RQ. To improve readability, I do not present the results of both parts, and then discuss the results of both parts. Instead, I first present and discuss the results of the first part (related to RQ1), and then present and discuss the results of the second part (related to RQ2). As a consequence, **Chapter 3** includes the results related to RQ1: attributes

and indicators that can affect drought resilience, the drought-resilience attributes and indicator of the specific agricultural area, the relative importance of the capital domains and GRPs and the differences between the stakeholder groups. **Chapter 4** discusses the results related to RQ1. This chapter discusses the relevance of the results beyond the case study and pinpoints the uncertainties in the results. Furthermore, I show that the results mainly confirm other studies but also give novel insights. **Chapter 5** includes the results related to RQ2: the validity, convenience and legitimacy of the participatory approach compared to the literature-based approach. **Chapter 6** discusses the results related to RQ2. I show how the results seemingly conflict with other studies but instead refine our understanding about participatory research. Finally, **Chapter 7** synthesizes the thesis. I conclude here which capital domains and GRPs are most important, and to what extent a participatory approach is more useful than a literature-based approach (5.1). I finish by recommending practitioners and experts based on the conclusions (5.2)

2. Methodology

I designed a research methodology to answer the research questions that were introduced in the previous chapter. Before I specify this methodology, the study area (Doesburger Eng) and the relevant stakeholders are described.

2.1 Study Area and Stakeholders

The specific agricultural area that was selected as case study was The Doesburger Eng. The Doesburger Eng is a distinct rural locality in the centre of The Netherlands. It is located within the municipality of Ede, directly north of the town of Ede (Figure 2.1).

The recent droughts affected agriculture in this locality. Some of the parcels only produced half of their regular yield in the dry years of 2018 and 2019 (land user, personal communication, 13-07-2020). Agriculture has multiple functions at the Doesburger Eng. Besides generating income and producing food, the agriculture characterizes the locality and supports culture-historical values (SGV, 2006). Local land users, inhabitants, visitors and policy officers therefore perceive it desirable to sustain agriculture at the Doesburger Eng (SGV, 2006).

The drought issues and local desire to sustain agriculture make the Doesburger Eng a relevant case to study drought resilience. Moreover, the variety in agricultural practices makes the stakeholders representative for many Dutch agricultural areas, while also the area itself resembles many of the Dutch agricultural areas that are affected by drought. In addition, the relatively easy access I had to the area made it also a practical case to study.

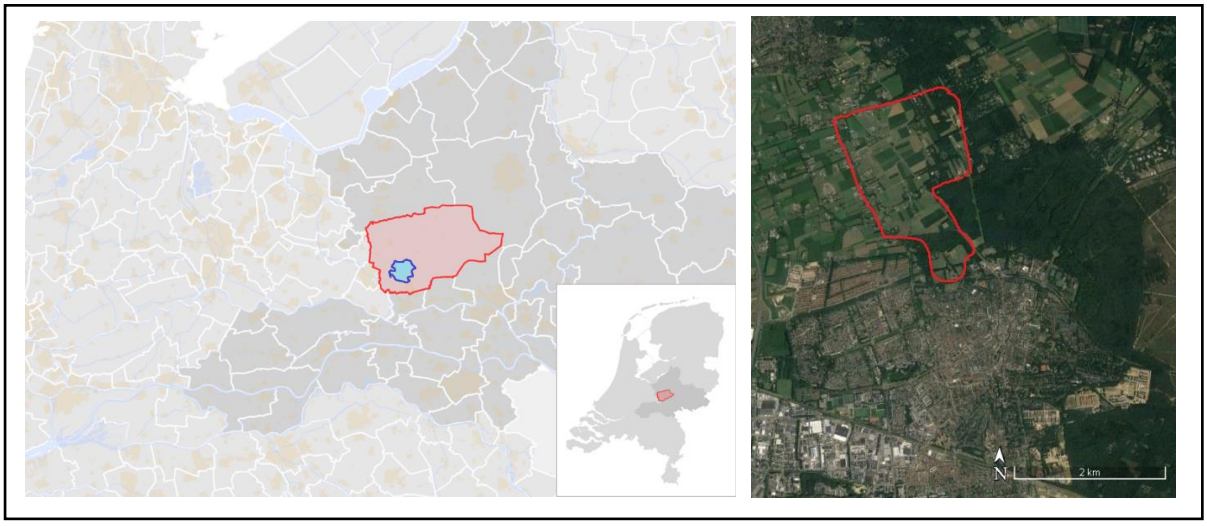


Figure 2.1: Left: Location of the municipality (red) and town (blue) of Ede within The Netherlands (adapted from Topografisch DK). Right: Location of the Doesburger Eng, north of the town of Ede (adapted from Google Earth).

2.1.1 Study Area Characteristics

A variety of agricultural activities is undertaken in the area. Meadows support the rearing of livestock (cattle, sheep), rye, maize and potatoes are produced and the area features tree nurseries. The open character, vision lines with historical buildings and surrounding forest are highly valued by inhabitants and visitors (SGV, 2006). The Doesburger Eng is located on the edge of the Veluwe, a sandy nature area on top of the largest strategic groundwater reserve in The Netherlands (De Louw & Mens, 2020). The Doesburger Eng is part of a transition area between the dry sandy soils of the Veluwe and the peat soils of the Gelderse Vallei. Its soils are sandy, but the groundwater table is relatively shallow (land user, personal communication, 13-07-2020). The drainage capacity of the soils and the relatively easy access to groundwater via wells makes it a suitable area for agriculture, explaining the long history of agriculture in

the area. The water that infiltrates here recharges groundwater from which water is withdrawn for domestic purposes (Prov. Gelderland, 2020).

Precipitation in the area, as measured by the nearest weather station (at 15 km distance), is well-distributed throughout the year and the annual surplus is approximately 300 mm. However, evapotranspiration is several factors higher around summer, resulting in a precipitation deficit from April to August (KNMI, 2020). Long dry periods can cause agricultural droughts (i.e. soil moisture deficits (Mishra & Singh, 2010)) in the area. Agricultural droughts at the Doesburger Eng can be mitigated through irrigation. Surface water cannot be transferred to the area, so agriculture depends on the groundwater for irrigation. Only a small portion of the agricultural firms has currently irrigation equipment installed (land user, personal communication, 13-07-2020).

2.1.2 Stakeholders

Land users, policy officers and independent experts were identified as relevant stakeholder groups. Land users and policy officers have most influence and interest in drought-resilience improvements, given their cultivation of and dependence on the land (land users) and their organizational power and responsibilities (policy officers). Experts have special interest with regard to the research agenda on drought resilience. Moreover, concerning the indicator development, these stakeholder groups are perceived as most knowledgeable (e.g. Jónsson et al., 2016). Similar stakeholder groups are commonly involved in indicator development studies (e.g. Lupoli & Morse, 2015; Jónsson et al., 2016; Lyttimäki et al., 2018). In the next paragraphs, I identify the individuals and groups that are part of these stakeholder groups at the Doesburger Eng. Table 2.1 gives an overview of all groups.

The land users include the farmers that actively manage and cultivate the land they own or lease at the Doesburger Eng. Some of the land users are affiliated to the local organization Stichting Buurtschap Doesburger Eng (SBDE). This foundation has as mission to 'stimulate and conserve the landscape and culture-historical values of the Doesburger Eng'[1]

Policy officers include the individuals that are involved in drought policy and employed by relevant governmental or agricultural organizations. Relevant governmental organizations are the local and regional layers of government under which jurisdiction the Doesburger Eng falls: the municipality of Ede, water authority 'Vallei and Veluwe' and the province of Gelderland. Relevant agricultural organizations are involved in combatting drought in or near the Doesburger Eng: Land and Tuinbouw Organisatie (LTO) and Collectief Veluwe.

The independent experts, hereafter referred to as experts, include the individuals involved in drought and/or resilience research or assessments. Experts employed at Dutch universities, research institutes or consultancies are considered relevant.

Table 2.1: overview of participating stakeholder groups

Stakeholder Group	Description
Land users	Doesburger Eng land users and landowners who are actively involved in the management of their land
Policy officers	Policy officers involved with drought and/or resilience working at governmental or agricultural organization at the same local or regional level as the Doesburger Eng.
Experts	Independent experts on drought and/or resilience working at Dutch universities, knowledge institutes or as consultant

[1] https://www.doesburgerbuurt.nl/Over-SBDE/

2.2 Methods

I addressed the two research questions (RQs) in separate parts. The sub RQs (Section 1.3) were each addressed in a research step (Figure 2.2).

During the first steps that address RQ1, a drought-resilience attribute and indicator set (AIS) was developed. During the indicator formulation (1A), attributes and indicators that can affect drought resilience were formulated through a literature-based approach and a participatory approach. During the indicator selection (1B), a final drought-resilience AIS was composed for the Doesburger Eng based on scores assigned to resilience attributes in a survey.

During the next steps related to RQ1, I quantitatively analysed the outcomes of the previous steps (1A and 1B). The intermediate and final outcomes were used to analyse the relative importance of capital domains and generic resilience principles (GRPs) (1C). The assigned scores were analysed to establish the differences between the stakeholder groups' perception about the capital domains' and GRPs' relative importance (1D).

During research part related to RQ2, I compared the instrumental qualities of the literature-based and participatory approach in the indicator formulation. The validity (2A), convenience (2B) and legitimacy (2C) were compared based on the outcomes of the indicator formulation.

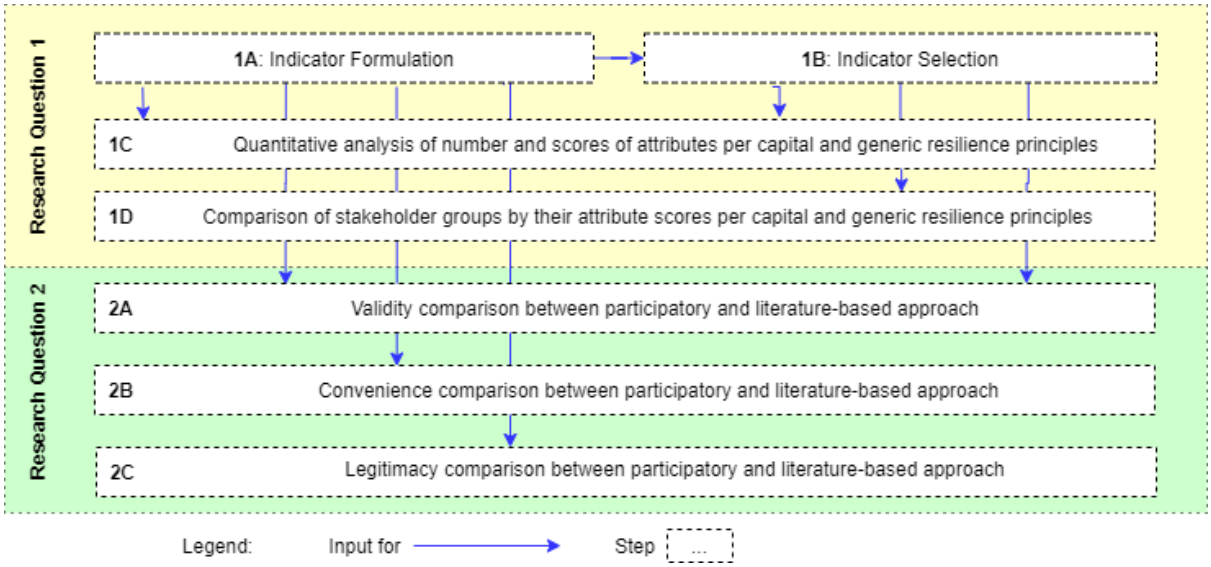


Figure 2.2: Overview of the research. The sub research questions (1a-d and 2a-c) were addressed stepwise (1A-D and 2A-C, respectively).

2.2.1 Indicator Formulation (1A)

The indicator formulation aimed to identify the attributes that can affect drought resilience and to identify the indicators through which those attributes can be measured. Whether a participatory approach or literature-based approach is more usable, is unknown (Section 1.2). I therefore combined a literature-based and a participatory approach to identify as many as possible relevant attributes and indicators. Moreover, these approaches were applied in parallel to be able to compare them in relation to RQ2.

A Systematic Literature Review (SLR) was used as literature-based method, while Fuzzy Cognitive Mapping (FCM) was applied as a participatory method. All relevant attributes and indicators were compiled in two initial indicator lists. Figure 2.3. presents an overview of the indicator formulation.

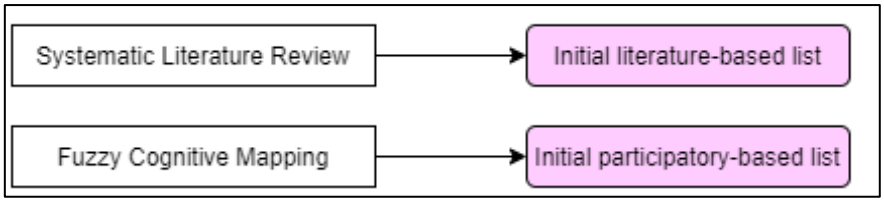


Figure 2.3: Overview of the steps (white rectangles) and outcomes (purple, rounded rectangles) of the indicator formulation (1A)

Systematic Literature Review

Scientific publications discussing drought-resilience indicators had to be recovered. A systematic literature review (SLR) ensures a replicable and transparent procedure to reveal relevant publications (Mengist et al., 2020). An SLR consists of a search, appraisal, synthesis, and analysis (Grant & Booth, 2009). Since I did not do a full literature review but applied the method to identify indicators, only the search and appraisal steps were followed.

The search step requires decisions on the information sources, databases, search queries and additional search methods (Moher et al., 2009; Mengist et al., 2020). Table 2.2 presents the choices made regarding those four aspects. Concerning the search queries, *drought* was used to find drought-resilience indicators for agriculture from the local to the regional levels, whereas *farm* was used to cover the farm level indicators. Although adaptability is a resilience dimension, some studies ignore adaptability as resilience dimension (Meuwissen et al., 2019), while other studies addressed it in isolation (e.g. Ripoll-Bosch et al., 2012). Accordingly, *adaptability* was used in parallel to *resilience.* The snowball sampling technique was used to recover additional relevant publications through the reference lists of publications that were identified using the search queries. The number of publications recovered through snowball sampling can be substantial (Papaioannou et al., 2010).

Table 2.2: overview of the selected search requirements

Search requirements	**Selected**
Information sources	Peer-reviewed publications
Databases	Scopus
Search queries	1. Drought + Resilience + Indicators 2. Drought + Adaptability + Indicators 3. Farm + Resilience + Indicators 4. Farm + Adaptability + Indicators
Additional search method	Snowball sampling

The appraisal step entails the evaluation and selection of the articles retrieved by the search (Mengist et al., 2020). Articles that because of their title and abstract seemed to contain drought-resilience indicators were included in the first selection. Articles were found to be eligible for the final selection when they contained relevant drought-resilience attributes and/or indicators.

Fuzzy Cognitive Mapping

Stakeholder participation in the form of consultation (Arnstein, 1969) was needed to identify drought-resilience indicators. Fuzzy cognitive mapping (FCM) was applied as a participatory method, because it elicits the participants' knowledge in a structured manner (Gray et al., 2015). In comparison to a survey with open questions, FCM allows for further explanation if ambiguities arise, and stimulation if participants find it hard to formulate answers. Finally, FCM facilitates transparent (pre)selection, because participants rate their answers quantitatively by importance.

FCM is the process of creating a web of terms depicting (causal) relations and assigning a weight to the importance of those relations. Such a web is called a fuzzy cognitive map. FCM, developed in the last decades (Axelrod, 1976; Kosko, 1986; Özesmi & Özesmi, 2004), has been applied in agricultural contexts (Fairweather, 2010; Vanwindekens et al., 2013) and resilience studies (Giordano et al., 2013; Gray et al., 2015; Tepes & Neumann, 2020). Although initially developed for modelling purposes, it has been successfully applied during indicator development (Giordano et al., 2013; Mendoza & Prabhu, 2003).

Potential participants were selected from each stakeholder group (land users, policy officers and experts) through snowball-sampling until saturation. Participants were asked to refer to other potential participants, until no new names were given. The first potential participants were selected with the aid of contacts at the *SBDE*, *Gemeente Ede*, *Provincie Gelderland* and the *Lumbricus project*[2] and a Dutch drought risk study (van der Vat et al., 2016).

Participants were asked to create the fuzzy cognitive map by writing the attributes and indicators that influence the drought adaptability on a prepared sheet (Figure 2.4). The FCM was conducted in four stages. First, the participants were given background information about the study, research terms and, if not familiar with it, the Doesburger Eng. Second, participants were asked to write down attributes influencing drought adaptability. I probed the participants to think and formulate attributes, without hinting at specific attributes. Third, they were asked to assign a number between 0 and 1 (between -1 and 0 in the case of a negative relation) to each attribute. The number represents the strength of the relation. Fourth, for each attribute they were asked to suggest a minimum of one indicator. Annex 1.1 contains a transcribed version of the instructions (in Dutch).

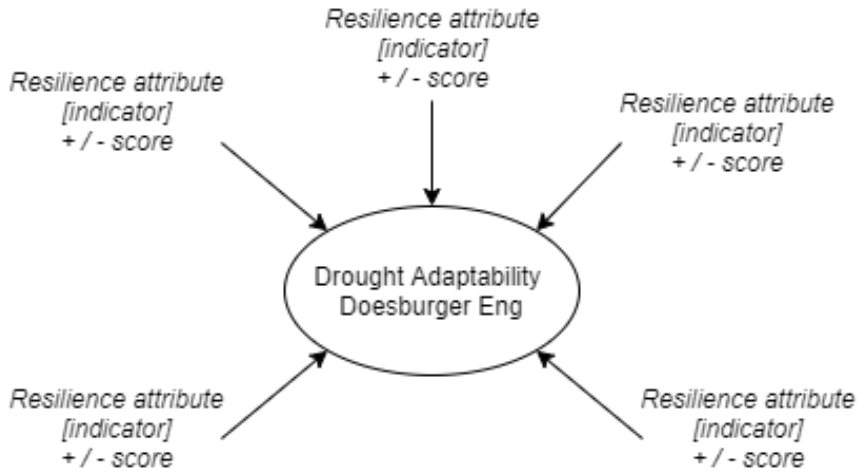


Figure 2.4: empty fuzzy cognitive map

The interviews with the land users were held in person. The interviews with the policy officers and experts were held digitally, making use of the online drawing platform *Miro*. All interviews were held in Dutch. The attributes and indicators were translated into English for this report.

Categorization

Two lists of drought-resilience attributes and indicators were created following the two methods (Figure 2.3). On each list, identical and similar attributes and indicators were merged. The remaining attributes and indicators were categorized according capital domain (Table 1.1)

[2] https://www.programmalumbricus.nl/

and GRP (Table 1.2). For example, crop diversity fitted in the natural domain and the diversity category. The approaches are both applied, because combined the capital domains and GRPs present a more complete picture about (drought) resilience than separately (Ifejika Speranza et al., 2014).

Studies that categorized resilience attributes and indicators according to capital domain (e.g. Zhang et al., 2019) and GRP (Meuwissen et al., 2019) were followed when possible. Attributes and indicators that were not categorized by another study were put in the most appropriate category based on expert judgement.

2.2.2: Indicator Selection (1B)

After the drought-resilience attributes and indicators were formulated (1A), a selection was made (Figure 2.2). The indicator selection aimed to identify the drought-resilience attributes at the Doesburger Eng and to identify the indicators that best reflect those attributes. A participatory approach was applied for instrumental reasons (Section 1.2). The indicator selection process loosely followed the conventional Delphi method as reviewed by Rowe et al. (1991) and applied in indicator development by Jónsson et al. (2016). The Delphi method was perceived adequate, because it supports 1) the integration of experts in different fields; 2) the involvement of experts at distance; 3) iteration; and 4) statistical aggregation of group results (Rowe et al., 1991; Jónsson et al., 2016).

A survey list with preselected attributes and indicators was created first. Next, participants were asked in a survey to assign scores on a 5-point scale to the attributes on the survey list. Using two different methods, a selection was made to form the final list. A robustness analysis was performed to test the robustness of the outcomes. These steps are captured in Figure 2.5.

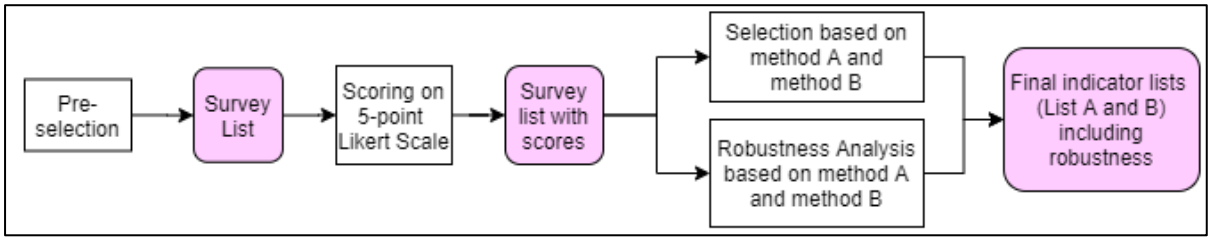


Figure 2.5: Overview of the steps (white rectangles) and outcomes (purple, rounded rectangles) of the indicator selection (1B)

Preselection

The preselection aimed to create a survey list that only featured the relevant attributes and indicators. A shorter, less time-consuming survey list was expected to yield more accurate results (Galesic & Bosnjak, 2009). From the participatory list, I included on the survey list those attributes that were signalled on the fuzzy cognitive maps as ‘relevant’ (higher than 0.5) by one individual or as ‘somewhat relevant’ by multiple individuals (resulting in a sum higher than 0.5). From the literature list, the drought-resilience indicators that did not fit the context of the Doesburger Eng were taken out. The attributes listed by more than one reference were added to the survey list.

Scoring

The scoring aimed to create a basis for distinguishing the drought-resilience attributes at the Doesburger Eng. A five-point Likert scale was used (Table 2.3) in line with Jónsson et al. (2016). That method was applied because it is easy to understand and allows for quantitative analysis. Furthermore, it allows participants to assign any score as frequently as they find

appropriate. This is crucial because the number of relevant drought-resilience attributes was not known beforehand.

The survey was distributed among the participants of the FCM and among relevant stakeholders that for practical reasons did not participate in the FCM. Survey participants were asked to assign to each attribute a score on a five-point Likert scale (Table 2.3). Certain attributes in the survey list were expressed by multiple indicators. The survey participants were asked to select the most relevant (one or more) from those indicators. The participants were allowed to skip any attribute or indicator if they felt uncertain. Whether the attributes and indicators were formulated during the FCM or SLR was not mentioned. The explanation that was given to the participants is included in Annex 1.2.

Table 2.3: The meaning of the assigned scores on the Likert scale.

Score	Meaning	
1	Not relevant:	this attribute should not be on the final list
2	Hardly relevant:	this attribute does not fit on the final list
3	Neutral:	this attribute could be on the final list
4	Quite relevant:	this attribute fits well on the final list
5	Extremely relevant:	this attribute must be part of the final list

Selection

The final list was created based on the scores. Jónsson et al. (2016) selected indicators on the basis of means, but the applicability of the mean in case of a Likert-scale is contested, as these scores are ordinal (Jamieson, 2004). I therefore applied two different selection methods (A and B), resulting in two final lists. I applied two methods, because it increases the robustness, and the literature specifies no best option when making a selection based on Likert scores.

The first condition (A) to be included in the final list was: an attribute should be considered as extremely or quite relevant (a 5 or 4 on the Likert scale) by at least half of the participants. The second condition (B) to be included in the final list was: an attribute should be considered on aggregate more relevant than neutral. In both cases, all participants were given equal weight.

The first condition is met when the median is 4 or higher. This was tested by calculating the median. The second condition is met when the distribution is shifted to right from 3. The distribution shift was tested by using a Wilcoxon rank sum test.

To perform a statistical test, a null hypothesis and an alternative hypothesis must be formulated. A researcher attempts to disprove the null hypothesis, which states that no relation exists between considered phenomena. A researcher attempts to prove the alternative hypothesis, which describes a relation between the considered phenomena. In this case, the null hypothesis was that an attribute does not influence (has no relation to) drought resilience. This is true if the distribution is around 3. The alternative hypothesis was that an attribute influences drought resilience. This is true if the distribution is shifted to the right from 3. A p-value of 0.05 was set as limit. RStudio software version 3.6.2 was used to perform this test. A p-value of 0.05 and RStudio software were applied in all other statistical tests described in the remainder, unless specified otherwise.

Robustness Analysis

A robustness analysis was applied to test the robustness of attributes on the final list. The robustness analysis copes with some of the uncertainty created by the methodological choices. To generate the final lists, all participants were given an equal weight. Assigning equal weights is common, but not the only option nor giving the best results per se (e.g. Bao et al., 2013). In

addition, using a solid demarcation line as condition (as here: median is 4 or larger; distribution is shifted right) does not give information on whether an attribute barely or easily fulfilled that condition.

To overcome these issues, a robustness analysis using bootstrap sampling was performed. During bootstrap sampling, one resamples with replacement from the original sample (Efron & Tibshirani, 1988), thereby creating a new sample. Bootstrap sampling is adequate as a method for a sensitivity or robustness analysis, even though it is not frequently applied (Morrison & Balcombe, 2002). The resampling is a way to test many different weightings, while it provides information on whether an attribute barely or easily made it to the final list. Thousand samples were taken from the 15 participants. For each sample, the selection methods (A and B) were applied to create a list of drought-resilience attributes at the Doesburger Eng. Subsequently, the presence for each attribute on those lists was calculated as a percentage. These percentages reflect the robustness of each attribute.

2.2.3 Quantitative Analysis of the Categories (1C)

In the next step (Figure 2.2), the results of the indicator formulation (1A) and selection (1B) were analysed to address the relative influence of capital domains and GRPs. I assessed the importance of the capital domains and GRPs through the resilience attributes because it lays the implicit preferences bare. Implicit preferences are often found to be more accurate than explicitly stated preferences (e.g. Lee & Kim, 2013). Moreover, this approach allows to analyse the literature as well.

As a starting point, I assumed that the categories' occurrence (number of attributes) and appraisal (attributes' scores) indicate the importance of their influence. Studies analysing drought resilience use (often implicitly) either occurrence or appraisal to assign relative importance to categories. When equal weights are assigned to all resilience attributes (e.g. Tambo & Wünscher, 2017), the number of attributes in a category is consequently equivalent to the category's importance. When weights are assigned per category (e.g. Jordaan et al., 2018), the scores given to those weights represent the category's importance.

I statistically compared the number of attributes in each category from the initial lists (1A), survey list (1B) and final lists (1B). In addition, I statistically compared the assigned scores to the attributes in each category. Figure 2.6 shows these steps.

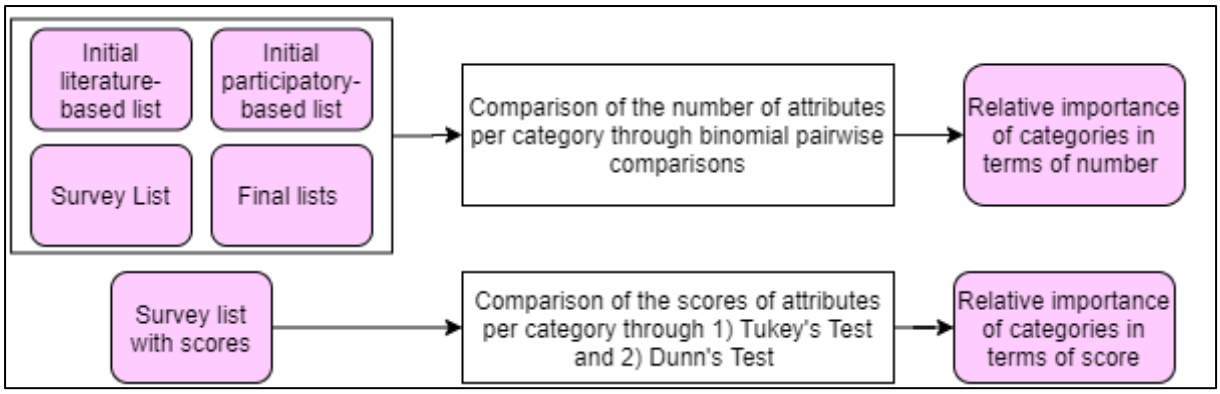


Figure 2.6 Overview of the quantitative analysis of the number and scores of attributes per CD and GRP (1C). It includes the steps (white rectangles) and the outcomes (purple, rounded rectangles). The outcomes from the left are were generated during step 1A and 1B.

From each attribute and indicator list developed in the previous steps, the numbers of attributes per category were compared using a pairwise binomial comparison, following a multinomial

test. The Holm correction, a modified Bonferroni correction, was applied, since it is less conservative than the unmodified correction, but equally valid (Olejnik et al., 1997). The null hypothesis (p. 18) was that the number of attributes in each category is equal, while the alternative hypothesis (p. 18) was that the number of attributes between categories differs.

All scores assigned to the attributes in each category, were compared using Tukey's Test and Dunn's Test with a Holm correction. The Tukey's Test, which follows linear regression, could probably be applied to ordinal data (Agresti & Finlay, 1997, p.162) but this is contested. Dunn's Test was applied additionally, because it is an undisputed method to use on ordinal data (Ruxton & Beauchamp, 2008), but it is more conservative than Tukey's Test. Dunn's Test is a pairwise comparison following a Kruskal-Wallis Test. The null hypothesis was that the scores of attributes in each category are equal to each of the scores for the other category, while the alternative hypothesis was that a difference exists.

2.2.4 Quantitative Analysis of the Stakeholder Group Perceptions (1D)

After comparing the relative importance of the various capital domains and GRPs (1C), I compared the perspectives of the land users, policy officers and experts (Figure 2.2). To make this comparison, I statistically analysed the scores the land users, policy officers and experts assigned to the attributes in each category (Figure 2.7).

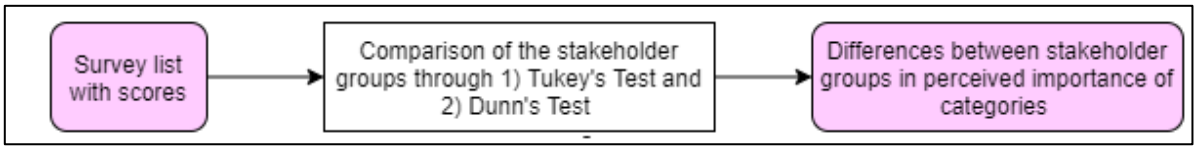


Figure 2.7 Overview of the comparison of the stakeholder groups by their scoring of the CDs and GRPs (1D). It includes the step (white rectangle) and the outcomes (purple, rounded rectangles) that were used and generated.

Conform the previous section, the scores assigned to the attributes in each category by the three groups separately, were compared using Tukey's Test and Dunn's Test with a Holm correction. The null hypothesis was that the scores of attributes awarded by one stakeholder group were equal to the other stakeholder group for each category, while the alternative hypothesis was that a difference exists.

2.2.5 Comparison of Validity (2A)

After having completed the first part of the research, I compared the usefulness of the indicator formulation outcomes, starting with the validity (Figure 2.2). The validity comparison aimed to determine whether a participatory approach produces more valid outcomes than a literature-based approach during indicator formulation. Indicator formulation outcomes are valid when they represent the actual situation (Table 1.3). The assumption was made that the final lists of attributes (outcomes of 1B) are the best representation of the actual situation. The survey list and final lists were used to establish the success rates (i.e. the probability of an indicator on the survey list being included on the final list) of the participatory-based and literature-based indicators. The survey list was used instead of the initial lists because only attributes from the survey list could make it to the final list. After establishing the success rates, these were compared to find the relative validity of the participatory approach versus the literature-based approach (Figure 2.8).

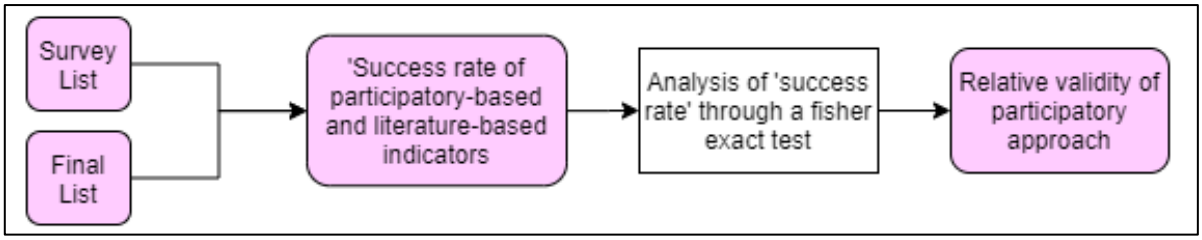


Figure 2.8. Overview of validity comparison (2A). It includes the step (white rectangle) and the outcomes (purple, rounded rectangles) that were used and generated.

The percentages of literature-based and participatory indicators in the final list relative to the survey list were compared using a Fisher exact test. The null hypothesis was that the percentages were similar, while the alternative hypothesis was that the percentage of participatory attributes on the final list was higher.

2.2.6 Comparison of Convenience (2B)

The convenience comparison was the second step of the second part of the research (Figure 2.2). The convenience comparison aimed to determine whether a participatory approach produces more convenient outcomes than a literature-based approach during indicator formulation. Indicator formulation outcomes are convenient when they are easily applied by any stakeholder. I used the data availability as proxy for convenience, since the easier it is to find the value of an indicator, the easier it is to apply that indicator. After the indicators on the survey list were rated based on data availability, these ratings were compared to find the relative convenience of the outcomes of a participatory approach versus a literature-based approach (Figure 2.9).

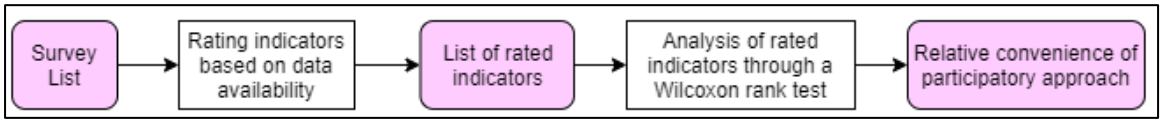


Figure 2.9 Overview of the convenience comparison (2B). It includes the steps (white rectangles) and the outcomes (purple, rounded rectangles) that were used and generated.

Each indicator on the survey list was ordinally rated in the following four categories: 1) directly available; 2) fragmentary available; 3) not available, requires medium effort; and 4) not available, requires high effort (Table 2.4). A Wilcoxon rank sum was employed to compare the indicators formulated through the FCM and SLR. The null hypothesis was that no difference exists, while the alternative hypothesis was that data concerning the participatory-based indicators was better available.

Table 2.4: The meaning of the assigned rates in relation to the data availability of indicators

Rate	**Data is …**
1	Directly and publicly available from desk
2	Available, yet fragmented and/or not publicly.
3	Not available, requires medium effort (survey, low-cost experiments)
4	Not available, requires high effort (long term observation, costly experiments)

2.2.7 Comparison of Legitimacy (2C)

The legitimacy comparison was the third and final step of the second part of the research (Figure 2.2). The legitimacy comparison aimed to determine whether a participatory approach produces outcomes perceived as more legitimate than a literature-based approach during indicator formulation. The legitimacy is the acceptance by stakeholders and has a subjective

nature. To overcome bias, the legitimacy was tested through a discrete choice experiment (DCE). A DCE has been used to elicit preferences in a variety of disciplines by presenting participants choice-sets (e.g. Ryan & Farrar, 2000). The DCE was conducted along the survey. The results of the DCE were analysed to find the relative legitimacy of the outcomes of a participatory approach versus a literature-based approach (Figure 2.10)

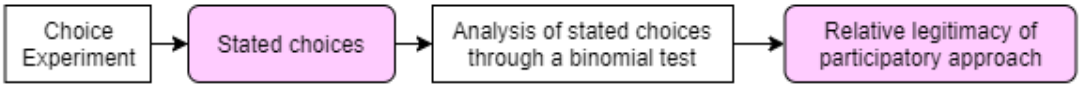


Figure 2.10. Overview of the validity comparison (2C). It includes the steps (white rectangle) and the outcomes (purple, rounded rectangles).

I assumed for the DCE setup that if participants have to choose the most valid set of attributes, they will select the more legitimate option when no obvious reason exists for a difference in validity (Box 2.1). In the DCE, participants had to choose between two choice-sets with six resilience attributes, one from each capital domain. All attributes were taken from literature. However, they were either labelled as a literature-based or a participatory attribute to fit the purpose of the DCE. The choice-sets were designed to be similar, with the number of literature-based and participatory attributes as main difference. The participants were given six such choices. I explained the procedure and asked participants to choose the more convincing and legitimate option. The choice-sets and explanation can be found in Annex 1.3, Table 2.5 displays one choice-set as illustration.

Box 2.1: Legitimacy Example

A simple example to explain the assumption: as a decently informed person, no immediate reason exists to think an apple is healthier than a pear. A choice for either seems equally valid, so when posing this choice to multiple people, the outcome is expected to be more or less similar. However, advise about health from a doctor will probably be perceived more legitimate than from a lawyer. So, if the doctor endorses the apple and the lawyer the pear, we can assume that a majority will choose the apple when asked to choose between an apple and a pear.

The stated choices had to be analysed using either a binomial or quasibinomial test, depending on the dispersion parameter of the results. The dispersion parameter is a measure of independence and when it is below 1.0 a binomial test can be used. If participatory-based attributes were seen as more legitimate, the choice-set with more participatory-based attributes was selected most. Therefore, the null hypothesis is that choice-sets with more participatory-based attributes were selected as often as choice-sets with more literature-based attributes. The alternative hypothesis was that choice-sets with more participatory-based attributes were selected more often.

Table 2.5 One of the six choice-sets given to the participants. They were asked to select the set that best represented drought resilience. whether an attribute was literature-based (lit) or interview-based (int) is indicated.

Choice A1	Choice B1
- Total Nitrate and Total Phosphate (lit)	- Total mass of Micro-organisms in the soil (lit)
- Willingness to learn (int)	- Willingness to adapt (int)
- Income inequality (lit)	- Median household income (int)
- Net migration (lit)	- Age of land user (int)
- Quality of buildings (lit)	- Amount of buildings (int)
- Financial situation local government (lit)	- Public awareness campaigns (lit)

3. Results related to Research Question 1

This chapter presents the results of the first part of the research. The structure of the chapter follows the structure of the first part of Section 2.2 (Figure 2.2).

3.1 Results of the Indicator Formulation (1A)

Outcomes Systematic Literature Review

The number of articles recovered and reviewed through the SLR are listed in Table 3.1. Out of 388 articles, 28 appeared to be relevant on the basis of their title and abstract. 9 additional articles were identified through references in those 28 articles and were included in the first selection. Out of the 37 articles in the first selection, the following 17 articles were selected:

- Cutter et al., (2008)
- Benegas et al., (2009)
- Simelton et al., (2009)
- Sherrieb et al., (2010)
- Habiba et al., (2011)
- Ripoll-Bosch et al., (2012)
- Mutabazi et al., (2015)
- Brown et al., (2016)
- Ciftcioglu (2017)
- Tambo et al., (2017)
- Williges et al., (2017)
- Mihunov et al., (2018)
- Panpakdee et al., (2018)
- Bizikova et al., (2019)
- Khatibi et al., (2019)
- Liu et al., (2019)
- Zhang et al., (2019)

The other 20 articles did not make the final selection. These 20 articles and the respective reason for not being included in the final selection can be found in Annex 2.1.

Table 3.1: overview of the number of retrieved articles. Numbers in brackets give the number of articles that were also retrieved through another search query.

Search method	No.	No. 1st selection	No. final selection
Drought + Resilience + Indicators	195	8 (1)	7 (1)
Drought + Adaptability + Indicators	38	6 (3)	2 (1)
Farm + Resilience + Indicators	118	14 (3)	6 (0)
Farm + Adaptability + Indicators	37	6 (5)	1 (0)
Snowball sampling	N.A.	9	2
Total	388	37	17

The initial literature-based indicator list was composed of attributes and indicators formulated in the selected 17 articles. After merging identical and similar attributes and indicators, the list contained 203 unique attributes and 328 unique indicators. Figures 3.1 and 3.2 summarize these attributes and indicators according to their categories. An overview of all individual attributes and indicators, including respective categories, is included in Annex 2.2.

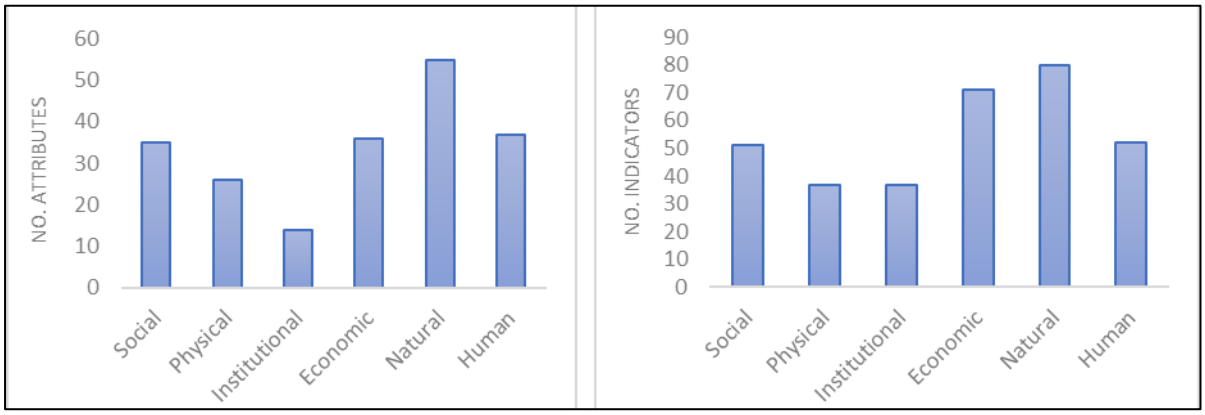


Figure 3.1: Number of attributes (left) and indicators (right) per CD identified through a systematic literature review.

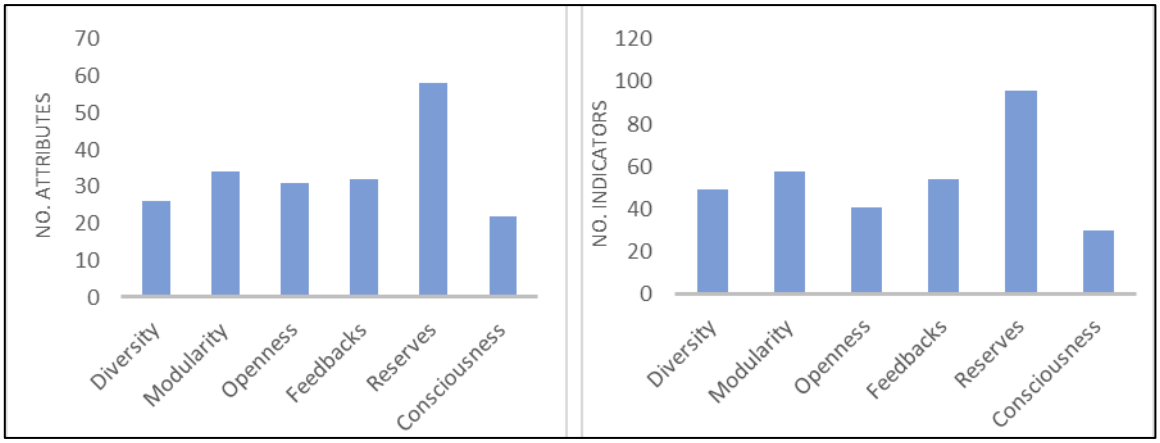


Figure 3.2: Number of attributes (left) and indicators (right) per GRP identified through a systematic literature review.

Outcomes Fuzzy Cognitive Mapping

Seven land users, nine policy officers and eight experts were identified and invited to participate in the FCM. Six local land users, five policy officers and five experts participated (Table 3.2). The remaining invitees either did not respond or could not participate due to a full schedule (the FCM took place from the beginning of July to the start of August).

Table 3.2: Numbers of invitees, participants, invitees that had agenda problems and non-respondents per stakeholder group.

Groups	Invited	Participated	Could not participate	Did not respond
Land Users	7	6	1	0
Policy Officers	9	5	3	1
Experts	8	5	1	2

The 16 participants created each one fuzzy cognitive map (Annex 3.1). Figure 3.3 presents one of these maps. The initial participatory-based list was composed of attributes and indicators from the fuzzy cognitive maps. After merging identical and similar attributes and indicators, the list contained 83 unique attributes and 139 unique indicators. Figures 3.4 and 3.5 summarize these attributes and indicators according to their categories. An overview of all attributes and indicators, including respective categories, is included in Annex 3.2.

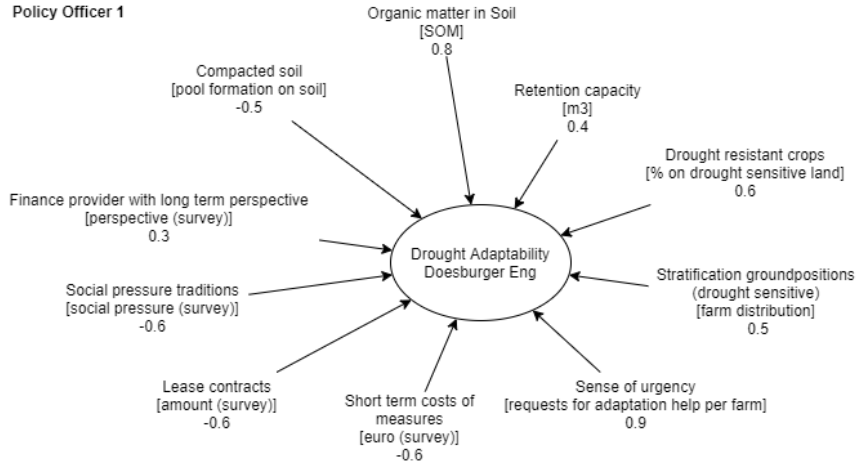


Figure 3.3: One of the 16 produced fuzzy cognitive maps, created in cooperation with one of the policy officers. The map shows the attributes, an indicator per attribute and the perceived attribute strength from -1 to 1.

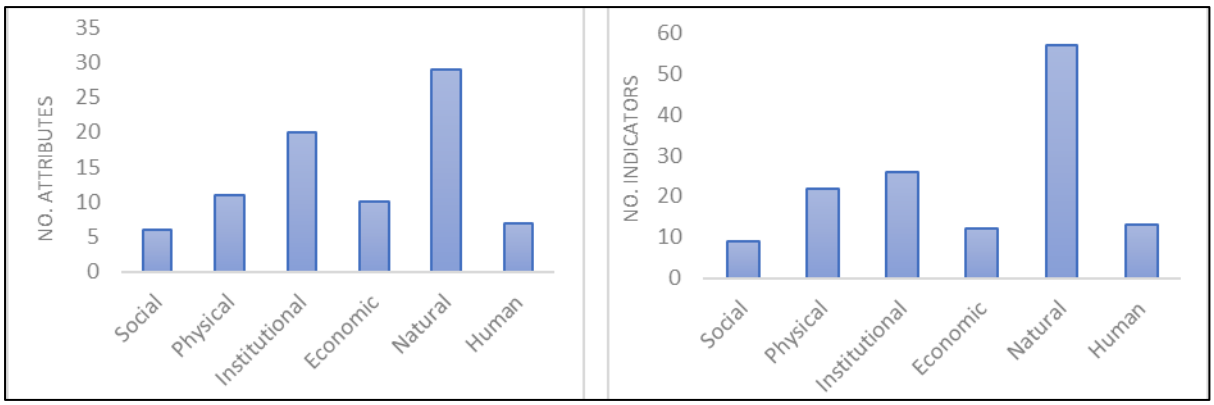


Figure 3.4: Number of attributes (left) and indicators (right) per CD identified through fuzzy cognitive mapping.

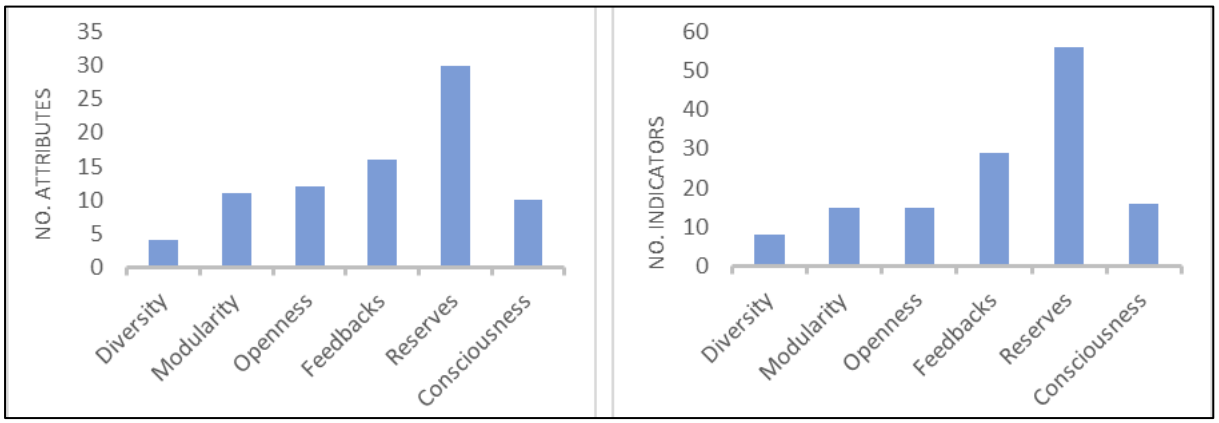
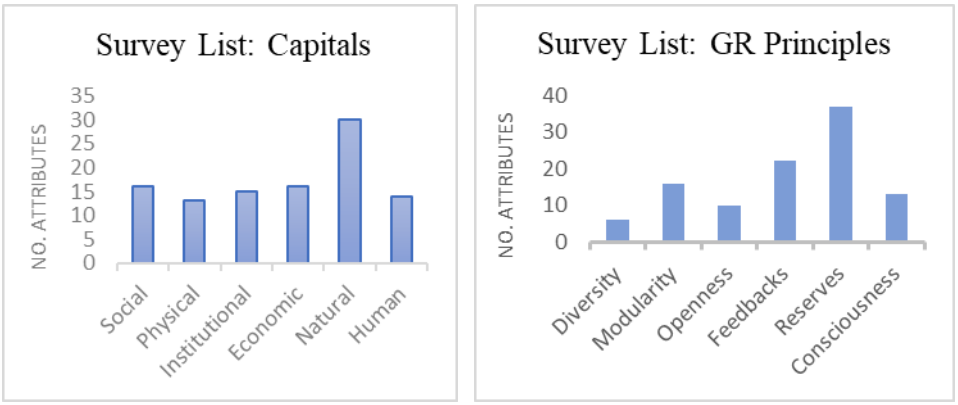


Figure 3.5: Number of attributes (left) and indicators (right) per GRP identified through fuzzy cognitive mapping.

3.2 Results of the Indicator Selection (1B)

After a preselection, the initial literature-based list and initial participatory list were combined to form the survey list. After merging similar attributes and indicators, the survey list contained 104 attributes and 171 indicators (English: Annex 4.1; Dutch: Annex 1.2). Figures 3.6 and 3.7 summarize those attributes according to the categories. Annexes 2.2 and 3.2 include an explanation of why certain attributes and indicators were merged or not preselected.



Figures 3.6 (left) and 3.7 (right): Number of attributes per category (3.6: capital domains; 3.7: generic resilience principles) in the survey list.

Five people from each stakeholder group scored the attributes on the survey list. Most of these people also participated in the FCM. One land user and one policy officer participated for the

first time. An overview of all scores assigned by the participants to the attributes is included in Annex 4.2. An overview of the preferences for the indicators are included in Annex 4.3.

Drought-resilience attribute and indicator set at the Doesburger Eng

Two methods were applied to create a final list of drought-resilience attributes resilience at the Doesburger Eng. The first method (method A) lead to a list of 49 attributes, while the second method (method B) lead to a list of 36 attributes. 35 attributes were part of both final lists. The attributes and corresponding indicators are presented in Table 3.3. Figures 3.8 and 3.9 summarize these attributes according to the categories.

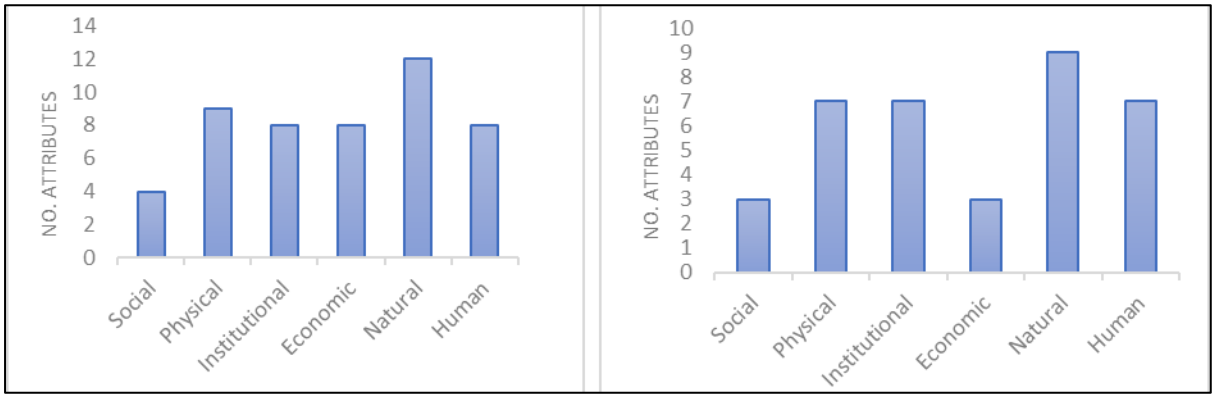


Figure 3.8: Number of attributes per CD in final list A (left) and final list B (right)

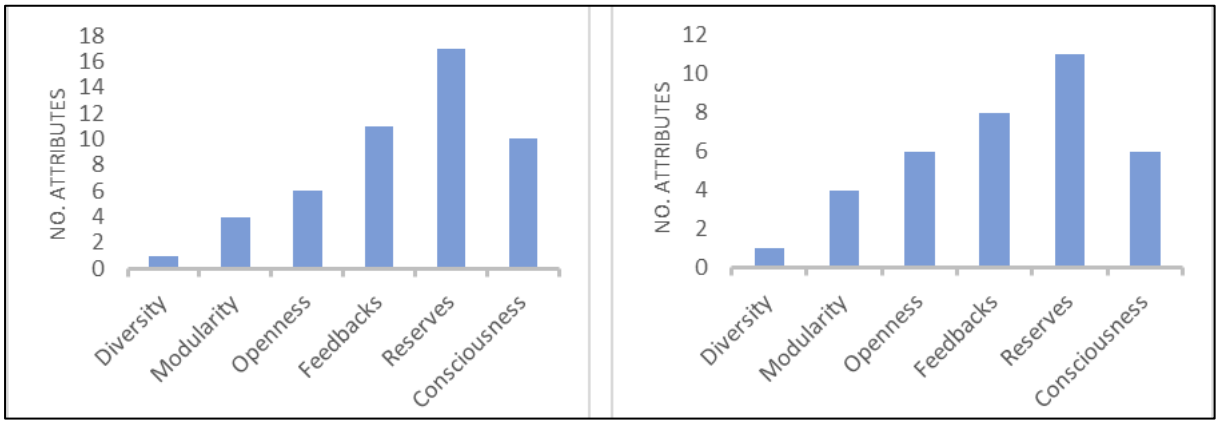


Figure 3.9: Number of attributes per GRP in final list A (left) and final list B (right)

Robustness of attributes

The robustness analysis assigned each attribute a percentage that indicates in how many of the bootstrapped samples that attribute met the 'final list conditions A and B' (Section 2.2.2). This percentage expresses the robustness of the attribute. 10 attributes met both conditions in more than 90% of the samples. 31 attributes (including the first 10) met on average the conditions in in more than 75% of the samples. 12 attributes met on average the conditions in 50-75% of the samples. Those 43 attributes are presented in Table 3.4. An overview of the robustness scores of all attributes is included in Annex 4.4.

Table 3.3.: the resilience attributes and corresponding indicators that are part of one or both final lists.

Resilience Attributes	**Corresponding Indicators**	**Final List**
Willingness to cooperate	# shared initiatives	Both
Local ambassador for measures	presence 'example farm'	Both
Age Land Users	Average age	Both
Wells and Irrigation	% dry ground covered	Both
Use of irrigation	Irrigated area in ha	Both
Possibility in landscape of irrigation	% of land	Both
Existing potential infrastructure storage and transfer	m3, m	Both
Costs Irrigation	revenue - costs	Both
Local retention surface water	m3	Both
Diversity water sources	amount	Both
Positive financial stimulation on measures	% participating	Both
Financial compensation nature management	% participating	Both
Cooperation and coordination between sectors and governmental levels	judged through a survey	Both
Clear agreements with and between governments	presence of public documents	Both
Attention to drought	number of people active in water conservancy	Both
Local water management	presence	Both
Agricultural investments	euro	Both
Short terms costs of measures	euro	Both
Farmers that use forecasts about droughts	%	Both
Use drought resistant crops	ha % on drought sensitive land	Both
Quality drought resistant crops	proteins/ha	Both
Knowledge on producing drought resistant crops	presence	Both
Market for drought resistant crops	% of sales	Both
Retention capacity soil	retention capacity	Both
Soil organic matter	SOM	Both
Biological quality soil	density of worms	Both
Physical quality soil	infiltration capacity	Both
Function follows water system	gap current vs optimal water levels	Both
Local knowledge on drought	knowledge, indicated in survey	Both
Local knowledge effectiveness measures	% land users having knowledge	Both
Knowledge on local water system	number of informative meetings	Both
Farm specific coaching	% participating land users % large changes among participants	Both
Willingness to innovate and change	innovativeness, indicated in survey	Both
Awareness and acceptance climate unpredictability	participants at practice-based meetings	Both
Sense of urgency	requests for adaptation help per farm	Both
Farmer population	Ratio farmers: non-farmers	Only A
Use wastewater	m3	Only A
Early drought warning	presence	Only A
Non-financial stimulation on measures	% participating	Only A
Drought Plan	clarity indicated in survey effectiveness	Only A
Agricultural income	Value of farm products sold in euro/km2	Only A
Price current crops	euro/tonnes	Only A
Production costs	euro/tonnes	Only A
Availability manure and organic matter	euro/kg	Only A
Taken adaptive measures	number of measures	Only A
Future business models	number of businesses with water plan	Only A
Adequate groundwater management	lowered pressure in mm	Only A
Physical option for measures	option	Only A
Scientific knowledge effectiveness measures	# reports and articles on measures	Only A
‘Deltaprogramma Agrarisch Waterbeheer’	# contact moments DAW team	Only B

Table 3.4: the robustness scores of the 43 most robust drought-resilience attributes. The scores are expressed in percentage of samples in which the attribute met the selection criteria.

Resilience Attribute	**% A**	**% B**	**Resilience Attribute**	**% A**	**% B**
Retention capacity soil	100	100	Knowledge on producing drought resistant crops	83.7	83.1
Willingness to innovate and change	100	100	Market for drought resistant crops	84.9	81.5
Short terms costs of measures	99.7	100	Existing potential infrastructure storage and transfer	90.5	74.4
Use drought resistant crops	99.7	100	Age Land Users	89.7	72.1
Use of irrigation	99.6	100	Clear agreements with and between governments	97.3	62.8
Awareness and acceptance climate unpredictability	99.7	99.1	Sense of urgency	60.7	95.8
Local knowledge effectiveness measures	99.6	95.7	Function follows water system	97.4	57.4
Costs Irrigation	92.8	100	Local water management	91.2	62.9
Positive financial stimulation on measures	93.8	98.0	Knowledge on local water system	78.4	73.7
Local ambassador for measures [presence 'example farm']	93.4	96.8	Adequate groundwater management	97.8	47.1
Quality drought resistant crops	84.3	99.9	Deltaprogramma agrarisch waterbeheer'	45.5	99.3
Local knowledge on drought	97.1	85.0	Production costs	91.6	44.2
Biological quality soil	97.2	84.8	Agricultural investments	84.1	57.2
Physical quality soil	96.9	84.2	Taken adaptive measures	79.0	46.6
Wells and Irrigation	99.7	80.0	Non-financial stimulation on measures	66.3	58.4
Soil organic matter	97.6	80.4	Use wastewater	67.5	55.5
Local retention surface water	97.0	80.8	Drought Plan	68.3	54.1
Farm specific coaching	84.9	91.3	Availability manure and organic matter	84.4	36.2
Diversity water sources	96.5	79.3	Future business models	66.1	52.6
Cooperation and coordination between sectors and governmental levels	79.6	96.2	Financial compensation nature management	59.2	55.2
Possibility in landscape of irrigation	78.2	97.2	Early drought warning	65.6	37.4
Willingness to cooperate	80.6	90.5			

3.3 Results of the Quantitative Analysis of the Categories (1C)

Analysis on capital domains

The number of attributes and indicators belonging to each capital domain was presented in the previous sections for the initial literature-based list (Figure 3.1), the initial participatory list (Figure 3.4), the survey list (Figure 3.6) and the final lists (Figure 3.8). The comparisons between the attribute numbers resulted in p-values, which can be found in Annex 5.1.

Figure 3.10 presents a graphic overview of these findings. The figure shows for each list which capital domains were significantly different in terms of occurrence. In the figure, capital domains are listed from left to right based on the number of attributes or indicators. The capital on the left featured the lowest number of attributes, the capital domainon the right featured the highest number. Capital domains that were not significantly different in number, are underlined. Thus, the top part of Figure 3.10 shows that the number of indicators representing

the institutional domain was the lowest, while indicators that represent the natural domain, were most abundant. Furthermore, that same part shows that the number of institutional, physical, social and human indicators did not differ significantly. Neither did the number of social, human, economic and natural indicators. Consequently, significantly more economic and natural indicators than institutional and physical indicators occurred on the initial literature-based list (Figure 3.10).

Furthermore, Figure 3.10 shows that significantly more natural attributes than institutional and physical attributes occurred on the initial literature-based list. Additionally, more social, human and economic attributes occurred than institutional. On the initial participatory list, significantly more natural indicators occurred than any of the other indicators, while significantly more natural attributes occurred than social, human and economic attributes. No significant differences were found in the survey list and both final lists.

The scores awarded to the attributes in the survey list were presented in Annex 4.2. The resulting p-values of the comparisons based on Dunn's Test and Tukey's Test can be found in Annex 5.1. Figure 3.11 presents a graphic overview of these findings. The figure shows which capital domains were significantly different in terms of score. Using Dunn's Test, I found that the social attributes received a significantly lower score than the physical, natural, institutional and human attributes. Additionally, Tukey's test found significant lower scores for economic attributes compared to institutional and human attributes.

Analysis on generic resilience principles

The number of attributes and indicators fitting within each generic resilience principle (GRP) were presented in the previous sections for the initial literature-based list (Figure 3.2), the initial participatory list (Figure 3.5), the survey list (Figure 3.7) and the final lists (Figure 3.9). The comparisons between the attribute and indicator numbers resulted in p-values, which can be found in Annex 5.2. Figure 3.12 presents a graphic overview of these findings. It shows for which list, which GRPs were significantly different in terms of occurrence.

On the initial literature list, there were significantly more modularity indicators than consciousness indicators. Additionally, significantly more reserves indicators occurred than indicators in any of the other categories. On the same list, there were significantly more reserves attributes than consciousness and diversity attributes. On the initial participatory list, significantly more feedback indicators occurred than diversity indicators, while significantly more reserves indicators were present than any of the other, again. Furthermore, significantly more feedback and reserves attributes occurred than diversity and consciousness attributes. On the survey list, there were significantly more feedback attributes than diversity attributes, while there were significantly more reserves attributes than diversity, openness and consciousness attributes. On final list A, there were significantly more reserves attributes than diversity attributes. On final list B, there were no significant differences.

The scores awarded to the attributes in the survey list were presented in Annex 4.2. The resulting p-values of the comparisons based on Dunn's Test and Tukey's Test can be found in Annex 5.2. Figure 3.13 presents a graphic overview of these findings. The figure shows which GRPs were significantly different in terms of score. Dunn's Test and Tukey's test yielded similar results. Diversity attributes were found to have received a significant lower score than feedback, openness and consciousness attributes. In addition, consciousness attributes were found to have received higher scores than modularity and reserves attributes.

1. **Indicators in Literature-based Initial List**

Institutional Physical Social Human Economic Natural

2. **Attributes in literature-based initial list**

Institutional Physical Social Economic Human Natural

3. **Indicators in participatory-based initial list**

Social Economic Human Physical Institutional Natural

4. **Attributes in participatory-based initial list**

Social Human Economic Physical Institutional Natural

5. **Attributes in Survey List**

Physical Human Institutional Economic Social Natural

6. **Attributes in majority based final list (A)**

Social Economic Human Institutional Physical Natural

7. **Attributes in distribution based final list (B)**

Economic Social Human Institutional Physical Natural

Figure 3.10: It is shown for each list whether a significant difference in the number of attributes or indicators belonging to the different capital domains was found. Capital domains that share an underscore did not differ significantly.

1. **Dunn's Test**

Social Economic Physical Natural Institutional Human

2. **Tukey's Test**

Social Economic Physical Natural Institutional Human

Figure 3.11: It is shown for Dunn's and Tukey's Test whether a significant difference in the scores assigned to the attributes belonging to the different capital domains was found. Capital domains that share an underscore did not differ significantly.

1. Indicators in Literature-based Initial List

Consciousness Openness Diversity Feedbacks Modularity Reserves

2. Attributes in literature-based initial list

Consciousness Diversity Openness Feedbacks Modularity Reserves

3. Indicators in participatory-based initial list

Diversity Modularity Openness Consciousness Feedbacks Reserves

4. Attributes in participatory-based initial list

Diversity Consciousness Modularity Openness Feedbacks Reserves

5. Attributes in Survey List

Diversity Openness Consciousness Modularity Feedbacks Reserves

6. Attributes in majority based final list (A)

Diversity Modularity Openness Consciousness Feedbacks Reserves

7. Attributes in distribution based final list (B)

Diversity Modularity Consciousness Openness Feedbacks Reserves

Figure 3.12: It is shown for each list whether a significant difference in the number of attributes or indicators belonging to the different GRPs was found. GRPs that share an underscore did not differ significantly.

Dunn's and Tukey's Test

Diversity Modularity Reserves Feedbacks Openness Consciousness

Figure 3.13: It is shown for Dunn's and Tukey's Test whether a significant difference in the scores assigned to the attributes belonging to the different GRPs was found. GRPs that share an underscore did not differ significantly.

3.4 Quantitative Analysis of the Stakeholder Group Perceptions (1D)

The attribute scores given by the stakeholders were presented in Annex 4.2. The p-values from the pairwise comparisons between the stakeholder groups are presented per capital domain in Table 3.5. The perception of experts on agricultural and economic capital domains contradicted significantly with the perception of land users and policy officers. The latter groups gave more importance to these categories (predictions are included in Annex 5.3). Tukey's Test, in contrast with Dunn's Test, also indicated a significant difference between policy officers and experts in the social category. No significant differences between the land users and policy officers were detected.

The p-values from the pairwise comparisons for the GRPs are summarized in Table 3.6. The perception of experts on reserves contradicted significantly with the perception of land users and policy officers. The latter groups gave more importance to this category (predictions are included in Annex 5.3). Tukey's Test, in contrast with Dunn's Test, also indicated a significant difference between policy officers and experts in the modularity category. No significant differences between the land users and policy officers were detected.

Table 3.5 (left) and 3.6 (right): p-values of the statistical tests for comparison between stakeholder groups on their perspectives on the capital domains (3.5) and generic resilience principles (3.6). Significant differences (p-value < 0.05) are marked with an asterisk.

Capital domain	Comparison	p-value Tukey	p-value Dunn
Agricultural	LU-PO	0.905	1.000
	LU-Exp	<.001*	<0.01
	Exp-PO	<.0001*	<.0001
Economic	LU-PO	1.000	1.000
	LU-Exp	<.0001*	<.0001
	Exp-PO	<.0001*	<.001
Human	LU-PO	1.000	1.000
	LU-Exp	0.993	1.000
	Exp-PO	0.917	1.000
Institutional	LU-PO	0.986	1.000
	LU-Exp	1.000	1.000
	Exp-PO	0.999	1.000
Physical	LU-PO	1.000	1.000
	LU-Exp	1.000	1.000
	Exp-PO	0.998	1.000
Social	LU-PO	0.902	1.000
	LU-Exp	0.787	1.000
	Exp-PO	0.013*	0.259

GR principle	Comparison	p-value Tukey	p-value Dunn
Diversity	LU-PO	1.000	1.000
	LU-Exp	0.139	1.000
	Exp-PO	0.278	1.000
Modularity	LU-PO	0.967	1.000
	LU-Exp	0.884	1.000
	Exp-PO	0.039*	0.241
Openness	LU-PO	0.996	1.000
	LU-Exp	0.982	1.000
	Exp-PO	0.240	0.502
Reserves	LU-PO	1.000	1.000
	LU-Exp	<.0001*	<.001*
	Exp-PO	<.0001*	<.0001*
Feedbacks	LU-PO	0.999	1.000
	LU-Exp	0.848	1.000
	Exp-PO	0.105	0.302
Consciousness	LU-PO	0.926	1.000
	LU-Exp	1.000	1.000
	Exp-PO	0.985	1.000

4. Discussion of Research Question 1

This chapter discusses my research results related to RQ1. I discuss the relevance of the findings beyond the Doesburger Eng. I then critically discuss the methodology and results. Subsequently, I relate my findings to the existing literature, and I discuss practical implications.

4.1 Relevance of findings for the Doesburger Eng, and beyond the Doesburger Eng

The initial participatory list, survey list, final lists and scores relate directly to the Doesburger Eng. The capital domains' and GRPs' analysis based on these lists is therefore relevant to the Doesburger Eng.

The agricultural requirements (e.g. financial input/legislation), conditions (e.g. topography/climate) and stakeholders determine which resilience attributes are most relevant (Cutter et al., 2008; Meuwissen et al., 2019). So, similar resilience attributes are likely relevant in agricultural areas with similar agricultural requirements, conditions and stakeholders. Consequently, my findings concerning the capital domains and GRPs will probably hold for agricultural areas similar to the Doesburger Eng (i.e. Dutch drought-affected meadows and open-air crop fields). Simultaneously, my findings will unlikely hold for agricultural areas that substantially differ in the agricultural requirements, conditions and stakeholders to the Doesburger Eng (e.g. greenhouse horticulture and agricultural areas outside The Netherlands). The findings' relevance in other agricultural areas needs to be verified through comparative research, which could not be executed in the given time.

4.2 Critical Reflection

In this section, I discuss weaknesses and uncertainties in the methodology and results of the capital domain and GRP comparison. This comparison was based on the statistical analyses of the attributes and indicators grouped into capital domains and GRPs. So, any uncertainties in 1) the individual attributes and indicator on the analysed lists and in 2) the categorization of those attributes and indicators are reflected in the results. I therefore first explore the weaknesses in both the formation of the attribute and indicator lists, as well in the categorization of the attributes. Then, I explore weaknesses in the capital domain and GRP comparison itself.

Uncertainties in the attribute and indicator lists

Regarding the **initial participatory list** (Section 3.1), additional participants had probably identified additional attributes and indicators. However, only eight relevant stakeholders did not participate. Moreover, in FCM each additional participant tends to identify less unique suggestions (Özesmi & Özesmi, 2004). So, after the first 16 participants, the remaining eight would likely have identified a limited number of unique attributes.

Regarding the **initial literature list** (Section 3.1), unnoticed relevant papers probably contain additional attributes and indicators. However, the number of unnoticed relevant papers is likely limited, because I applied broad search queries and additional snowball sampling. Moreover, similar to participants in FCM, each additional article tends to contain less unique attributes and indicators. So, after the first 17 articles, additional articles (probably limited in number) would likely have contained a limited number of unique attributes.

Regarding the **survey list** (Section 3.2), I forgot to include the attributes *diversity of crops* and *diversity of income sources*, despite fulfilling the preselection criteria. Furthermore, other attributes would have been included when other or more lenient preselection criteria were applied. Relatively strict and straightforward preselection criteria were chosen to limit the number of attributes on the list and to ensure the replicability (Section 2.2.2).

Regarding the **final lists** (Section 3.2)**,** the attributes' scores and selection criteria determined which attributes were included. An additional survey round, in line with the 'ideal' conventional Delphi methodology (Rowe et al., 1991), probably had resulted in other individual scores. However, in additional survey rounds, participants tend to adjust their scores toward the mean or median (Rowe et al., 1991). Such score adjustments unlikely affect the mean or median, so would unlikely change the final selection. Two selection criteria were already applied to make the final list more robust. The robustness analysis could have been used to re-create the final lists. However, such a 'robustness-based list' would not differ substantially from the original final lists, because the 31 highly robust (i.e. robustness >75%) attributes were part of the original final lists.

In conclusion, methodological limitations regarding the initial and final lists likely had limited impact on the lists' composition. Under different preselection criteria the survey list probably would have differed substantially, but the most pragmatic criteria were chosen Additional research would help to understand the limitations and uncertainties more comprehensively. Such additional research should compare the current outcomes to the outcomes of an approach that includes the other relevant stakeholders, applies supplementary search queries to identify unnoticed publications, applies other preselection criteria, and adds a survey round. I could not perform this additional research due to time constraints.

Uncertainties in the Categorization

Decisions had to be made on which categories to include, and on which attribute and indicator to assign to which category (Section 3.1). Such decisions are arbitrary, even though I based them on literature. For example, I labelled *costs of irrigation equipment* in the physical capital domain, because it (negatively) affects the physical capabilities in the area more directly than the economic capabilities. However, it also qualifies in the economic capital domain because it restricts the economic capabilities. Assigning a different category to an attribute would alter the amount and scores for the respective categories. A sensitivity analysis in which ambiguous attributes are assigned to other categories has the potential to reveal how categorization affects uncertainty. This sensitivity analysis was timewise not an option.

Uncertainty in the capital domain and GRP comparisons

Additional research, as suggested above, increases confidence in the results, but also probably changes the attribute and indicator lists and categorization. Consequently, these changes alter the comparisons' results. The changes are likely limited for the initial and final lists. The extent of the changes is unknown for the survey list and categorization. However, changes in the survey list and categorization only influence the comparisons' results when the number and scores of attributes in a specific category changes strongly respective to those in other categories. This is most probable for diversity (2 preselected attributes not included) and economic domain ('costs' is the main ambiguous aspect in the categorization), making conclusions about these categories most uncertain. The highly significant results (e.g. the frequency reserves attributes occur, Annex 5.1. and 5.2) are least uncertain due to the large margin of the identified differences. The suggested additional research can disclose the uncertainty for each category.

I analysed the capital domains and GRPs through the resilience attributes and indicators that were formulated through literature and stakeholders and selected by stakeholders. Another option, in theory, was to analyse the capital domains and GRPs through empirically grounded resilience attributes and indicators. However, given the lack of studies on drought resilience in The Netherlands, an exploratory approach using a participatory and literature-based approach was the only option. After the indicator selection, the influence selected attributes and

indicators have on drought resilience could be empirically tested. Such an empirical study would verify (or contradict) the validity of the final selection, thereby verifying the comparison's results. The empirical verification was outside the scope of my research.

4.3 Theoretical implications

Capital domains

Not all capital domains contribute equally to drought resilience according to my findings. These findings agree with Jordaan et al. (2018). However, Jordaan et al. (2018), the reviewed articles and the participants disagreed about the relative importance of the specific capital domains. For example, the institutional and physical capital attributes were in number less represented in the literature, while these were perceived as more important by the Dutch stakeholder groups both in number and scores. The capital domains' importance likely depends on case specific characteristics. Which characteristics cause these differences, and how these characteristics cause them is unknown. Further analysis could reveal those reasons but was outside the scope of this study.

Remarkably, the most frequent occurring capital domain (i.e. natural capital) also occurred most frequently in the literature (Figure 3.10) and was valued as most important by Jordaan et al. (2018). This observation leaves the option open that natural capital is overall the most important capital domain for drought resilience.

My findings conflict with the study by Zhang et al. (2019), who assume (implicitly) that the capital domains are equally important. That capital domains are equally important is unlikely (e.g. Jordaan et al., 2018; this study). However, when all capital domains are equally important, this study showed that some capital domains, especially social capital, get underappreciated in literature and by land users, policy officers and experts.

Generic Resilience Principles

Up to this point, no articles have discussed the relative importance of individual GRPs. Nevertheless, I found in the literature an imbalance in the number of attributes representing the GRPs (Figure 3.12). This suggests that the GRPs are not viewed as equally important in literature. The outcomes based on the participants' input confirm the notion that not all GRPs contribute equally to drought resilience. This is a novel finding that requires further attention. Further research on the relative importance of GRPs would greatly benefit the understanding of resilience but was outside the scope of this study.

Consciousness is absent in some key conceptual resilience frameworks about socio-ecological systems (e.g. Resilience Alliance, 2010; Meuwissen et al., 2019). The absence contradicts with the conclusion that consciousness is an important GRP with regard to drought resilience. Not only did the participants in this study perceive consciousness as important, Cutter at al. (2014) also included consciousness (albeit in separate GRPs) and many studies involve consciousness attributes and indicators in their analysis (e.g. Bizikova et al., 2019; Brown et al., 2016; Panpakdee et al., 2018). Therefore, consciousness should be part of all future resilience frameworks that include GRPs. In any case, more explicit and frequent use of GRPs can help forward the theory.

Stakeholder Groups

I am the first to find differences between the perspectives on drought resilience of experts on the one hand and the policy officers and land users on the other hand. The identified differences do fit in the assumptions underlying participatory research approaches, namely that practitioners (here: land users and policy officers) have different knowledge and stakes than experts (e.g. Reed, 2008; Wesselink et al., 2011). Furthermore, the identified differences also

fit in the apparent disconnect between science (experts) and decision-making (practitioners), as described in research on science-practice gaps (e.g. Bertuol-Garcia et al., 2018). The reasons behind the exact differences are unknown. Further analysis could reveal these reasons but was beyond the scope of this research.

The absence of differences between policy officers and land users about the relative importance of capital domains and GRPs can be largely attributed to the within-groups differences. So, the heterogeneity of the respective stakeholder groups better explains the lack of difference than like-mindedness among land users and policy officers. The large within-groups differences confirm the conclusion by Taysom and Crilly (2017) that individuals differ in perspective on resilience. The participating policy officers worked at different institutes and land users commonly have divergent (world)views and knowledge (Blackstock et al., 2010; Greiner & Gregg, 2011). This probably partly explains the within-group differences. Nonetheless, to reach a conclusive explanation requires further analysis, which was outside the scope of this research.

Drought Resilience

A wide array of resilience attributes and indicators depict drought resilience at the Doesburger Eng. An AIS consisting of 30+ indicators is not uncommon (c.f. Bizikova et al., 2019; Habiba et al., 2011; Jónsson et al., 2016). The high quantity of relevant attributes and indicators in this study and other publications underscores the argument made by Quinlan et al. (2016), who argue that resilience is complex and should not be reduced to a narrow set of indicators if one wants to gain a deeper understanding.

Therefore, when applying a framework that is based on the theory about capital domains (e.g. Li et al., 2016) or GRPs (Nemec et al., 2014; Bouska et al., 2019) the drought resilience concept should not be confined within the bounds of that theory. Combining the GRP and capital approach in one framework is a way to address the complexity. Ifejika Speranza et al. (2014) did incorporate aspects from both approaches in their livelihood framework. Their framework could be taken as a starting point to develop a similar approach relevant to drought resilience.

4.4 Practical implications

The relevant drought-resilience attributes and indicators can be used and quantified to further analyse and increase drought resilience at the Doesburger Eng. Meanwhile, the comparisons' results indicate that natural capital and reserves and consciousness principles deserve most attention when researching or improving drought resilience. However, the other capital domains and GRPs cannot be neglected.

Outside the Doesburger Eng, the relative importance of capital domains and GRPs at the Doesburger Eng can be a starting point for dialogue, improvements and research. For example, when resilience attributes are established without a thorough selection procedure, giving explicit attention to the capital domains and GRPs helps balancing the types of attributes.

The results concerning the stakeholders' perspectives indicate that land users and policy officers have in their resilience perspectives no differences that will obstruct cooperation. However, the differences within these stakeholder groups probably obstructs internal cooperation. Additionally, the differences between the experts and other stakeholder groups probably obstruct

5. Results related to Research Question 2

This chapter presents the results of the second part of the research. The structure of the chapter follows the structure of the second part of Section 2.2 (Figure 2.2).

5.1 Results of Validity Comparison (2A)

Table 5.1 shows the amount and percentages of attributes from the survey list that were and were not included in final lists A and B (Section 3.2). These attributes have been classified as literature-based and participatory-based attributes. The 23 Attributes that were formulated both by participants and in literature were added to both groups. These attributes could be specified in 13 "yes" / 10 "no" and 12 "yes" / 11 "no", for list A and list B, respectively.

Table 5.1: Overview of the number of attributes of each type that met the selection criteria

Type (List A)	**Yes # (%)**	**No # (%)**		**Type (List B)**	**Yes # (%)**	**No # (%)**
Participatory	37 (60)	25 (40)		Participatory	29 (47)	33 (53)
Literature	25 (38)	40 (62)		Literature	19 (29)	46 (71)

The fisher exact test returned a p-value of 0.013 and 0.032 for final list A and B, respectively. Therefore, no matter the selection method, the null hypothesis was rejected. The alternative hypothesis that participatory-based attributes are more valid than literature-based attributes was accepted.

5.2 Results of Convenience Comparison (2B)

Table 5.2 shows the total amount of indicators for each data availability rating. Annex 4.1 includes an overview of the rates for each individual indicator, including justifications. The Wilcoxon rank sum test returned a p-value of 0.517. As a result, the null hypothesis could not be rejected. Thus, no proof was found that participation-based indicators are more convenient than literature-based indicators.

Table 5.2: Overview of the number of indicators rated 1, 2, 3 and 4

Type of indicator	**Rate 1**	**Rate 2**	**Rate 3**	**Rate 4**
Participatory based	9	39	33	10
Literature-based	8	39	45	3

5.3 Results of Legitimacy Comparison (2C)

14 participants responded to the choice experiment. Their respective responses are presented in Table 5.3. The dispersion parameter was 0.82. The binomial test returned a p-value of 0.969. Consequently, the null hypothesis could not be rejected, and no proof was found that the participants found participatory-based attributes more legitimate. The 5th choice-set was arguably not well-balanced. Omitting this result, the binomial test (which was used as the dispersion factor was 0.80) returned a p-value of 0.799, resulting in the same conclusion.

Table 5.3: The participants' choices. The choice for either the literature-based (Lit, Blue) or participatory-based (Part, Yellow) dominated option is given.

Participant	Group	Choice 1	Choice 2	Choice 3	Choice 4	Choice 5	Choice 6
1	LU	Part	Part	Part	Part	Lit	Lit
2	LU	Lit	Part	Part	Lit	Lit	Lit
3	LU	Part	Lit	Lit	Lit	Lit	Lit
4	LU	Part	Lit	Lit	Lit	Lit	Lit
5	LU	Part	Part	Lit	Lit	Lit	Part
6	Exp	Part	Lit	Part	Part	Lit	Part
7	Exp	Part	Lit	Part	Lit	Lit	Part
8	Exp	Lit	Part	Lit	Lit	Lit	Lit
9	Exp	Part	Lit	Lit	Lit	Part	Part
10	Exp	Part	Part	Lit	Lit	Part	Part
11	PO	Part	Lit	Lit	Part	Lit	Lit
12	PO	Part	Lit	Lit	Lit	Lit	Part
13	PO	Lit	Part	Lit	Part	Lit	Lit
14	PO	Lit	Lit	Lit	Part	Lit	Part

6. Discussion of Research Question 2

This chapter discusses my research results related to RQ2. I critically discuss the methodology and results. Subsequently, I relate my findings to the existing literature, and I discuss practical implications.

6.1 Critical Reflection

To be able to measure **validity** (2A), I assumed that the attributes on the final lists are a valid representation of drought resilience at the Doesburger Eng. The validity of the final lists was discussed in Section 4.2. Although uncertainties remain, the attributes on the final list are currently the best reflection of drought resilience at the Doesburger Eng.

Convenience was captured through data availability. Data availability is a key aspect of convenience, but convenience entails more aspects, for example understandability. Whether a participatory approach produces for those aspects more convenient outcomes than a literature-based approach remains uncertain. Further analysis, e.g. on the understandability, will overcome this uncertainty, but was not possible to conduct timewise

Even though the choice-sets were designed to be equally valid, small imbalances probably existed between the choices. However, small unbalances would not have influenced the outcome, given the large p-value by which the hypothesis that a participatory approach produces more **legitimate** answers was rejected.

6.2 Theoretical implications

The outcomes seemingly contradict the existing literature on participatory processes. Firstly, the idea that a participatory approach leads to more convenient, easier applicable indicators (Reed et al., 2008) was not supported by my research. Secondly, where Reed et al. (2008) concluded that participation-based indicators were (almost) equally valid to literature-based indicators, I found that they were more valid. Finally, the idea that participatory-based indicators are viewed as more legitimate (Wesselink et al., 2011) was not supported either.

However, instead of contradicting, my findings refine the current understanding on participatory processes. The starting point of Reed et al. (2008) was to formulate easy-to-use indicators to monitor change. My starting point was to formulate valid indicators to express and measure an intangible phenomenon (drought resilience). In both cases, the participatory approach led to better outcomes regarding the goal of the indicator formulation. So, a participatory approach produces more valid or more convenient outcomes than a literature-based approach, depending on the starting point of the indicator formulation. Reed et al. (2008) and this study suggest that a participatory approach unlikely produces outcomes that are both more valid and more convenient (i.e. in terms data availability).

Wesselink et al. (2011) discuss the outcomes' legitimacy of a participatory process and a process without any participation. Contrarily, I compared a participatory approach to a literature-based approach that was supported by a participatory approach. The literature-based indicator formulation was followed by a participatory indicator selection. In the choice-experiment, literature-based and participatory indicators were combined in the choices. Additionally, the selection in the choice-experiment was done by the participants. My results suggest that if a process already uses participatory methods, additional participation is not likely to increase the perceived legitimacy.

6.3 Practical implications

The answers to RQ2 and their theoretical implications also have practical implications for designing an indicator formulation phase. Depending on the goal of the indicator formulation,

a participatory approach potentially identifies more valid or more convenient indicators than a literature-based approach. Therefore, those goals need to be made explicit.

If the goal is to formulate valid attributes, a participatory approach is likely to produce more valid outcomes than a literature-based approach. However, a literature-based approach also produces unique valid outcomes, so a combined approach identifies the highest number of valid results.

So, for validity reasons applying a participatory or combined approach during indicator formulation is wise. However, also pragmatic (e.g. Brandt et al., 2013), power-related (e.g. Agarwal, 2001) and moral (e.g. Wesselink et al., 2011) aspects should be considered with regard to applying a participatory approach. The findings regarding the validity help making an informed decision about whether to apply a participatory approach.

After this study, a literature-based approach to drought-resilience indicator formulation only requires an evaluation of the initial attribute and indicator lists (Annexes 2.2 and 3.2). Since I applied a combined approach to indicator formulation, those lists likely contain more valid drought-resilience attributes than a participatory approach would yield, at least for drought-resilience indicator formulation in The Netherlands. Therefore, if indicator formulation is required in a context similar to one where a combined or participatory approach has been applied and documented, a literature-based approach is likely better from a validity perspective than a participatory approach.

7. Conclusions and Recommendations

7.1 Conclusions

This drought-oriented study was the first in The Netherlands that took a drought-resilience perspective. I addressed in seven steps the posed sub research questions, and I presented and discussed the results of these seven steps. I arrived at the following conclusions based on those results and discussions.

I conclude that over 200 attributes, measurable through over 400 indicators, can affect drought resilience (RQ1a). The list is extensive but not exhaustive. 31 attributes and 33 related indicators affect drought resilience at the Doesburger Eng (RQ1b). These attributes and indicators relate to soil, irrigation, cooperation, attitudes, local knowledge and governmental support. This high number of relevant attributes and indicators allows a detailed understanding of local drought resilience.

I conclude that drought-resilience attributes from different capital domains and GRPs appeared most frequently in literature, and were mentioned most frequently and scored highest by stakeholders (RQ1c). Natural capital attributes and reserves attributes were most frequently mentioned. Consciousness attributes received the highest scores and social capital attributes. These results were most significant. Diversity attributes received the lowest scores, but this result is highly uncertain. The experts scored the social and natural capital attributes and reserves attributes lower than the policy officers and land users (RQ1d).

The participatory approach formulated more valid (RQ2a) indicators than the literature-based but not more convenient indicators (RQ2b). A study that aimed to create convenient indicators concluded the opposite. I concluded that a participatory approach, depending on its goal and design, potentially produces more valid or convenient outcomes than a literature-based approach. The participatory approach was not more legitimate than the literature-based approach (RQ2c). I refined the idea that a participation leads to legitimacy by concluding that when process already uses participatory methods, additional participation is not likely to increase the perceived legitimacy.

General synthesis

Regarding RQ1, I conclude that at the Doesburger Eng some capital domains and GRPs affect drought resilience more than others, but not to a large extent. The natural capital affects drought resilience the most, the institutional capital second-most, while the social capital least. The GRPs that affects drought resilience most are reserves and consciousness, while diversity affects drought resilience least. The latter conclusion is uncertain. The land users and policy officers had no conflicting views over the importance of the various categories, while both stakeholder groups had some differences in insight with the experts. These conclusions probably hold for similar Dutch agricultural areas. Moreover, I conclude that in general, the capital domains and GRPs do not affect drought resilience equally. This a novel finding regarding the GRPs. Case specific conditions appear to dictate which capital domains and GRPs affect drought resilience the most. Regarding RQ2, I conclude that a participatory approach produces to a limited extent more usable outcomes than a literature-based approach. When aiming to create accurate indicators, only regarding the validity is a participatory approach is more useful.

Regarding the research approach, I conclude that developing a resilience attribute and indicator set (AIS) helps to understand resilience for the system the AIS was created for. Simultaneously, it helps to analyse more abstract resilience concepts (here: capitals and GRPs) and allows to improve future AIS development by analysing the AIS development process.

7.2 Recommendations

Based on my findings and conclusions, I make recommendations to 1) (drought)-resilience practitioners and scholars regarding their general focus; 2) persons involved in indicator development regarding indicator formulation and 3) land users of the specific agricultural area regarding drought resilience.

I recommend drought-resilience practitioners to actively consider and debate the resilience attributes, capital domains and GRPs most relevant in their area. Especially Dutch practitioners can use my findings to start that debate. Furthermore, I advise Dutch drought-resilience experts to talk to land users and policy officers to identify where their respective differences come from. Additionally, I recommend all drought-resilience scholars to combine the capital and GRP approach in a framework to structure research. First, however, researchers of resilience in socio-ecological systems should include consciousness as GRP in their framework if they currently not do so.

I recommend anyone that starts developing an AIS to make the goal of the indicator formulation phase explicit. The instrumental, pragmatic, moral and other arguments can be weighted in relation to that goal. When developing a drought-resilience AIS in The Netherlands, I recommend using the outcomes of the indicator formulation phase (Section 3.1) of this study, because those outcomes resulted from a combined literature and participatory approach.

I advise the land users of the Doesburger Eng to take notice of and discuss the key attributes (most of them will be familiar) and to recognize which attributes can easily be improved and which are currently weak. Even if drought is not the largest threat, improvements on many of the attributes will offer additional benefits. Since the Doesburger Eng is a small area, the land users should initiate cooperation with policy officers. The absence of major differences in their perception about the most important capital domains and GRPs, offers a good starting point for them to strengthen resilience together.

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Annex 1 – Participant Instructions

A1.1 Transcription of instructions of Fuzzy Cognitive Mapping (FCM)

Welkomstwoord
Welkom en bedankt voor het deelnemen.

Uitleg droogteweerbaarheid en adaptatievermogen
De afgelopen twee jaar is droogte in Nederland op de agenda gekomen. Veel onderzoek en initiatieven richten zich nu op het monitoren en voorspellen van droogte en de gevolgen. Daarnaast worden ook de oplossingen bestudeerd. Dat is veelal geredeneerd vanuit de droogte, de bodem en het water. Ik wil in mijn onderzoek een andere blik werpen op de droogteproblematiek en meer vanuit 'het gebied' redeneren. De bedoeling hierbij is de droogteweerbaarheid in kaart te brengen.

Nu zul je wel een voorstelling van droogteweerbaarheid hebben. In mijn onderzoek kijk ik ook naar een specifiek onderdeel van weerbaarheid: het adaptatievermogen. Dit is het vermogen tot aanpassen aan veranderingen die op de lange termijn het effect van een type stress, in dit geval droogte, kunnen verergeren.

Ik geef een voorbeeld van een dergelijke verandering aan de hand van overstromingen. Stel een gebied dat soms overstroomt met de functie wonen – een functie die we willen behouden. Naar mate het gebied dichter bevolkt raakt, zal de schade bij eenzelfde overstroming toenemen. Wij willen weten hoe adaptief het gebied op dit moment is, dus of het een bevolkingsgroei aankan. Er zullen dan betere uitvalswegen nodig zijn. De vraag is hier: hoe makkelijk kunnen die uitvalswegen aangelegd worden indien het nodig wordt. Dus in dit voorbeeld bepalen onder andere reservering van ruimte en technische kennis het adaptatievermogen.

Tot dusver duidelijk wat het adaptatievermogen is?

Uitleg context en focus
Nu is mijn vraag, wat bepaalt het adaptatievermogen in de Doesburger Eng.

Voor zij die niet bekend zijn met de Doesburger Eng: Ik geef eerst kort een achtergrond over het gebied. De Doesburger Eng ligt ten noorden van Ede, aan de rand van de Veluwe. Er wordt al lange tijd landbouw bedreven vanwege de gunstige ligging als overgangsgebied tussen de natte delen van de Gelderse Vallei ten westen en de hoge zandgronden ten oosten. Het water draineert makkelijk, maar de grondwaterstand is relatief hoog. Tegenwoordig bestaat het uit grasland voor vooral melkvee, wordt er rogge geteeld en zijn er boomkwekerijen aanwezig. Mais was populair, maar is langzaam aan het verdwijnen. Dit heeft met name te maken met de wens voor goede zichtlijnen in dit oude cultuurlandschap. Nog verder vragen over de Doesburger Eng?

Om te kunnen zeggen wat het adaptatievermogen in de Doesburger Eng bepaald, moeten we eerst de functies bepalen die tijdens behouden dienen te worden. Ik kijk naar hoe landbouw door een droogte zo min mogelijk in gevaar komt, vanwege het belang voor productie, inkomen en cultuur-historie.

Mogelijke toekomstige veranderingen die droogte verergeren zouden kunnen zijn:

- Ergere en langere droogtes
- Een daling van de grondwaterstand
- Strengere en snellere restricties voor grondwatergebruik

Tot dusver duidelijk wat de context en focus zijn?

Uitleg FCM deel 1/3: attributen
Dit interview maakt gebruik van de 'cognitive mapping techniek'. Hier gaan we in drie stappen doorheen. Cognitive mapping is zoals een woordweb, waarin elementen die elkaar beïnvloeden worden opgenomen. Daarbij wordt aangegeven of het een positieve of negatieve relatie is. Hier is een voorbeeld om een beter beeld te krijgen. De elementen noemen we attributen.

In de cognitive map die jullie gaan invullen, staat 'adaptatievermogen ten behoeve van landbouw in de Doesburger Eng' centraal. De bedoeling is om ieder attribuut op te schrijven dat hierin een rol speelt. Hiermee wordt doorgegaan tot er geen attributen meer te bedenken zijn.

Duidelijk wat er moet gebeuren?

Uitleg FCM deel 2/3: score attributen
De volgende stap is bedoeld om een waarde toe te kennen aan het belang van de verschillende attributen. Deze moet tussen 0 – 1 liggen (of 0 en -1 en geval van een negatief effect), waarbij 0 geen effect is en 1 een zeer sterk effect.

Duidelijk wat er gebeuren moet?

Uitleg FCM deel 3/3: indicatoren voor attributen
De laatste is bedoeld om indicatoren aan de attributen toe te kennen. Een indicator maakt in dit geval iets abstracts meetbaar. We kijken weer naar het voorbeeld hierboven. Prijs heeft geen aparte indicator nodig. Afstand kunnen we meten in meter, maar ook in tijd. In dit geval lijkt tijd relevanter. Beleefdheid van het personeel is lastiger. Een voorbeeld kan zijn: gegroet worden per medewerker, of beleefdheid in een enquête. Als 1 indicator voldoende lijkt, is dat genoeg. Anders mag er nog per attribuut een tweede bij.

Duidelijk wat er gebeuren moet?

Afsluiting
Hartelijk dank voor het deelnemen. Een vragenlijst volgt volgende maand in navolging van dit interview. Graag zou ik van u willen weten wie ik verder zou moeten benaderen voor dit onderzoek.

Heeft u nog vragen en/of opmerkingen?

A1.2 Survey instructions and Survey (Dutch)

Beste deelnemer,

Hieronder staan de factoren en indicatoren voor het adaptatievermogen op de Doesburger Eng. Dit is een mooie en lange lijst geworden met 104 verschillende factoren. Er is dan al een eerste schifting gemaakt. Het is nu de bedoeling om tot een uiteindelijke lijst met factoren te komen die samen het adaptatievermogen met betrekking tot droogte op de Doesburger Eng zo goed mogelijk weergeven.

De factoren staan dikgedrukt aangegeven, met indicatoren eronder. Het is de bedoeling om het belang van elke factor aan te geven met een waardering van 1, 2, 3, 4 of 5, elk met de volgende betekenis.

Waardering	Betekenis
1	Niet relevant: deze factor hoort absoluut niet op de uiteindelijke lijst
2	Enigszins relevant: deze factor past niet goed op de uiteindelijke lijst
3	Neutraal: deze factor kan op de uiteindelijke lijst
4	Behoorlijk relevant: deze factor past goed op de uiteindelijke lijst
5	Uiterst relevant: deze factor mag niet op de uiteindelijk lijst ontbreken

Soms zijn er per factor meerdere indicatoren benoemd. Deze hoeven niet ieder apart beoordeeld te worden. Dus per factor geef je een eigen cijfer. Deze indicatoren zijn met geel aangegeven en de vraag is om de beste aan te kruizen. Ben je van mening dat een combinatie van indicatoren nodig is, dan kun je ook meerdere aankruisen. Ben je onzeker over een attribuut of indicator, dan mag deze worden overgeslagen.

Zie hieronder een voorbeeld met redenen om naar een supermarkt te gaan:

	Factor [indicator]	Waardering (1-5)
1.	**Afstand** [ ] [km] [x] [tijd]	5
2.	**Prijs** [euro]	5
3.	**Klantvriendelijkheid** [x] [begroetingen per medewerker] [x] [tijd die het kost om vraag juist te beantwoorden]	3

Verklaring ingevuld voorbeeld: De afstand en prijs van een supermarkt hebben een 5 gekregen, de klantvriendelijkheid een 3. Verder heb ik aangegeven dat tijd de beste manier zou zijn om afstand te meten, terwijl klantvriendelijkheid het beste met beide indicatoren gemeten kan worden.

De lijst begint op de volgende pagina

Succes!

	Factor [indicator]	Waardering (1-5)
1.	**Bereidheid tot samenwerken** [ ] [hoeveelheid gedeelde initiatieven] [ ] ['bereidheid' aangegeven in enquête]	
2.	**Sociale druk op behoud tradities** ['sociale druk' aangegeven in enquête]	
3.	**Lokale voorbeelden/ambassadeurs voor maatregelen** [aanwezigheid voorbeeldveld of -boerderij]	
4.	**Sociale Cohesie** [sociale cohesie, aangegeven in enquête]	
5.	**Sociale netwerken** [ ] [hoeveelheid netwerken] [ ] [betrokkenheid in netwerken per huishouden] [ ] [informatie-uitwisseling in netwerken]	
6.	**Familie** [ ] [hoeveelheid hulp van familie] [ ] [hoeveelheid naaste verwanten in de regio]	
7.	**Participatie** [% deelnemers aan lokaal georganiseerde evenementen]	
8.	**Solidariteit** [ ] [hoeveelheid vrijwilligers] [ ] ['solidariteit' aangegeven in enquête]	
9.	**Religie** [ ] [hoeveelheid religieuze organisaties] [ ] [hoeveelheid religieuze inwoners]	
10.	**Vrouwelijke betrokkenheid bij beslissingen** [%]	
11.	**Huishoudens met vrouw aan het hoofd** [%]	
12.	**Agrarische bevolking** [ ] [Hoeveelheid agrariërs] [ ] [Ratio agrariërs: niet-agrariërs]	
13.	**Leeftijd van grondgebruiker** [gemiddelde leeftijd]	
14.	**65-plussers** [%]	
15.	**Eenpersoonshuishoudens** [%]	
16.	**Migratiegraad** [migratiegraad]	
17.	**Putten en irrigatie** [ ] [% droge gronden gedekt] [ ] [aanwezigheid]	
18.	**Gebruik van irrigatie** [ ] [geïrrigeerd oppervlakte in ha] [ ] [efficiëntie (benut : onttrokken)]	
19.	**Mogelijkheid voor irrigatie** [% van het land]	
20.	**Aanwezigheid potentiële infrastructuur voor wateropslag en -toevoer**	

[m3] [m]	
21. Kosten irrigatie [ ] [euro/ton gewas] [ ] [opbrengst - kosten]	
22. Lokale wateropslag [ ] [m3] [ ] [potentiële afvoer – reële afvoer]	
23. Diversiteit waterbronnen [hoeveelheid]	
24. Multifunctioneel drainage systeem [% van het gebied]	
25. Hergebruik restwaterstromen [ ] [m3] [ ] [kosten in euro/m3] [ ] [ratio m3 hergebruikt restwater : m3 restwater]	
26. Huizenvoorraad [hoeveelheid/km2]	
27. Kwaliteit huizenvoorraad [% reparaties nodig]	
28. Kwaliteit schuren [ ] [Opslagcapaciteit] [ ] [% reparaties nodig]	
29. Waarschuwingssysteem droogte [aanwezigheid]	
30. Financiële capaciteit lokale overheid [ ] Omzet [euro/capita] [ ] Uitgaven [euro/capita]	
31. Positieve financiële stimulatie voor maatregelen [% deelnemende grondgebruikers]	
32. Andersoortige stimulatie voor maatregelen [% deelnemers]	
33. Financiële compensatie voor natuurbeheer [% deelnemende grondgebruikers]	
34. Lange termijns- en adaptieve plannen [ ] [aanwezigheid en fase in regionaal proces met betrokkenen] [ ] [aanwezigheid beleidsdocument] [ ] [hoeveelheid 'verandering' genoemd in relevante beleidsstukken]	
35. Droogteplan [ ] [aanwezigheid] [ ] [duidelijkheid aangegeven in enquête] [ ] [effectiviteit] [ ] [hoeveelheid programma's over droogte] [ ] [hoeveelheid inwoners beïnvloed] [ ] [% organisaties die het gebruiken] [ ] [gebruik in ruimtelijke planning]	
36. Deelname aan Deltaprogramma agrarisch waterbeheer [hoeveelheid contactmomenten met DAW-team]	
37. Juridische mogelijkheid nieuwe verdien- en bedrijfsmodellen [aanwezigheid]	
38. Samenwerking en coördinatie tussen sectoren en overheden [ ] [aanwezigheid] [ ] [beoordeling via enquête]	
39. Duidelijke afspraken met en tussen overheden [aanwezigheid publieke documenten]	

40. Wetten voor droogteadaptatie [ ] [hoeveelheid] [ ] [wettelijk afgedwongen wateropslag in m3 pp]	
41. Kwaliteit ruimtelijke planning [ ] [% kwetsbare gebieden aangegeven in planning] [ ] [% fysieke infrastructuur ingetekend] [ ] [aanwezigheid registers voor beperking watergebruik]	
42. Aandacht voor droogte [ ] [Hoeveelheid commissies voor droogte] [ ] [Hoeveelheid strategische alliantie voor droogte] [ ] [Hoeveelheid mensen actief in waterbesparing]	
43. Lokaal waterbeheer [aanwezigheid]	
44. Pachtcontracten [% van land]	
45. Inkomen / Bruto regionaal product [ ] [Inkomen: euro/inwoner] [ ] [Inkomen: euro/huishouden] [ ] [% verandering in inkomen over afgelopen jaar] [ ] [BRP: euro/inwoner]	
46. Agrarisch inkomen [ ] [Waarde van verkochte agrarische producten in euro/km2] [ ] [Bruto nationaal product van de landbouw]	
47. Grootte agrarische ondernemingen [lokaal relatief: percentages groot, middel en klein]	
48. Economische gelijkheid [ ] [% populatie onder armoedegrens] [ ] [Gini-index]	
49. Vermogen [ ] [waarde eigendom] [ ] [waarde eigendom, behalve grond] [ ] [huurprijzen]	
50. Werkloosheid [werkloosheidsgraad]	
51. Spaargeld / Schulden [ ] [euro] [ ] [solvabiliteit]	
52. Prijs huidige gewassen [euro/ton]	
53. Productiekosten [euro/ton]	
54. Investeringen in landbouw [euro]	
55. Beschikbaarheid veevoer [euro/kg]	
56. Beschikbaarheid mest en organische stof [euro/kg]	
57. Korte termijn kosten maatregelen droogte [euro]	
58. Genomen maatregelen droogte [hoeveelheid]	
59. Privé- of gemeenschappelijke verzekering [% verzekerd]	
60. Gebruik weersverwachting om te anticiperen op droogte	

[% grondgebruikers]	
61. Alternatieve graasstrategieën [ ] [% vee dat graast in andere gebieden tijdens droogte] [ ] [aanwezigheid gemeenschappelijke graasgronden]	
62. Gebruik droogteresistente gewassen [ ] [ha] [ ] [% op droogtegevoelig land] [ ] [watergebruik in mm] [ ] [potentieel – huidige evapotranspiratie] [ ] [m3/ha]	
63. Kwaliteit droogteresistente gewassen [ ] [eiwitten /ha] [ ] [eiwitten / droog jaar]	
64. Kosten droogteresistente gewassen [ ] [euro/ton] [ ] [euro/ha]	
65. Kennis over methoden droogteresistente gewassen [aanwezigheid]	
66. Markt voor droogteresistente gewassen [% van verkoop]	
67. Kwaliteit gewassen voor bufferzones [eiwitten/ha]	
68. Extensieve vormen van landbouw [% van totaal]	
69. Vee [ ] [livestock/ha] [ ] [opbrengst/ha]	
70. Natuurinclusieve landbouw [% van potentieel gebruik]	
71. Toekomstgerichte duurzame bedrijfsvoering [ ] [hoeveelheid duurzaam georiënteerde bedrijven] [ ] [hoeveelheid deelnemende bedrijven waterplan]	
72. Watervasthoudendvermogen bodem [ ] [watervasthoudendvermogen] [ ] [mm] [ ] [bodemvochtgehalte]	
73. Organisch stofgehalte bodem [organisch stofgehalte]	
74. Biologische kwaliteit van de bodem [dichtheid wormen]	
75. Chemische kwaliteit van de bodem [nitraatconcentratie 0,5m onder de wortelzone]	
76. Fysische kwaliteit van de bodem [ ] [compactheid] [ ] [infiltratiecapaciteit] [ ] [% ondoorlaatbare bodem]	
77. Productiviteit [ ] [ton/ha zonder extra giften aan bodem] [ ] [ton /ha] [ ] [ton/capita]	
78. Winterploegen of niet ploegen [ratio toegepast : niet toegepast]	
79. Gebruik kunstmest [ ] [kg/ha]	

[ ] [% organische mest]	
80. Bomen [ha]	
81. Begroeide stukken land [% beschutte grond/dag]	
82. Noodzaak open karakteristiek landschap [ ] [aantrekkelijkheid, aangegeven in enquête] [ ] [aantal jaar in gebruik als landbouwgrond]	
83. Adequaat grondwaterbeheer [ ] [mm opslag] [ ] [vermindering gebruik in mm]	
84. Grootte en vorm van percelen [ ] [ha aaneengesloten en rechthoekige percelen] [ ] [ratio aaneengesloten stukken : eigenaren]	
85. Mobiliteit grondposities [% eigenaar gewisseld / jaar]	
86. Potentiële mobiliteit grondposities [ ] [aantal jaar eigendom zelfde huishouden (emotionele waarde)] [ ] [m huis tot veld] [ ] [grondprijs in euro/ha]	
87. Fysieke mogelijkheid voor maatregelen [ ] [mogelijkheid] [ ] [ruimte: *ratio agrarisch land : ander gebruik*]	
88. Functie in gebied volgt watersysteem [gat tussen huidige en optimale waterstanden]	
89. Connectie soorten landgebruik [aanwezigheid]	
90. Biodiversiteit [biodiversiteitsindex]	
91. Lokale kennis over droogte [[kennis, aangegeven in enquête]	
92. Lokale kennis over effectiviteit maatregelen [ ] [kennis, aangegeven in enquête] [ ] [% grondgebruikers met kennis] [ ] [gerealiseerde waterbesparingen]	
93. Wetenschappelijke kennis over effectiviteit maatregelen [hoeveelheid rapporten en artikelen over maatregelen]	
94. Kennis over lokaal watersysteem [ ] [aanwezigheid openbaar toegankelijke beschrijving] [ ] [hoeveelheid informatiebijeenkomsten over lokaal watersysteem]	
95. Bedrijfsspecifieke coaching over droogte [ ] [% deelnemende grondgebruikers] [ ] [% grote veranderingen bij deelnemende grondgebruikers]	
96. Bereidheid tot innovatie en verandering [innovatievermogen, aangegeven in enquête]	
97. Bewustzijn en acceptatie onvoorspelbaar klimaat [% deelnemers aan praktisch ingestelde bijeenkomsten]	
98. Gevoel van urgentie [aantal verzoeken voor hulp bij adaptatie per agrarisch bedrijf]	
99. Maatschappelijke acceptatie 'minder' [euro/kg, aangegeven in enquête]	
100. Wenselijkheid om in het gebied te blijven [ ] [hoop voor de toekomst, aangeven in enquête] [ ] [verbondenheid met gebied, aangeven in enquête]	

[ ] [kwaliteit van leven, aangegeven in enquête]	
101. Mentale gezondheid [mentale gezondheid, aangegeven in enquête]	
102. Opleidingsniveau [ ] [opleidingsniveau hoofd huishouden [ ] [% ouder dan 25 met middelbare school diploma] [ ] [gemiddeld opleidingsniveau]	
103. Landbouwervaring [jaren]	
104. ICT vaardigheden [% ICT vaardig, aangegeven in enquête]	

A1.3 Choice-experiment Instructions and Choice-experiment (Dutch)

Beste deelnemer,

Op de volgende pagina staan zes keuzes gegeven. Telkens gaat de keuze tussen twee sets (A en B) van adaptatiefactoren. De opdracht is om telkens de set te kiezen die het beste het adaptatievermogen van de Doesburger Eng beschrijft voor droogte en verminderde grondwaterbeschikbaarheid.

Elke set bestaat uit zes factoren, waar ook bij is aangegeven of deze alleen of voornamelijk in de wetenschappelijke literatuur *(lit)* is genoemd, of tijdens de interviews *(int)*.

Hieronder volgt een voorbeeld (met 2 ipv 6 factoren):

A - Voorbeeld	B - Voorbeeld
- Gebruik restwater (int) - Diversiteit inkomsten (lit)	- Watervasthoudendvermogen bodem (int) - Aantal sportorganisaties (lit)

Uit deze twee kies ik de meest relevante set. Voor de duidelijkheid: het gaat dus om welke set in het geheel het adaptatievermogen beter kan omschrijven. Vervolgens maak ik de keuze duidelijk door de letter van de betere set een kleur te geven, of die van de minder goede set weg te halen. Dus als ik A beter vind, geef ik dat zo weer:

A - Voorbeeld	
- Gebruik restwater (int) - Diversiteit inkomsten (lit)	- Watervasthoudendvermogen bodem (int) - Aantal sportorganisaties (lit)

OF

A - Voorbeeld	B - Voorbeeld
- Gebruik restwater (int) - Diversiteit inkomsten (lit)	- Watervasthoudendvermogen bodem (int) - Aantal sportorganisaties (lit)

De sets staan op de volgende pagina.

Succes!

A1	B1
- Totaal nitraat en fosfor (lit) - Bereidheid om te leren (int) - Inkomensgelijkheid (lit) - Netto migratie (lit) - Kwaliteit van bebouwing (lit) - Financiële slagkracht lokale overheid (lit)	- Biomassa micro-organismen in bodem (lit) - Bereidheid tot adaptatie (int) - Gemiddeld inkomen huishouden (int) - Leeftijd grondgebruiker (int) - Hoeveelheid bebouwing (int) - Publieke bewustwordingscampagnes (lit)
A2	**B2**
- Organisch stofgehalte bodem (int) - Mentale gezondheid in gebied (lit) - Toerisme potentie (lit) - Religie (int) - Kosten van irrigatie (int) - Hoeveelheid droogteplannen (lit)	- Biomassa micro-organismen in bodem (lit) - Voorkomen chronische ziekten (lit) - Lokaal toegevoegde waarde producten (lit) - Sociale netwerken (lit) - Fysieke mogelijkheid irrigatie (lit) - Publieke bewustwordingscampagnes (lit)
A3	**B3**
- Begroeide delen land (lit) - Mentale gezondheid in gebied (lit) - Stabiliteit banen (lit) - Sociale netwerken (lit) - Gebruik irrigatie (lit) - Allianties voor droogteadaptatie (lit)	- Bosareaal (lit) - Ervaring grondgebruiker (lit) - Verzekeringen (int) - Criminaliteit (int) - Kwaliteit van bebouwing (lit) - Betrokken Ngo's* bij droogteadaptatie (int)
A4	**B4**
- Diversiteit gewassen (lit) - Opleidingsniveau (int) - Schulden (int) - Leeftijd grondgebruiker (int) - Betrouwbare wegen (lit) - Financiële slagkracht lokale overheid (lit)	- Hoeveelheid biologische gewassen (int) - Goed begrip 'risico' (int) - Gemiddeld inkomen huishouden (int) - Deel inwoners dat stemt (int) - Betrouwbare elektriciteitsvoorziening (int) - Betrokken Ngo's* bij droogteadaptatie (int)
A5	**B5**
- Diversiteit gewassen (lit) - Bereidheid om te leren (int) - Verzekeringen (int) - Conflicten over water (lit) - Betrouwbare wegen (lit) - Allianties voor droogteadaptatie (lit)	- Begroeide delen land (lit) - Opleidingsniveau (int) - Schulden (int) - Religie (int) - Hoeveelheid bebouwing (int) - Mensen actief met waterbesparing (int)
A6	**B6**
- Organisch stofgehalte bodem (int) - Ervaring grondgebruiker (lit) - Toerisme potentie (lit) - Conflicten over water (lit) - Gebruik irrigatie (lit) - Profiterende huishoudens droogteplan (lit)	- Diversiteit gewassen (lit) - Bereidheid tot adaptatie (int) - Stabiliteit banen (lit) - Criminaliteit (int) - Kosten irrigatie (int) - Mensen actief met waterbesparing (int)

*Ngo = non-gouvernementele organisatie (organisatie die zich los van de overheid inzet voor maatschappelijke doelen)

Annex 2 – Outcomes Systematic Literature Review

A2.1 Eliminated articles from systematic literature review

Below are the articles that were part of the first selection in the systematic literature review. They were read, but not used to create initial list for various reasons. Those reasons are given in the table below.

Article	Reason not included
1. Bergamini et al., 2013	All indicators part of Cifcioglu, 2017
2. Birthal et al., 2015	Only a few indicators (irrigation and drought resistant crops)
3. Brooks et al., 2005	Not relevant (only national level)
4. Easdale et al., 2010	No resilience indicators
5. FAO, 2010	All indicators part of Tambo & Wunscher, 2017
6. Gil et al,. 2017	No resilience indicators
7. Hinkel, 2011	No resilience indicators
8. Hoy 2015	Only 2 indicators (biological and cultural diversity)
9. Maleksaeidi et al,. 2015	Low quality indicators
10. Meuwissen et al., 2019	No resilience indicators
11. Murphy 2007	No resilience indicators
12. Nelson et al., 2007	No resilience indicators
13. Perrin et al. 2020	Not relevant (resilience defined as satisfaction)
14. Rao et al., 2016	Not relevant
15. Ruiz et al., 2010	No resilience indicators
16. Shah et al. 2017	No resilience indicators
17. Shi et al., 2017	Not relevant
18. Van Apeldoorn et al., 2011	Only a few indicators (soil and nitrogen focused)
19. Vommaro et al., 2020	Not relevant
20. Wang et al., 2013	Not relevant (saline agriculture)

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A2.2 Initial attributes and indicators from SLR

In the table below, the attributes and indicators retrieved via SLR are listed. The capital and general resilience principle for each attribute and indicator are given, as well as the sources. Additionally, a note is made when two similar (but not identical) indicators were merged, and a note is made on choices in the preselection that were not straightforward.

The colour-coding represents how attributes and indicators were treated in the preselection.

- Green: selected
- Orange: not selected, because only listed by one source
- Red: not selected, because of another reason
- Blue: selected, but merged with others

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
Cohesion	Social	Modularity	Value Cohesion	Social	Diversity	Cutter et al 2008	N.A.	Split indicators in attributes - which meant value cohesion had only one source
			Social Cohesion	Social	Modularity	Habiba et al 2011; Brown et al 2016	Social cohesion and sense of community combined	N.A.
Cultural Traditions	Social	Feedbacks	Degree of maintenance of cultural traditions	Social	Feedbacks	Ciftioglu 2017	N.A.	N.A.
Social network	Social	Modularity	Social networks	Social	Modularity	Mutabazi et al 2015	N.A.	blue combined to [number of social networks]
			Farmer networks	Social	Modularity	Brown et al 2016	N.A.	N.A.
			intercooperation and partnership	Social	Modularity	Khatibi et al 2019	N.A.	N.A.
			Number of household member in social network	Social	Modularity	Tambo et al 2017	N.A.	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
			Diversity of social networks	Social	Diversity	Panpakdee et al 2018	N.A.	N.A.
			Knowledge exchange in networks	Social	Feedbacks	Panpakdee et al 2018	N.A.	N.A.
Family	Social	Reserves	Family support	Social	Reserves	Brown et al 2016	N.A.	blue combined with family support as [amount of family support]
			Number of close relatives	Social	Openness	Zhang et al 2019	N.A.	N.A.
			Family farm labour	Social	Reserves	Mutabazi et al 2015	N.A.	N.A.
Participation	Social	Modularity	Participation in conservation activities	Social	Modularity	Khatibi et al 2019	N.A.	blue combined in participation in locally organized events
			Participation	Social	Modularity	Habiba et al 2011; Panpakdee et al 2018; Cutter et al 2008	N.A.	N.A.
Solidarity	Social	Modularity	Number of people volunteered to assist	Social	Modularity	Zhang et al 2019	N.A.	N.A.
			Degree of solidarity	Social	Modularity	Panpakdee et al 2018	N.A.	N.A.
Neighbours	Social	Consciousness	Examples set by neighbours	Social	Consciousness	Panpakdee et al 2018	N.A.	N.A.
Isolation	Social	Openness	Isolation	Social	Openness	Brown et al 2016	N.A.	N.A.
Cooperatives	Social	Modularity	Being in a cooperative	Social	Modularity	Panpakdee et al 2018	N.A.	N.A.
Conflict	Social	Feedbacks	Water related conflict	Social	Feedbacks	Habiba et al 2011	N.A.	N.A.
			Highlighting dramas	Social	Feedbacks	Habiba et al 2011	N.A.	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
Leadership	Social	Modularity	Acceptance of leader	Social	Modularity	Habiba et al 2011	N.A.	N.A.
Crimes	Social	Consciousness	Serious crimes known by police / 10,000 individuals	Social	Consciousness	Mihunov et al 2018	N.A.	N.A.
Consensus	Social	Diversity	Consensus	Social	Diversity	Habiba et al 2011	N.A.	N.A.
Religion	Social	Modularity	Number of faith based organizations	Social	Modularity	Cutter et al 2008	N.A.	N.A.
			Number of religious adherents	Social	Diversity	Sherrieb et al 2010	N.A.	N.A.
Sport and civic organizations	Social	Modularity	Amount	Social	Modularity	Sherrieb et al 2010	N.A.	N.A.
Urban influence	Social	Openness	Urban influence	Social	Openness	Sherrieb et al 2010	N.A.	N.A.
Involvement women in decision-making	Social	Modularity	%	Social	Modularity	Ciftioglu 2017; Panpakdee et al 2018; Cutter et al 2008	N.A.	N.A.
Female-headed households	Social	Diversity	%	Social	Diversity	Mihunov et al 2018; Mutabazi et al 2015	Mutabezi et al literally: gender household head	N.A.
Female workforce	Social	Diversity	%	Social	Diversity	Mihunov et al 2018	N.A.	N.A.
Urban-Rural population	Social	Openness	Rural population	Social	Reserves	Simelton et al 2009; Bizikova et al 2019	N.A.	Not relevant: no clear distinction as on edge of town
			Urbanization rate	Social	Openness	Simelton et al 2009	N.A.	N.A.
Farmer population	Social	Reserves	% Rural farm population	Social	Diversity	Mihunov et al 2018	N.A.	Not relevant: no clear distinction as on edge of town,

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
								farm population aspect also part of other two indicators below
			Number of farmers	Social	Reserves	Bizikova et al 2019	N.A.	N.A.
			Ratio farmers: non-farmers	Social	Reserves	Liu et al 2019	N.A.	N.A.
Labour ability	Social	Reserves	Workers household/household size	Social	Reserves	Zhang et al 2019	N.A.	N.A.
Civilian labour force	Social	Reserves	%	Social	Reserves	Mihunov et al 2018	N.A.	N.A.
Access to labour	Social	Openness	Access to labour	Social	Openness	Brown et al 2016	N.A.	N.A.
Age of land user	Social	Feedbacks	Average age	Social	Feedbacks	Brown et al 2016; Cutter et al 2008	N.A.	N.A.
Farmers over 65s	Social	Diversity	%	Social	Diversity	Bizikova et al 2019; Liu et al 2019; Mihunov et al 2018	N.A.	N.A.
Total under 5s	Social	Modularity	%	Social	Modularity	Mihunov et al 2018	N.A.	N.A.
Single person households	Social	Reserves	%	Social	Reserves	Bizikova et al 2019; Panpakdee et al 2018	N.A.	N.A.
Single parent families	Social	Reserves	Ratio single parent : two parents	Social	Reserves	Sherrieb et al 2010	N.A.	N.A.
Size of household	Social	Reserves	Average amount	Social	Reserves	Mihunov et al 2018	N.A.	N.A.
Migration	Social	Openness	Migration rate	Social	Openness	Ciftioglu 2017; Sherieb et al 2010; Habiba et al 2011	Habiba et al literally: migration	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
Temporal Migration	Social	Openness	% Temporal migration for work	Social	Openness	Benegas et al 2009	N.A.	N.A.
			% Farms affected by temporal migration	Social	Openness	Benegas et al 2009	N.A.	N.A.
Population growth	Social	Reserves	Natural population growth rate	Social	Reserves	Liu et al 2019	N.A.	N.A.
Voting behaviour	Social	Consciousness	% Population voted in national election	Social	Consciousness	Mihunov et al 2018	N.A.	N.A.
Origin inhabitants	Social	Diversity	% Population born in the same area	Social	Diversity	Mihunov et al 2018	N.A.	N.A.
Housing Stock	Physical	Reserves	[amount/km2]	Physical	Reserves	Mihunov et al 2018; Liu et al 2019	N.A.	N.A.
Housing Quality	Physical	Reserves	% Repairs needed	Physical	Reserves	Bizikova et al 2019; Cutter et al 2008; Zhang et al 2019	Zhang et al literally: housing condtions	N.A.
Mobile homes	Physical	Reserves	[amount/km2]	Physical	Reserves	Mihunov et al 2018	N.A.	N.A.
Plumbing	Physical	Feedbacks	% Households with no plumbing	Physical	Feedbacks	Mihunov et al 2018	N.A.	N.A.
Telephone service	Physical	Openness	% Housing units with no telephone service	Physical	Openness	Mihunov et al 2018; Bizikova et al 2019; Tambo et al 2017; Brown et al 2016	N.A.	Not relevant in this part of the NL - 100%
Electricity	Physical	Feedbacks	Electricity supply	Physical	Feedbacks	Habiba et al 2011; Tambo et al 2017	N.A.	Not relevant in this part of the NL - 100%
Fuel	Physical	Feedbacks	Fuel supply	Physical	Feedbacks	Habiba et al 2011	N.A.	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
ICT	Physical	Openness	% Access and ability to use ICT services	Physical	Openness	Panpakdee et al 2018; Bizikova et al 2019	N.A.	N.A.
Quality of roads	Physical	Modularity	Road density in km/km2	Physical	Modularity	Bizikova et al 2019; Brown et al 2016; Cutter et al 2008	Brown et al literally: road networks; Cutter et al literally: transport network	Not considered relevant in NL: well connected
			Distance to all-weather road in km	Physical	Openness	Tambo et al 2017	N.A.	N.A.
Rail network	Physical	Openness	Rail density in km/km2	Physical	Openness	Simelton et al 2009; Brown et al 2016; Cutter et al 2008	Brown et al literally: rail networks; Cutter et al literally: transport networks	Not considered relevant in NL: well connected
Barn quality	Physical	Reserves	Barn quality	Physical	Reserves	Bizikova et al 2019	N.A.	Defined as [% repairs needed]
			Food storage capacity	Physical	Reserves	Liu et al 2019	N.A.	N.A.
Greenhouse usage	Physical	Modularity	Greenhouse usage	Physical	Modularity	Bizikova et al 2019	N.A.	N.A.
Risk farm infrastructure	Physical	Modularity	% Farm infrastructure in high flood risk zone	Physical	Modularity	Bizikova et al 2019	N.A.	N.A.
Machinary Power	Physical	Reserves	kW	Physical	Reserves	Simelton et al 2009	N.A.	N.A.
Slaughterhouse access	Physical	Openness	Slaughterhouse access	Physical	Openness	Ripoll-Bosch et al 2012	N.A.	N.A.
Early drought warning	Physical	Consciousness	Presence early warning systems	Physical	Consciousness	Benegas et al 2009;Tambo et al 2017; Habiba et al 2011	Habiba et al mention specifically 'drought	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
							warning' , others 'early warning'	
Access to general infrastructure	Physical	Openness	Degree of access to basic infrastructure	Physical	Openness	Ciftioglu 2017	N.A.	Not considered relevant in NL, well connected
			Critical infrastructure	Physical	Modularity	Cutter et al 2008	N.A.	N.A.
Quality of general infrastructure	Physical	Openness	Age and quality of infrastructure	Physical	Openness	Bizikova et al 2019	N.A.	N.A.
Presence of irrigation and wells	Physical	Reserves	Irrigation system and channels	Physical	Reserves	Habiba et al 2011; Khatibi et al 2019	Khatibi et al literally: attention to irrigation channels	blue combined to [presence of irrigation and wells]
			Irrigation Facilities	Physical	Reserves	Habiba et al 2011; Panpakdee et al 2018	N.A.	N.A.
			Modified irrigation measures	Physical	Reserves	Khatibi et al 2019	N.A.	N.A.
			Number of wells	Physical	Reserves	Liu et al 2019	N.A.	N.A.
Use of irrigation	Physical	Reserves	Efficiency of irrigation system	Physical	Reserves	Benegas et al 2009	N.A.	N.A.
			Irrigation prevalence	Physical	Reserves	Williges et al 2017; Habiba et al 2011	Habiba et al literally: supplemental irrigation	blue combined as irrigated area [ha]
			Irrigated area in ha	Physical	Reserves	Simelton et al 2009	N.A.	N.A.
			Irrigation used	Physical	Reserves	Mutabazi et al 2015	N.A.	N.A.
Costs of irrigation	Physical	Feedbacks	Water irrigation costs	Physical	Feedbacks	Bizikova et al 2019; Liu et al 2019	N.A.	No specific measure, so integrated in

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
								participatory indicator
Diversity of water sources	Physical	Diversity	Amount	Physical	Diversity	Panpakdee et al 2018; Brown et al 2016	N.A.	N.A.
Reservoirs	Physical	Reserves	Reservoir capacity	Physical	Reserves	Liu et al 2019; Habiba et al 2011: Brown et al 2016	Habiba et al and Brown et al: water reservoir	blue combined as retention in [m3]
			Rain water harvesting	Physical	Reserves	Habiba et al 2011	N.A.	N.A.
			Presence dam	Physical	Modularity	Habiba et al 2011	N.A.	Not relevant in NL
Locally adapted water infrastructure	Physical	Feedbacks	% Water infrastructure adapted to local use	Physical	Feedbacks	Benegas et al 2009	N.A.	N.A.
Access to water	Physical	Modularity	% Without water access	Physical	Modularity	Bizikova et al 2019	N.A.	N.A.
Rainfall dependency	Physical	Reserves	Dependency on rainfall	Physical	Reserves	Habiba et al 2011	N.A.	N.A.
Finances local government	Institutional	Reserves	Revenue local government in euro/capita	Institutional	Reserves	Mihunov et al 2018; Cutter et al 2008	Cutter et al literally: municipal revenues	N.A.
			General expenditures local government in euro/capita	Institutional	Reserves	Mihunov et al 2018; Habiba et al 2011	Habiba et al literally: aids, subsidy	N.A.
Education money	Institutional	Reserves	Expenditure for education local government	Institutional	Reserves	Mihunov et al 2018	N.A.	N.A.
Drought money	Institutional	Feedbacks	Financial schemes to combat drought	Institutional	Feedbacks	Benegas et al 2009	N.A.	N.A.
Drought plans	Institutional	Consciousness	Hazard mitigation plans	Institutional	Consciousness	Cutter et al 2008	N.A.	Combined with water management

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
								activities in: [existence]
			Effectiveness of plan	Institutional	Reserves	Habiba et al 2011	N.A.	N.A.
			Continuity of plans	Institutional	Feedbacks	Cutter et al 2008	N.A.	Closely related to effectiveness, so decided to ignore
			Number of projects on droughts	Institutional	Consciousness	Benegas et al 2009	N.A.	N.A.
			Amount of projects on drought	Institutional	Feedbacks	Benegas et al 2009	N.A.	N.A.
			Participation in hazard reduction programs	Institutional	Modularity	Cutter et al 2008	N.A.	Closely related to beneficiaries, so decided to ignore
			% Familes benefiting from projects	Institutional	Modularity	Benegas et al 2009	N.A.	N.A.
			Water management activities	Institutional	Consciousness	Habiba et al 2011; Bizikova et al 2019	Bizikova et al literally: frequency of water shortage measures	Combined with hazard mitigation plans in [existence]
Programmes for awareness	Institutional	Consciousness	Public awareness programme	Institutional	Consciousness	Habiba et al 2011	N.A.	N.A.
			Training	Institutional	Openness	Habiba et al 2011	N.A.	N.A.
			Community leader	Institutional	Consciousness	Habiba et al 2011	N.A.	N.A.
Laws for drought adaptation	Institutional	Feedbacks	Number of laws related to drought adaptation	Institutional	Feedbacks	Benegas et al 2009	N.A.	Combined in [amount]
			Degree of effective protection by	Institutional	Openness	Ciftioglu 2017	N.A.	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
			relevant institutions					
Drought agreements	Institutional	Consciousness	Number of emergency and strategic agreements on drought	Institutional	Consciousness	Benegas et al 2009	N.A.	N.A.
			Number of pacts and agreements on drought adaptation	Institutional	Consciousness	Benegas et al 2009	N.A.	N.A.
			Evaluation of agreements on drought	Institutional	Modularity	Benegas et al 2009	N.A.	N.A.
			Number of meetings on adaptation per year	Institutional	Consciousness	Benegas et al 2009	N.A.	N.A.
Quality spatial planning	Institutional	Modularity	% Planning that includes vulnerable areas	Institutional	Modularity	Benegas et al 2009	N.A.	N.A.
			% Physical infrastructure on operative plans	Institutional	Modularity	Benegas et al 2009; Bizikova et al 2019	Bizikova et al literally: unmapped infrastructure	N.A.
			Existence of registers of reduction of water use	Institutional	Feedbacks	Benegas et al 2009	N.A.	N.A.
Drought in planning	Institutional	Consciousness	Incorporation drought plans in planning	Institutional	Consciousness	Habiba et al 2011	N.A.	Part of Drought Plan
			% Organizations employing national drought plans in region	Institutional	Consciousness	Benegas et al 2009	N.A.	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
Standards in planning	Institutional	Modularity	Zoning and building standards	Institutional	Modularity	Cutter et al 2008	N.A.	N.A.
Awareness of planning	Institutional	Consciousness	% Actors aware about planning on vulnerable areas	Institutional	Consciousness	Benegas et al 2009	N.A.	N.A.
Coordination and Communication	Institutional	Modularity	Coordination of intersectorial meeting for active participation	Institutional	Modularity	Benegas et al 2009	N.A.	Combined in [presence]
			Coordination	Institutional	Modularity	Habiba et al 2011	N.A.	N.A.
			Interoperable communication	Institutional	Modularity	Cutter et al 2008	N.A.	N.A.
Attention to drought	Institutional	Consciousness	Number of strategic alliances	Institutional	Modularity	Benegas et al 2009	N.A.	N.A.
			Support by GOs and NGOs	Institutional	Feedbacks	Habiba et al 2011	N.A.	Vague, considered part of other indicators
			Number of commissions, entities and managing resources for droughts	Institutional	Modularity	Benegas et al 2009	N.A.	N.A.
			Collaboration	Institutional	Modularity	Habiba et al 2011	N.A.	Vague, considered part of other indicators
			Number of people active in water conservency	Institutional	Consciousness	Liu et al 2019	N.A.	N.A.
Monitor ability	Institutional	Consciousness	Ability to monitor infrastructure for entities in charge	Institutional	Consciousness	Benegas et al 2009	N.A.	N.A.
Diversity in income sources	Economic	Diversity	Occupation diversity	Economic	Diversity	Khatibi et al 2019; Sherrieb et	N.A.	Overlooked by researcher, see discussion

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
						al 2010; Cutter et al 2008		
			Farm managers with other gainfull employment	Economic	Diversity	Williges et al 2017	N.A.	N.A.
			Other Income-generating activities	Economic	Diversity	Habiba et al 2011	N.A.	N.A.
			Diversity of livelihoods at household level	Economic	Diversity	Ciftioglu 2017; Zhang et al 2019	Zhang et al literally: number of types of livelihoods	N.A.
			% Additional alternative income	Economic	Reserves	Benegas et al 2009; Ciftioglu 2017	Ciftioglu literally: degree of income from agriculture	N.A.
			% Off farm income	Economic	Diversity	Bizikova et al 2019; Brown et al 2016	N.A.	N.A.
			Off farm engagement	Economic	Diversity	Mutabazi et al 2015	N.A.	N.A.
			Diversity income sources (on and off farm)	Economic	Diversity	Panpakdee et al 2018; Brown et al 2016	N.A.	N.A.
			Number of household income sources	Economic	Diversity	Tambo et al 2017; Ripoll-Bosch et al 2012	N.A.	N.A.
			major agricultural income / total agric. Income	Economic	Diversity	Ripoll-Bosch et al 2012	N.A.	N.A.
			Income source	Economic	Diversity	Habiba et al 2011	N.A.	N.A.
Natural resources	Economic	Reserves	Available natural resources	Economic	Reserves	Brown et al 2016	N.A.	Not considered relevant in NL

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
			Degree of dependence on natural resources	Economic	Diversity	Ciftioglu 2017	N.A.	N.A.
Selling assets	Economic	Reserves	Selling of assets	Economic	Reserves	Habiba et al 2011	N.A.	N.A.
Remittances	Economic	Reserves	% Households receiving remittances	Economic	Openness	Benegas et al 2009	N.A.	Not relevant in NL
			Received remittances	Economic	Reserves	Mutabazi et al 2015	N.A.	N.A.
Tourism potential	Economic	Reserves	Number of tourist sites	Economic	Reserves	Benegas et al 2009	N.A.	N.A.
Cash assistance	Economic	Openness	Opportunity for cash asssistance	Economic	Openness	Zhang et al 2019	N.A.	N.A.
Value added products	Economic	Reserves	Value added products	Economic	Reserves	Panpakdee et al 2018	N.A.	N.A.
Ecological services	Economic	Reserves	Utilization ecological services	Economic	Reserves	Panpakdee et al 2018	N.A.	N.A.
Income, GDP	Economic	Reserves	Income in euro/capita	Economic	Reserves	Mihunov et al 2018; Tambo et al 2017; Bizikova et al 2019; Liu et al 2019	N.A.	N.A.
			Median household income in euro/household	Economic	Reserves	Mihunov et al 2018; Sherrieb et al 2010	N.A.	N.A.
			GRP of area	Economic	Reserves	Bizikova et al 2019; Liu et al 2019	N.A.	N.A.
			Cash income	Economic	Reserves	Zhang et al 2019	N.A.	Not more relevant than total income in NL
			% Change in income over past year	Economic	Reserves	Tambo et al 2017	N.A.	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
			Wealth generation	Economic	Reserves	Cutter et al 2008	N.A.	Vague, considered part of other indicators
Agricultural income	Economic	Reserves	GDP in agriculture	Economic	Reserves	Simelton et al 2009	N.A.	N.A.
			Total farm cash flow	Economic	Reserves	Williges et al 2017	N.A.	Seen as not very different from two selected indicators
			Gross output of farming	Economic	Reserves	Liu et al 2019	N.A.	N.A.
			Ratio agricultural output	Economic	Reserves	Liu et al 2019	N.A.	N.A.
			Business gain/loss rate	Economic	Reserves	Sherrieb et al 2010	N.A.	N.A.
			Value of farm products sold in euro/km2	Economic	Reserves	Mihunov et al 2018	N.A.	N.A.
Economic equality	Economic	Diversity	% Farmers that receive just payment in established time	Economic	Reserves	Benegas et al 2009	N.A.	Not considered relevant
			% Population living below poverty	Economic	Feedbacks	Mihunov et al 2018	N.A.	N.A.
			Gini-index	Economic	Diversity	Sherrieb et al 2010	N.A.	N.A.
Fixed assets	Economic	Reserves	Median rent	Economic	Feedbacks	Mihunov et al 2018	N.A.	N.A.
			Median value of owner-occupied housing	Economic	Reserves	Mihunov et al 2018	N.A.	Seen as part of value property
			Total breeding livestock assets	Economic	Reserves	Williges et al 2017; Tambo et al 2017	N.A.	Seen as part of non-land assets

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
			Household fixed capital	Economic	Reserves	Zhang et al 2019; Simelton et al 2009	N.A.	Seen as part of value below
			Value non-land assets	Economic	Reserves	Tambo et al 2017; Panpakdee et al 2018; Williges et al 2017	Panpakdee et al literally: equipment; Williges et al literally: buildings and machines	N.A.
			Value property	Economic	Reserves	Cutter et al 2008	N.A.	N.A.
Current assets	Economic	Reserves	Total current assets	Economic	Reserves	Williges et al 2017	N.A.	N.A.
Savings	Economic	Reserves	Euro	Economic	Reserves	Khatibi et al 2019; Tambo et al 2017	N.A.	Combined with debt
			Use of savings	Economic	Consciousness	Habiba et al 2011	N.A.	Vague
Employment	Economic	Feedbacks	Employment	Economic	Feedbacks	Cutter et al 2008; Sherrieb et al 2010	N.A.	Combined in [unemployment rate]
			Unemployment rate	Economic	Feedbacks	Mihunov et al 2018	N.A.	N.A.
Dependency ratio	Economic	Modularity	Ratio productive : nonproductive population	Economic	Modularity	Tambo et al 2017	N.A.	N.A.
Creative class occupation	Economic	Diversity	% Creative class occupation	Economic	Diversity	Sherrieb et al 2010	N.A.	N.A.
Agriculture occupation	Economic	Modularity	% Employment in agriculture services, forestry and fish	Economic	Modularity	Mihunov et al 2018	N.A.	N.A.
Transportation and utilities occupation	Economic	Diversity	% Employment in transportation and public utilities	Economic	Diversity	Mihunov et al 2018	N.A.	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
Public and Private sector	Economic	Diversity	Ratio household members in public/private sector	Economic	Diversity	Ciftioglu 2017	N.A.	N.A.
Stability of employment	Economic	Feedbacks	Changing occupation	Economic	Feedbacks	Habiba et al 2011	N.A.	Overlooked by researcher, see discussion
			Household members that lost job in last year	Economic	Feedbacks	Tambo et al 2017	N.A.	N.A.
Access to credit	Economic	Openness	Access to credit	Economic	Openness	Benegas et al 2009; Ciftioglu 2017; Mutabazi et al 2015; Tambo et al 2017; Brown et al 2016; Habiba et al 2011	Habiba et al literally: credit	Not considered relevant in NL
Diversity of credit sources	Economic	Diversity	Diversity credit sources	Economic	Diversity	Panpakdee et al 2018	N.A.	N.A.
Debt	Economic	Reserves	Farm solvency	Economic	Reserves	Williges et al 2017	N.A.	Combined with savings
			Euro/farm	Economic	Reserves	Bizikova et al 2019; Brown et al 2016	N.A.	N.A.
Production costs	Economic	Feedbacks	Production costs	Economic	Feedbacks	Brown et al 2016	N.A.	All combined as [production costs in euro/ton]
			Labour costs	Economic	Feedbacks	Brown et al 2016	N.A.	N.A.
			Expenditure	Economic	Feedbacks	Simelton et al 2009	N.A.	N.A.
Land price	Economic	Feedbacks	Land price	Economic	Feedbacks	Brown et al 2016	N.A.	N.A.
Insurance score	Economic	Reserves	Crop insurance index score	Economic	Reserves	Williges et al 2017	N.A.	N.A.
Access to insurance	Economic	Openness	Access to drought insurance	Economic	Openness	Benegas et al 2009	N.A.	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
Insurance overage	Economic	Reserves	% Farms with insurance	Economic	Reserves	Bizikova et al 2019; Khatibi et al 2019	Khatibi et al literally: insurance	N.A.
Safety nets	Economic	Reserves	Safety net participation	Economic	Reserves	Tambo et al 2017	N.A.	N.A.
Access to markets	Economic	Openness	Access to markets	Economic	Openness	Benegas et al 2009; Brown et al 2016; Ripoll-Bosch et al 2012; Ciftioglu 2017	N.A.	Considered as well established in NL
Diversity of markets	Economic	Diversity	Diversity of markets	Economic	Diversity	Panpakdee et al 2018	N.A.	N.A.
Agricultural investments	Economic	Openness	Investments in agriculture	Economic	Openness	Simelton et al 2009; Panpakdee et al 2018	N.A.	N.A.
Conservency investments	Economic	Openness	Investments in water conservency	Economic	Openness	Liu et al 2019	N.A.	N.A.
Rental households	Economic	Modularity	% Renting household	Economic	Modularity	Mihunov et al 2018	N.A.	N.A.
Revenue adaptation	Economic	Feedbacks	Revenue of drought solutions	Economic	Feedbacks	Khatibi et al 2019	N.A.	N.A.
Local crops use	Agri/Natural	Diversity	Degree of use of local crop and seed species	Agri/Natural	Diversity	Ciftioglu 2017	N.A.	N.A.
			Degree of production of locally sourced species	Agri/Natural	Diversity	Ciftioglu 2017	N.A.	N.A.
			Degree of use of local names of plants and animals	Agri/Natural	Consciousness	Ciftioglu 2017	N.A.	N.A.
Diversity of crops	Agri/Natural	Diversity	Number of crop species cultivated	Agri/Natural	Diversity	Ciftioglu 2017	N.A.	Overlooked by researcher, see discussion

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
			Use of crop diversification	Agri/Natural	Diversity	Mutabazi et al 2015	N.A.	N.A.
			Species diversity	Agri/Natural	Diversity	Bizikova et al 2019; Panpakdee et al 2018	N.A.	N.A.
			Diversity of varieties	Agri/Natural	Diversity	Panpakdee et al 2018	N.A.	N.A.
			Types of crop (organic, transgenic, root)	Agri/Natural	Diversity	Bizikova et al 2019	N.A.	N.A.
Drought resistant crops	Agri/Natural	Reserves	Cultivating drought-tolerant plants	Agri/Natural	Reserves	Khatibi et al 2019; Habiba et al 2011; Mutabazi et al 2015	N.A.	N.A.
Crop structure	Agri/Natural	Diversity	Crop structure (annual perennial)	Agri/Natural	Diversity	Bizikova et al 2019	N.A.	N.A.
Fruit trees	Agri/Natural	Diversity	Fruit tree plantation	Agri/Natural	Diversity	Habiba et al 2011	N.A.	N.A.
Livestock	Agri/Natural	Modularity	Livestock part of system	Agri/Natural	Modularity	Mutabazi et al 2015	N.A.	N.A.
Early maturing varieties	Agri/Natural	Diversity	Use of early maturing varieties	Agri/Natural	Diversity	Mutabazi et al 2015	N.A.	N.A.
Productivity	Agri/Natural	Reserves	tonnes /ha	Agri/Natural	Reserves	Williges et al 2017; Bizikova et al 2019; Liu et al 2019	N.A.	N.A.
			tonnes/capita	Agri/Natural	Reserves	Simelton et al 2009	N.A.	N.A.
Feed production	Agri/Natural	Reserves	kg/ha	Agri/Natural	Reserves	Bizikova et al 2019	N.A.	N.A.
Livestock	Agri/Natural	Reserves	livestock/ha	Agri/Natural	Reserves	Bizikova et al 2019; Zhang et al 2019	Zhang et al literally: number of livestock	N.A.
			Livestock productivity	Agri/Natural	Reserves	Liu et al 2019	N.A.	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
Use of fertilizer	Agri/Natural	Openness	kg/ha	Agri/Natural	Openness	Bizikova et al 2019; Liu et al 2019; Williges et al 2017	Williges et al literally: fertilizer use	All blue combined in [kg/ha]
			tonnes	Agri/Natural	Openness	Simelton et al 2009; Williges et al 2017	N.A.	N.A.
			Presence	Agri/Natural	Openness	Mutabazi et al 2015; Williges et al 2017	N.A.	N.A.
			% Farms using organic fertilizers [	Agri/Natural	Diversity	Benegas et al 2009	N.A.	N.A.
			Nutrient input in kg/ha	Agri/Natural	Openness	Bizikova et al 2019	N.A.	N.A.
Pesticide use	Agri/Natural	Openness	kg active substance	Agri/Natural	Openness	Bizikova et al 2019; Liu et al 2019	N.A.	Not considered relevant to drought resilience
Veterinary drug use	Agri/Natural	Openness	mg active substance/animal	Agri/Natural	Openness	Bizikova et al 2019	N.A.	N.A.
Dependence on local inputs	Agri/Natural	Openness	Dependence on local inputs	Agri/Natural	Openness	Panpakdee et al 2018	N.A.	N.A.
Taken adaptive measures	Agri/Natural	Consciousness	Taken adaptive measures	Agri/Natural	Consciousness	Panpakdee et al 2018; Tambo et al 2017	N.A.	N.A.
Novel technologies	Agri/Natural	Feedbacks	% Producers using novel technologies	Agri/Natural	Feedbacks	Benegas et al 2009	N.A.	N.A.
Use of forecasts	Agri/Natural	Openness	% Farmers that uses forecasts about droughts	Agri/Natural	Openness	Benegas et al 2009; Mutabazi et al 2015	Mutabazi et al literally: adjusting planting dates to forecast	N.A.
Microzoning	Agri/Natural	Modularity	% Farmers using microzoning on their parcels	Agri/Natural	Modularity	Benegas et al 2009	N.A.	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
Improved pastures	Agri/Natural	Consciousness	% Grazing farms with improved pastures	Agri/Natural	Consciousness	Benegas et al 2009	N.A.	N.A.
Preserve cattle food	Agri/Natural	Reserves	% Grazing farms who employ silos to preserve cattle food	Agri/Natural	Reserves	Benegas et al 2009	N.A.	N.A.
Grazing strategies	Agri/Natural	Openness	% Farmers who move livestock to other zones during critical drought	Agri/Natural	Openness	Benegas et al 2009	N.A.	N.A.
			Communal grazing	Agri/Natural	Modularity	Ripoll-Bosch et al 2012	N.A.	N.A.
Agroforestry	Agri/Natural	Modularity	Presence	Agri/Natural	Modularity	Mutabazi et al 2015	N.A.	N.A.
Manure management	Agri/Natural	Feedbacks	% Area under manure management strategy	Agri/Natural	Feedbacks	Bizikova et al 2019	N.A.	N.A.
Manure storage	Agri/Natural	Reserves	Manure storage type	Agri/Natural	Reserves	Bizikova et al 2019	N.A.	N.A.
Tile drainage	Agri/Natural	Openness	% Area with tile drainage	Agri/Natural	Openness	Bizikova et al 2019	N.A.	N.A.
Deep plowing	Agri/Natural	Reserves	Deep plowing in rainy season	Agri/Natural	Reserves	Khatibi et al 2019	N.A.	N.A.
Timing of crop cultivation	Agri/Natural	Feedbacks	Accuracy in timing of crop cultivation	Agri/Natural	Feedbacks	Khatibi et al 2019	N.A.	N.A.
Soil health	Agri/Natural	Reserves	Soil health	Agri/Natural	Reserves	Brown et al 2016	N.A.	N.A.
Water conservation	Agri/Natural	Reserves	Use of soil water conservation	Agri/Natural	Reserves	Mutabazi et al 2015	N.A.	N.A.
Organic Matter	Agri/Natural	Reserves	Soil organic matter content	Agri/Natural	Reserves	Liu et al 2019	N.A.	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
Erosion	Agri/Natural	Modularity	Soil erosion area	Agri/Natural	Modularity	Liu et al 2019	N.A.	Not considered relevant in this part of NL
			Soil erosion rate	Agri/Natural	Modularity	Cutter et al 2008	N.A.	N.A.
Microbes in the soil	Agri/Natural	Reserves	Soil microbial biomass	Agri/Natural	Reserves	Liu et al 2019	N.A.	N.A.
TN and TP in soil	Agri/Natural	Reserves	TN and TP in soil	Agri/Natural	Reserves	Liu et al 2019	N.A.	N.A.
Conservation	Agri/Natural	Modularity	% Area under conservation management	Agri/Natural	Modularity	Bizikova et al 2019	N.A.	Considered part of nature inclusive agriculture
			Degree of conservation	Agri/Natural	Modularity	Ciftioglu 2017	N.A.	N.A.
			% Farms and area under natural regeneration	Agri/Natural	Reserves	Benegas et al 2009	N.A.	N.A.
Buffer zones	Agri/Natural	Reserves	Existence of buffer zones	Agri/Natural	Reserves	Bizikova et al 2019	N.A.	N.A.
Plant protection	Agri/Natural	Consciousness	Degree of important plant protection efforts	Agri/Natural	Consciousness	Ciftioglu 2017	N.A.	N.A.
Land ownership	Agri/Natural	Modularity	% Land owned	Agri/Natural	Modularity	Mutabazi et al 2015; Tambo et al 2017; Panpakdee et al 2018	N.A.	Considered part of land lease
Access to land	Agri/Natural	Modularity	Degree of clear access	Agri/Natural	Modularity	Ciftioglu 2017	N.A.	Considered part of potential ground mobility
			Land access	Agri/Natural	Modularity	Ripoll-Bosch et al 2012	N.A.	N.A.
Total land	Agri/Natural	Reserves	Total land	Agri/Natural	Reserves	Simelton et al 2009	N.A.	N.A.
Agricultural land	Agri/Natural	Reserves	Agricultural land	Agri/Natural	Reserves	Simelton et al 2009	N.A.	Amount of land not considered as important

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
			Cultivated land in km2/capita/km2	Agri/Natural	Reserves	Zhang et al 2019	N.A.	N.A.
			Meadow land in km2/capita/km2	Agri/Natural	Reserves	Zhang et al 2019	N.A.	N.A.
Damaged agricultural land	Agri/Natural	Reserves	Degree of damaged agricultural land	Agri/Natural	Reserves	Ciftioglu 2017	N.A.	N.A.
Farm size	Agri/Natural	Reserves	Locally relevant: small, medium, large	Agri/Natural	Reserves	Bizikova et al 2019; Brown et al 2016; Mutabazi et al 2015	N.A.	N.A.
Green cover	Agri/Natural	Feedbacks	% cover/day	Agri/Natural	Feedbacks	Habiba et al 2011; Bizikova et al 2019	N.A.	N.A.
			ha green area /capita	Agri/Natural	Feedbacks	Liu et al 2019	N.A.	Considered as part of first
			Undisturbed land cover	Agri/Natural	Feedbacks	Bizikova et al 2019	N.A.	N.A.
Impervious surface	Agri/Natural	Modularity	% Impervious surface	Agri/Natural	Modularity	Cutter et al 2008; Mihunov et al 2018	Mihunov et al literally: average impervious rate	Combined in physical quality soil
Built up area	Agri/Natural	Modularity	Built up area	Agri/Natural	Modularity	Habiba et al 2011	N.A.	N.A.
Wetland area	Agri/Natural	Diversity	% Wetland area	Agri/Natural	Diversity	Bizikova et al 2019; Cutter et al 2008	N.A.	Not relevant in this part of NL
Forest cover	Agri/Natural	Diversity	% Forest coverage	Agri/Natural	Diversity	Bizikova et al 2019; Liu et al 2019	Bizikova et al literally: deforestation	N.A.
Spatial diversity	Agri/Natural	Diversity	Degree of spatial heterogeneity	Agri/Natural	Diversity	Ciftioglu 2017	N.A.	N.A.
Connectivity land uses	Agri/Natural	Modularity	Degree of connectivity among land uses	Agri/Natural	Modularity	Ciftioglu 2017	N.A.	Combined as [presence] of connectivity

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
			Integration of agricultural land	Agri/Natural	Modularity	Khatibi et al 2019	N.A.	N.A.
Elevation	Agri/Natural	Modularity	Mean elevation	Agri/Natural	Modularity	Mihunov et al 2018	N.A.	N.A.
Water bodies	Agri/Natural	Reserves	Average water rate	Agri/Natural	Reserves	Mihunov et al 2018	N.A.	Not relevant in this part of NL
			Water bodies	Agri/Natural	Reserves	Habiba et al 2011	N.A.	N.A.
Biodiversity	Agri/Natural	Diversity	Biodiversity	Agri/Natural	Diversity	Ciftioglu 2017; Cutter et al 2008; Brown et al 2016	Ciftioglu literally: decline in biodiversity	N.A.
			Land fragmentation threatening biodiversity	Agri/Natural	Modularity	Bizikova et al 2019	N.A.	Considered as part of the first
			Number of wild plant species	Agri/Natural	Diversity	Ciftioglu 2017	N.A.	N.A.
Recovery rate	Agri/Natural	Reserves	Degree of recovery rate	Agri/Natural	Reserves	Ciftioglu 2017	N.A.	N.A.
Pest risk	Agri/Natural	Openness	Incidence of pests	Agri/Natural	Openness	Bizikova et al 2019; Brown et al 2016	N.A.	Considered not relevant for drought resilience
Wildfire risk	Agri/Natural	Modularity	Wildfire risk	Agri/Natural	Modularity	Bizikova et al 2019	N.A.	N.A.
Willingness to stay	Human	Feedbacks	Hope for the future	Human	Feedbacks	Khatibi et al 2019; Tambo et al 2017	All of these attributes are the idea of people willing to stay and make the best of their area	N.A.
			Sense of Pride	Human	Feedbacks	Khatibi et al 2019	N.A.	Considered part of sense of belonging
			Motivation to continue living in village	Human	Feedbacks	Khatibi et al 2019	N.A.	Seen as willingness to stay

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
			Quality of life	Human	Feedbacks	Cutter et al 2008	N.A.	N.A.
			Sense of Belonging	Human	Modularity	Khatibi et al 2019; Bizikova et al 2019	N.A.	N.A.
			Sense of identity	Human	Openness	Khatibi et al 2019	N.A.	Considered part of sense of belonging
Willingness to learn	Human	Consciousness	Willingness to learn	Human	Consciousness	Panpakdee et al 2018	N.A.	N.A.
Willingness to adapt	Human	Consciousness	Willingness to adapt	Human	Consciousness	Brown et al 2016	N.A.	N.A.
General motivation	Human	Consciousness	Assiduity to achieve goals	Human	Consciousness	Khatibi et al 2019	N.A.	N.A.
Fatalism	Human	Feedbacks	Fatalism	Human	Feedbacks	Khatibi et al 2019	N.A.	N.A.
Active medical doctors	Human	Reserves	Active medical doctors [doctors/10,000 inhabitants]	Human	Reserves	Mihunov et al 2018; Sherieb et al 2010	N.A.	Considered not relevant in NL (sufficient doctors)
Counseling	Human	Openness	Counseling services	Human	Openness	Cutter et al 2008	N.A.	N.A.
Basic Health Care	Human	Openness	Degree of access to basic health care	Human	Openness	Ciftioglu 2017; Tambo et al 2017; Habiba et al 2011	Habiba et al literally: primary health care	Considered as sufficient in NL
Emergency services	Human	Openness	Access to health emergency systems	Human	Openness	Bizikova et al 2019; Tambo et al 2017; Cutter et al 2008	Cutter et al literally: emergency services	Considered as sufficient in NL
Disease	Human	Feedbacks	Extent of disease	Human	Feedbacks	Habiba et al 2011; Khatibi et al 2019	N.A.	Considered as no large differences in NL
Chronic Disease	Human	Feedbacks	3-year average chronic illness deaths/10,000 inhabitants	Human	Feedbacks	Mihunov et al 2018	N.A.	Considered as no large differences in NL

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
			Occurance chronic diseases	Human	Feedbacks	Bizikova et al 2019	N.A.	N.A.
Disabled and not working labour force	Human	Reserves	Disabled and not working labor force/10,000	Human	Reserves	Mihunov et al 2018	N.A.	N.A.
Low birthweight cases	Human	Reserves	3-year total low birthweight babies/10,000	Human	Reserves	Mihunov et al 2018	N.A.	N.A.
Mental Health	Human	Consciousness	Self indicated mental health	Human	Consciousness	Bizikova et al 2019; Brown et al 2016	N.A.	N.A.
Psychopathologies (drug, alcohol, spouse abuse)	Human	Feedbacks	Absence of psychopathologies	Human	Feedbacks	Cutter et al 2008	N.A.	N.A.
Safe water access	Human	Reserves	Access to safe water	Human	Reserves	Habiba et al 2011; Bizikova et al 2019	N.A.	Considered as sufficient in NL
			Time period having access to safe water	Human	Reserves	Habiba et al 2011	N.A.	N.A.
			Frequency of water contamination	Human	Reserves	Bizikova et al 2019	N.A.	N.A.
Consumption of food	Human	Diversity	Food consumption	Human	Diversity	Habiba et al 2011	N.A.	Considered as sufficient in NL
			Household dietary diversity score (HDDS)	Human	Diversity	Tambo et al 2017	N.A.	N.A.
Food security	Human	Reserves	Household food insecurity access score [(HFIAS)	Human	Reserves	Tambo et al 2017	N.A.	Considered as sufficient in NL
			Diversity of food sources produced at household level	Human	Diversity	Ciftioglu 2017	N.A.	N.A.

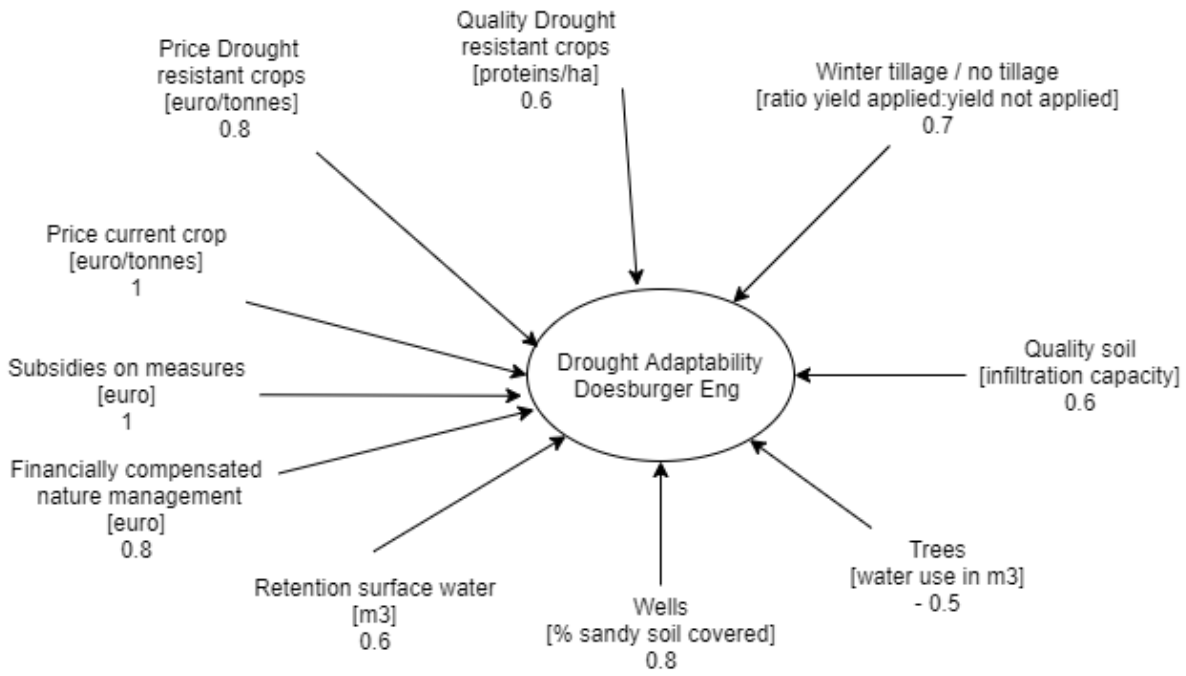
Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
Scientists working in agriculture	Human	Feedbacks	Number of scientists working in agricultural sector	Human	Feedbacks	Williges et al 2017	N.A.	N.A.
Diversity of information sources	Human	Diversity	Diversity information sources	Human	Diversity	Panpakdee et al 2018	N.A.	N.A.
Education platforms	Human	Diversity	Number of educational platforms	Human	Diversity	Panpakdee et al 2018; Habiba et al 2011	Habiba et al literally: school/college	Considered as no large difference in NL
Local input education	Human	Consciousness	% Courses designed by locals	Human	Consciousness	Panpakdee et al 2018	N.A.	N.A.
Access to information	Human	Openness	Access to information	Human	Openness	Brown et al 2016	N.A.	N.A.
Extension services	Human	Openness	Extension services	Human	Openness	Brown et al 2016	N.A.	N.A.
Education level	Human	Feedbacks	Degree of education quality	Human	Feedbacks	Ciftioglu 2017; Panpakdee et al 2018; Brown et al 2016; Ripoll-Bosch et al 2012	N.A.	Combined as [average level of education]
			Labor education level [ranks]	Human	Feedbacks	Zhang et al 2019	N.A.	N.A.
			Household head education level	Human	Feedbacks	Zhang et al 2019; Mutabazi et al 2015	N.A.	N.A.
			% Population over 25 without high school degree	Human	Feedbacks	Mihunov et al 2018	N.A.	N.A.
Agricultural training	Human	Feedbacks	% Farm managers with full agricultural training	Human	Feedbacks	Williges et al 2017	N.A.	N.A.
Literacy rate	Human	Feedbacks	Literacy rate	Human	Feedbacks	Habiba et al 2011	N.A.	N.A.

Attributes	Attribute Capital	Attribute GR principle	Indicator	Indicator Capital	Indicator GR principle	Sources	Note on combination	Note on selection
Traditional knowledge	Human	Diversity	Degree of traditional knowledge about wild plants	Human	Feedbacks	Ciftioglu 2017	N.A.	Considered as not relevant in NL
			Degree of documentation on cultural traditions	Human	Modularity	Ciftioglu 2017; Panpakdee et al 2018	N.A.	N.A.
			Use of modern and indigenous knowledge	Human	Diversity	Khatibi et al 2019	N.A.	N.A.
Farming experience	Human	Feedbacks	Years	Human	Feedbacks	Mutabazi et al 2015; Panpakdee et al 2018; Brown et al 2016	N.A.	N.A.
Skills	Human	Feedbacks	Required skills	Human	Feedbacks	Panpakdee et al 2018; Brown et al 2016	N.A.	Considered too vague, could be part of experience
Understanding risk	Human	Consciousness	Understanding of risk	Human	Consciousness	Cutter et al 2008	N.A.	N.A.
Business skills	Human	Feedbacks	Business skills	Human	Feedbacks	Brown et al 2016	N.A.	N.A.
Consumer strategies	Human	Modularity	Strategies for loyal consumers	Human	Modularity	Panpakdee et al 2018	N.A.	N.A.
Preventive measures	Human	Consciousness	Taking preventive measures	Human	Consciousness	Habiba et al 2011	N.A.	N.A.
Knowledge about drought	Human	Feedbacks	Knowledge about drought	Human	Feedbacks	Habiba et al 2011; Tambo et al 2017	N.A.	N.A.
Awareness about drought	Human	Consciousness	Awareness about drought	Human	Consciousness	Habiba et al 2011	N.A.	N.A.
Demonstration plots	Human	Modularity	New crops and technologies demonstration plots	Human	Modularity	Benegas et al 2009; Habiba et al 2011	Habiba et al literally: demonstration	Combined as local ambassador for measures

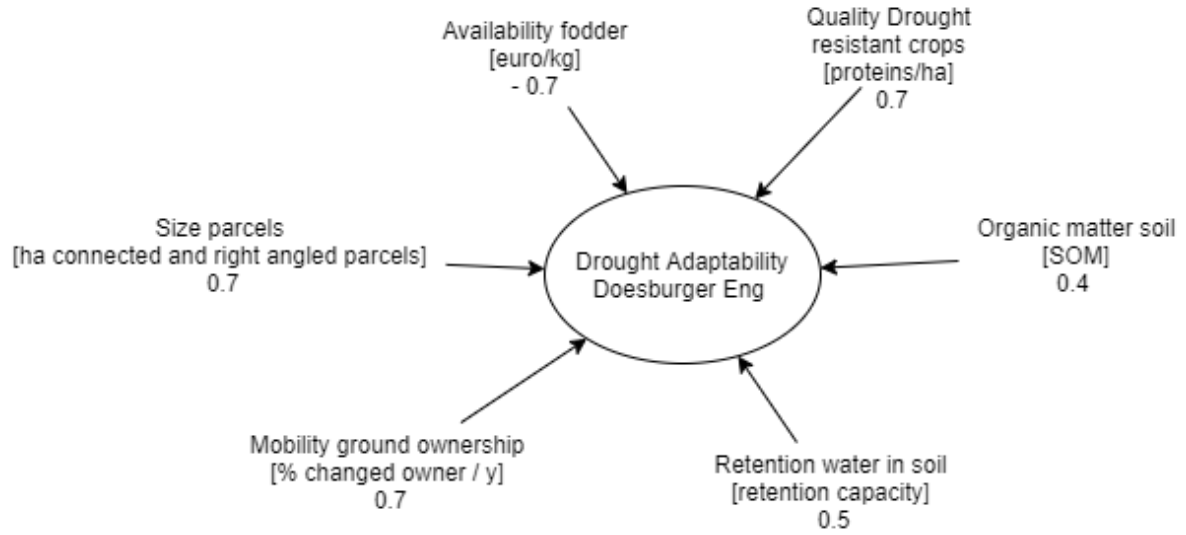
Annex 3 – Outcomes Fuzzy Cognitive Mapping

A3.1 Fuzzy Cognitive Maps

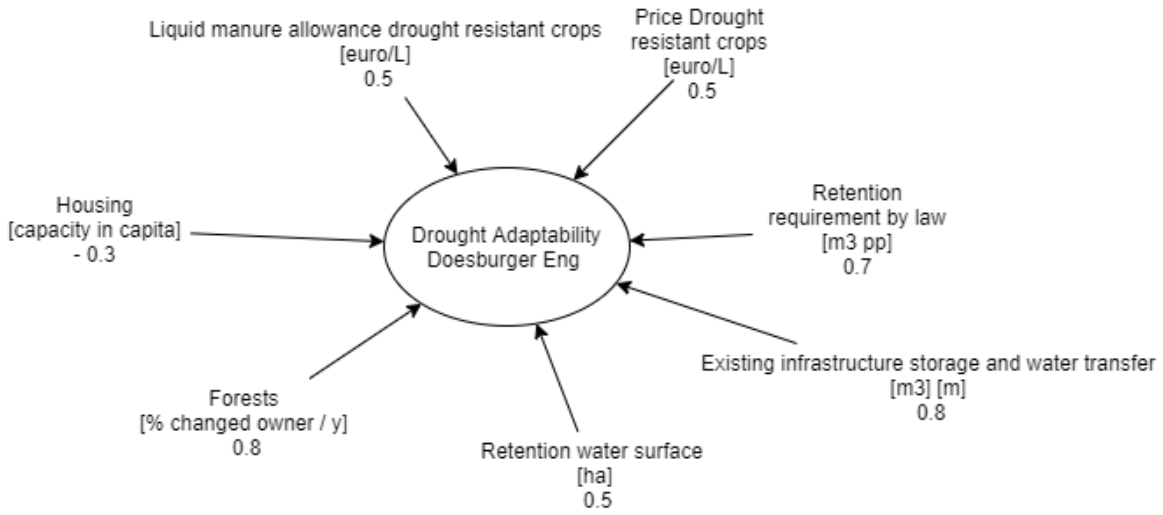
Land User 1



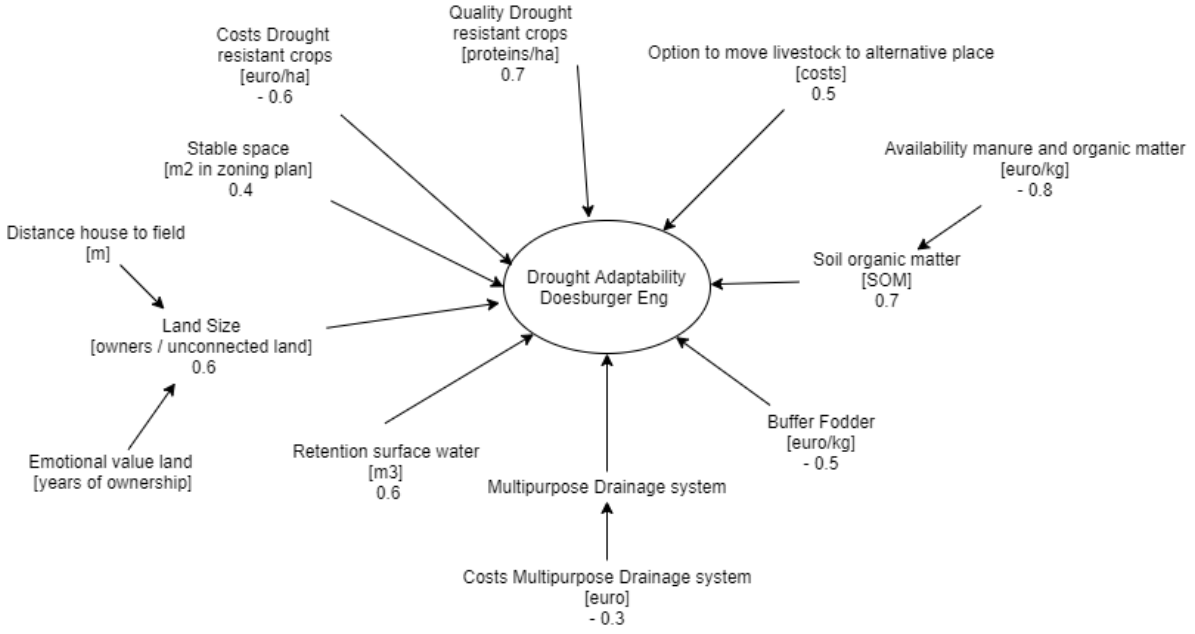
Land User 2



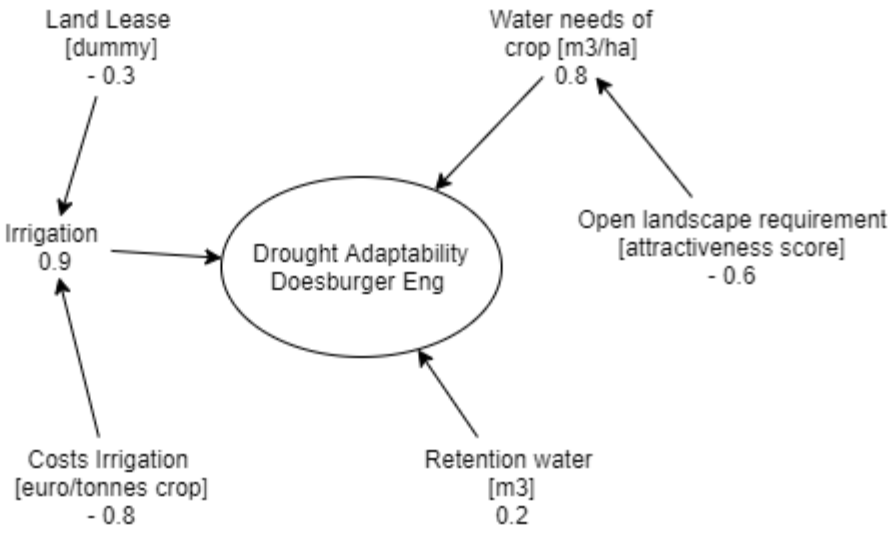
Land User 3



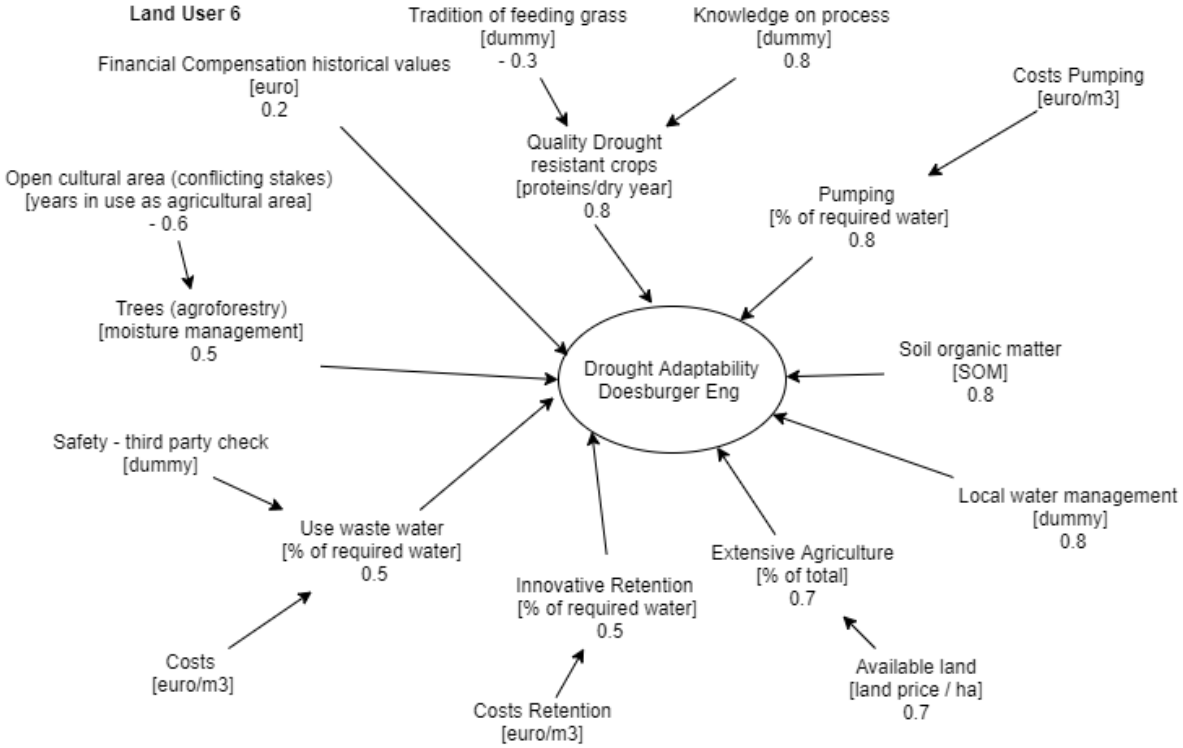
Land User 4



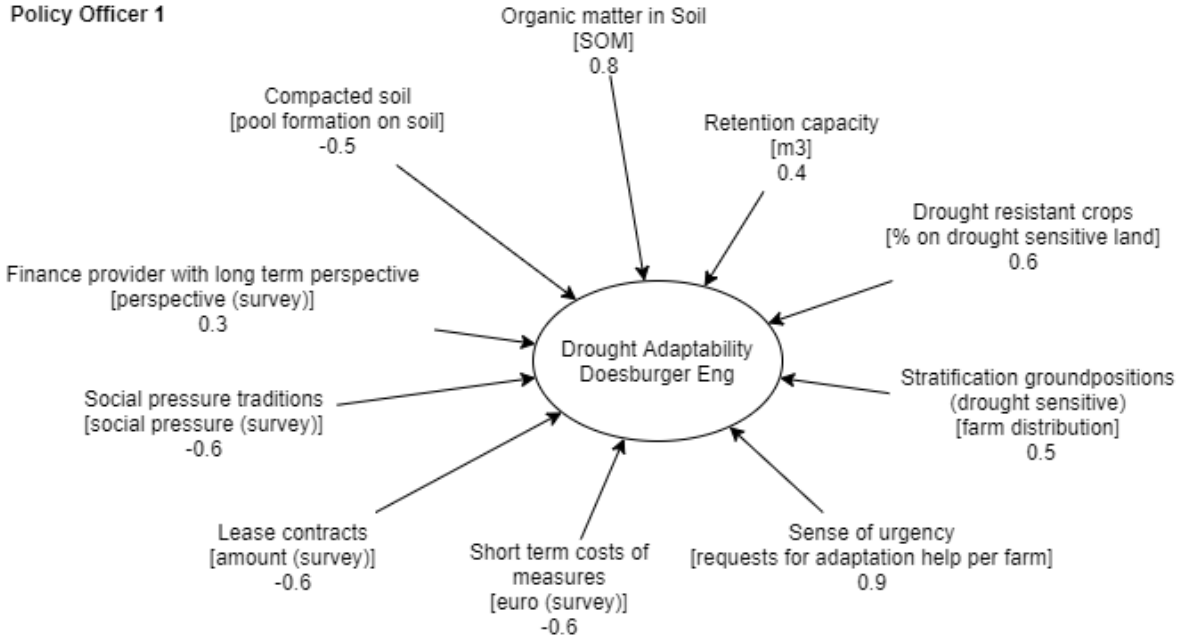
Land User 5



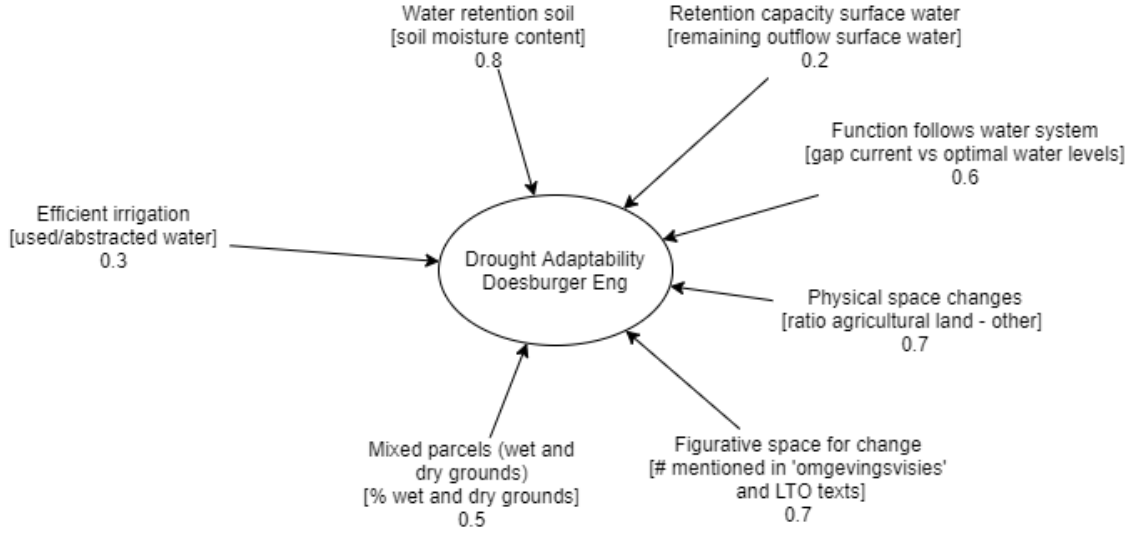
Land User 6



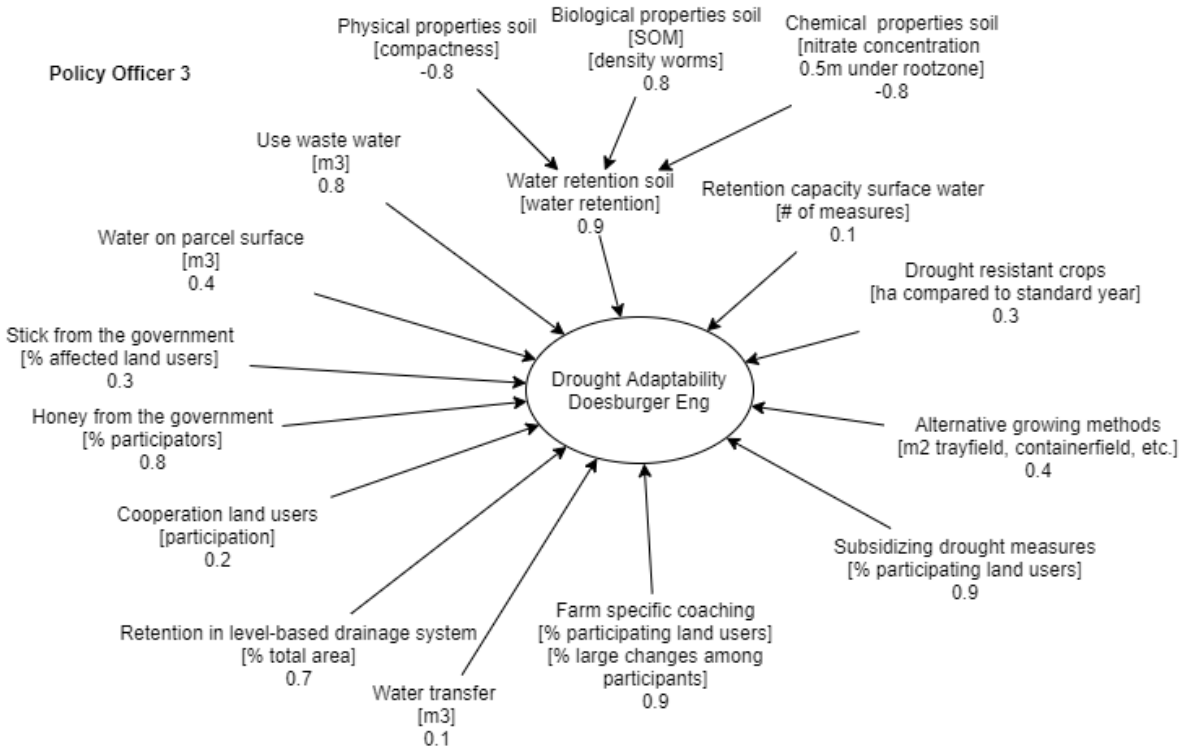
Policy Officer 1



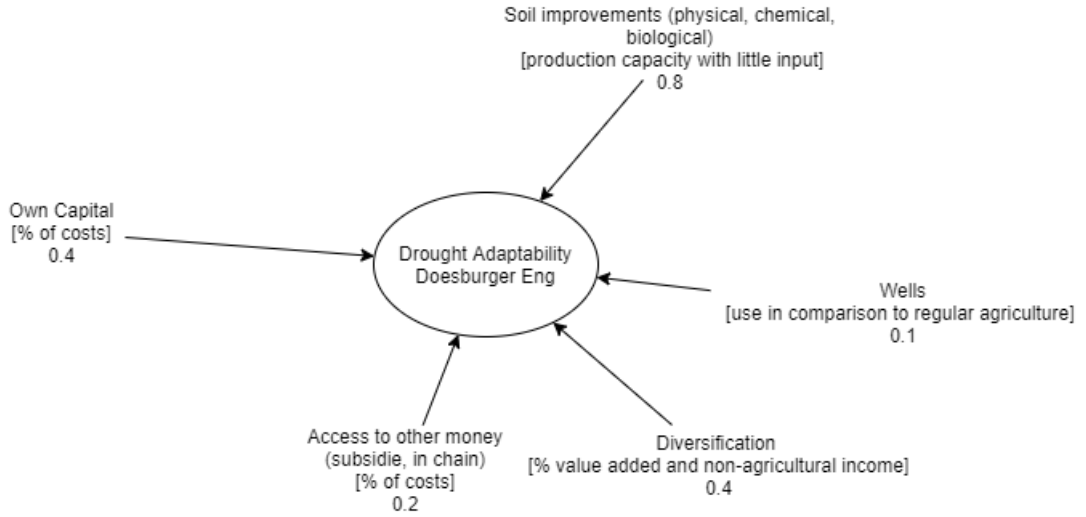
Policy Officer 2



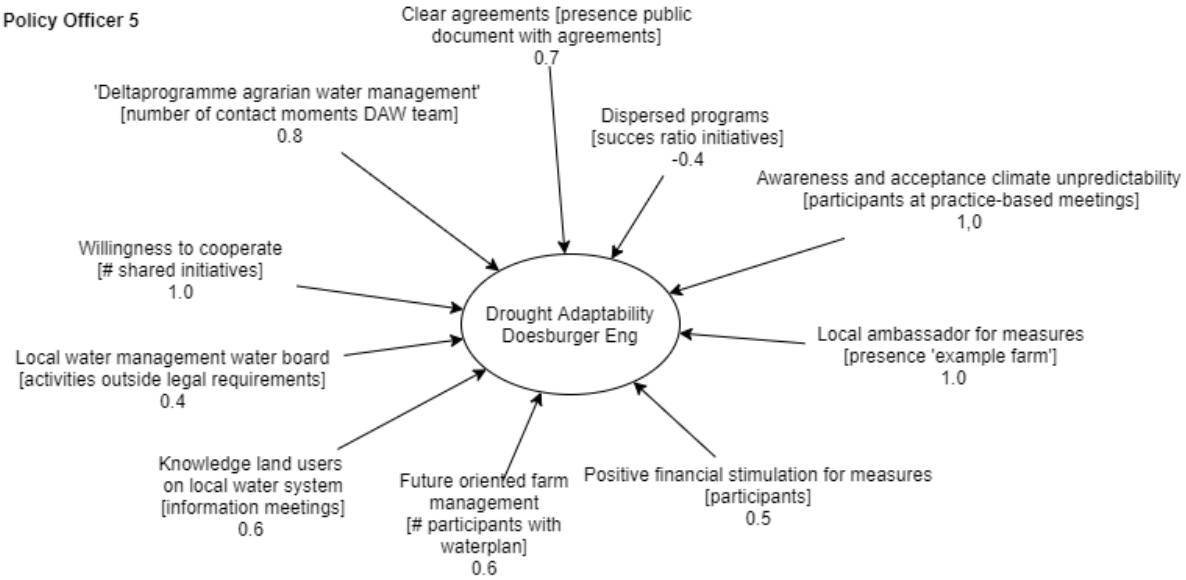
Policy Officer 3



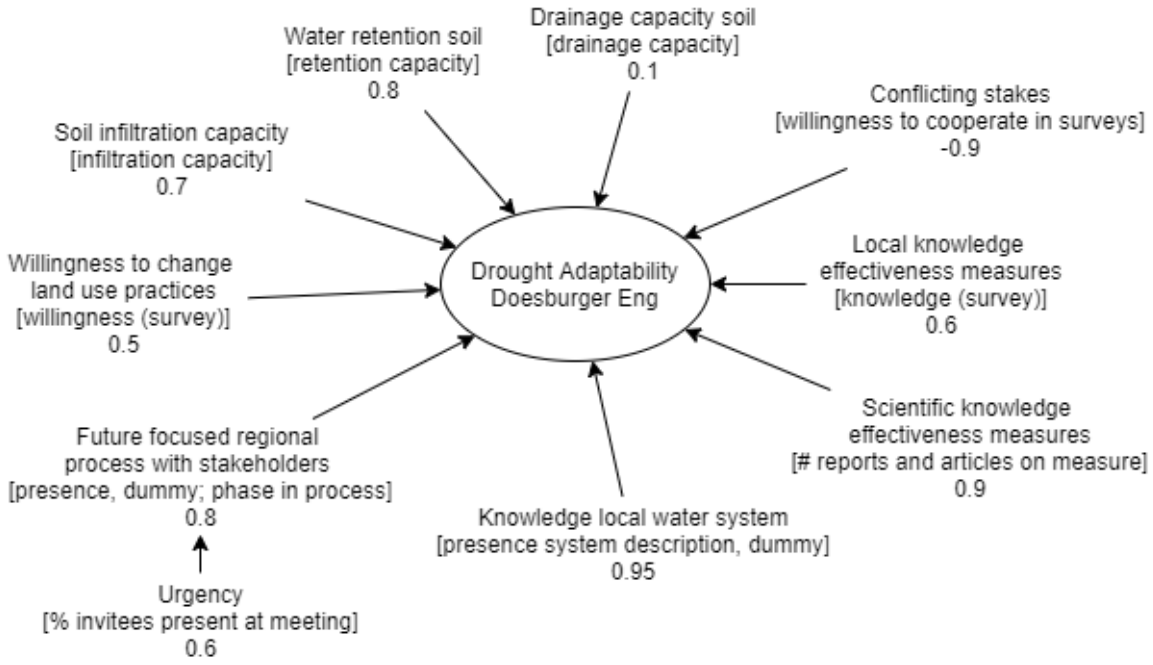
Policy Officer 4



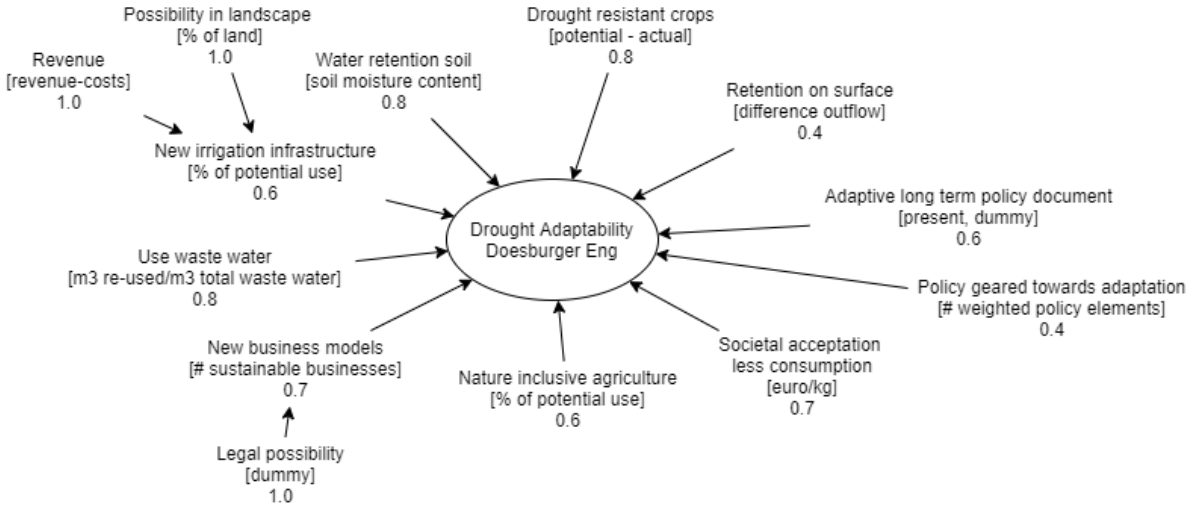
Policy Officer 5



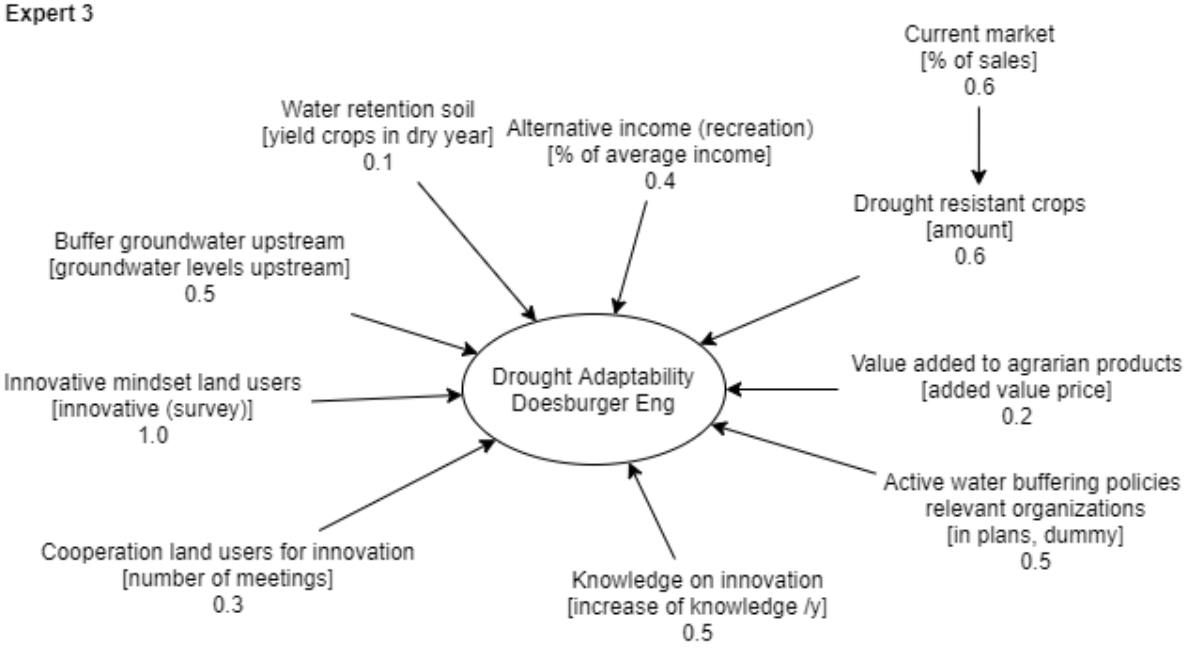
Expert 1

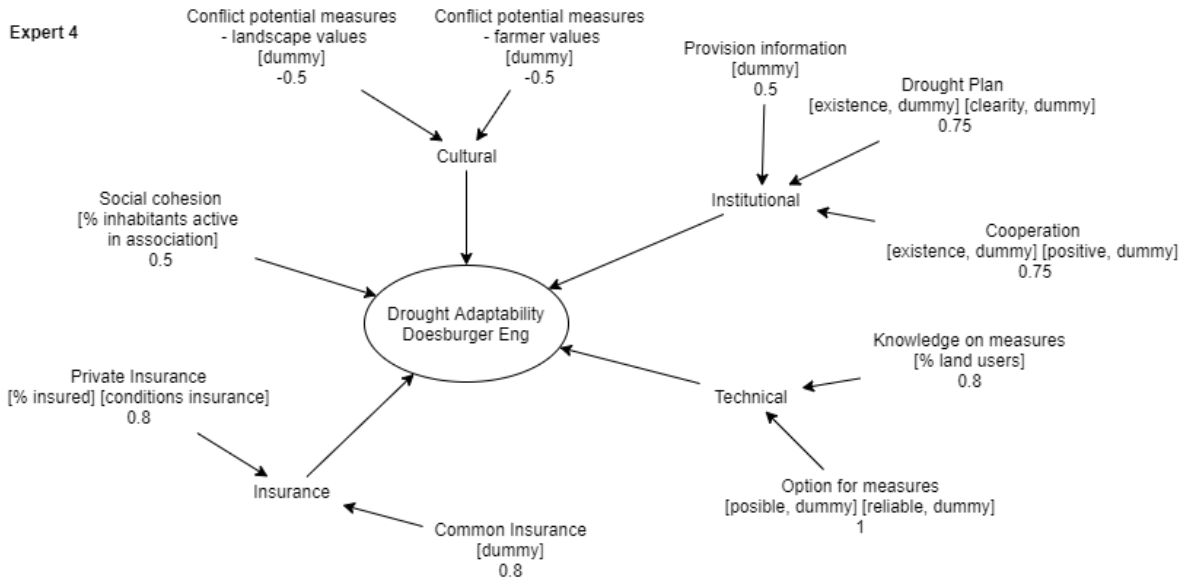


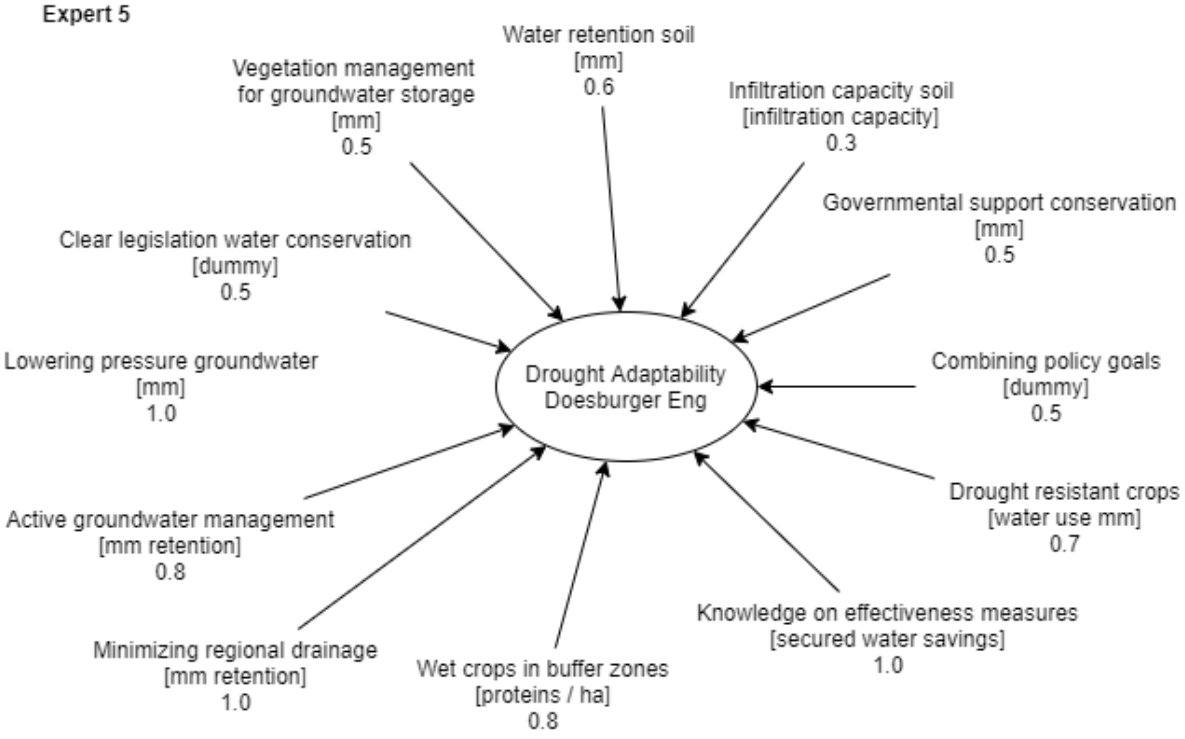
Expert 2



Expert 3




Expert 4
Conflict potential measures - landscape values [dummy] -0.5
Conflict potential measures - farmer values [dummy] -0.5
Provision information [dummy] 0.5
Drought Plan [existence, dummy] [clearity, dummy] 0.75
Cultural
Institutional
Social cohesion [% inhabitants active in association] 0.5
Cooperation [existence, dummy] [positive, dummy] 0.75
Drought Adaptability Doesburger Eng
Knowledge on measures [% land users] 0.8
Private Insurance [% insured] [conditions insurance] 0.8
Technical
Insurance
Option for measures [posible, dummy] [reliable, dummy] 1
Common Insurance [dummy] 0.8


Expert 5
Water retention soil [mm] 0.6
Vegetation management for groundwater storage [mm] 0.5
Infiltration capacity soil [infiltration capacity] 0.3
Governmental support conservation [mm] 0.5
Clear legislation water conservation [dummy] 0.5
Lowering pressure groundwater [mm] 1.0
Drought Adaptability Doesburger Eng
Combining policy goals [dummy] 0.5
Drought resistant crops [water use mm] 0.7
Active groundwater management [mm retention] 0.8
Knowledge on effectiveness measures [secured water savings] 1.0
Minimizing regional drainage [mm retention] 1.0
Wet crops in buffer zones [proteins / ha] 0.8

A3.2 Initial attributes and indicators from FCM

The table shows the attributes (which were based on the specific attributes), the specific attributes and corresponding indicators. The capital and generic resilience categories for the attributes and indicators are given. Moreover, the scores from the FCM are summed on the right.

The colour-coding represents whether the attributes and indicators were preselected:

- Green: on survey list
- Orange: not on survey list
- Blue: on survey list, but merged (an explanation for each attribute and indicator highlighted in blue is given below the table)

Attribute	Attribute capital	Attribute GR attribute	Specific attribute [indicator]	Indicator capital	Indicator GR attribute	Sum Total	LU sum	PO sum	Exp sum
Social Cohesion	Social	Modularity	Social cohesion [% inhabitants active in association]	Social	Modularity	0.5	0	0	0.5
Cooperation Land Owners	Social	Modularity	Cooperation land owners for innovation [number of meetings]	Social	Modularity	0.3	0	0	0.3
			Cooperation land users [participation]	Social	Modularity	0.2	0	0.2	0
			Willingness to cooperate [# shared initiatives]	Social	Modularity	1	0	1	0
Conflicts with measures vs values	Social	Feedbacks	Conflict potential measures - landscape values [dummy]	Social	Feedbacks	-0.5	0	0	-0.5
			Conflict potential measures - farmer values [dummy]	Social	Feedbacks	-0.5	0	0	-0.5
Conflicting stakes	Social	Diversity	Conflicting stakes [willingness to cooperate in surveys]	Social	Diversity	-0.9	0	0	-0.9
Social pressure	Social	Modularity	Social pressure traditions [social pressure (survey)]	Social	Modularity	-0.6	0	0	-0.6
Local ambassador	Social	Consciousness	Local ambassador for measures [presence 'example farm']	Social	Consciousness	1	0	1	0
Housing	Physical	Reserves	Housing [capacity in capita]	Physical	Reserves	-0.3	-0.3	0	0
Wells and Irrigation	Physical	Reserves	Wells and Irrigation [% dry ground covered]	Physical	Reserves	0.8	0.8	0	0
			" [use in comparison to regular agriculture]	Physical	Reserves	0.1	0	0.1	0
			" [dummy]	Physical	Reserves	2.3	1.7	0	0.6

Attribute	Attribute capital	Attribute GR attribute	Specific attribute [indicator]	Indicator capital	Indicator GR attribute	Sum Total	LU sum	PO sum	Exp sum
Costs irrigation	Physical	Feedbacks	Costs Irrigation [euro/tonnes crop]	Physical	Feedbacks	-1.6	-1.6	0	0
			" [revenue - costs]	Physical	Feedbacks	1	0	0	1
Possibility irrigation	Physical	Feedbacks	Possibility in landscape of irrigation [% of land]	Physical	Feedbacks	1	0	0	1
Efficiency irrigation	Physical	Reserves	Efficiency irrigation [used/abstracted water]	Physical	Reserves	0.3	0	0.3	0
Existing potential infrastructure	Physical	Reserves	Existing potential infrastructure storage and transfer [m3] [m]	Physical	Reserves	0.8	0.8	0	0
Water transfer	Physical	Openness	Water transfer [m3]	Physical	Openness	0.1	0	0.1	0
Multipurpose drainage	Physical	Reserves	Multipurpose drainage system [% of total area]	Physical	Reserves	0.7	0	0.7	0
			" [costs euro]	Physical	Feedbacks	-0.3	-0.3	0	0
Waste water use	Physical	Reserves	Use waste water [% of required water]	Physical	Reserves	0.5	0.5	0	0
			" [m3 re-used/m3 total waste water]	Physical	Reserves	0.8	0	0	0.8
			" [m3]	Physical	Reserves	0.8	0	0.8	0
			" [costs euro/m3]	Physical	Feedbacks	-1.3	-0.5	-0.8	0
Potential waste water use	Physical	Feedbacks	Safety - third party check [dummy]	Physical	Feedbacks	0.5	0.5	0	0
Local retention surface water	Physical	Reserves	Retention surface water [m3]	Physical	Reserves	2.2	1.4	0.8	0
			" [retention capacity / required water]	Physical	Reserves	0.5	0.5	0	0
			" [diff outflow] [remaining outflow]	Physical	Reserves	0.6	0	0.2	0.4
			" [# of structures]	Physical	Reserves	0.1	0	0.1	0
			Innovative retention [% of required water]	Physical	Reserves	0.5	0.5	0	0
Positive financial stimulation on measures	Institutional	Feedbacks	Positive financial stimulation on measures [% participating]	Institutional	Feedbacks	2.4	1	1.4	0
Financial compensation nature management	Institutional	Reserves	Financial compensation nature management	Institutional	Reserves	0.8	0.8	0	0
Subsidies historical values	Institutional	Reserves	Financial compensation historical values [euro]	Institutional	Reserves	0.2	0.2	0	0

Attribute	Attribute capital	Attribute GR attribute	Specific attribute [indicator]	Indicator capital	Indicator GR attribute	Sum Total	LU sum	PO sum	Exp sum
Long term adaptive plans and process	Institutional	Consciousness	Future focused regional process with stakeholders [dummy] [phase in process]	Institutional	Consciousness	0.8	0	0	0.8
			Adaptive long term policy document [dummy]	Institutional	Consciousness	0.6	0	0	0.6
			Policy geared towards adaptation [# weighted policy elements]	Institutional	Consciousness	0.4	0	0	0.4
			Figurative space for change [# mentioned in relevant documents]	Institutional	Consciousness	0.7	0	0.7	0
Drought Plan	Institutional	Consciousness	Drought plan [existence, dummy; clearity, dummy]	Institutional	Consciousness	0.75	0	0	0.75
Water buffering plans	Institutional	Consciousness	Active water buffering policies from relevant organizations [dummy]	Institutional	Consciousness	0.5	0	0	0.5
Dispersed programmes	Institutional	Modularity	Dispersed programmes [succes ratio initiatives]	Institutional	Modularity	-0.4	0	-0.4	0
DAW	Institutional	Openness	Deltaprogramma agrarisch waterbeheer' [# contact moments DAW team]	Institutional	Openness	0.8	0	0.8	0
Legislation sustainable business	Institutional	Feedbacks	Legal possibility new business models [dummy]	Institutional	Feedbacks	1	0	0	1
Legislation conservation	Institutional	Feedbacks	Clear legislation water conservation [dummy]	Institutional	Feedbacks	0.5	0	0	0.5
			Retention requirement by law [m3 pp]	Institutional	Reserves	0.7	0.7	0	0
Stable space	Institutional	Reserves	Stable space [m2 in zoning plan]	Institutional	Reserves	0.4	0.4	0	0
Local water management	Institutional	Consciousness	Local water management [dummy]	Institutional	Consciousness	0.8	0.8	0	0
			" [activities water board outside required tasks]	Institutional	Consciousness	0.4	0	0.4	0
Information provision	Institutional	Openness	Provision of information [dummy]	Institutional	Openness	0.5	0	0	0.5
Non-financial support	Institutional	Openness	Governmental support conservation [mm]	Institutional	Openness	0.5	0	0	0.5
			Honey from government [% participators]	Institutional	Openness	0.8	0	0.8	0
Negative Support	Institutional	Openness	Stick from the government [% affected land users]	Institutional	Openness	0.3	0	0.3	0
Land Lease	Institutional	Modularity	Land lease [dummy] [amount]	Institutional	Modularity	-0.9	-0.3	0	-0.6

Attribute	Attribute capital	Attribute GR attribute	Specific attribute [indicator]	Indicator capital	Indicator GR attribute	Sum Total	LU sum	PO sum	Exp sum
Cooperation	Institutional	Openness	Cooperation [existence, positive; dummy]	Institutional	Openness	0.75	0	0	0.75
Combining Goals	Institutional	Modularity	Combining policy goals [dummy]	Institutional	Modularity	0.5	0	0	0.5
Sustainable finance provider	Institutional	Consciousness	Finance provider with long term perspective [perspective (survey)]	Institutional	Consciousness	0.3	0	0.3	0
Agreements	Institutional	Openness	Clear agreements [presence public document]	Institutional	Openness	0.7	0	0.7	0
Alternative income	Economic	Diversity	Alternative income (recreation) [% of average income]	Economic	Diversity	0.4	0	0	0.4
			Value added to agrarian products [added value price]	Economic	Reserves	0.2	0	0	0.2
			Diversification [% value added and non-agricultural income]	Economic	Diversity	0.4	0	0.4	0
Market drought resistant crops	Economic	Openness	Market drought resistant crops [% of sales]	Economic	Openness	0.6	0	0	0.6
Price current crops	Economic	Reserves	Price current crops [euro/tonnes]	Economic	Reserves	1	1	0	0
Fodder costs	Economic	Reserves	Availabilty fodder [euro/kg]	Economic	Reserves	-0.7	-0.7	0	0
Costs measures	Economic	Feedbacks	Short terms costs of measures [euro (survey)]	Economic	Feedbacks	-0.6	0	-0.6	0
Manure costs	Economic	Reserves	Availability manure and organic matter [euro/kg]	Economic	Reserves	-0.8	-0.8	0	0
Private insurance	Economic	Reserves	Private insurance [% insured] [conditions insurance]	Economic	Reserves	0.8	0	0	0.8
Common insurance	Economic	Reserves	Common insurance [dummy]	Economic	Reserves	0.8	0	0	0.8
Own capital	Economic	Reserves	Own capital [% of costs]	Economic	Reserves	0.4	0	0.4	0
Access to other money	Economic	Openness	Access to other money (subsidies, chain) [% of costs]	Economic	Openness	0.2	0	0.2	0
Drought resistant crops	Natural/Agri	Reserves	Drought resistant crops [potential - actual evapo]	Natural/Agri	Reserves	0.8	0	0	0.8
			" [ha]	Natural/Agri	Reserves	0.6	0	0	0.6
			" [water use mm]	Natural/Agri	Reserves	0.7	0	0	0.7
			" [% on drought sensitive land]	Natural/Agri	Reserves	0.6	0	0	0.6
			" [ha compared to standard year]	Natural/Agri	Reserves	0.3	0	0.3	0

Attribute	Attribute capital	Attribute GR attribute	Specific attribute [indicator]	Indicator capital	Indicator GR attribute	Sum Total	LU sum	PO sum	Exp sum
			" [m3/ha]	Natural/Agri	Reserves	-0.8	-0.8	0	0
Quality drought resistant crops	Natural/Agri	Reserves	Quality drought resistant crops [proteins /ha]	Natural/Agri	Reserves	2	2	0	0
			" [protiens / dry year]	Natural/Agri	Reserves	0.8	0.8	0	0
Costs drought resistant crops	Natural/Agri	Feedbacks	Costs drought resistant crops [euro/tonnes]	Natural/Agri	Feedbacks	0.8	0.8	0	0
			" [euro/L]	Natural/Agri	Feedbacks	0.5	0.5	0	0
			" [euro/ha]	Natural/Agri	Feedbacks	-0.6	-0.6	0	0
			Liquid manure allowance drought resistant crops [euro/L]	Natural/Agri	Feedbacks	0.5	0.5	0	0
Factors influencing adoptation drc	Natural/Agri	Feedbacks	Knowledge on process [dummy]	Natural/Agri	Feedbacks	0.8	0.8	0	0
			Tradition of feeding grass [dummy]	Natural/Agri	Feedbacks	-0.3	-0.3	0	0
Wet resistant crops	Natural/Agri	Reserves	Wet crops in buffer zones [proteins/ha]	Natural/Agri	Reserves	0.8	0	0	0.8
Extensive agriculture	Natural/Agri	Reserves	Extensive agriculture [% of total]	Natural/Agri	Reserves	0.7	0.7	0	0
Tillage	Natural/Agri	Reserves	Winter tillage / no tillage [ratio yield applied : not applied]	Natural/Agri	Reserves	0.7	0.7	0	0
Livestock Feeding	Natural/Agri	Reserves	Option to move livestock to alternative feeding ground [costs]	Natural/Agri	Openness	0.5	0.5	0	0
			Buffer Fodder	Natural/Agri	Reserves	0.5	0.5	0	0
Alternative growing methods	Natural/Agri	Reserves	Alternative growing methods [m2 containerfield etc.]	Natural/Agri	Reserves	0.4	0	0.4	0
Nature inclusive agriculture	Natural/Agri	Modularity	Nature inclusive agriculture [% of potential use]	Natural/Agri	Modularity	0.6	0	0	0.6
Future business models	Natural/Agri	Consciousness	New business models [# sustainable businesses]	Natural/Agri	Consciousness	0.7	0	0	0.7
			Future oriented farm management [# participants with waterplan]	Natural/Agri	Consciousness	0.6	0	0.6	0
Soil biological quality	Natural/Agri	Reserves	Soil organic matter [SOM]	Natural/Agri	Reserves	3.5	1.9	1.6	0
			Biological properties soil [density worms]	Natural/Agri	Reserves	0.8	0	0.8	0
Soil chemical quality	Natural/Agri	Reserves	Chemical properties soil [nitrate concentration 0,5m under rootzone]	Natural/Agri	Reserves	-0.8	0	-0.8	0

Attribute	Attribute capital	Attribute GR attribute	Specific attribute [indicator]	Indicator capital	Indicator GR attribute	Sum Total	LU sum	PO sum	Exp sum
Drainage capacity	Natural/Agri	Openness	Drainage capacity soil [drainage capacity]	Natural/Agri	Openness	0.1	0	0	0.1
Retention capacity soil	Natural/Agri	Reserves	Retention water in soil [retention capacity]	Natural/Agri	Reserves	2.2	0.5	0.9	0.8
			" [mm]	Natural/Agri	Reserves	0.6	0	0	0.6
			" [soil moisture level]	Natural/Agri	Reserves	1.6	0	0.8	0.8
			" [yield in dry year]	Natural/Agri	Reserves	0.1	0	0	0.1
Soil infiltration capacity	Natural/Agri	Modularity	Soil infiltration capacity [infiltration capacity]	Natural/Agri	Modularity	1.6	0.6	0	1
Soil production quality	Natural/Agri	Reserves	Soil improvements [production capacity with little input]	Natural/Agri	Reserves	0.8	0	0.8	0
Compactness	Natural/Agri	Modularity	Physical properties soil [compactness]	Natural/Agri	Modularity	-0.8	0	-0.8	0
			Compacted soil [pool formation on soil]	Natural/Agri	Modularity	-0.5	0	-0.5	0
Tree cover	Natural/Agri	Reserves	Trees [water abstraction, m3]	Natural/Agri	Reserves	-0.5	-0.5	0	0
			" [ha]	Natural/Agri	Diversity	0.8	0.8	0	0
			" [moisture management]	Natural/Agri	Reserves	0.5	0.5	0	0
Open landscape	Natural/Agri	Diversity	Open landscape requirement (related to type of crop and trees) [attractiveness score]	Natural/Agri	Diversity	-0.6	-0.6	0	0
			" [years in use as agricultural land]	Natural/Agri	Diversity	-0.6	-0.6	0	0
Costs local retention	Natural/Agri	Feedbacks	Costs retention surface water [euro/m3]	Natural/Agri	Feedbacks	-0.5	-0.5	0	0
Regional retention	Natural/Agri	Openness	Buffer groundwater upstream [gw levels upstream]	Natural/Agri	Openness	0.5	0	0	0.5
Adequate groundwater management	Natural/Agri	Reserves	Minimized regional drainage [mm retention]	Natural/Agri	Reserves	1	0	0	1
			Active groundwater management [mm retention]	Natural/Agri	Reserves	0.8	0	0	0.8
			Lowering pressure groundwater [mm]	Natural/Agri	Reserves	1	0	0	1
			Vegetation mananagement for groundwater storage [mm]	Natural/Agri	Reserves	0.5	0	0	0.5
Size and shape land positions	Natural/Agri	Modularity	Size parcels [connected, right-angled in ha]	Natural/Agri	Modularity	0.7	0.7	0	0

Attribute	Attribute capital	Attribute GR attribute	Specific attribute [indicator]	Indicator capital	Indicator GR attribute	Sum Total	LU sum	PO sum	Exp sum
			" [owners / unconnected pieces of land]	Natural/Agri	Modularity	0.6	0.6	0	0
Stratification land positions	Natural/Agri	Diversity	Stratification ground positions: (non)-drought sensitive [farm distribution]	Natural/Agri	Diversity	0.5	0	0.5	0
			" [% wet and dry grounds]	Natural/Agri	Diversity	0.5	0	0.5	0
Mobility land ownership	Natural/Agri	Feedbacks	Mobility ground ownership [% changed owner / y]	Natural/Agri	Feedbacks	0.7	0.7	0	0
Potential Mobility	Natural/Agri	Feedbacks	Emotional value land [years of ownership]	Natural/Agri	Feedbacks	0.6	0.6	0	0
			Distance house to field [m]	Natural/Agri	Feedbacks	0.6	0.6	0	0
			Available land [land price / ha]	Natural/Agri	Feedbacks	-0.7	-0.7	0	0
Physical option for measures	Natural/Agri	Feedbacks	Option for measures [possible, reliable; dummy]	Natural/Agri	Feedbacks	1	0	0	1
			Physical space for change [ratio agricultural land - other]	Natural/Agri	Reserves	0.7	0	0.7	0
Function follows water system	Natural/Agri	Reserves	Function follows water system [gap current vs optimal water levels]	Natural/Agri	Reserves	0.6	0	0.6	0
Local Knowledge on measures	Human	Feedbacks	Local knowledge effectiveness measures [knowledge (survey)]	Human	Feedbacks	0.6	0	0	0.6
			" [% land users]	Human	Feedbacks	0.8	0	0	0.8
			" [secured water savings]	Human	Reserves	1	0	0	1
			Knowledge on innovation [increase of knowledge /y]	Human	Feedbacks	0.5	0	0	0.5
Scientific knowledge effective measures	Human	Feedbacks	Scientific knowledge effectiveness measures [# reports and articles on measures]	Human	Feedbacks	0.9	0	0	0.9
Knowledge on local water system	Human	Modularity	Knowledge on local water system [presence description, dummy]	Human	Feedbacks	0.95	0	0	0.95
			Knowledge land users on local water system [informative meetings]	Human	Modularity	0.6	0	0.6	0
Farm specific coaching	Human	Openness	Farm specific coaching [% participating land users] [%large changes among land users]	Human	Openness	0.9	0	0.9	0
Willingness to change	Human	Consciousness	Willingness to change land use practices [willingness (survey)]	Human	Consciousness	0.5	0	0	0.5

Attribute	Attribute capital	Attribute GR attribute	Specific attribute [indicator]	Indicator capital	Indicator GR attribute	Sum Total	LU sum	PO sum	Exp sum
			Innovative mindset land users [innovative (survey)]	Human	Consciousness	1	0	0	1
Acceptation less consumption	Human	Consciousness	Societal acceptation less consumption [euro/kg]	Human	Consciousness	0.7	0	0	0.7
			Awareness and acceptance climate unpredictability [participants at practice-based meetings]	Human	Consciousness	1	0	1	0
Sense of urgency	Human	Consciousness	Sense of urgency [requests for adaptation help per farm]	Human	Openness	0.9	0	0.9	0

Explanation of merged attributes and indicators

Attribute / Indicator	Explanation
Cooperation Land Owners	Represented by 'willingness to cooperate'
Conflicting Stakes [willingness to cooperate]	Represented by 'willingness to cooperate'
Retention requirement by law [m3 pp]	Represented by 'Laws for drought adaptation'
Cooperation [existence, positive; dummy]	Represented by 'Cooperation between sectors and governments'
Private Insurance and Common Insurance	Merged as 'private or common insurance'
Soil infiltration capacity AND Compactness	Merged as 'physical quality soil'

Annex 4 - Survey Outcomes

A4.1 Survey List: all attributes and indicators (including origin and convenience of indicators)

All attributes and related indicators in the survey list are listed in the table below. Additional information is provided about the indicator formulation (lit or int, lit standing for literature and int for interview) and convenience rating.

I rated the indicators for convenience, and then had it checked for a second opinion. We agreed on the rates without a note. All rates that are marked (*) have been adjusted on the basis of the expert. Additionally, rates that I did not adjust have a remark in the column 'note on convenience'. In case of the rate '1', either it was about the presence, or a source is given as note.

Attribute	Indicator	Lit or Int	Conve-nience	Note on convenience
1. Willingness to cooperate	[# shared initiatives]	Int	2	Not necessary to consult everyone
	[willingness to cooperate in surveys]	Int	3	N.A.
2. Social pressure traditions	[social pressure (survey)]	Int	3	N.A.
3. Local ambassador for measures	[presence 'example farm']	Int Lit	2	N.A.
4. Social cohesion	[social cohesion, in survey]	Int Lit	3	N.A.
5. Social networks	[number of social networks]	Lit	3	N.A.
	Household member in social network [#]	Lit	3	N.A.
	Knowledge exchange in networks	Lit	3	N.A.
6. Family	[amount of family support]	Lit	3	N.A.
	[Number of close relatives]	Lit	2	N.A.
7. Participation	[% attendance to locally organized events]	Int Lit	3	N.A.
8. Solidarity	People volunteered to assist [#]	Lit	3	N.A.
	Degree of solidarity [-]	Lit	3	N.A.
9. Religion	Faith based organizations [#]	Lit	2	N.A.
	Religious adherents [-]	Lit	3	N.A.
10. Involvement women in decision-making	[%]	Lit	3	N.A.
11. Female-headed households	[%]	Lit	3	N.A.
12. Farmer population	Farmers [#]	Lit	2	N.A.
	Ratio farmers : non-farmers [-]	Lit	2	CBS
13. Age Land Users	Average age	Lit	2	CBS
14. Over 65s	[%]	Lit	2	CBS
15. Single person households	[%]	Lit	2	CBS
16. Migration rate	Migration rate	Lit	2	CBS
17. Wells and Irrigation	[% dry ground covered]	Int	3	N.A.
	[presence, dummy]	Int Lit	1	N.A.
18. Use of irrigation	Irrigated area [ha]	Lit	2	N.A.

Attribute	Indicator	Lit or Int	Conve-nience	Note on convenience
	Efficiency (used:withdrawn)]	Lit	3	N.A.
19. Possibility in landscape of irrigation	[% of land]	Int	3*	N.A.
20. Costs Irrigation	[euro/tonnes crop]	Int	3*	N.A.
	[revenue - costs]	Int	3*	N.A.
21. Existing potential infrastructure storage and transfer	m^3; m	Int	3	N.A.
22. Local Retention surface water	[m^3]	Int Lit	3	N.A.
	[possible outflow - remaining outflow]	Int	4	N.A.
23. Diversity water sources	[amount]	Lit	3	N.A.
24. Multipurpose drainage system	[% of total area]	Int	2	N.A.
25. Use waste water	[m3]	Int	2	N.A.
	[costs euro/m3]	Int	3	N.A.
	[m3 re-used/m3 total waste water]	Int	3	N.A.
26. Housing Stock	[#/km2]	Int Lit	2	CBS
27. Housing Quality	[% repairs needed]	Lit	4	N.A.
28. Barn Quality	[Food storage capacity]	Lit	2	N.A.
	[% repairs needed]	Lit	4	N.A.
29. Early drought warning	[presence]	Lit	2	N.A.
30. Financial capacity local government	[Revenue in euro/capita]	Lit	1	Document[3]
	[General expenditures in euro/capita]	Lit	1	Document[1]
31. Positive financial stimulation on measures	[% participating]	Int Lit	2	N.A.
32. Non-financial stimulation on measures	[% participating]	Int	2	N.A.
33. Financial compensation nature management	[% participating]	Int	2	N.A.
34. Long term adaptive plans and process	[Presence and stage of future focused regional process with stakeholders]	Int	2	N.A.
	[Presence Adaptive long term policy document]	Int	1	N.A.
	[number 'change' mentioned in relevant documents]	Int	2	N.A.
35. Drought Plan	[existence]	Int Lit	1	N.A.
	[clearity indicated in survey]	Int	3	N.A.
	[effectiveness]	Lit	4	N.A.
	[Amount of projects on droughts]	Lit	2	N.A.

[3] https://ede.begroting-2020.nl/assets/docs/Programmabegroting%202020-2023%20inclusief%20MPG%20-%20Versie%20definitief.pdf

Attribute	Indicator	Lit or Int	Conve-nience	Note on convenience
	[Beneficiaries families by projects]	Lit	3	N.A.
	[%organizations using it]	Lit	3	N.A.
	[use in spatial planning]	Lit	3	N.A.
36. Deltaprogramma agrarisch waterbeheer'	[# contact moments DAW team]	Int	2	N.A.
37. Legal possibility new business models	[existence]	Int	2	N.A.
38. Cooperation and coordination between sectors and governmental levels	[presence]	Int Lit	1	N.A.
	[judged through a survey]	Int	3	N.A.
39. Clear agreements with and between governments	[presence of public documents]	Int	1	N.A.
40. Laws for drought adaptation	[amount]	Lit	2	N.A.
	[Retention requirement by law in m3 pp]	Int	1	N.A.
41. Quality spatial planning	[% vulnearable areas included in planning]	Lit	2	N.A.
	[% Physical infrastructure on operative plans]	Lit	2	N.A.
	[Existence of registers of reduction of water use]	Lit	1	N.A.
42. Attention to drought	[number of commissions, entities and managing resources for droughts]	Lit	2	N.A.
	[number of strategic alliances]	Lit	2	N.A.
	[number of people active in water conservency]	Lit	2	N.A.
43. Local water management	[presence]	Int	2	N.A.
44. Land lease	[% of the area]	Int Lit	2	N.A.
45. Income / Gross Regional Product	Income [euro/capita]	Lit	2	CBS
	Median household income [euro/household]	Lit	2	CBS
	Change in income over past year [%]	Lit	3	N.A.
	GRP of area [euro/capita]	Lit	2	N.A.
46. Agricultural income	[Value of farm products sold in euro/km2]	Lit	3	N.A.
	[GDP in agriculture]	Lit	1	CBS[4]
47. Farm size	[locally relevant: small, medium,]	Lit	3	N.A.

[4] https://www.cbs.nl/nl-nl/nieuws/2020/19/landbouw-droeg-in-2019-evenveel-bij-aan-economie-als-tien-jaar-eerder#:~:text=Nederlandse%20landbouw%20en%20voedingsindustrie%20exporteren%20veel&text=De%20toegevoegde%20waarde%20van%20het,bruto%20binnenlands%20product%20(bbp).

Attribute	Indicator	Lit or Int	Conve-nience	Note on convenience
48. Economic equality	[%Population living below poverty line]	Lit	3	Not available at CBS
	[Gini-index]	Lit	3	N.A.
49. Assets	[Value property]	Lit	2	CBS
	[Value non-land assets]	Lit	2	N.A.
	[Median rent]	Lit	2	N.A.
50. Unemployment	[Unemployment rate]	Lit	2	N.A.
51. Savings / Debt	[euro]	Lit	3	N.A.
	[farm solvency]	Lit	2	N.A.
52. Price current crops	[euro/tonnes]	Int	2	N.A.
53. Production costs	[euro/tonnes]	Lit	3	N.A.
54. Agricultural investments	[euro]	Lit	2	N.A.
55. Availability fodder	[euro/kg]	Int	2	N.A.
56. Availability manure and organic matter	[euro/kg]	Int	2	N.A.
57. Short terms costs of measures	[euro]	Int	2	N.A.
58. Taken adaptive measures	[number of measures]	Lit	3	N.A.
59. Private or common insurance	[% covered]	Int Lit	2	N.A.
60. Farmers that uses forecasts about droughts	[%]	Lit	3	N.A.
61. Alternative Grazing strategies	[% livestock grazing in other zones during critical drought]	Int Lit	3	N.A.
	[presence communal grazing grounds]	Lit	2	N.A.
62. Use drought resistant crops	[ha]	Int Lit	2*	N.A.
	[% on drought sensitive land]	Int	3	Need to assess drought sensitive land
	[water use mm]	Int	3	N.A.
	[potential - actual evapotranspiration]	Int	3	No database
	[m3/ha]	Int	2*	N.A.
63. Quality drought resistant crops	[proteins/ha]	Int	2*	N.A.
	[proteins/dry year]	Int	2*	N.A.
64. Costs drought resistant crops	[euro/tonnes]	Int	2	N.A.
	[euro/ha]	Int	2	N.A.
65. Knowledge on producing drought resistant crops	[presence]	Int	2	N.A.
66. Market for drought resistant crops	[% of sales]	Int	2	N.A.
67. Quality wet crops in buffer zones	[proteins/ha]	Int	3	N.A.

Attribute	Indicator	Lit or Int	Conve-nience	Note on convenience
68. Extensive agriculture	[% of total]	Int	3	N.A.
69. Livestock	[livestock/ha]	Lit	2	N.A.
	[livestock productivity]	Lit	3	N.A.
70. Nature inclusive agriculture	[% of potential use]	Int Lit	3*	No database
71. Future business models	[number of sustainable businesses]	Int	4*	Defining sustainable business is hard
	[number of businesses with waterplan]	Int	2	N.A.
72. Retention capacity soil	[retention capacity]	Int	4	N.A.
	[mm]	Int	4	N.A.
	[soil moisture level]	Int	3	N.A.
73. Soil organic matter	[SOM]	Int Lit	3	N.A.
74. Biological quality soil	[density of worms]	Int	4	N.A.
75. Chemical quality soil	[nitrate concentration 0.5m under rootzone]	Int	4	N.A.
76. Physical quality soil	[compactness]	Int	3	N.A.
	[infiltration capacity]	Int	4	N.A.
	[% impervious surface]	Lit	2	N.A.
77. Productivity	[ton/ha without inputs]	Int	3*	N.A.
	[ton/ha]	Lit	2	Farm records
	[ton/capita]	Lit	2	Farm records
78. Winter tillage / no tillage	[ratio field applied : not applied]	Int	2*	N.A.
79. Use of fertilizer	[kg/ha]	Lit	3	N.A.
	[% organic fertilizer]	Lit	3	N.A.
80. Tree cover	[ha]	Int Lit	1	Geo-portal[5]
81. Green cover	[% covered/day]	Lit	2	N.A.
82. Open landscape requirement	[attractiveness, through survey]	Int	3	Survey
	[years in use as agricultural land]	Int	2	N.A.
83. Adequate groundwater management	[mm retention]	Int	4	N.A.
	[lowered pressure in mm]	Int	4	N.A.
84. Size and shape land positions	[ha connected, right-angled parcels]	Int	2	N.A.
	[ratio connected parcels : owners]	Int	2	N.A.
85. Mobility land ownership	[% changed owner / y]	Int	2	N.A.
86. Potential Mobility land ownership	[Emotional value land in years of ownership]	Int	2	N.A.
	[Distance house to field in m]	Int	2	Kadaster
	[land price in euro / ha]	Int	2	N.A.

[5] https://geo.ede.nl/index.php?@CHW-Extern

Attribute	Indicator	Lit or Int	Conve-nience	Note on convenience
87. Physical option for measures	[option]	Int	3	N.A.
	[ratio agricultural land - other]	Int	1	Geo-portal
88. Function follows water system	[gap current vs optimal water levels]	Int	4	N.A.
89. Connectivity land uses	[presence]	Lit	3	N.A.
90. Biodiversity	[biodiversity index]	Lit	3*	N.A.
91. Local knowledge on drought	[knowledge, indicated in survey]	Lit	3	N.A.
92. Local knowledge effectiveness measures]	[knowledge, indicated in survey]	Int	3	N.A.
	[% land users having knowledge]	Int	3	N.A.
	[secured water savings]	Int	3*	N.A.
93. Scientific knowledge effectiveness measures	[# reports and articles on measures]	Int	2	N.A.
94. Knowledge on local water system	[presence public description]	Int	1	N.A.
	[number of informative meetings]	Int	2	N.A.
95. Farm specific coaching	[% participating land users]	Int	3	N.A.
	[% large changes among participants]	Int	3	N.A.
96. Willingness to innovate and change	[innovativeness, indicated in survey]	Int Lit	3	N.A.
97. Awareness and acceptance climate unpredictability	[participants at practice-based meetings]	Int	3	N.A.
98. Sense of urgency	[requests for adaptation help per farm]	Int	2	N.A.
99. Societal acceptation less consumption	[euro/kg, indicated in survey]	Int	3	N.A.
100. Willingness to stay in area	[Hope for the future, indicated in survey]	Lit	3	N.A.
	[Sense of Belonging, indicated in survey]	Lit	3	N.A.
	[quality of life, indicated in survey]	Lit	3	N.A.
101. Mental health	[mental health, indicated in survey]	Lit	3	N.A.
102. Education level	[Household head education level]	Lit	3	No database
	[% of population over 25 without high school degree]	Lit	3	N.A.
	[average level of education]	Lit	3	N.A.
103. Farming experience	[years]	Lit	3	No database
104. ICT competences	[ICT competence, indicated in survey]	Lit	3	N.A.

A4.2 Scored attributes

The table below displays the scores given to each attribute on the survey list by the land users (L), policy officers (P) and experts (E).

Attribute	L 1	L 2	L 3	L 4	L 5	P 1	P 2	P 3	P 4	P 5	E 1	E 2	E 3	E 4	E 5
1. Willingness to cooperate	2	3	4	2	4	5	5	5	3	3	5	5	3	4	4
2. Social pressure traditions	2	2	2	2	3	4	3	5	2	4			2	2	2
3. Local ambassador for measures [presence 'example farm']	3	4	5	3	4	4	5	5	3	5		4	4	4	2
4. Social Cohesion	4	3	2	3	3	2	4	4	2	3	5		1	1	
5. Social networks	3	3	5	3	2	3	4	4	3	4	5		3	4	2
6. Family	3	2	1	2	4	1	3	3	2	2	5		1	1	1
7. Participation	3	1	3	1	2	2	4	2	3	4			2	2	1
8. Solidarity	4	2	4	1	4	3	4	2	2	2	5		1	1	3
9. Religion	3	1	1	1	4	2	3	4	2	2			1	1	1
10. Involvement women in decision-making	4	3	1	2	5	1	3	4	4	3			3	1	1
11. Female-headed households	2	2	1	2	4	1	3	4	3	3			2	1	1
12. Farmer population	3	3	4	4	4	3	4	5	2	4			2	2	4
13. Age Land Users	3	4	3	4	5	4	4	5	3	4			4	5	1
14. Over 65s	3	3	3	2	5	4	3	1	3	3			1	1	1
15. Single person households	2	2	1	1	3	1	3	5	2	1			1	1	1
16. Migration	2	2	3	2	1	1	3	4	2	2			1	1	1
17. Wells and Irrigation	4	4	5	4	4	4	4	5	3	4	4	2	4	5	1
18. Use of irrigation	4	4	5	4	3	4	4	5	3	4	4	3	4	5	5
19. Possibility in landscape of irrigation	3	4	5	4	3	4	5	5	3	3	4	2	3	5	5
20. Existing potential infrastructure storage and transfer	4	5	1	4	3	5	4	5	2	3	4	5	3	5	4
21. Costs Irrigation	3	5	5	5	5	5	5	5	3	4	4	3	3	5	3
22. Local Retention surface water	4	5	2	5	2	4	4	5	2	4	5	4	2	5	4
23. Diversity water sources	4	5	2	5	4	2	4	5	2	4	5	4	2	4	4
24. Multipurpose drainage system	3	5	3	5	1		4	5	2	4	5	3	2	5	3
25. Use waste water	4	3	2	4	1	4	3	5	3	4	5		3	5	4
26. Housing Stock	3	2	1	2	2	1	3	3	3	1	1		1		1
27. Housing Quality	2	3	1	2	2	2	3		3	1	1		1	1	1
28. Barn Quality	3	3	1	2	3	2	3	5	2	1	1	3	1	1	1
29. Early drought warning	4	2	4	2	4	4	4	5	2	4	4		2	3	3
30. Financial capacity local government	3	2	3	3	2	2	3	5	2	1	4		1		1
31. Positive financial stimulation on measures	4	3	5	3	4	5	5	5	2	4	5		4	3	4
32. Non-financial stimulation on measures	4	3	5	3	4	4	4	5	2	4	5		3	3	1
33. Financial compensation nature management	4	2	2	4	5	5	5	5	2	5			2	3	3
34. Long term adaptive plans and process	3	4	2	3	1	5	4	5	3	4	3		4	3	5
35. Drought Plan	4	4	5	3	3	1	4	5	2	4	4	3	3		5
36. Deltaprogramma agrarisch waterbeheer'	3	4	3	3	4	3	4	4	3	4	4	3	3		4

Attribute	L 1	L 2	L 3	L 4	L 5	P 1	P 2	P 3	P 4	P 5	E 1	E 2	E 3	E 4	E 5
37. Legal possibility new business models	3	3	2	4	2	5	4	5	3	5	3		3		3
38. Cooperation and coordination between sectors and governmental levels	3	5	2	4	5	4	5	5	3	5	3	4	3	3	5
39. Clear agreements with and between governments	4	5	2	4	5	4	4	5	2	4	4		1		5
40. Laws for drought adaptation	3	4	1	3	3	4	3	3	2	2	4		2	5	3
41. Quality spatial planning	4	4	2	4	2	2	4	3	2	4	3		2	3	4
42. Attention to drought	3	3	1	4	5	2	4	5	2	4	5	4	3	4	5
43. Local water management	4	4	1	3	5	4	5	5	2	4	5	4	?		3
44. Land lease	2	5		3	5	4	3	4	2	3	3		4	5	2
45. Income / Gross Regional Product	3	5	1	4	5	2	3	3	2	1	1		2	1	1
46. Agricultural income	4	4	3	5	4	1	3	4	2	4	4		3	4	1
47. Farm size	3	5	5	3	3	2	4	4	3	4	1		3	4	1
48. Economic equality	3	3	4	3	3	1	3	5	2	1	1		1	1	1
49. Assets	4	4	3	4	4	2	3	1	3	1	4		3	1	1
50. Unemployment	3	2	1	3	1	1	3	4	2	2	1		1	1	1
51. Savings /Debt	2	3	1	3	5	1	3	4	3	2	4		3	1	1
52. Price current crops	5	4	1	4	5	4	4	5	2	4	3		2	3	1
53. Production costs	4	5	1	4	5	5	5	5		4	4		2	3	1
54. Agricultural investments	4	4	1	5	4	5	5	5	3	4	4		2	3	2
55. Availability fodder	3	5	1	5	5	4	4	5	3	4	1		2	1	1
56. Availability manure and organic matter	5	4	5	5	5	5	5	5	3	4	1		2	1	1
57. Short terms costs of measures	4	4	4	4	4	5	4	5	3	5	3	4	3	5	4
58. Taken adaptive measures	4	5	2	2	3	1	4	5	3	4	5	4	2	5	4
59. Private or common insurance	3	3	1	1	1	1	3	3	3	3	5		3	1	1
60. Farmers that uses forecasts about droughts	4	3		3	4	5	4	3	3	4	4	3	4	1	4
61. Alternative Grazing strategies	2	4	1	3	4	3	4	5	3	4	3		2	1	4
62. Use drought resistant crops	5	5	4	3	5	5	5	5	3	5	5	3	4	5	4
63. Quality drought resistant crops	5	4	4	4	3	4	5	5	3	4	5		3	3	3
64. Costs drought resistant crops	3	4	2	4	2	3	4	5	3	3	4		3	3	3
65. Knowledge on producing drought resistant crops	2	4	4	3	4	2	5	5	3	5	4		3	4	4
66. Market for drought resistant crops	3	4	2	4	2	4	5	5	3	5	4		4	4	3
67. Quality wet crops in buffer zones	3	5	2	4	1	2	4	5	2	4	4		2	1	4
68. Extenisive agriculture	3	4	2	3	2	4	4	5	2	5	3		2	4	4
69. Livestock	4	3	2	3	5	1	3	5	3	4	1		2	3	1
70. Nature inclusive agriculture	3	5	2	2	5	3	4	5	2	4	1		2	4	3
71. Future business models	3	4	5	3	5	4	4	5		4	1	4	3	3	2
72. Retention capacity soil	5	5	5	4	4	5	5	5	3	5	5	4	2	5	5
73. Soil organic matter	4	5	5	4	5	5	5	5	3	5	4	2	1	4	2
74. Biological quality soil	4	4	5	4	5	5	4	5	3	5	3	3	1	4	4
75. Chemical quality soil	3	3	5	3	3	4	4	5	3	3	3	3	1	3	4
76. Physical quality soil	4	5	5	4	5	5	4	5	3	4	3	3	1	4	4

Attribute	L 1	L 2	L 3	L 4	L 5	P 1	P 2	P 3	P 4	P 5	E 1	E 2	E 3	E 4	E 5
77. Productivity	3	3	4	4	3	3	4	5	3	4	1	3	2		2
78. Winter tillage / no tillage	5	4	2	3	4	2	3	5	2	3	3		1	2	2
79. Use of fertilizer	3	4	1	3	5	4	3	5	2	4	1		2	3	2
80. Tree cover	2	4		3	3	2	3	5	2	4	2		1	1	3
81. Green cover	2	5	4	3	2	2	3	5	2	3	4		1	3	3
82. Open landscape requirement	3	4	1	3	5	1	3	4	2	3	2		1	1	2
83. Adequate groundwater management	4	4	1	4	5	5	5	5	2	5	5	4	1	1	5
84. Size and shape land positions	5	4	5	4	1	1	4	5	2	4	1		2	1	1
85. Mobility land ownership	3	3	5	3	3	1	4	5	2	3	3		1	3	1
86. Potential Mobility land ownership	4	2	4	4	2	3	4	5	2	4	3		1	1	1
87. Physical option for measures	3	2	5	3	2	4	4	5	2	4	5	4	3	1	5
88. Function follows water system	4	5	1	3	4	5	4	5	2	5	4	4	1	4	5
89. Connectivity land uses	3	3	1	3	3	3	4	5	2	4	1		1	1	4
90. Biodiversity	3	3	2	3	4	4	4	5	3	5	1		1	4	5
91. Local knowledge on drought	2	4	2	4	5	2	5	5	3	4	4	4	4	4	4
92. Local knowledge effectiveness measures	3	5	2	4	4	4	4	5	2	5	4	4	4	4	5
93. Scientific knowledge effectiveness measures	4	4	3	4	4	5	4	2	2	4	3		1	2	5
94. Knowledge on local water system	3	5	2	3	4	5	5	4	3	5	3	4	1	5	5
95. Farm specific coaching	4	5	2	3	5	3	5	5	2	5		4	3	4	5
96. Willingness to innovate and change	4	4	4	4	5	4	5	5	3	5	4	4	4	3	5
97. Awareness and acceptance climate unpredictability	3	5	4	2	4	4	5	4	3	5	4	4	4	4	5
98. Sense of urgency	3	3	3	3	3	5	4	5	3	5	4	5	5	2	5
99. Societal acceptation less consumption	4	4	2	3	3	3	4		2	4			1	1	1
100. Willingness to stay in area	4	4	3	3	5	4	3	5	3	4	4		2	1	3
101. Mental Health	5	2	4	2	4	1	4	5	2	3	4		2	1	1
102. Education level	4	3	4	3	2	1	4	1	2	4	2		4	1	1
103. Farming experience	4	3	4	4	4	1	4	5	2	3	4		3	3	1
104. ICT competences	4	3	4	3	3	1	4	3	2	4	2		3	3	1

A4.3 Indicator choices in Survey

The table below shows all attributes that had more than one related indicator listed. Not all respondents indicated their choices. The choices of the participants that did indicate them are presented in the table. The green highlighted indicators were selected the most within their attribute.

Attributes	Indicators	All	LU 1	LU 2	LU 3	PO 1	PO 2	PO 3	Ex 1	Ex 2
Willingness to cooperate	[# shared initiatives]	5	0		1	0	1	1	1	1
	[willingness to cooperate in surveys]	2	1		0	1	0	0	0	0
Social networks	[number of social networks]	1	0		0	0	0	0	0	1
	Household member in social network [#]	4	0		0	0	1	1	1	1
	Knowledge exchange in networks [-]	4	1		1	1	0	1	0	0
Family	[amount of family support]	2	1					1	0	
	[Number of close relatives]	1	0					0	1	
Solidarity	People volunteered to assist [#]	2	1			0			1	
	Degree of solidarity [-]	1	0			1			0	
Religion	Faith based organizations [#]	1	1					0	0	
	Religious adherents [-]	2	0					1	1	
Farmer population	Farmers [#]	2	1		1	0			0	0
	Ratio farmers : non-farmers [-]	3	0		0	1			1	1
Wells and Irrigation	[% dry ground covered]	5	1		0	1	1	1	1	0
	[presence, dummy]	3	0		1	0	0	1	0	1
Use of irrigation	Irrigated area [ha]	5	0		0	1	1	1	1	1
	Efficiency (used:withdrawn)]	2	1		1	0	0	0	0	0
Costs Irrigation	[euro/tonnes crop]	3	0	0	0		1	0	1	1
	[revenue - costs]	4	1	1	1		0	1	0	0
Local Retention surface water	[m3]	3	1	0				1	0	1
	[possible outflow - remaining outflow]	2	0	1				0	1	0
Use waste water	[m3]	4	0	0		0	1	1	1	1
	[costs euro/m3]	1	0	1		0	0	0	0	0
	[m3 re-used/m3 total waste water]	3	1	0		1	0	1	0	0
Barn Quality	[Food storage capacity]	4	1	1	1				1	
	[% repairs needed]	0	0	0	0				0	
Financial capacity local government	[Revenue in euro/capita]	1	1	0						0
	[General expenditures in euro/capita]	2	0	1						1
Long term adaptive plans and process	[Presence and stage of future focused regional process with stakeholders]	7	1	0	1	1	1	1	1	1
	[Presence Adaptive long term policy document]	2	0	0	0	1	0	1	0	0
	[number 'change' mentioned in relevant documents]	3	0	1	0	0	0	1	0	1

Attributes	Indicators	All	LU 1	LU 2	LU 3	PO 1	PO 2	PO 3	Ex 1	Ex 2
Drought Plan	[existence]	1	0	0	0			1	0	
	[clarity indicated in survey]	2	1	1	0			0	0	
	[effectiveness]	2	0	0	1			1	0	
	[Amount of projects on droughts]	0	0	0	0			0	0	
	[Beneficiaries families by projects]	1	0	0	0			1	0	
	[%organizations using it]	1	0	0	0			0	1	
	[use in spatial planning]	1	0	0	0			1	0	
Cooperation and coordination between sectors and governmental levels	[presence]	2	0	0		0	1	1	0	0
	[judged through a survey]	5	1	1		1	0		1	1
Laws for drought adaptation	[amount]	1	1	0					0	0
	[Retention requirement by law in m3 pp]	3	0	1					1	1
Quality spatial planning	[% vulnearable areas included in planning]	2	1	0	0			1	0	
	[% Physical infrastructure on operative plans]	1	0	0	1			0	0	
	[Existence of registers of reduction of water use]	2	0	1	0			0	1	
Attention to drought	[number of commissions, entities and managing resources for droughts]	0	0	0				0	0	0
	[number of strategic alliances]	2	0	1				1	0	0
	[number of people active in water conservency]	4	1	0				1	1	1
Income / Gross Regional Product	Income [euro/capita]	0	0	0					0	
	Median household income [euro/household]	0	0	0					0	
	Change in income over past year [%]	1	1	0					0	
	GRP of area [euro/capita]	2	0	1					1	
Agricultural income	[Value of farm products sold in euro/km2]	5	1	1	1			1	1	
	[GDP in agriculture]	0	0	0	0			0	0	
Economic equality	[%Population living below poverty line]	2	0	1					1	
	[Gini-index]	1	1	0					0	
Assets	[Value property]	2	0	1			1		0	
	[Value non-land assets]	2	1	0			0		1	
	[Median rent]	0	0	0			0		0	
Savings / Debt	[euro]	2	1	0					1	
	[farm solvency]	1	0	1					0	
Alternative Grazing strategies	[% livestock grazing in other zones during critical drought]	3	1	0			1		1	

Attributes	Indicators	All	LU 1	LU 2	LU 3	PO 1	PO 2	PO 3	Ex 1	Ex 2
	[presence communal grazing grounds]	1	0	1			0		0	
Use drought resistant crops	[ha]	3	0	0	0	0	1	1	0	1
	[% on drought sensitive land]	3	0	0	0	1	0	1	1	0
	[water use mm]	2	0	0	1	0	0	1	0	0
	[potential - actual evapotranspiration]	2	0	1	0	1	0	0	0	0
	[m3/ha]	1	1	0	0	0	0	0	0	0
Quality drought resistant crops	[proteins/ha]	5	0	0	1		1	1	1	1
	[proteins/dry year]	3	1	1	0		0	1	0	0
Costs drought resistant crops	[euro/tonnes]	2	1		0		0	1	0	0
	[euro/ha]	5	0		1		1	1	1	1
Livestock	[livestock/ha]	2	0		0		1			1
	[Livestock productivity]	2	1		1		0			0
Future business models	[number of sustainable businesses]	2	0	1	0				0	1
	[number of businesses with waterplan]	3	1	0	1				1	0
Retention capacity soil	[retention capacity]	7	1	1	1	1	1	1		1
	[mm]	1	0	0	0	0	0	1		0
	[soil moisture level]	2	0	0	0	1	0	1		0
Physical quality soil	[compactness]	0	0	0	0		0	0		0
	[infiltration capacity]	6	1	1	1		1	1		1
	[% impervious surface]	1	0	0	0		0	0		1
Productivity	[ton/ha without inputs]	3	1	1	0		0		1	
	[ton/ha]	2	0	0	1		1		0	
	[ton/capita]	0	0	0	0		0		0	
Use of fertilizer	[kg/ha]	0	0	0	0					
	[% organic fertilizer]	3	1	1	1					
Open landscape requirement	[attractiveness, through survey]	1	0	1	0					
	[years in use as agricultural land]	2	1	0	1					
Adequate groundwater management	[mm retention]	1	1	0	0					
	[lowered pressure in mm]	2	0	1	1					
Size and shape land positions	[ha connected, right-angled parcels]	2	1	0	1					
	[ratio connected parcels : owners]	1	0	1	0					
Potential Mobility land ownership	[Emotional value land in years of ownership]	1	0	0		1				
	[Distance house to field in m]	0	0	0		0				
	[land price in euro / ha]	2	1	1		0				

Attributes	Indicators	All	LU 1	LU 2	LU 3	PO 1	PO 2	PO 3	Ex 1	Ex 2
Physical option for measures	[option]	3	1		1	1			0	
	[ratio agricultural land - other]	1	0		0	0			1	
Local knowledge effectiveness measures	[knowledge, indicated in survey]	0	0	0	0				0	
	[% land users having knowledge]	3	1	1	1				0	
	[secured water savings]	1	0	0	0				1	
Knowledge on local water system	[presence public description]	1	0	1	0					
	[number of informative meetings]	2	1	0	1					
Farm specific coaching	[% participating land users]	2	1	0	0				1	
	[% large changes among participants]	2	0	1	1				0	
Willingness to stay in area	[Hope for the future, indicated in survey]	0	0	0	0	0	0			
	[Sense of Belonging, indicated in survey]	3	0	0	1	1	1			
	[quality of life, indicated in survey]	2	1	1	0	0	0			
Education level	[Household head education level]	1	0	0	0				1	
	[% of population over 25 without high school degree]	2	1	1	0				0	
	[average level of education]	1	0	0	1				0	

A4.4 Additional information resilience attributes

The table below includes the drought resilience attributes that were on the survey list. For each attribute, the robustness, presence on final list, capital category, generic resilience principle category and origin (literature or interview) is given.

Attribute	Robustness A	Robustness B	Final A	Final B	Capital	GR Primciple	Lit or Int
1. Willingness to cooperate	80.6	90.5	Yes	Yes	Social	Modularity	Int
2. Social pressure traditions	0.7	0.2	No	No	Social	Modularity	Int
3. Local ambassador for measures [presence 'example farm']	93.4	96.8	Yes	Yes	Social	Consciousness	Int Lit
4. Social Cohesion	6.7	2.1	No	No	Social	Modularity	Int Lit
5. Social networks	25.4	54.3	No	No	Social	Modularity	Lit
6. Family	0.1	0	No	No	Social	Reserves	Lit
7. Participation	0	0	No	No	Social	Modularity	Lit
8. Solidarity	11.9	1.1	No	No	Social	Modularity	Lit
9. Religion	0	0	No	No	Social	Modularity	Lit
10. Involvement women in decision-making	5.3	0.6	No	No	Social	Modularity	Lit
11. Female-headed households	0.2	0	No	No	Social	Diversity	Lit
12. Farmer population	54.9	40.3	Yes	No	Social	Reserves	Lit
13. Age Land Users	89.7	72.1	Yes	Yes	Social	Feedbacks	Lit
14. Over 65s	0.2	0.1	No	No	Social	Diversity	Lit
15. Single person households	0	0	No	No	Social	Reserves	Lit
16. Migration	0	0	No	No	Social	Feedbacks	Lit
17. Wells and Irrigation	99.7	80	Yes	Yes	Physical	Reserves	Int Lit
18. Use of irrigation	99.6	100	Yes	Yes	Physical	Reserves	Lit
19. Possibility in landscape of irrigation	78.2	97.2	Yes	Yes	Physical	Feedbacks	Int
20. Existing potential infrastructure storage and transfer	90.5	74.4	Yes	Yes	Physical	Reserves	Int
21. Costs Irrigation	92.8	100	Yes	Yes	Physical	Feedbacks	Int Lit
22. Local Retention surface water	97	80.8	Yes	Yes	Physical	Reserves	Int Lit
23. Diversity water sources	96.5	79.3	Yes	Yes	Physical	Diversity	Lit
24. Multipurpose drainage system	46.1	48.4	No	No	Physical	Reserves	Int

Attribute	Robustness A	Robustness B	Final A	Final B	Capital	GR Primciple	Lit or Int
25. Use waste water	67.5	55.5	Yes	No	Physical	Reserves	Int
26. Housing Stock	0	0	No	No	Physical	Reserves	Int Lit
27. Housing Quality	0	0	No	No	Physical	Reserves	Lit
28. Barn Quality	0	0	No	No	Physical	Reserves	Lit
29. Early drought warning	65.6	37.4	Yes	No	Physical	Consciousness	Lit
30. Financial capacity local government	0.2	0.1	No	No	Institutional	Reserves	Lit
31. Positive financial stimulation on measures	93.8	98	Yes	Yes	Institutional	Feedbacks	Int Lit
32. Non-financial stimulation on measures	66.3	58.4	Yes	No	Institutional	Openness	Int
33. Financial compensation nature management	59.2	55.2	Yes	Yes	Institutional	Reserves	Int
34. Long term adaptive plans and process	45.2	47.2	No	No	Institutional	Consciousness	Int
35. Drought Plan	68.3	54.1	Yes	No	Institutional	Consciousness	Int Lit
36. Deltaprogramma agrarisch waterbeheer'	45.5	99.3	No	Yes	Institutional	Openness	Int
37. Legal possibility new business models	16.1	44.4	No	No	Institutional	Feedbacks	Int
38. Cooperation and coordination between sectors and governmental levels	79.6	96.2	Yes	Yes	Institutional	Modularity	Int Lit
39. Clear agreements with and between governments	97.3	62.8	Yes	Yes	Institutional	Openness	Int
40. Laws for drought adaptation	3.9	6	No	No	Institutional	Feedbacks	Int Lit
41. Quality spatial planning	29	9.6	No	No	Institutional	Modularity	Lit
42. Attention to drought	80.3	55	Yes	Yes	Institutional	Consciousness	Lit
43. Local water management	91.2	62.9	Yes	Yes	Institutional	Consciousness	Int
44. Land lease	31.1	43.6	No	No	Institutional	Modularity	Int Lit
45. Income / Gross Regional Product	0.9	0.2	No	No	Economic	Reserves	Lit
46. Agricultural income	67.1	23.7	Yes	No	Economic	Reserves	Lit
47. Farm size	25.4	14.5	No	No	Economic	Reserves	Lit
48. Economic equality	0	0	No	No	Economic	Diversity	Lit
49. Assets	11	1	No	No	Economic	Reserves	Lit
50. Unemployment	0	0	No	No	Economic	Feedbacks	Lit
51. Savings /Debt	0.3	0	No	No	Economic	Reserves	Lit

Attribute	Robustness A	Robustness B	Final A	Final B	Capital	GR Primciple	Lit or Int
52. Price current crops	66.6	22.4	Yes	No	Economic	Reserves	Int
53. Production costs	91.6	44.2	Yes	No	Economic	Feedbacks	Lit
54. Agricultural investments	84.1	57.2	Yes	Yes	Economic	Openness	Lit
55. Availability fodder	44.7	7.8	No	No	Economic	Reserves	Int
56. Availability manure and organic matter	84.4	36.2	Yes	No	Economic	Reserves	Int
57. Short terms costs of measures	99.7	100	Yes	Yes	Economic	Feedbacks	Int
58. Taken adaptive measures	79	46.6	Yes	No	Natural	Consciousness	Lit
59. Private or common insurance	0	0	No	No	Economic	Reserves	Int Lit
60. Farmers that uses forecasts about droughts	63.5	61.1	Yes	Yes	Natural	Openness	Lit
61. Alternative Grazing strategies	27.6	9.1	No	No	Natural	Openness	Int Lit
62. Use drought resistant crops	99.7	100	Yes	Yes	Natural	Reserves	Int Lit
63. Quality drought resistant crops	84.3	99.9	Yes	Yes	Natural	Reserves	Int
64. Costs drought resistant crops	10.1	35.7	No	No	Natural	Feedbacks	Int
65. Knowledge on producing drought resistant crops	83.7	83.1	Yes	Yes	Natural	Feedbacks	Int
66. Market for drought resistant crops	84.9	81.5	Yes	Yes	Economic	Openness	Int
67. Quality wet crops in buffer zones	45	9	No	No	Natural	Reserves	Int
68. Extenisive agriculture	46.5	33.4	No	No	Natural	Reserves	Int
69. Livestock	3	2.5	No	No	Natural	Reserves	Lit
70. Nature inclusive agriculture	24.8	15.5	No	No	Natural	Modularity	Int Lit
71. Future business models	66.1	52.6	Yes	No	Economic	Consciousness	Int
72. Retention capacity soil	100	100	Yes	Yes	Natural	Reserves	Int Lit
73. Soil organic matter	97.6	80.4	Yes	Yes	Natural	Reserves	Int Lit
74. Biological quality soil	97.2	84.8	Yes	Yes	Natural	Reserves	Int Lit
75. Chemical quality soil	8.6	38.6	No	No	Natural	Reserves	Int Lit
76. Physical quality soil	96.9	84.2	Yes	Yes	Natural	Modularity	Int Lit
77. Productivity	9.9	14.4	No	No	Natural	Reserves	Int Lit
78. Winter tillage / no tillage	3.7	3.2	No	No	Natural	Reserves	Int

Attribute	Robustness A	Robustness B	Final A	Final B	Capital	GR Primciple	Lit or Int
79. Use of fertilizer	10.7	4.4	No	No	Natural	Openness	Lit
80. Tree cover	1.2	0.5	No	No	Natural	Reserves	Int Lit
81. Green cover	3.3	5.2	No	No	Natural	Feedbacks	Lit
82. Open landscape requirement	0.4	0.3	No	No	Natural	Diversity	Int
83. Adequate groundwater management	97.8	47.1	Yes	No	Natural	Reserves	Int
84. Size and shape land positions	45	2.7	No	No	Natural	Modularity	Int
85. Mobility land ownership	0.3	2	No	No	Natural	Feedbacks	Int
86. Potential Mobility land ownership	25.8	1.4	No	No	Natural	Feedbacks	Int
87. Physical option for measures	58.5	39.9	Yes	No	Natural	Feedbacks	Int
88. Function follows water system	97.4	57.4	Yes	Yes	Natural	Reserves	Int
89. Connectivity land uses	3.4	1	No	No	Natural	Modularity	Lit
90. Biodiversity	43.9	25.1	No	No	Natural	Diversity	Lit
91. Local knowledge on drought	97.1	85	Yes	Yes	Human	Feedbacks	Lit
92. Local knowledge effectiveness measures]	99.6	95.7	Yes	Yes	Human	Feedbacks	Int
93. Scientific knowledge effectiveness measures	64.3	30.5	Yes	No	Human	Feedbacks	Int
94. Knowledge on local water system	78.4	73.7	Yes	Yes	Human	Modularity	Int
95. Farm specific coaching	84.9	91.3	Yes	Yes	Human	Openness	Int
96. Willingness to innovate and change	100	100	Yes	Yes	Human	Consciousness	Int Lit
97. Awareness and acceptance climate unpredictability	99.7	99.1	Yes	Yes	Human	Consciousness	Int
98. Sense of urgency	60.7	95.8	Yes	Yes	Human	Consciousness	Int
99. Societal acceptation less consumption	9.6	0.8	No	No	Human	Consciousness	Int
100. Willingness to stay in area	43.7	41.9	No	No	Human	Feedbacks	Lit
101. Mental Health	23.7	1.7	No	No	Human	Consciousness	Lit
102. Education level	12	0.2	No	No	Human	Feedbacks	Lit
103. Farming experience	46.3	17.5	No	No	Human	Feedbacks	Lit
104. ICT competences	3	3.5	No	No	Human	Openness	Lit

Annex 5 – Outcomes Statistical Tests

A5.1 Comparison of Capitals (p-values)

Counts: Indicators in literature-based initial list

	Social	Physical	Institutional	Economic	Natural	Human
Count	51	37	37	71	80	52
P-value						
Social	-	-	-	-	-	-
Physical	0.9616	-	-	-	-	-
Institutional	0.9616	1.0000	-	-	-	-
Economic	0.7648	0.0180	0.0180	-	-	-
Natural	0.1553	0.0013	0.0013	1.0000	-	-
Human	1.0000	0.9616	0.9616	0.8336	0.1843	-

Counts: Attributes in literature-based initial list

	Social	Physical	Institutional	Economic	Natural	Human
Count	35	26	14	36	55	37
P-value						
Social	-	-	-	-	-	-
Physical	1.000	-	-	-	-	-
Institutional	0.042	0.606	-	-	-	-
Economic	1.000	1.000	0.031	-	-	-
Natural	0.446	0.024	1e-05	0.527	-	-
Human	1.000	1.000	0.024	1.000	0.606	-

Counts: Indicators in participatory-based initial list

	Social	Physical	Institutional	Economic	Natural	Human
Count	9	22	26	12	57	13
P-value						
Social	-	-	-	-	-	-
Physical	0.2650	-	-	-	-	-
Institutional	0.0599	1.0000	-	-	-	-
Economic	1.0000	0.7287	0.2684	-	-	-
Natural	1.8e-08	0.0012	0.0097	5.2e-07	-	-
Human	1.0000	0.8773	0.3728	1.0000	1.3e-06	-

Counts: Attributes in participatory-based initial list

	Social	Physical	Institutional	Economic	Natural	Human
Count	6	11	20	10	29	7
P-value						
Social	-	-	-	-	-	-
Physical	1.0000	-	-	-	-	-
Institutional	0.1029		-	-	-	-
Economic	1.0000	1.0000	0.8886	-	-	-
Natural	0.0018	0.0771	1.0000	0.0439	-	-
Human	1.0000	1.0000	0.1916	1.0000	0.0044	-

Counts: Attributes in Survey List

	Social	Physical	Institutional	Economic	Natural	Human
Count	16	13	15	16	30	14
P-value						
Social	-	-	-	-	-	-
Physical	1.00	-	-	-	-	-
Institutional	1.00	1.00	-	-	-	-
Economic	1.00	1.00	1.00	-	-	-
Natural	0.47	0.14	0.33	0.47	-	-
Human	1.00	1.00	1.00	1.00	0.22	-

Counts: Attributes in median based final list

	Social	Physical	Institutional	Economic	Natural	Human
Count	4	9	8	8	12	8
P-value						
Social	-	-	-	-	-	-
Physical	1	-	-	-	-	-
Institutional	1	1	-	-	-	-
Economic	1	1	1	-	-	-
Natural	1	1	1	1	-	-
Human	1	1	1	1	1	-

Counts: Attributes in distribution based final list

	Social	Physical	Institutional	Economic	Natural	Human
Count	3	7	7	3	9	7
P-value						
Social	-	-	-	-	-	-
Physical	1	-	-	-	-	-
Institutional	1	1	-	-	-	-
Economic	1	1	1	-	-	-
Natural	1	1	1	1	-	-
Human	1	1	1	1	1	-

Scores: Dunn's Test

	Social	**Physical**	**Institutional**	**Economic**	**Natural**
Physical	<.0001	-	-	-	-
Institutional	<.0001	1.000	-	-	-
Economic	0.061	0.276	0.063	-	-
Natural	<.0001	1.000	1.000	0.222	-
Human	<.0001	1.000	0.910	0.052	1.000

Scores: Tukey's Test

	Social	**Physical**	**Institutional**	**Economic**	**Natural**
Physical	0.0001	-	-	-	-
Institutional	<.0001	0.9519	-	-	-
Economic	0.1141	0.2135	0.0161	-	-
Natural	<.0001	1.0000	0.8286	0.1167	-
Human	<.0001	0.9690	1.0000	0.0227	0.8772

A5.2 Comparison of Generic Resilience Principles (p-values)

Counts: Indicators in literature-based initial list

	Diversity	Modularity	Openness	Reserves	Feedbacks	Consciousness
Count	49	58	41	96	54	30
P-value						
Diversity	-	-	-	-	-	-
Modularity	1.0000	-	-	-	-	-
Openness	1.0000	0.7515	-	-	-	-
Reserves	0.0015	0.0302	4.1e-05	-	-	-
Feedbacks	1.0000	1.0000	1.0000	0.0091	-	-
Consciousness	0.3373	0.0375	1.0000	4.6e-08	0.1047	-

Counts: Attributes in literature-based initial list

	Diversity	Modularity	Openness	Reserves	Feedbacks	Consciousness
Count	26	34	31	58	32	22
P-value						
Diversity	-	-	-	-	-	-
Modularity	1.0000	-	-	-	-	-
Openness	1.0000	1.0000	-	-	-	-
Reserves	0.0088	0.1762	0.0721	-	-	-
Feedbacks	1.0000	1.0000	1.0000	0.0966	-	-
Consciousness	1.0000	1.0000	1.0000	0.0011		-

Counts: Indicators in participatory-based initial list

	Diversity	Modularity	Openness	Reserves	Feedbacks	Consciousness
Count	8	15	15	56	29	16
P-value						
Diversity	-	-	-	-	-	-
Modularity	1.0000	-	-	-	-	-
Openness	1.0000		-	-	-	-
Reserves	8.3e-09	1.5e-05	1.5e-05	-	-	-
Feedbacks	0.0083	0.4389	0.4389	0.0451	-	-
Consciousness	0.9095	1.0000	1.0000	2.9e-05	0.5072	-

Counts: Attributes in participatory-based initial list

	Diversity	Modularity	Openness	Reserves	Feedbacks	Consciousness
Count	4	11	12	30	16	10
P-value						
Diversity	-	-	-	-	-	-
Modularity	0.948	-	-	-	-	-
Openness	0.691	1.0000	-	-	-	-
Reserves	9.2e-05	0.056	0.095	-	-	-
Feedbacks	0.130	1.0000	1.0000	0.541	-	-
Consciousness	1.0000	1.0000	1.0000	0.031	1.0000	-

Counts: Attributes in Survey List

	Diversity	Modularity	Openness	Reserves	Feedbacks	Consciousness
Count	6	16	10	37	22	13
P-value						
Diversity	-	-	-	-	-	-
Modularity	0.5010	-	-	-	-	-
Openness			-	-	-	-
Reserves	2.5e-05	0.0603	0.0014	-	-	-
Feedbacks	0.0446	1.0000	0.5010	0.5396	-	-
Consciousness	1.0000	1.0000	1.0000	0.0122	1.0000	-

Counts: Attributes in median based final list

	Diversity	Modularity	Openness	Reserves	Feedbacks	Consciousness
Count	1	4	6	17	11	10
P-value						
Diversity	-	-	-	-	-	-
Modularity	1.0000	-	-	-	-	-
Openness	1.0000		-	-	-	-
Reserves	0.0022	0.0936	0.3816	-	-	-
Feedbacks	0.0889	1.0000	1.0000	1.0000	-	-
Consciousness	0.1406	1.0000	1.0000	1.0000	1.0000	-

Counts: Attributes in distribution based final list

	Diversity	Modularity	Openness	Reserves	Feedbacks	Consciousness
Count	1	4	6	11	8	6
P-value						
Diversity	-	-	-	-	-	-
Modularity	1.000	-	-	-	-	-
Openness	1.000	1.000	-	-	-	-
Reserves	0.095	1.000	1.000	-	-	-
Feedbacks	0.547	1.000	1.000	1.000	-	-
Consciousness	1.000	1.000	1.000	1.000	1.000	-

Scores: Tukey's Test

	Diversity	**Modularity**	**Openness**	**Reserves**	**Feedbacks**
Modularity	0.3703	-	-	-	-
Openness	0.0030	0.1481	-	-	-
Reserves	0.0656	0.9397	0.3596	-	-
Feedbacks	0.0075	0.3452	0.9577	0.7197	-
Consciousness	<.0001	0.0033	0.9392	0.0087	0.3119

Scores: Dunn's Test

	Diversity	**Modularity**	**Openness**	**Reserves**	**Feedbacks**
Modularity	0.426	-	-	-	-
Openness	0.007	0.193	-	-	-
Reserves	0.063	0.776	0.486	-	-
Feedbacks	0.013	0.357	0.449	1.000	-
Consciousness	<.0001	0.003	0.600	0.015	0.299

A5.3 Predictions of stakeholder group scores for categories

Predictions of stakeholder group scores for capitals. Based on linear regression.

Capitals	Land Users	Policy Officers	Experts	Average
Social	2.76	3.14	2.30	2.73
Physical	3.34	3.54	3.25	3.38
Institutional	3.35	3.67	3.44	3.49
Economic	3.49	3.40	2.26	3.05
Natural	3.47	3.75	2.79	3.34
Human	3.54	3.64	3.23	3.47

Predictions of stakeholder group scores for generic resilience principles. Based on linear regression.

Generic Resilience Principles	Land Users	Policy Officers	Experts	Average
Diversity	3.13	3.03	2.04	2.73
Modularity	3.11	3.45	2.70	3.09
Openness	3.45	3.80	3.03	3.42
Reserves	3.39	3.48	2.69	3.19
Feedbacks	3.37	3.59	3.01	3.32
Consciousness	3.43	3.84	3.48	3.59