



AGRICULTURAL INNOVATION IN GROUNDWATER PROTECTION AREAS

*An analysis of the institutional framework
within the Province of Overijssel using the
IAD framework*

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Abstract

This report contains an analysis of both the constraining and enabling institutional rules in the stimulation of agricultural innovations in the groundwater protection areas in the province of Overijssel. The contemporary institutional framework was analysed using Ostrom's (2011) Institutional Analysis and Development (IAD) framework which consists of seven rules. These rules regulate; 1) which positions actors can fulfil in the action situation, 2) how they can either enter or leave the action situation, 3) which responsibilities and restrictions they have, 4) which actions they take in relation to wanted outcomes, 5) how information is shared, 6) which actors have power to make decisions, and 7) who benefits or pays for actions and outcomes. The rules within this framework were operationalised through questions in order to analyse. The methods used for the data gathering were: academic literature research, policy analysis and qualitative interviews. Based on the analysis, the conclusion can be drawn that there are institutional obstructions in stimulating the agricultural innovations within five out of the seven rules. These obstructions can be combined in three overarching dilemmas; 1) both the sense of urgency and the generated innovation are not communicated clearly, 2) there is a lack of enforcement, and 3) the agricultural chain partners are not sufficiently involved. In order to both overcome these dilemmas and stimulate the innovation effort, 1) the role of communicator and facilitator has to be fulfilled, 2) enforcement has to be enabled, and finally, 3) the peripheral involvement in the effort has to be stimulated.

Key words:

IAD framework, constraining and enabling institutional rules, agricultural optimisation, transition theory

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Table of contents

Abstract	2
Acknowledgements	3
Table of contents.....	4
1: From maximisation toward optimisation: an agricultural transition	6
1.1 Objectives and research questions	7
1.2 Introducing the case	8
1.3 Scientific relevance.....	9
1.4 Structure of the report	10
2: Theoretical framework.....	11
2.1: The transition towards smart-farming and optimisation.....	11
2.2: The transition of agriculture in groundwater protection areas	12
2.3: Analysing the institutional framework.....	13
2.4 Operationalising the IAD Framework.....	16
2.5 Two types of outcomes and their implications; institutional restrictions and opportunities	18
2.6 Building the conceptual model.....	19
3: Methodology	21
3.1 Research strategy: Case-study	22
3.2 Applied methods	22
3.2.1 Semi-structured interviews	23
3.2.2 Policy analysis.....	24
3.2.3 Literature study	25
3.3 Ethics	26
4: Analysis of the action situation using the IAD Framework	27
4.1 Introducing the actors	27
4.2 Position rules	29
4.3 Boundary rules	33
4.4 Choice rules	37
4.5 Scope rules	40
4.6 Information rules.....	43
4.7 Aggregation rules	46
4.8 Payoff.....	48
4.9 Defining the rules, building the framework	51
5: Conclusion and discussion.....	53
5.1 Main findings and their implications for planning practice	53

5.2 Reflecting on the conceptual model and research design	54
5.3 Suggestions for future research	56
5.4 Reflection on process	56
Summary	58
Nederlandse samenvatting	60
References.....	62
Appendix I: Code tree.....	i
Appendix II: Academic literature database	ii
Appendix III: Policy database	iv
Appendix IV: outcome analysis interview data using Atlas Ti.....	v

1: From maximisation toward optimisation: an agricultural transition

The big societal and institutional changes that occurred shortly after the Second World War resulted in the upscaling of agricultural enterprises in the Netherlands and in Europe. During this War a famine occurred, which is the reason that the agricultural policy of the countries participating in the European Economic Community (a forerunner of the European Union) was restructured. This restructuring aimed to maximize production, which would be reached by upscaling and intensifying farming. It stimulated a transition from mixed farming to mono-functional farming (Europa Nu, 2017; Westerman, 2015). This change can be interpreted as an institutional shift, which still has great influence on present day farming practice. This is exemplified by the contemporary maximisation oriented agricultural practice and the dependency the chain partners and the consumers on this practice; maximised agriculture provides large amounts of relatively cheap bulk goods (Vivano, 2017).

This maximisation approach exceeded its purpose and led to overproduction of food. This destabilized the food-market (Lewis, 1996). Besides an overcapacity, other downsides of the new, intensive and mono-functional agricultural practice became evident. The pollution of the groundwater is one of those additional downsides. As a part of the upscaling, an increasing amount of pesticides were used to decrease the chance of crop-plagues, and to remove weeds from pastures. Besides this, increasing amounts of manure were excreted by an increasing amount of livestock, and more manure and chemical fertilizer was used to fertilize crops. This growing amount of chemicals and manure used, resulted in an increased dry deposition of elements like nitrate. The emission of nitrate, phosphate and pesticides to the groundwater increased as well. This resulted in environmental damage and decreasing biodiversity (Europa Nu, 2017; European commission, 2016; Zijlstra et. al., 2011).

To overcome those problems (overproduction and pollution), new policies started to arise with the goal of limiting the negative effects of the mono-functional agricultural practice. These policies were the start of the transition towards an optimized farming practice. Innovations would be used to minimize the usage of agricultural chemicals, while simultaneously ensuring production. Restrictions were put on the amount of manure that could be produced and applied to the soil in the fertilizer policy (Hees et. al., 2012, Van Eerdt et. al., 2004). The amount of phosphorus that can be emitted was restricted in the Programmatic Approach Nitrogen (PAS) (Ministry of Agriculture, Nature and Food quality, 2018), and incentives were created for farmers to take ecological development in account in the Common agricultural policy (CAP) (Dijksma, 2014). The amount of nitrate that could be emitted was limited, firstly in the Nitrate directive from 1991 which was later incorporated in the European Water Framework directive in 2000 (Hees et. al. 2012). The aims of these policies can be interpreted as putting limits on the emission of agricultural chemicals polluting the environment, halting the rampant growth of agricultural businesses and initiating a transition from maximisation-oriented agriculture towards an optimisation-oriented practice.

Transitioning towards optimisation and smart-farming seems especially important for farming in groundwater protection areas, since the inability to stop pollution of the groundwater in these locations might endanger the drinking water supply and thereby could endanger public health (Claessens et. al., 2017; Ministry of Agriculture, Nature and Food quality, 2017). The European Water Framework Directive (EWFd) is a policy from the European Union to, among other things, protect the chemical quality and quantity of usable groundwater thus protecting the drinking water supply. The implementation of this directive in the Netherlands is particularly relevant for this report, since it places norms regarding nitrate, and pesticide and herbicide pollution in the groundwater supply (European Commission, 2014; Rijksoverheid, 2018; RIVM, 2011). On a national level the rights and position of the agricultural sector are protected as well however, which likely creates a conflict of

interests between reaching the norms stated in the WFD on the one hand and protecting the economic interests of the farmers on the other (Freriks et. al. 2016; Velthof et. al. 2018).

This paper aims to define the institutional difficulties and points for improvement by using Ostrom's IAD framework. This framework is based on the idea to solely identify difficulties within a situation (Ostrom, 2011). In this report, the contemporary institutional framework is analysed in which agricultural innovation in groundwater protection areas is to take place for the Dutch Province of Overijssel. Since the case study is in the Province of Overijssel, the institutional framework in that province is the unit of analysis. This report follows a historical institutionalist view, as described by Hall and Taylor (1996). This is because path-dependency in the field of agriculture is a key concept for this research. Path-dependency means that once an institutional structure has taken shape, it becomes inflexible and gets in a state of equilibrium. In this state it tries to maintain its structure, thus is unsusceptible to change. Transitions therefore happen gradually towards a tipping point, after which a new institutional structure can be implemented (Brugge et. al., 2005). Beside the historical institutionalism perspective, the sociological perspective is relevant for this research as well. The reason for this is that besides formal institutional rules, the informal rules will be taken into account in this research. Consequently the focus of the analysis is not only on the interests of the different actors, yet on their behaviours and values as well. This is an intrinsic part of the sociological institutionalism perspective (Hall & Taylor, 1996).

1.1 Objectives and research questions

In this report, the institutional framework is analysed by the means of interviews and policy analysis. This framework includes the diversity in agricultural innovation in groundwater protection areas are to occur. This means that the focus of the report lies on which contemporary institutional rules and forms of cooperation interfere with reaching the set standard for groundwater quality. By identifying the institutional difficulties, the cause for the stagnation of participants in the projects of the Province of Overijssel will be identified.

Ostrom's IAD framework will be operationalised to analyse this institutional framework. It is described as an action situation, consisting of seven different elements and related rules (Ostrom, 2011). Transition theory is used to provide this institutional analysis with the context of the transition from maximisation towards optimisation, based on the work from van der Brugge et. al. (2005). This is intertwined with the earlier described path-dependency (Hall & Taylor, 1996), because the element of transition in gradual stages is considered. Hence, Transition theory is primarily used as a framing tool for the context, and less so as a part of the institutional analysis. However, the context of the transition is relevant to describe due to gaining an understanding of the agricultural and institutional in-depth information. The main research question for this report is:

How do institutional constraints and possibilities influence the transition to smart-farming and agricultural optimisation in groundwater protection areas in the Province of Overijssel?

To answer the main research question four sub-questions are formulated. The paper is constructed around these sub-questions and is in the conclusion being answered with the answers to the sub-questions.

1. How can the agricultural transition from produce-maximisation towards produce-optimisation and smart-farming be defined?

This question focuses on explaining what this "transition towards smart-farming" entails. It is a key element to explain which type of innovations part of this transition are and therefore are focussed upon within this research (Walker, 2008). The goal of this sub-question is to provide the context. The implementation of technical innovations and innovations in business operation strategies that focus

on agricultural produce optimisation instead of produce maximisation are seen as the basis of this transition in this research. By the means of Transition theory (Brugge et. al., 2005) the context is defined. This constructing of the context is done with regards the path-dependency (Hall & Taylor, 1996) element.

2. How can Ostrom's IAD framework be operationalised to analyse the institutional framework in which smart-farming is to be implemented in groundwater protection areas?

In this sub-question, the focus lies on the theoretical part of the research. Not "what to research" but "how to research" is being described in answering this sub-question. This is key, because performing an institutional analysis is challenging and it must be structured well. In this sub-question, research is being done on how the IAD framework can contribute in analysing the institutional framework, pinpointing institutional possibilities and constraints (Ostrom, 2011). Transition theory can help to frame the research in time and context.

3. What is the action situation in which technical innovations and innovations in operation management by farmers in Overijssel's groundwater protection areas are to take place in?

This question focuses on the actual analysis of the institutional framework. An action arena, as described by Ostrom (2016) and Hijdra et. Al (2015) is the combination of actors, positions, actions, information, control, costs and benefits, and potential outcomes. These elements together form an institutional framework.

4. Which constraining and enabling institutional factors can be defined in relation to agricultural innovation in groundwater protection by applying the IAD Framework?

In this sub-question the action situation as researched in the preceding question is analysed to find possible institutional constraints and opportunities. Which elements that are in place are sufficient, and which elements need adaptations. The need to adapt could arise from a multitude of reasons, like an overload on rules and regulations or a void on regulation and institutions that work as an overarching frame. A lack of willingness and/or possibility also could form constraints as described by Zuidema (2016).

1.2 Introducing the case

Overijssel is in the east of the Netherlands (see figure 1). In the east of the province the soil type is dry sand, which is notoriously vulnerable for the washing out of nitrates, phosphates and other agricultural chemicals (Jongmans et. al., 2013; Koopmans & van der Veen, 2015; Van den Brink et. al. 2010 Van Vught et. al., 2017) The province falls within the groundwater body "rhine-east" (Deltares, 2013). The drinking water company responsible for the quality of the drinking water in Overijssel is Vitens (Kloosterman, 2016). There are 22 groundwater protection areas in the Province of Overijssel, as is made visible in figure 1.

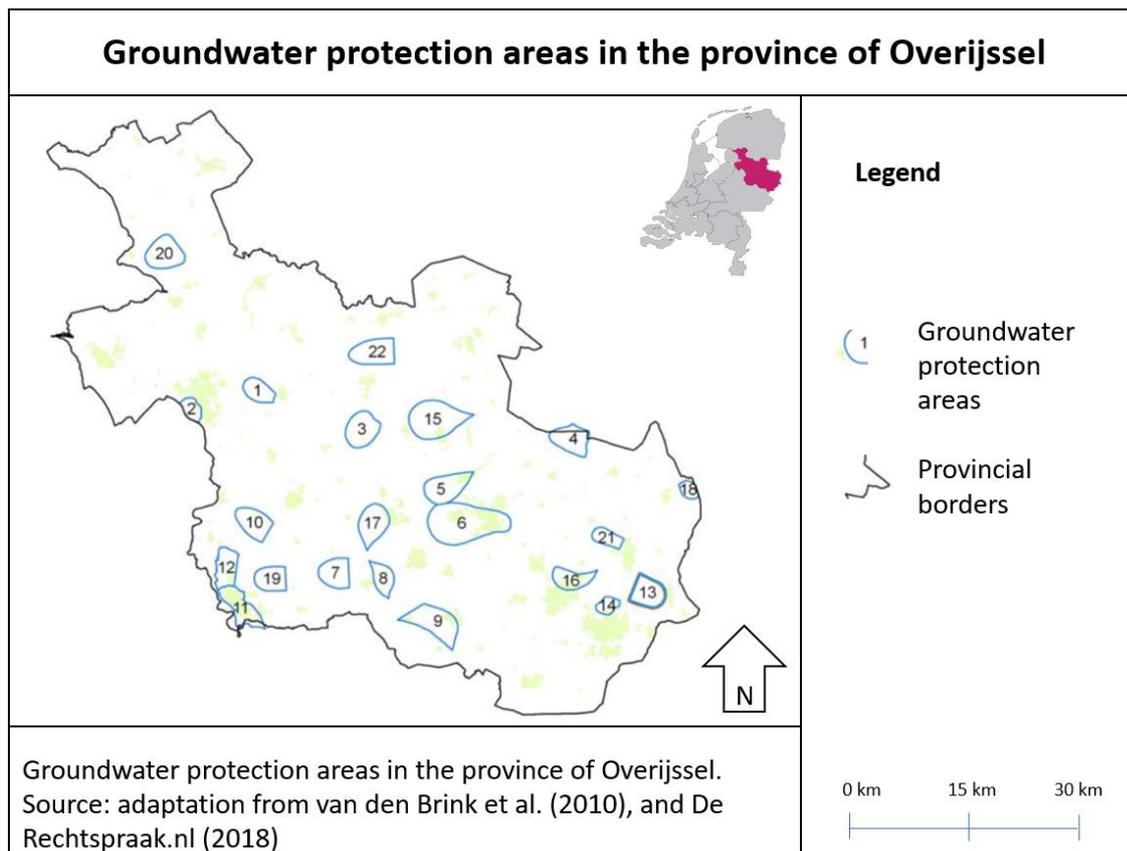


Figure 1: groundwater protection areas in the Province of Overijssel

The choice to research the institutional framework of the Province of Overijssel, besides its particular vulnerability to the washing out of agricultural chemicals, is primarily based on the availability of a relevant project to research; “Farmers for Drinking Water” (van den Brink et al. 2017). In this project some frontrunners of the agricultural community present in the area, combined with the Province of Overijssel and drinking water company Vitens, actively pursue a renewed ‘smart-farming’ approach with a decreased impact on water quality. This shows the willingness of the Province of Overijssel to find solutions in cooperation with the drinking water company Vitens and it also shows that a growing group of agricultural businesses in Overijssel are actively trying to implement measures to prevent further pollution of groundwater (Stimuland, 2016). This makes it a relevant case to research since the factors to participate in such projects or not are more likely to be found.

1.3 Scientific relevance

The scientific relevance of this research is threefold. Firstly, The IAD framework from Ostrom (2011) has not been applied in this context. Performing this research therefore can be seen as a way to test Ostrom's theory in this specific context, to check its validity. Secondly, applying the IAD framework could also provide new insights on the institutional transition of agricultural practices in groundwater protection areas in Overijssel, which might not be discovered using other methods. Applying the IAD framework in this case therefore has scientific relevance in analysing the context of the agricultural transition towards optimisation, as well as in testing Ostrom's theory. This report specifically takes the gradual nature of transitions into account. This is done due to a perceived flaw in Ostrom's theory. This critique involves the disregarding of the element of time. A third scientific relevance is the possibility to make generalisations for a national context, based on the outcomes of the case-study. Albeit that the majority of the outcomes likely is case-specific, some hypothesis could be made for their applicability on a national context. The reason for this is that some of the institutional barriers and possibilities are formed on a national governmental scale.

1.4 Structure of the report

The structure of the thesis is as follows: Chapter two provides a theoretical framework, in which the IAD framework is explained, and operationalised in a conceptual model. This is done to clarify the complex nature of the model. In chapter three the methodology, a case study research, and relating methods used in this report are explained. Chapter four forms the core of the research. In this chapter, the analysis is done on the action arena of agricultural innovation in groundwater protection areas. The thesis ends with some conclusions about the main institutional factors that restrain agricultural innovation in groundwater protection areas in the Province of Overijssel, the extent to which this can be used to make generalisations. A discussion is also added, providing explanations on how the results of this research should be used, and providing some questions for further research. Besides this a critical reflection on the outcomes of the report and on the process of research are provided.

2: Theoretical framework

This chapter focusses on the way the IAD framework can be operationalised as a tool to analyse the institutional framework. The theoretical framework forming the underlying basis for this research is explained and explored. This is a key step in defining the focus of the research, as an answer is given to what will be researched and on what grounds and which theories will be used to do so. Firstly, transition theory is used to frame the research. The relation between the transition towards agricultural maximisation shortly after the Second World War and the transition from maximisation towards smart-farming is explained, to frame the contemporary position of the agricultural sector. This second transition forms the context for the niche that is researched in this report: The institutional framework in which agricultural practices transition in groundwater protection areas are to take place in. This part of this chapter is used to answer the first sub question:

How can the agricultural transition from produce-maximisation towards produce-optimisation and smart-farming be defined?

This institutional framework can be researched using the IAD framework, which is operationalised to perform the analysis in this context. After this the theoretical concepts and theories are combined in a comprehensive conceptual model, which forms the basis for the conducted research in this report. The conceptual model in combination with the operationalisation of the IAD framework can be considered the answer to the second sub-question:

How can Ostrom's IAD framework be operationalised to analyse the institutional framework in which smart-farming is to be implemented in groundwater protection areas?

2.1: The transition towards smart-farming and optimisation

As described earlier, contemporary agriculture is transitioning from a highly intensive practice using a great deal of manure, pesticides and fertilizer with a focus on maximisation of production, towards a practice focused on producing optimisation. This transition happened over time and was already starting to transpire shortly after the mono-functional, large-scale type of farming became institutionalised. Already in the late 1960's awareness started to occur regarding the negative impact of the upscaling and intensification of agricultural practices, as the worries expressed in the first report of the newly founded non-profit foundation "Foundation nature and environment" show. The fertilizer law or "meststoffenwet" from 1987 can be seen as the first regulation in place to slow down agricultural maximisation. (Hees et. al., 2012; Van Eerdt et. al., 2004)

Agricultural maximisation since then, is transitioning towards an optimized farming practice. The most important elements of this transition are innovations in business operations and in technical appliances. One element of these innovations is the decrease of the negative impact that the maximisation orientated agriculture has on biodiversity landscape and water quality. It aims to do this by reducing the amount of chemicals from pesticides and fertilizer washing out in the groundwater and surface water. On the other hand, these innovations should ensure the economic growth of agricultural enterprises, since the innovations aim to minimize the amount of resources like pesticides and nitrate that are wasted and wash out while maintaining a high level of production to cope with the demand. In other words, technical and operational innovations will improve in making agricultural practices as efficient as possible, by minimising the negative impact it can have while ensuring production. (Hees et. al., 2012; Huirne, 2011; Van Eerdt et. al., 2004).

Transition management can be useful in situations with a high degree of complexity, meaning that there is a high degree of uncertainty and a high degree of interconnectedness within the system that is transitioning, as well as between other systems (Duit & Galaz, 2008; Loorbach, 2010). This is the case

with transition that is researched in this report. Thus, agriculture in the Netherlands can be considered as a nested system. It is a substantial part of the Dutch economy, from the local scale to the national scale. Besides this the food market, to which the Dutch agriculture is a big contributor, is a global system. This means that changes in Dutch agriculture may have big effects on the global food market and the other way around (Vermaas, 2017; Vivano, 2017). Within Dutch agriculture itself there is a high degree of complexity as well, since every individual farmer can have a different approach to farming (e.g. bio-farming versus mass-production). Besides this, there is already a big difference in business operations between the different types of agricultural enterprise. This latter means that the impact that for example a cattle farmer has on the environment, differs from the impact of a crop farmer, or a greenhouse farmer (Cattle farmer 1, 2018; Representative of LTO Noord, 2018).

A key element of transition theory is the multi-phase concept and the related S-curve. This concept is based on the idea that a transition follows four different stages; pre-development, take-off, acceleration and stabilisation, as can be seen in figure 2. A transition can be defined as a radical restructuring of a system, in which the entire system changes in structure and function into a new system (Loorbach, 2010; Van der Brugge et. al. 2005).

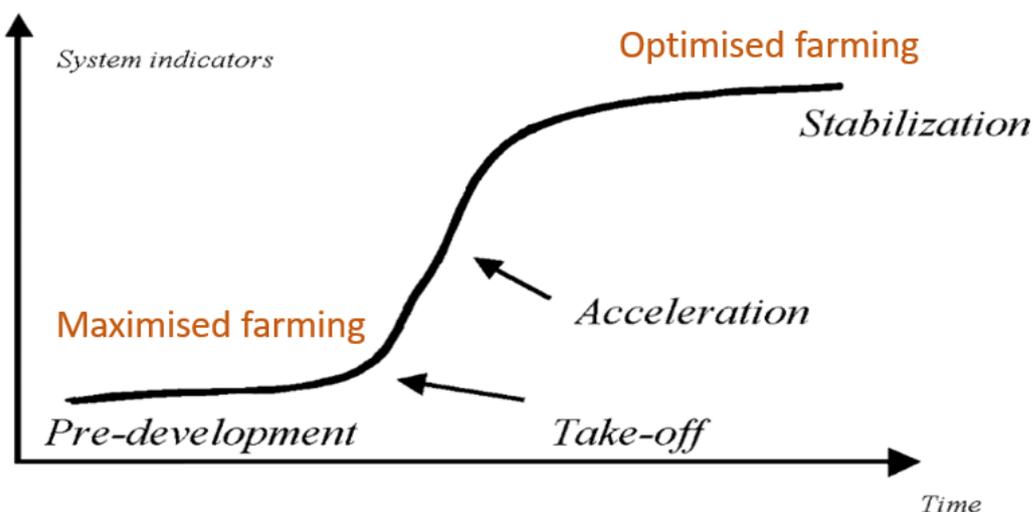


Figure 2: S-curve depicting the transition from maximisation towards optimisation. Source: adaptation from Loorbach, 2010

2.2: The transition of agriculture in groundwater protection areas

A niche within this greater transition towards smart-farming is formed by the agricultural practices in groundwater protection areas. This specific context makes the transition towards smart-farming more pressing, since the washing out of pesticides and fertilizer might pollute the groundwater supply here which is extracted as drinking water (Fraters et. al. 2007). Especially nitrates and phosphates form a problem, specifically on dry sand grounds. Failing to reduce the pollution and to transition towards an optimized way of farming could therefore form a risk for the wellbeing of consumers of the extracted water (Cleassens et. al. 2017).

Because the protection of groundwater protection areas is important for the national drinking water supply, additional policies and regulations are in place. In the Nitrate Objective of the water framework directive is decided that the maximum amount of nitrate in groundwater should not exceed 50 milligrams per litre for shallow groundwater for example (European Commission, 2008). Besides supranational and national regulations to decrease environmental pollution due to intensive agricultural land use, the Dutch Provinces carry the responsibility to safeguard the groundwater protection areas against pollution in their respective territory (Freriks et. al. 2016; Velthof et. al. 2018).

Drinking Water companies are tasked with the extraction of water and of delivering clean drinking water (Kloosterman, 2016; Representative of Drinking Water company Vitens, 2018).

Multiple organisations, including agricultural organisation, are meeting and deliberating on accelerate the transition to smart-farming in groundwater protection areas. Those organisations aim to start and further projects, to give agricultural businesses guidance and incentive to innovate towards the new, optimisation-based farming practice. The project “Farmers for Drinking Water” is an example of this effort (Stimuland, 2016; Van den Brink et. al., 2017). Relating this to Transition theory, the transition seems to be in the take-of phase. However, institutional restrictions and opportunities may be in place that hamper the transition. The institutional framework of agriculture in groundwater protection areas will be explored to find answers on why this is so. Exploring the institutional perspective is necessary as it will provide insight in the institutional rules that dictate the contemporary agricultural practice. These rules can then be analysed on elements that hamper the transition from maximisation into a new institutional framework focussed on optimisation.

2.3: Explaining institutions

Institutions are a key concept used in the social sciences and are often explained as being “the rules of the game”. They can best be explained as agreements and rules that shape human interaction and enable and constrain behaviour (Helmke & Levitsky, 2004; Hodgson, 2006). Institutions can be seen as a social construct that regulate the social environment, based on the sociological institutionalism perspective (Hall & Taylor 1996). Following this perspective, a division should be made between formal institutions and informal institutions (Helmke & Levitsky, 2004). Formal institutions encompass rules that are enforced through official channels. Laws and regulations are examples of such rules, which are enforced by state institutions like bureaucracies and courts. Organisational rules that officially determine how organisations function, can also be categorized as formal institutions (Helmke & Levitsky, 2004; Koppenjan and Groenewegen, 2005). An example of a formal institution is the responsibilities of the drinking water companies to process groundwater and deliver drinking water via the drinking water law. Another example is the responsibilities of the provincial governments to protect the groundwater quality. Informal institutions are those rules that are not formally decided upon, are usually not noted, and are enforced through unofficial channels. These rules are therefore elusive and difficult to research. Informal institutions are based on cultural behaviour, common practices and norms and values (Helmke & Levitsky, 2004). Examples of these type of institutional rules are the relational interactions between the stakeholders in the action situation; which organisations are farmers willing to speak and to listen to, and for what reasons. As Helmke and Levitsky (2004) state, the effect and impact of informal institution depends on the strength of the formal institutions (a weak formal institution leaves more room for an informal one to have a large impact), and on the amount of overlap in the goals of the formal and informal institutions. If these goals are divergent, formal and informal institutions can become conflicting. (Helmke & Levitsky, 2004) Both formal and informal institutions are important for the institutional framework analysis in this research. The interplay between both is what creates the institutional framework in the action situation, and therefore both are researched.

Besides the sociological institutionalism perspective, the historical institutionalism perspectives is particularly relevant for this research as well. This perspective is relevant, since the concept of path-dependency is an intrinsic part of this institutionalism approach. This concept means that actions at the start of a process can dictate the further development of this process; the further development is confined to a certain path based on preceding choices (Hall & Taylor 1996).

2.3: Analysing the institutional framework

The core element of the conceptual model is the incorporation of the IAD framework, which revolves around seven rules to analyse the seven core elements of an institutional context. This can be seen in

figure (3). Ostrom (2011) defines this as the action situation. She describes how a combination of actors, their positions and their allowed actions influence the action taken which can lead to different outcomes. The amount of information and control over the transformation from action to outcome, and the amount of incentives and deterrents that influence which actions are most preferable lead to a possible outcome. The action arena in the context of this study can be understood as the transition towards optimised agriculture in groundwater protection areas in the Province of Overijssel. The implementation of mutual-gains measures through projects like "Farmers for Drinking Water" is instrumental in this action situation.

Ostrom and Basurto (2011) argue that a state in which no rules are present will inevitably lead to a tragedy of the commons, meaning that a lack of normative restrictions will lead to a situation in which all actors will only try to serve their own needs without taking the needs of the others into account. The rules thus form normative restrictions, which limit individualistic behaviour of actors in an action situation (Ostrom & Basurto, 2011). The transition towards an optimised agricultural practice likely includes the necessity to adapt the institutional framework. Analysing the contemporary institutional rules will aid in developing an understanding on which rules hamper or aid the innovation process, thus influence the transition.

In this paragraph each of the seven rules and their relating institutional elements will be explained, to operationalise them in the context of agricultural practices in groundwater protection areas. The interpretations of the IAD framework from Hijdra, Woltjer, and Arts, (2015). Li, Van den Brink and Woltjer (2016), Ostrom (2011), and Ostrom and Basurto (2011), form the basis of this operationalisation.

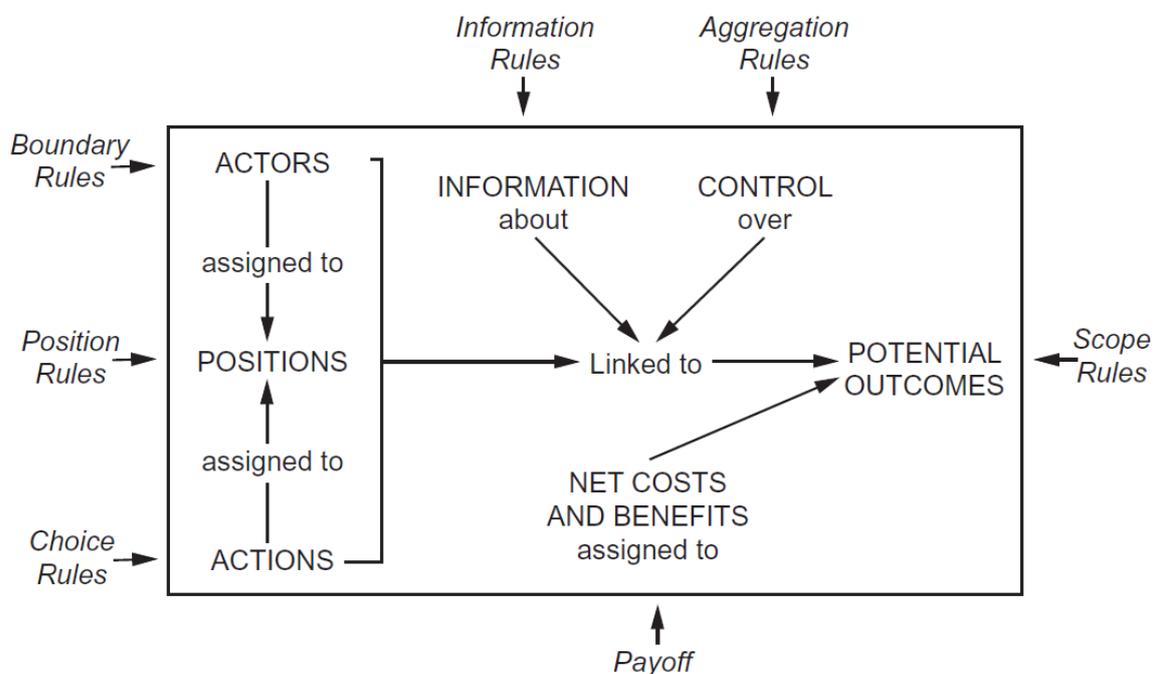


Figure 3: IAD framework. Source: Ostrom, 2011

1. Position rules

These rules explain the positions actors have in the action situation. They help decide which actors are, or should be involved, and what type of role they have or should have in the process. The goal of position rules is determining a set of specific positions in the action situation which are filled in by the actors (Hijdra et. al., 2015; Li et. al., 2016; Ostrom, 2011). One can think of the role the Provincial government can in the action situation, like the position of stimulator of development or monitor and regulator of the rules. Some possible positions Ostrom and Basurto (2010) define are local and external monitor. This means that either an internal party or external party monitors if the rules are compiled too.

2. *Boundary rules*

The boundary rules relate strongly to the position rules and indicate when an actor should enter or leave the action situation. This includes determining when an actor should be involved in the action situations. Selection criteria take an important role in these rules (Li et. al., 2016; Ostrom, 2011). In relation to the research conducted in this report, when do the different actors get the chance to get involved in the action situation. Examples of relevant actors within this action situation are the farmers in groundwater protection areas, the provincial governments, and the Drinking water companies (such as Vitens). Besides this rule makes clear if the actors can enter or leave the process whenever they want (Ostrom, 2011).

3. *Choice rules*

These rules determine which actions the actor can or cannot undertake. They entail putting limitations on the choices the actors can make, while allowing other actions by giving rights by the means of permits for example. Regarding restrictions one can think of the responsibilities the provincial governments and drinking water companies have via the Water law on protecting the ground-, and drinking water quality. The choice rules also determine the responsibilities of the different actors, meaning the actions they must take in relation to their position (Li et. al., 2016; Ostrom, 2011).

4. *Scope rules*

The scope rules decide which actions lead to which potential outcomes, focussing on how different actions can affect outcomes and how outcomes affect actions (Li et. al., 2016; Ostrom, 2011). In relation to the research the scope rules already have a clear frame: the outcome should be a less polluting, optimisation-based form of smart-farming within groundwater protection areas (Van den Brink et. al. 2017). Actions that hamper this, for example the contemporary maximisation based agricultural approach therefore have become unwanted. Actions that stimulate smart-farming on the other hand are wanted as they are the goal of the transition (Ministerie van Landbouw, Natuur en Voedselkwaliteit, Ministerie van Infrastructuur en Waterstaat, 2017). Continuity of the farms is a priority as well however (Schnabel, 2001).

5. *Information rules*

These rules specify which information is available to each position and affect the communication of actions and outcomes (Li et. al., 2016; Ostrom, 2011). As Forrester (1982) stated "Knowledge is power". This is also relevant in this research, because sharing knowledge likely is key for the transition. Therefore, it is important to research whether all actors in the action situation have access to the same information or not. Whether or not the actors have access to the information is key. This is key because information can be used to inform and to steer which decisions are taken, and participation in the action situation is voluntary. Beside this it is also important to determine via what communication path the information is accessible; is communication shared freely and transparent or not? A lack of transparency can lead to miscommunication and unwillingness to cooperate, which could hamper the transition process (Lane & McDonald, 2005). As participation in the action situation is voluntary for

farmers, preventing miscommunication and unwillingness could have a significant influence on the number of participants in projects like “Farmers for Drinking Water”.

6. *Aggregation rules*

The aggregation rules revolve around the decision-making process. They decide on what basis authority for decision making is granted, and how decisions are made. The division between top-down decision making and bottom-up decision making is a clear example of this. Top-down decision making gives the decision-making power to the most powerful organisation present to form restrictive decision. Bottom-up decision making gives this power to the collective of actors to form more deliberative decisions. The rules determine the control over the action situation by the means of decisions (Li et. al., 2016; Ostrom, 2011).

Multiple organisational actors are present in the action situation that is researched in this report, in the form of governments, Vitens and the LTO and others. Therefore, it is very important to research the power division in the decision-making process. Is this done top-down by one of those organisations in deliberative processes, or bottom-up by individual agricultural businesses? It is also relevant to research under which circumstances taking top-down decisions is legitimized, as a future research implication.

7. *Payoff rules*

These rules influence the incentives and deterrents for the combinations of possible actions and outcomes. wanted actions and outcomes are promoted, while unwanted actions and outcomes are hampered. Besides this the division of gains and economic/financial costs is entailed within these rules (Li et. al., 2016; Ostrom, 2011). In relation to the research conducted in this report, determining where the costs and benefits of adopting new agricultural business practices and adopting innovations toward smart-farming is relevant. There is a strong economic proponent in this action situation, as described earlier in relation to the complexity of the problem: agriculture forms a large component of the local, national and global economies. A lack of gains, or even additional costs for agricultural businesses could hamper their market positions and continuity, which could damage those economies (Vermaas, 2017).

2.4 Operationalising the IAD Framework

In this paragraph the IAD framework is operationalised to be able to analyse agricultural practices in groundwater protection areas. The operationalisation is made visible in table 1, and is done by the means of questions that need to be answered to explain the institutional framework. The approaches from Hijdra, Woltjer, and Arts, (2015) and Ostrom and Basurto (2011) in operationalising the IAD framework form the basis for the operationalisation in this research.

Rule	Core elements	Operationalisation in questions
Position	Set of specific positions that are filled	<ul style="list-style-type: none"> • Which actors have governing power in groundwater protection areas? • Which actors play a role in initiating or stimulating projects to reduce negative impact on those areas?

		<ul style="list-style-type: none"> • Which actors have an antagonistic approach towards this transition? • Which actors have knowledge about the actions that need to be taken to reduce the negative impact of agriculture on groundwater protection areas?
Boundary	Set of conditions for entering and leaving the action situation, linked to actors.	<ul style="list-style-type: none"> • Which actors are primarily involved in the action situation and on what grounds? • Are there any actors that are less involved in the action situation than is either foreseen or wanted? • What are the restrictions for those actors to either enter or leave the situation?
Choice	Set of allowed and prohibited actions in relation to their potential outcome, set of responsibilities.	<ul style="list-style-type: none"> • Which actors have responsibility in furthering the transition towards optimisation in groundwater protection areas? • What type of agricultural practices are restricted or even prohibited, and how is this enforced? • Which measures are “ground water proof”, and are therefore stimulated? How are these measures stimulated? • Are there any restrictions on implementing the “ground water proof” measures?
Scope	Set of potential outcomes related to actions	<ul style="list-style-type: none"> • Are the measures taken enough to reach the nitrate objective (50 milligrams per litre) and to decrease the amount of other chemical pollutants according to the European Water Framework directive? • How is this measured?
Information	Availability of information to each actor	<ul style="list-style-type: none"> • Which actors are involved in the knowledge generation of suitable measures to optimize farming in groundwater protection areas? • Which actors have access to this information, and which do not (on what basis)? • Is there a shared sense of urgency?

Aggregation	The degree of control over actions and choices	<ul style="list-style-type: none"> • Which actors are involved in deciding on which measures are “groundwater proof” or not? • Which actors are involved in deciding on which research into new measures is to be pursued? • Which actors decide which of the approved groundwater protection measures are to be implemented on what location or business?
Payoff	Costs and benefits linked to different actions and different outcomes	<ul style="list-style-type: none"> • What incentives are in place to stimulate agricultural businesses to implement “groundwater proof” measures • What deterrents are in place to discourage unwanted actions and outcomes? • What are the costs of implementing optimisation focussed measures in agricultural practices? • What are the benefits of implementing optimisation focussed measures in agricultural practices?

Table 1: Operationalisation of the IAD Framework. Source; interpretation of Hijdra et. al. 2015; Li et. al, 2016; Ostrom, 2011; Ostrom and Basurto, 2011

2.5 Two types of outcomes and their implications; institutional restrictions and opportunities

Out of the analysis two different outcomes related to the effectiveness of the rules can be distinguished, as is visualised in figure 4. Rules can form restrictions that hamper the action situation. These rules are therefore classified as constraining. If an institutional rule proves to form a restriction, institutional dilemmas can occur. This means that these rules are conflicting with other rules or form a barrier in reaching the goal of agricultural optimisation. Opposite to this, rules can provide possibilities for furthering the action situation and in overcoming restrictions. These type of rules are therefore classified as enabling. The specific interpretations of the rules in the IAD Framework are divided over these categories, by relating them to the goal of transitioning to optimisation via agricultural innovations.

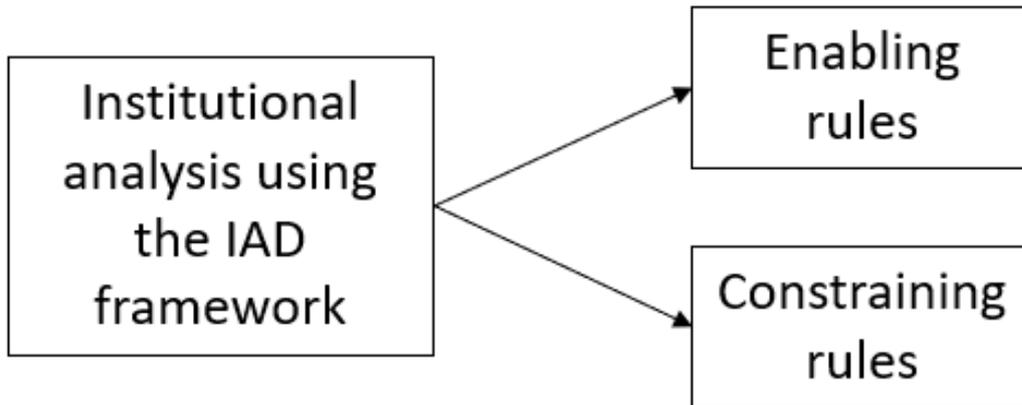


Figure 4: Three outcomes of the IAD framework. Source; author

2.6 Building the conceptual model

Combining the theories as described above a conceptual model can be made, which forms the basis of this research. This model can be seen in figure 5. The model shows that the IAD framework from Ostrom (2011) is used to analyse the institutional framework of agricultural innovation projects in groundwater protection areas. The rules addressed in the IAD framework together with the context of the innovation projects, form the action situation under research. Two outcomes regarding the institutional rules can be distinguished; they can either be form constraints, or enable furthering the transition towards optimisation via innovations (within the context of groundwater protection areas).

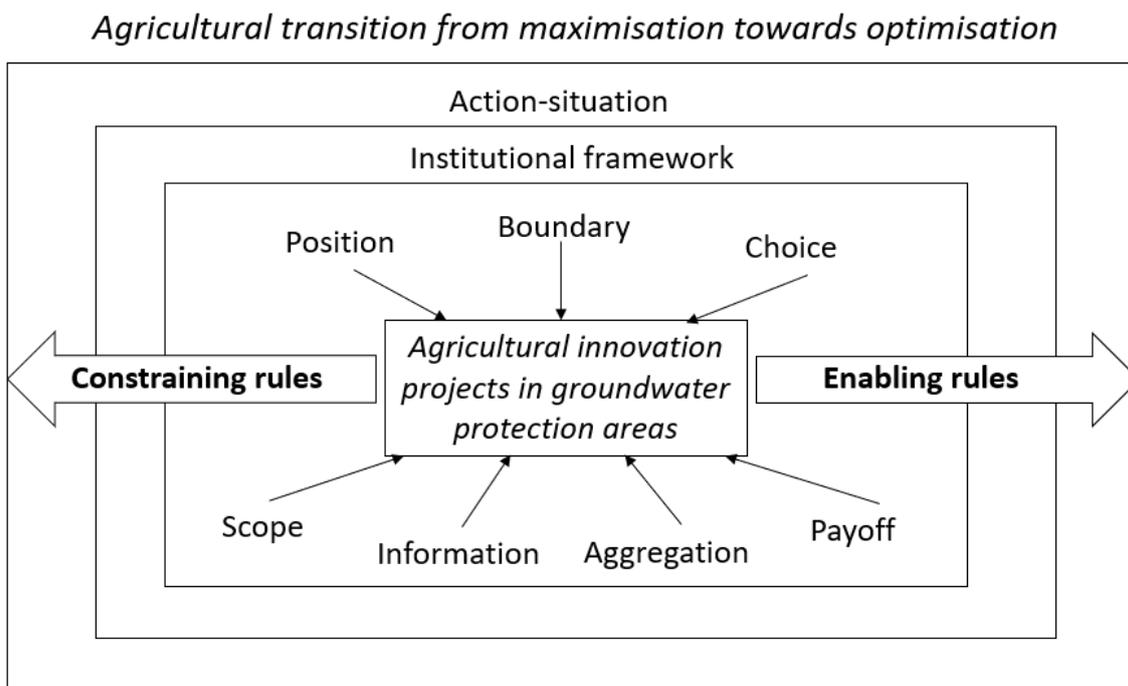


Figure 5: conceptual model. Source, author

In short, the agricultural transition towards optimisation can be defined as the implementation of technical innovations and business management innovations. This can also be defined as smart-farming. The operationalisation of the IAD framework entails the formulation of questions for each rule. Answering these questions provides a specific interpretation per rule for this context. Combining the interpretation of these rules results in the institutional framework. Consequently, the institutional framework can be analysed in relation to the two identified types of institutional rules; enabling or constraining (read chapter 2.5).

3: Methodology

This chapter elaborates upon the potential methodologies, and what methodology is applied to this report. This report is a qualitative research and contains an instrumental case study. Furthermore, more detail is provided on the gathering of data and information. For clarity purposes, the data-gathering and data-analysis is divided in phases. This serves the purpose to explain what kind of data is gathered, and through which method this data-gathering is conducted., Table 2 shows the basic outline of the research strategy for this report, clarifying which methods, sources information and data processing were used to answer each sub-question.

Sub-research question	Methods	Sources	Information collected (results)	Data processing
1	Policy analysis	Policy documents abstracted through the European Union, national government and Province of Overijssel (this is supplemented with academic literature)	Contextual Information that is related to which innovations in agricultural practices are wanted and stimulated, and on what grounds. This is essential to operationalise the concept "innovations" for this report	Building a document database, scanning the documents for their key information (see appendix III)
2	Literature study (complemented with policy analysis and analysis of other grey literature)	Academic literature on the theory of Transition management, and on (operationalising) the IAD framework	Core concepts that contribute to specify the conceptual model, information on operationalising the IAD framework for this research	Building a document database, scanning the documents for key information, applying the key information in a conceptual model (see appendix II)
3	Policy analysis, Interviews	Experts from the action arena, policy documents from the different actors, additional documents	Information per actor, per rule of the IAD framework.	Building a document database and scanning the policy documents for key information, Atlas ti. (version 8.2) for coding the interviews.

4	Analysing the IAD framework for dilemmas, opportunities and hurdles	The developed IAD framework for the specific action arena	Enabling and constraining institutional rules in furthering the transition towards optimisation via agricultural innovations	Summary of the analysis of the IAD framework
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Table 2: Research outline. Source, author

3.1 Research strategy: Case-study

The case study research methodology is used in researches that aim to provide in-depth knowledge base on a small to mid-sized amount of cases. According to Punch (2014), this strategy aims to develop a full understanding of the situation; the strategy aims to be holistic. This is particularly relevant for this research, as conflicting interest on multiple different scale-levels (from local to national) exist within the action-situation. In this research a single case is used to gain insight in the phenomenon of agricultural innovation in groundwater protection areas in the Province of Overijssel. This will be gained through Ostrom's IAD framework. This research can be considered an instrumental case study, as described by Taylor (2016). Punch (2014) expounds this instrumental case study as a tool to give insight in an issue, and to refine a theory.

A critique often given on case study research, and especially single case-study research, is that it is not possible to generalise the outcomes. This supposedly would make the methodology less valuable for scientific research. However, this notion is wrong on multiple accounts. Firstly, if strategically chosen, generalisations can be made from a single case. This is especially true if the case is used as a method of falsification or validation. This leads to the following reason; case studies can be used as validation or falsification of hypotheses as well as for creating them. More importantly however, generalisation is overrated while the power of examples is underestimated (Flyvbjerg, 2006). In the specific case setting of this research, the essential goal is operationalising a theoretical concept. This concept is Ostrom's IAD framework, which specific application to this case setting is unique. Hereby this case-study could add validity to the theoretical method or uncover weaknesses. Besides this, some generalisations are made based on the single-case study conducted in this report in chapter 5.8. The results and generalisations are valid for the purposes of this report due to the comprehensive way of formulating. They exceed the context of the case study.

A further benefit of applying case-study research as a methodology in general, is that it allows for flexibility in the methods used for data generation. Quantitative and qualitative methods, as well as mixed methods can provide usable information for a case study research (Taylor, 2016). In this report only qualitative methods are used however, albeit a variety of them. It is decided to not apply quantitative methods; the foundations of this decision are elaborated upon in the next paragraph..

3.2 Applied methods

This paragraph describes the different methods of data-collection and processing that are applied in this report. The following three main methods are applied: semi-structured interviews, academic literature analysis, and policy analysis. In addition to describing these methods, it is of high significance to state that triangulation forms an essential element in the gathering and analysing of the information. Triangulation entails the consultation of various information sources before formulation a statement. The use of multiple sources is supportive to increasing the validity of a statement.

Furthermore, they provide additional insights to the perspective. In the context of this report, this process of triangulation has been visualised in figure6.

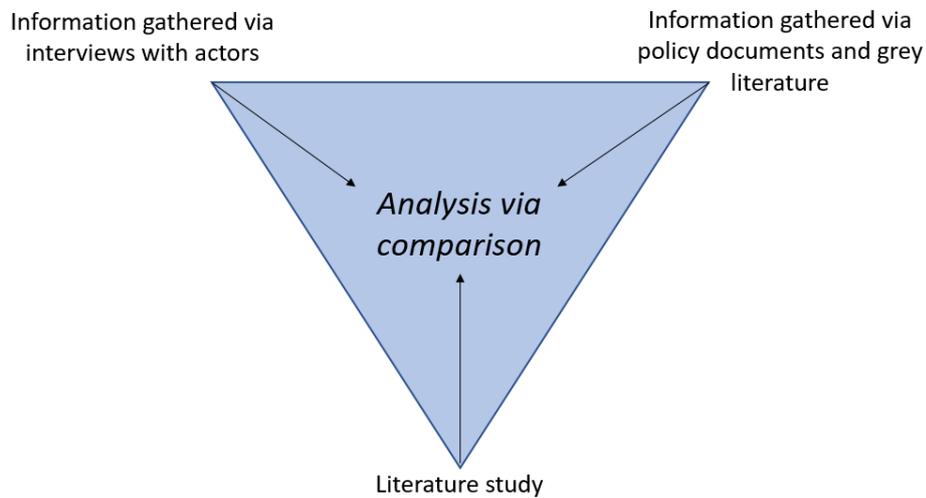


Figure 6: Triangulation in this research. Source, author

Other considered methods

To collect appropriate data, two data collection methods proved to be insufficient. These methods are: conducting structured interviews, and the distribution of online questionnaires. The consideration of these two methods is based upon the structural nature of the IAD framework. This means that the seven specific rules act as a guide-line to draw conclusions. Because these rules are specific, generating specific data to describe the rules would have simplified analysing the collected data. Structured interviews and, more specifically quantitative data-gathering methods put a stronger restriction on the possible answers the respondents can give. This is in contrast with the open-ended way of questioning that is conducted semi-structured interviews (Longhurst, 2016). The goal of this research is, to find both. On the one hand the formal, and, on the other hand, the informal institutional rules that shape Ostrom's institutional framework. Ostrom's (2011) IAD framework aims to generate a holistic perspective of the institutional framework. This means that additional information that is provided by interviewees is key. This information extends mostly to contextual knowledge and the interactions with other actors. Due to the in-depth nature of the data, this contextual data would likely not be gathered through a closed-ended way of questioning. Therefore, this closes-ended way of questioning is rejected in favour of the three methods that were applied; semi-structured interviews, literature study, and policy analysis. In short, by the means of the selected methods, the researchers expect to gain a more in-depth insight in the case.

3.2.1 Semi-structured interviews

To gain insights of the action situation from different perspectives, semi-structured interviews are being conducted. These interviewing method aims to perceive the perspectives of the different actors and actor groups in the specific action situation. Therefore, these interviews act as a direct tool to gain contextual insights. The semi-structured way of conducting the interviews serves the purpose of this report. An advantage of conducting semi-structured interviews with open-ended questions in comparison to structured interviews with closed-ended questions, is that this allows for flexibility. This flexibility entails that the researcher can ask probing questions on unanticipated themes when such themes emerge during the interview. The semi-structured interview therefore can provide additional

valuable information that possibly would not have been gathered through more restrictive tools of data collection (Longhurst, 2016).

The method of sampling can be considered ‘deliberate’ or ‘purposive’ sampling, which means that there will be made an appeal on existing social networks to contact the so-called gatekeepers of the community. Gatekeepers are representatives of the actor or actors’ group and have an extensive social network (Cope & Kurtz, 2016; Longhurst, 2016). To reach the gatekeeper, the network of the participants in the “Farmers for Drinking Water” project is used. This is decided upon, as this project is one of the main reasons for researching the case of the Province of Overijssel in this report (besides the particular vulnerability of the Province of Overijssel due to the dry, sandy soil in the east as described earlier). An overview of the interviewees is presented in table 3.

If possible, the interviews were conducted face-to-face. Some advantages of this method are that the setting is more personal, which makes it more likely that interviewees share additional information, and that asking follow-up questions is easier (Longhurst, 2016; Opdenakker, 2006). If arranging a face-to-face interview was either not possible or impractical, the interviews were held by the means of telephone as a fall-back method. Advantages of interviews by the means of telephone are that they are easier to arrange for both the interviewer and the interviewee.

Actor-position and name of referencing in this report	Date	How conducted
Representative of Drinking Water company Vitens	18-04-2018	Face-to-face
Representatives of the Province of Overijssel	07-05-2018	Face-to-face
Representative of LTO-Noord	09-05-2018	Telephone
Cattle farmer 1 (frontrunner)	1-06-2018	Telephone
Cattle farmer 2 (frontrunner)	1-06-2018	Telephone
Academic expert Wageningen 1	13-06-2018	Telephone
Academic expert Wageningen 2	18-06-2018	Telephone

Table 3 : Cartelistic of the interviewees. Source, author

In mutual agreement, all the interviews were recorded. To analyse the interviews, they are transcribed and coded using Atlas Ti. (version 8.2). The coding is based on the operationalisation of the IAD framework, hence on a theoretical concept. Therefore, it can be considered an content and thematic analysis (Taylor, 2016). By the means of a coding tree, the interpreting of the gathered information is done consistently. For more detail on the code tree, please read the enclosed Appendix I. The analysis of the interviews can be found in Appendix IV.

3.2.2 Policy analysis

Additional applied sources of information are the policy documents that describe the position of the actors in the action situation, or that influence the behaviour from the actors by the means of top-down policy (e.g. a higher government layer directing a lower one). The documents are analysed on their set goals and on the formulated strategies on achieving the set goals. As the formulated goal of this research is analysing difficulties and opportunities in the transition towards optimised agriculture, the selected policy documents are restricted to the most recent policy document available for each actor (Taylor, 2016; Healy & Healy, 2016). Preceding policy documents will not be taken into account

as they are being a part of the formal institutional framework, although these documents provide background information to the context of the most recent policy course. The documents are bundled in a database (see Appendix III), and the main interpretations will be added for the purpose of the analysis. These policy documents will not be coded in Atlas Ti., because of the large amount of data.

Additionally, other grey literature sources were used to reflect on the information gathered through the policy analysis to reflect on the practical implications. Examples of the grey literature sources that are studied are news articles on agricultural behaviour and opinion pieces produced by interest groups. Two relevant documents are “Zover het eigen instrumentarium rijkt¹” (Freriks et. al. 2016) and “Wettelijk instrumentarium voor landbouwmaatregelen om waterkwaliteit te verbeteren; Realisatie van nutriënten doelstellingen uit de Kaderrichtlijn Water²” (Velthof et. al. 2018). While these documents are not policy documents, they are academic reflections on the contemporary policy context regarding agriculture in groundwater protection areas. Therefore, these documents were considered particularly valuable.

The policy documents that have been studied for the purpose of analysing are featured in Appendix III, the most significant documents are:

- Deltaplan agrarisch waterbeheer (Deltaplan Agrarisch Waterbeheer, 2013)
- Groundwater Protection in Europe; the new groundwater directive, consolidating the EU regulatory Framework (European Commission, 2008)
- Veerkrachtig vooruit Langetermijnvisie op onze infrastructuur (Kloosterman, 2016)
- Werkprogramma Stroomgebiedbeheerplannen 2015. Ministerie van Infrastructuur en Milieu (2012)
- Gebiedsdossiers drinkwaterwinningen Overijssel; Deel 2: Witharen (van den Brink et. al. 2010)
- Gebiedsdossiers drinkwaterwinningen Overijssel Deel 2: Gebiedsdossier Nijverdal (Van Vugt et. al., 2017)

3.2.3 Literature study

Literature study encompasses analysis of academic writings and concepts. This method is necessary to provide a broadly-based theoretical framework. Therefore, this method will be primarily used to answer the second research question, which aims to operationalise the IAD framework. This operationalisation is built upon several academic interpretations of the IAD framework.

The collected information is bundled and enclosed in a literature database (see Appendix III). The operationalisation of the interpretations of each concept that is used in this report and the use of those concepts in a conceptual model can be considered the data-processing step. (Healy & Healy, 2016).

Three ways of identification of relevant literature were used. Firstly, the online databases of both the University of Groningen (Smartcat) and Google Scholar were scanned for literature regarding the concepts under research. The following two key words were mainly used to find relevant literature in these databases; *Operationalisation IAD framework* and *Transition Management*. Secondly, the articles used provided the author with their reference lists. These lists are scanned for additional relevant literature. Thirdly, suggestions for relevant literature by either the supervisors, interviewees, or faculty members of the faculty of Spatial Sciences were used. Academic articles, academic books and reports written by academics all were considered relevant sources.

¹ As far as the own set of instruments reaches

² Legal instruments for agricultural measures to improve water quality; Realisation of nutrient objectives from the Water Framework Directive

The selection of relevant literature is primarily based on the date of publication and on the amount of references. Recent publications regarding the concepts under research in this report (primarily the IAD framework) are most likely to provide the most relevant insights. Recent publications thus are considered as more relevant as older publications. In this consideration, the amount of times an article is referenced in other (academic) work is taken into account.

3.3 Ethics

An important part of conducting research is describing the ethical practice used while gathering, analysing and presenting information. This is especially the case in researches in which information is gathered by the means of interviews, as sensitive information could be easily linked to an individual if not handled carefully. To try to prevent this, and to answer other ethical questions, the way of incorporating the five values of ethical research in the Netherlands in this research; “scrupulousness, reliability, verifiability, impartiality and independence” (Association of Universities in the Netherlands, 2012), are elaborated upon (Hay, 2016).

As the context of the research is one of possible conflict between reaching the norms set by the EWFD and protecting agricultural interests, the output of the interviews could provide information that could jeopardise their position in the action situation. Information gathered by the means of interviews thus will be treated confidentially, and the transcripts will therefore not be included in the report. The interviewees will be asked for permission to record the conversation, and the transcript will be sent to them to give the possibility to either consent the usage of the information in the research, or to edit or remove information from the transcript (thus excluding it from the analysis). Furthermore, the identities of the interviewees are protected by anonymising them to the level of their function in the action situation. To ensure the verifiability of the statements, the information procured by the means of interviews will be kept for a period of one year. All used information, including information procured from literature, policy documents and other grey literature like articles and opinion pieces, will be properly sourced using the Harvard method. (Association of Universities in the Netherlands, 2012; Hay, 2016)

Impartiality is guaranteed since no party gives any form of compensation for conducting this research. Any personal biases that may exist are tried to be negated by applying triangulation (Taylor, 2016; Hay, 2016) as will also be done with the gathered information through the interviews.

It is necessary to mention as well that one of the supervisors, Dr. in. C. Van den Brink has a link to the action situation; he is project manager in the project “Farmers for Drinking Water”. This has some implications for the research conducted in this report. Because of his link with the action situation, he provided a considerable amount of contextual information. Furthermore, by the means of his social network, the relevant interviewees could be contacted. His involvement in supervising this research has proven to be beneficial in decreasing the amount of time needed to create an understanding of the action situation.

4: Analysis of the action situation using the IAD Framework

In this chapter, an in-depth exploration of the institutional framework will be performed, using the rules that frame the IAD framework. Chapter two provides an in-depth background to the operationalisation of this framework, chapter four contains the analysis. The rules are analysed in the following sequence: position rules, boundary rules, choice rules, scope rules, information rules, aggregation rules, and finally payoff rules. Due to the interrelated nature of these rules, some overlap between the descriptions occurs. The information that emerged from the conducted semi-structured interviews is underlying the analysis. The output of the interviews is featured in Appendix IV. For the purpose of validity, triangulation is applied. This means that multiple sources were used to either back the statements made, or to provide a counterargument if possible (Association of Universities in the Netherlands, 2012; Taylor, 2016). Both the third and fourth sub-questions are answered in this section;

What is the action situation in which technical innovations and innovations in operation management by farmers in Overijssels groundwater protection areas are to take place?

Which constraining and enabling institutional factors can be defined in relation to agricultural innovation in groundwater protection by applying the IAD Framework?

4.1 Introducing the actors

Before the analysis per rule can be executed, it is necessary to specify the unit of analysis. This is dilated upon by linking the different actors and their actions and influences on the action situation. A division can be made between actions and actors. On the one hand, they occur within the action situation (internally). On the other hand, actors that influence the action situation externally are detectable. While the external actors do not hold a position within the action situation, their influence on the internal actions and actions are noticeable. Because of their influence, these external actors are elaborated upon. Figure 7 visualises the action-situation that is under research. The box represents the action situation; agriculture in groundwater protection areas. The distinction is drawn between primary actors on the one hand, and secondary actors on the other hand. This is based on the information that is gathered during the interviews (Academic expert Wageningen 1, 2018; Academic expert Wageningen 2, 2018, Cattle farmer 1, 2018; Cattle farmer 2, 2018; Representative of Drinking water company Vitens, 2018; Representative of LTO Noord, 2018; Representatives of the Province of Overijssel, 2018). The division between the primary (internal) and secondary actors is displayed by their location in relation to the action situation in figure 7; internal actors are placed within the action situation, and external actors are placed outside of the action situation. The big blue arrow represents projects like “Farmers for Drinking Water” since those are instrumental for the innovation effort. The small blue arrows represent influence over the types of projects, either directly or through other actors. The dotted orange line represents the possible influence the municipalities or water boards could have.

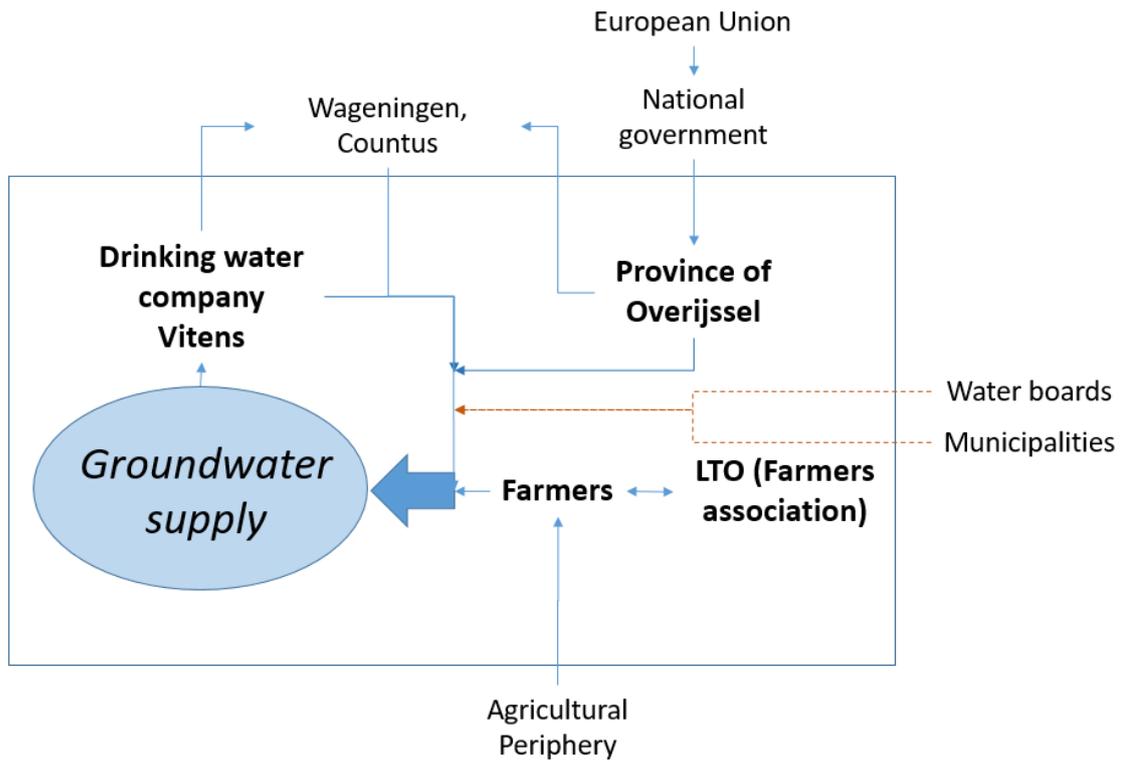


Figure 7: Action situation under research. Source, Author, based on information provided by the interviewees

The rules in the contemporary action situation solely relate to the current situation. Hence, the analysis is based on the IAD framework, and provides a snapshot of the contemporary situation (Ostrom and Basurto, 2011). After the rules at this juncture are described, they are linked to the future goal of the action situation. This goal is that agricultural businesses are adapted to minimise the emission of agricultural chemicals to the groundwater supply, while their continuity is preserved (Representative of Drinking water company Vitens, 2018; Representatives of the Province of Overijssel, 2018).

4.2 Position rules

These rules lay focus on the position of the actors in the action situation. This is of significance since these positions possibly shape the amount of control and influence each actor has. The actors' control is on shaping decisions and is therefore influencing the institutional framework (Ostrom, 2011). The operationalisation of the position rules (as featured in chapter two) developed into four questions:

- Which actors have governing power in groundwater protection areas?
- Which actors play a role in initiating or stimulating projects to reduce negative impact on those areas?
- Which actors have an antagonistic approach towards this transition?
- Which actors have knowledge about the actions that need to be taken to reduce the negative impact of agriculture on groundwater protection areas?

The output of these rules is a set of positions that are fundamental for the action situation. For the purpose of clarification, these positions are linked to actions that are undertaken by some stakeholders. The following three positions have been distinguished based on the information that emerged from the interviews: Government, Target of the innovation effort, and Support provider. These three positions will be elaborated upon in the following sections.

Government as stimulator of innovation

Groundwater protection means in this context the containment of groundwater pollution. Three governmental layers influence the action situation in relation to groundwater protection. These are: the European Union, the Dutch national government, and the Dutch provinces (Freriks et. al., 2016; Representatives of the Province of Overijssel, 2018; Velthof et. al., 2018,). The European Union has influence. It sets the norms on nitrate, phosphate, antibiotics, pesticides and herbicides to which the chemical groundwater quality should suffice. For nitrate as an example, the amount in the groundwater supply cannot exceed 50 milligrams per litre. These norms are mainly captured in the European Water framework directive, with the primary goal of restoring the quality of the groundwater and surface water (Bij 12, N.D; European Commission, 2008; Representative of Drinking water company Vitens, 2018; Rijksoverheid, 2018). The chemical norms are defined as limiting and restricting. If these norms are not met, economic sanctions are imposed on the Dutch national government (Bij 12, N.D.). Therefore, the role of the European Union is interpretable as regulating based on authority. This is supported by the distinguished by Adam, Hurka and Knill (2017); they state that there is a relatively powerful restriction on the behaviour of the national government and that there are potential consequences for not complying to these restrictions.

This report focusses on groundwater protection areas; therefore, the focus lies on the influences the groundwater norms have on this action situation. Through the water law, the provinces are responsible for guarantying the groundwater quality and quantity. They are perceived in the role of problem owner. Hence, of the three defined governmental layers, the provinces are mostly held accountable for the groundwater protection areas. (Freriks et. al., 2016; Representatives of the Province of Overijssel, 2018; Rijksoverheid, 2018; Velthof et. al. 2018). However, the jurisdiction of the provinces in the action situation is limited,. The implementation of the norms set by EWFD are fragmented over multiple policies. These legal power over these policies are fragmented, some of which are enforced on a national level (Freriks et. al., 2016; Velthof et. al. 2018). Besides this, the national government has a conflicted interest in the situation, since it also protects the market-position of Dutch agriculture which is a large economic asset for the country. This protection of agricultural interests and the fragmentation of jurisdictions leads to the conclusion that no significant consequences can be put on farmers when the norms are not met, at least not by the provinces. No strong restrictions are put on

individual behaviour (Freriks et. al., 2016; Academic expert Wageningen 1, 2018; Velthof et. al. 2018). The regulatory relationship between the Province of Overijssel, the national government, and the farmers in the action situation can therefore be classified as “permissive” based on the distinction of Adam, Hurka and Knill (2017).

The governance-approach used by the Province of Overijssel aims to reach the norms and focusses on the implementation of “mutual-gains measures”. This means that the Province of Overijssel focusses on the stimulation of innovation by farmers. The participating farmers apply measures to reduce their emission of agricultural chemicals to the groundwater improving their business practices to be more efficient. The province stimulates this by providing knowledge, financing for research, utilising their network and by networking through scrum-sessions; effectively functioning as a support provider to create networks of innovations. This is being done to reach their goal of “mutual-gains” (Representatives of the Province of Overijssel, 2018). This governance-approach could be considered as “self-organising networks” based on Rhodes’ (1996) description, as there is a lack of legitimacy for a directive style of governance. Hereby is meant that there is a large degree of interdependency between stakeholders (due to high autonomy of participants) and the chosen governance-approach (that focusses on networking and generating knowledge).

Frontrunners and non-participating farmers as targets of the innovation effort

The action situation focusses on assisting agricultural practices in their transition from a maximisation-oriented practice to an optimised practice, including less negative impact on the groundwater supply. This is done through innovation and the implementation of measures that reduce pollution (Representative of Drinking water company Vitens, 2018; Representatives of the Province of Overijssel, 2018, Van den Brink et. al. 2017). Therefore, farmers have multiple positions in this action situation. All farmers fill the position of target of the innovation effort. However, between different groups of farmers dissimilarities are distinguished. On the one hand, there are farmers that participate in the role as frontrunner. On the other hand, there are farmers that do not participate. The latter group can be separated into two groups. Firstly, there is a group that does not participate yet, but might be willing to do so if the conditions and incentives are sufficient. The second group consists of farmers that do are unwilling to participate in the action situation from an antagonistic motive (Academic expert Wageningen 2, 2018; Cattle farmer 1, 2018; Cattle farmer 2, 2018; Representative of LTO Noord, 2018). As an interpretation of some recent news articles, this first group is a considerable part of the total agricultural sector (NOS, 2018). They are probably easier to convince to participate in projects like “Farmers for Drinking Water” than the second group consisting of antagonistic farmers. Although this division does not take the nuances that can exist in the attitude from individual farmers towards participation in projects to find mutual-gains into account, it does help in roughly categorising farmers accordant with their position in the action situation.

Support providers as stimulator of the effort

Besides the Province of Overijssel and the frontrunners, almost all involved actors support the effort. For example, the drinking water company Vitens provides knowledge on a project-scale by aiding in calculations and providing financial means for research into the “mutual-gains” solutions (Representative of Drinking water company Vitens, 2018; Representatives of the Province of Overijssel, 2018). The contemporary involved persons and organisations in projects (like in “Farmers for Drinking Water”) are key support providers as well. The participating farmers also act as support provider, as they deliver information regarding points of improvement in the action situation (Representative of

Drinking water company Vitens, 2018; Representative of LTO Noord, 2018; Representatives of the Province of Overijssel, 2018). Concluding, support can be provided in this action situation by the means of; knowledge generation and information sharing, financing and networking. The LTO (Land- en Tuinbouw Organisatie Nederland, translated to English as Dutch federation of Agriculture and Horticulture) is a prime example of the latter, since they agreed to find new participants among their members and the entire farmers group (Deltaplan agrarisch waterbeheer, 2013; Ministerie van Landbouw, Natuur en Voedselkwaliteit & Ministerie van Infrastructuur en Waterstaat 2017; Representative of LTO Noord, 2018). Another example is the organisation Stimuland, it is focussing on initiating communication with farmers. The aim is to guide them in projects like “Farmers for Drinking Water” (Stimuland, 2016).

Position	Explanation
Government as stimulator of innovation	Even though the European Union creates a top-down push to reach groundwater quality norms, the national government does not use a regulative approach to reach them; it has an economic interest in protecting the agricultural sector. The provincial government lacks jurisdiction and enforcing power, this creates a necessity to take a permissiveness-based regulation approach. The “mutual-gains” approach they apply relates to the ‘self-organising networks’ governance style.
Target of the innovation effort	This group consists of the farmers in groundwater protection areas. Three subcategories can be distinguished, namely; 1) farmers that participate in the action situation, 2) farmers that do not yet participate yet might be convinced with the right incentive, and 3) farmers that do not want to participate and are unlikely to change their mind. These different groups of farmers can thus be categorised as; participating, willing to participate when given the right incentive, and unwilling to participate (or antagonistic).
Stimulator of the effort	Multiple actors are related to this position. As an example, the Province of Overijssel and Vitens provide financial means for research, research organisations like Wageningen provide knowledge, as do the participating farmers that act like frontrunners in implementing knowledge.

Table 4: Position rules. source, author

Constraints due to lack of enforcer

The three distinguished position rules (read table 4) in the action situation determine the division of the positions to be fulfilled between the government, farmers and other organisations. Both the Province of Overijssel and the supporting organisations focus on positive stimulation of the action situation. The farmers primarily are target of the innovation effort by the means of the “mutual-gains approach”.

This action situation must take restrictions into consideration. A restriction within this action situation is a lack of an enforcing position. Even though a lack of this position is explainable due to the restricting choices made on a national governmental level, transitioning agriculture towards an optimisation-oriented form, with a decreased impact on the chemical groundwater quality is less likely to succeed if no organisation can enforce sanctions for transgressions. Ostrom and Basurto (2011) distinguish between the position of, one the one hand, an external enforcer, and, on the other hand, an internal enforcer. This means that an enforcer can be either outside or inside the action situation. That is put into focus in this report. It is an obstruction that neither of those enforcers are present. Several

interviewees agreed that it is necessary to be able to impose sanctions on transgressions. This can be interpreted as they want to enforce other rules in the action situation. As one of the interviewees stated; “you also need to be able to hand out minuses, and not only plusses for behaviour”, meaning that besides awarding positive behaviour, negative behaviour needs to be sanctioned (Academic expert Wageningen 1, 2018).

4.3 Boundary rules

As elaborated upon in chapter two, the main focus of these rules is determining which actors are mainly involved in the action situation, and when they enter and leave the situation. As described by Ostrom and Basurto (2011) not every actor has the means to unrestrictedly enter and leave. The operationalisation of these rules resulted in the following three questions:

- Which actors are primarily involved in the action situation and on what grounds?
- Are there any actors that are less involved in the action situation than is either foreseen or wanted?
- What are the restrictions for those actors to either enter or leave the situation?

Based on the interviews, five rules emerged that steer the possibility for an actor to enter the action situation. These are; landownership, responsibilities related to (the use of) groundwater, jurisdiction, knowledge related to the generation of “mutual-gains measures”, and influence on agricultural behaviour. The involved actors and some missing actors are categorised in accordance to these five rules.

Landownership in groundwater protection areas

The primary actors that are classified within this defined category are the farmers in the groundwater protection areas of Overijssel. As the pollution under research in this report originates primarily from the agricultural businesses, the farmers, both participating and non-participating in projects to generate mutual-gains, are perceived by all interviewees as the key actors to involve. This is mainly the perception because of the controlling power farmers have on land and businesses; those areas are the origin of the problem of pollution. Innovations that reduce the amount of nitrate, pesticides and phosphate among others, flowing into the groundwater supply therefore must be applied on their businesses. This makes them significant in the transition from a maximisation oriented agricultural practice towards an optimized one (Academic expert Wageningen 1, 2018; Academic expert Wageningen 2, 2018, Cattle farmer 1, 2018; Cattle farmer 2, 2018; Representative of Drinking water company Vitens, 2018; Representative of LTO Noord, 2018; Representatives of the Province of Overijssel, 2018).

Responsibilities related to groundwater

Multiple actors have a responsibility related to groundwater in the action situation. The primary governmental layers with responsibilities are; the national government and the Province of Overijssel. The national government accepted to meet the norms set by the EWFD from the European Union, thus has the responsibility to improve the amount of groundwater to a sufficient chemical quality. The ministry that is held accountable for reaching the norms is the ministry of Infrastructure and Water management, through their operative organisation Rijkswaterstaat (RIVM, 2011). However, since the norms relate to environmental quality and agriculture as well, the implementation of the norms is fragmented over multiple laws and regulations (such as the ministry of Agriculture Nature and Food Quality). The national government made reaching the goals of the EWFD a shared responsibility between them and the other governmental layers. In the action situation the provincial governments have the responsibility to ensure the availability of clean groundwater, by the means of the drinking water law (Velthof et. al, 2018).

Another organisation with a responsibility related to safeguard the groundwater quality is Vitens, as the drinking water company in the action situation. Vitens is responsible for supplying clean drinking

water, which is largely subtracted from the groundwater protection areas. This means that the organisation benefits from groundwater that is as clean as possible, since the treatment of water will be less labour-intensive (hence cheaper). Therefore, the organisation takes an active part in aiding the innovations to reduce the pollution from agricultural practices (Kloosterman, 2016; Representative of drinking water company Vitens, 2018).

The LTO, as the largest representative organisation for the Dutch agricultural sector, also has a responsibility in the action situation. The organisation has signed the sixth nitrate action programme. The goal of this action programme is reducing the nitrate in the groundwater, aiming for a concentration of 50 milligrams per litre or lower. The organisation is responsible for mobilising farmers to participate in projects that reduce the emission agricultural chemicals (more specifically nitrate) to the groundwater supply, as they took the obligation upon them to do so by signing the sixth nitrate action programme. The organisation tries to mobilise farmers to participate in projects to reduce the nitrate emission by the means of as described in their programme, "Delta Plan Agricultural Water Management" (Deltaplan agrarisch waterbeheer, 2016; Ministerie van Landbouw, Natuur en Voedselkwaliteit & Ministerie van Infrastructuur en Waterstaat, 2017; Representative of LTO Noord, 2018).

Fragmented jurisdiction

Due to the fragmentation of the responsibilities over multiple governmental layers, the situation concerning jurisdiction conforms to this fragmentation as well. Multiple governmental layers have jurisdiction over elements related to the action situation: The European Union, the national government, the water boards and the municipalities. Firstly, The European Union is not directly involved in the action situation, yet it has influence as it has set the standards concerning the chemical quality of the groundwater that has to be attained. Furthermore, the national government has jurisdiction by the means of the Manure policy for example, the Province of Overijssel has jurisdiction over groundwater protection areas by the means of the Water law and Environmental law, among others. Thirdly, the water boards also have moderate jurisdiction over these areas albeit that this jurisdiction relates more to surface water. They can influence the situation by the means of an activity decision as a part of the water law. In this activity decision they can make a prescription for custom measures to protect their assets. The final governmental layer of influence is the municipalities. The municipalities have some influence by the means of the law for Spatial Planning. Concluding, two governmental layers have jurisdiction specifically focused on groundwater protection and reducing pollution of groundwater. These are the national government and the Province of Overijssel (Academic expert Wageningen 1, 2018; Freriks et. al., 2016; Velthof et. al., 2018).

The jurisdiction of the Province of Overijssel is hampered by the national government though, as the agricultural interests are protected to ensure the position of the farmers on the global food market. This means that the lower governments, including the Province of Overijssel, cannot enforce measures on farmers in the action situation based on their jurisdiction, if these impedes the competitive position of agricultural businesses. Thus, the national government restricts the provincial capacity to reach these norms by limiting the power to enforce, in favour of protecting the economical position of the agricultural sector (Academic expert Wageningen 1, 2018; Representative of drinking water company Vitens, 2018; Representatives of the Province of Overijssel, 2018).

Knowledge generation

Wageningen University has been mentioned by multiple interviewees as an influencer for the action situation, since this organisation (and other knowledge institutes) are useful for generating and sharing the information necessary to find new innovations. The University helps with implementing the innovations correctly and assists in calculating the effects of participation in the project. The

organisation Countus also plays a large role in calculating the effects. (Cattle Farmer 1, 2018; Cattle farmer 2, 2018; Representatives of the Province of Overijssel, 2018). Especially the latter is useful to calculate if the win-win that is aimed for by the "mutual-gains" approach is generated. This organisation can mostly be considered as a supporter of innovation within the action situation, based on the provision of knowledge (cattle farmer 2, 2018; Van den Brink et. al. 2017). Therefore, the ability to generate or provide knowledge forms a significant rule for possibly entering the action situation. Besides the University of Wageningen, some of the interviewees perceive Vitens, the Province of Overijssel and water boards as providers of knowledge (Cattle farmer 1; 2018, Cattle farmer 2, 2018; Representative of LTO Noord, 2018).

Peripheral influence on agricultural behaviour

The main group filling in this boundary rule consists of the chain-partners for the agricultural sector; the agricultural periphery. Some of the peripheral partners are being involved in the action situation according to some of the interviewees. However, their involvement seems to be limited to solely attending meetings. According to other interviewees, large parts of the periphery are not involved (yet), while this would be useful in stimulating the action-situation. As will be explained further in chapter 4.3, their involvement can possibly influence the flexibility of farmers to participate in projects to reduce the outwash of agricultural chemicals. These interviewees acknowledged that the influence the periphery can have on the actions of farmers forms a basis for their involvement in the action situation (Academic expert Wageningen 2, 2018, Representative of drinking water company Vitens, 2018; Representatives of the Province of Overijssel, 2018). Influence thus, is a rule for entering or leaving the action situation, albeit that the peripheral partners that can exert their influence are almost not involved (Academic expert Wageningen 2, 2018).

However, the perception of the peripheral influence as a rule can be debated upon, as it is an external influence. For the purpose of this report, the author decided to elaborate the different points of view that emerged from the interviews. This rule came across several times and is therefore added. It is in accordance with Ostrom's IAD framework (2011) to display several perspectives to the same subject to gain insights in the problem situation.

Boundary	Main actors	Missing actor (less involved actors)
Landownership	Farmers in groundwater protection areas	-
Responsibilities related to groundwater	The national government, the Provincial government, Vitens, LTO (Noord)	-
Jurisdiction	The Province of Overijssel	The national government, Water boards, Municipalities
Knowledge related to the generation of mutual-gains measures	Wageningen, Countus, The Province of Overijssel, Vitens, Participating farmers	Water boards, Municipalities
Peripheral Influence over agricultural behaviour	-	Chain partners

Table 5: Boundary rules. source, author

Enabling institutional elements for increased peripheral involvement

Through the IAD framework five boundary rules are distinguished in the action situation (see Table 5). These rules are sufficient in allowing the right actors to enter and leave the action situation; they allow entering the action situation based on landownership, jurisdiction, responsibilities and relevant knowledge.

The last element of the boundary rule allows peripheral partners to enter or leave the action situation, as the periphery can have a large impact on the flexibility of farmers to participate in the action situation. This outcome is acknowledged by some of the interviewees, which validates the existence of this rule; this rule provides an opportunity for the involvement of peripheral partners with external influence in the action situation. However, it is noteworthy that the periphery consists of a large amount of diverse organisation with a diverse amount of influence. To give some examples; the Rabobank as a financier, Friesland Campina as a buyer of produce, or contractors working on the farms, have varying amounts of influence (Academic expert Wageningen 2, 2018, Representative of Drinking water company Vitens, 2018; Representatives of the Province of Overijssel, 2018). Arguably, this is because they deliver different services to farmers and because they operate on different scales. One could question if every peripheral partner is welcome to enter the action situation. The second uncertainty is on what grounds this is decided. No constraint for the chain partners to be involved in the action situation is distinguished within the institutional framework based on the analysis. However, they arguably were not involved enough at the start of the innovation projects. Because of this the argument can be made that a path-dependency has developed in which the level of peripheral is unsatisfactory for some of the interviewees (Academic expert Wageningen 2).

4.4 Choice rules

These choice rules focus on revealing the responsibilities that actors have in the action situation, as well as the possible presence of restrictions on actions. In other words, these rules entail the amount of choice an actor has in deciding own behaviour and action within the action situation. The latter is determined by these rules; which actions are required, permitted or forbidden (Ostrom, 2011). In chapter two, four questions were formulated to operationalise this rule;

- Which actors have responsibility in furthering the transition towards optimisation in groundwater protection areas?
- What type of agricultural practices are restricted or even prohibited, and how is this enforced?
- Which measures are “ground water proof”, and are therefore stimulated? How are these measures stimulated?
- Are there any restrictions on implementing the “ground water proof” measures?

Regarding to the requirements, one rule can be distinguished; the norms as stated in the EWFD must be reached. Three restrictions can be distinguished, namely; 1) Participation of farmers in projects to implement mutual-gains measures needs to be voluntary, 2) No direct financial stimulation may be given to farmers, as this can be considered as state support, and 3) Any enforceable restrictions imposed on farmers limiting their emission of chemicals and limiting their growth must be met

Reaching the norms within a landscape of conflicting interests

There is a national responsibility reaching the different goals of the EWFD, one of which relates to the chemical quality of the groundwater (Bij 12, N.D.; RIVM, 2011). The responsibility of ensuring groundwater quality in groundwater protection areas rests with the provincial government. Thus, the Province of Overijssel must justify their attempts to ensure the groundwater quality to the national government (which must justify their results to the European Union) (Representatives of the Province of Overijssel, 2018; Rijksoverheid, 2018; Velthof et. al. 2018). Due to the conflicting interests the national government has, the Province of Overijssel must manoeuvre a diverse political and regulatory landscape in their attempts to improve the groundwater quality (Representatives of the Province of Overijssel, 2018). LTO Noord also has taken responsibility in the action situation by signing for increased effort on their behalf in the sixth nitrate action programme to increase the number of participating farmers (Deltaplan agrarisch waterbeheer, 2013; Ministerie van Landbouw, Natuur en Voedselkwaliteit & Ministerie van Infrastructuur en Waterstaat, 2017; Representative of LTO Noord, 2018).

Voluntary participation, no enforcement

A restriction for the provinces in meeting their responsibilities (ensuring clean groundwater in groundwater protection areas), is that the market position of agriculture is protected on a national level. Therefore, it is not possible for any governmental layer lower than the state level to enforce the implementation of measures that will make agricultural practices “groundwater-proof”. For all lower governments this means that there is a restriction on steering and enforcing power within the action situation, and that they must aim for cooperation on all areas in which they cannot exert pressure by the means of jurisdiction. Besides this, there are different laws and regulations with elements that influence the action situation. Zuidema (2016) explains these types of phenomena as vertical (between governmental scales) as and horizontal (between different laws) fragmentation. For the action situation this means that the Province of Overijssel cannot oblige farmers to participate in projects which aim to reduce the emission of agricultural chemicals to the groundwater. Therefore, the province needs to take a voluntary approach; farmers need to be enticed to participate (Academic

expert Wageningen 1, 2018; Representative of drinking water company Vitens, 2018; Velthof et. al., 2018).

No direct financial stimulation

Another rule that can be distinguished is: no direct financial stimulation can be given from the governmental actors to individual farmers to implement measures. This would be considered state support, which is prohibited by the European Union. For the action situation this means that the Province of Overijssel cannot stimulate farmers to implement measures to reduce the emission of agricultural chemicals to the groundwater supply by the means of direct financial stimulation. Furthermore, their inability to enforce measures by the means of jurisdiction is in play. The province therefore uses indirect financial stimulation, by paying for research to discover the mutual-gains measures they seek to implement (Academic expert Wageningen 1, 2018; Representative of the Province of Overijssel, 2018; Velthof et. al., 2018). The drinking water company Vitens helps in this financial stimulation as described in paragraph 4.1 and 4.2 (Representative of drinking water company Vitens, 2018).

Meeting enforced norms and restrictions

Based on the restrictions on the behaviour of the Province of Overijssel as described earlier, the farmers have flexibility in the possible participation in projects to reduce pollution of the groundwater. However, there are restrictions for farmers by the means of other regulations that are enforced. Based on some of the laws mentioned above, restrictions are placed on the amount of manure they can produce and apply to their soil (although there is some flexibility in this based on so called derogation), and on the amount of nitrogen, phosphorus ammonia, herbicides and pesticides they can use and excrete (Cattle farmer 1, 2018; Representative of LTO Noord, 2018; Velthof et. al., 2018). These restrictions limit their actions in relation to the action situation in two ways. Firstly, the restrictions ensure that the negative effects of the maximisation oriented agricultural practices on groundwater quality cannot increase. The other negative effect is that the restrictions put limits on the growth and expansion of agricultural businesses (Ministerie van Landbouw, Natuur en Voedselkwaliteit & Ministerie van Infrastructuur en Waterstaat, 2017). A possible side-effect could be that it hampers innovations and implementation of some measures.

Choice rules	Explanation
The norms as stated in the EWFD must be reached	There is a requirement to reach the norms from the EWFD, as the national government has agreed to act to reach them; reaching the norms is not noncommittal.
Participation of farmers in projects to implement mutual-gains measures needs to be voluntary	As the market position of farmers is protected on a national governmental scale, farmers cannot be forced to participate in the action situation.
No direct financial stimulation may be given to farmers	Direct financial stimulation is considered state-support. This is prohibited by the European union.
Any enforceable restrictions imposed on farmers limiting their emission of chemicals and limiting their growth must be met by them	A multitude of laws and regulations restrict the growth of farming practices and limits the amount of chemicals they use. These are not so strict that the norms from the EWFD can be met, yet they form a restriction on farmers.

Table 6: Choice rules. Source, author

Constraints on enforcement and flexibility

The four choice rules in the action situation (as features in table 6) result in multiple conflicts and restrictions. The primary requirement of the action situation for the Province of Overijssel, Vitens and LTO Noord, is that the groundwater quality reaches the norms that are determined in the EWFD. There are restrictions on their ability of reaching these however, as participation of farmers must be voluntary. Thus, the farmers are not obliged to participate, furthermore positive stimulation by the means of direct financing is not allowed. In other words; these restrictions limit both the enforcement and direct financial stimulation, which severely limits the ways on how the Province of Overijssel can try to reach the norms (Academic expert Wageningen 1, Freriks et. al., 2018; Velthof, 2018).

Further restrictions for reaching the goals can be identified in the restrictions that are placed upon the farmers. On the one hand, they must take the existing norms and regulations into account, which limits their flexibility. This primarily limits growth and chemical usage (Cattle farmer 1, 2018; Cattle farmer 2, 2018; Representative of Drinking water company Vitens, 2018; Representative of LTO Noord, 2018). On the other hand, an obstacle can be identified in the role the periphery plays; agricultural practices are nested in the agricultural chain, which gives peripheral partners a lot of influence on how farmers act. The periphery therefore impedes the flexibility of farmers to act independently, which could provide difficulties for participation in the action situation (Academic expert Wageningen 2, 2018). The agricultural periphery thus impedes the flexibility of farmers. Actors such as: buyers of the produced goods (which extends to the consumer), financing and agricultural advisory groups, suppliers of agricultural chemicals and fodder and contract workers all are a part of this group, as they can hinder the flexibility of individual farmers to participate in projects like "Farmers for Drinking Water" (Academic expert Wageningen 2, 2018). To give some examples; investments that are conflicting with the long-term goals of the transition might be advised upon and be financed to be incorporated, the market demand for cheap products results in low prices for the produce of the farmers which inhibits their possibilities to finance measures, and the inability of contractors to buy the necessary equipment to aid the implementation of "ground waterproof" measures. Although some of these behaviours might be out of the control of specific chain-partner and might be unintentional, they can restrict the flexibility of the farmers who want to participate in "mutual-gains" projects (academic Expert Wageningen 2, 2018). Adaption of farmers can be stimulated by positive behaviours of actors in the periphery. The peripheral organisation Friesland Campina, a company that produces and sells dairy-based products, can be used as an example. The programme of Friesland Campina financially rewarding farmers for letting their cattle graze outside more often to get the label "Weidemelk" can attest for this, as the number of participants in the programme continuously grew since its introduction (Friesland Campina, 2018 a, b).

4.5 Scope rules

As explained in chapter two, the scope rules determine the relationship between actions and their outcomes. In other words; what is the potential result of the actions taken in the action situation, and are these actions sufficient (Ostrom, 2011)? The different positions, the different involved stakeholders and the responsibilities and restrictions explained in the previous paragraphs lead to an explanation of the actions taken. Another explanation can be formulated in relation to possible outcomes. Two operationalisation questions were described in chapter two;

- Are the measures taken sufficient to reach the nitrate objective (50 milligrams per litre) and to decrease the amount of other chemical pollutants according to the European Water Framework directive?
- How is this measured?

Five scope rules can be distinguished in the action situation, namely; 1) custom measures are necessary, since there are physical restrictions on implementing generic measures, 2) The measures should decrease the outwash of the agricultural chemicals to a level that meets the norms from the EWFD, 3) the measures should provide financial benefit for farmers who implement them, or at least do not result in financial costs, 4) the measures should ensure long term continuity for both the agricultural practices and for the decreased outwash of agricultural chemicals to the groundwater, and 5) all farmers in the groundwater protection areas should participate in the action situation.

Custom approaches instead of generally applicable measures

The first rule that defines the scope of the action situation, is the need for finding customised measures. When starting the project, multiple measures were tested on a multitude of agricultural businesses, yet as one of the primary results of the project “Farmers for Drinking Water” it must be concluded that none of the found measures is generally applicable on all agricultural practices. For the action situation, this entails that it remains necessary to research how the measures can be implemented on each farm. Physical limitations like height differences, accessibility, and soil type influence the effectiveness of each measure. The land-use of each parcel (for grazing or crop-farming as an example) influence this as well. Because of these physical limitations, the application of measures is treated as a custom approach for each individual business (Academic expert 2, 2018; Cattle farmer 1; 2018, Cattle farmer 2, 2018; Representative of drinking water company Vitens, 2018, Representatives of the Province of Overijssel, 2018). Developing custom approaches thus has become a rule in the contemporary situation, since the physical limitations make implementing generic measures impractical or even conflicting with the mutual gains interest. Custom approaches are pursued on an institutional level, both in research and in implementation. (Academic expert 2, 2018; Cattle farmer 1; 2018, Cattle farmer 2, 2018; Representative of drinking water company Vitens, 2018, Representatives of the Province of Overijssel, 2018).

Decreasing emission

A significant scope rule for the Province of Overijssel, Vitens and LTO Noord in the action situation relates to decreasing the emission of agricultural chemicals (especially nitrate) to the groundwater supply. All these organisations have a responsibility in relation to groundwater quality. This responsibility is either in protecting or improving the chemical quality of the groundwater, or in decreasing the cleaning process of groundwater to drinking water. The main incentive of the Province of Overijssel and Vitens for participation in the action situation especially is an outcome in which the

emission of chemicals is decreased to the norms set by the European union in the EWFD. For the Province of Overijssel and LTO Noord this would mean that they can attest that their effort in furthering the action situation was successful. For Vitens it would simplify their treatment of water in the process of transforming extracted groundwater in drinking water (Representative of drinking water company Vitens, 2018, Representatives of the Province of Overijssel, 2018).

Stable financial gains for implementation

As described earlier, participation in the action situation is entirely on a voluntary basis for farmers. This means that farmers need to be enticed to participate. As farms foremost are commercial businesses, they have an economical interest. Providing a financial gain for participation in projects like “Farmers for Drinking Water” is of relevance (Academic expert Wageningen 2, Cattle farmer 1, 2018; Cattle farmer 2, 2018; representative of LTO Noord, 2018). The “mutual-gains” strategy the Province of Overijssel uses in the action situation, provides incentive by researching measures that decrease the output on the groundwater supply while optimising the agricultural business practices of participating farmers; decreasing outwash of agricultural chemicals also means that less chemicals need to be used and go to waste (Academic expert Wageningen 2, 2018). This would provide long-term, continuous economic benefits for the farmers, without providing state-support or short-term financial gain. The Province of Overijssel and Vitens finance the research into mutual-gains measures and do not directly finance farmers (Representative of drinking water company Vitens, 2018, Representatives of the Province of Overijssel, 2018).

Long term continuity versus short-term gains

The researched and implemented measures should provide benefits for the long-term, both for the quality of the groundwater supply and for the financial situation of the participating farmers. If the financial gains of implementing measures would not provide benefits for the long-term, then it becomes more likely that the measures will be taken out of practice if the short-term gains are used up. This would mean that the farms fall back to their old practices, which would reverse the positive effects that the implemented measures had on the groundwater supply. Therefore, it is unwanted that the measures do not provide a long-term financial stimulus, as a bounce-back to the old approach would negate any positive effects that the applied measures could have on the chemical quality of the groundwater (Academic Expert Wageningen 2, 2018; Representatives of the Province of Overijssel, 2018; Schnabel, 2011). Therefore , a significant scope rule is that the implemented “mutual-gains” measures are investments which provide benefits for the long-term; in this way they will ensure long-term continuity.

Participation of all farmers in the action situation in a voluntary situation

As participation in the projects is voluntary, the success hinges on the number of farmers willing to participate. The goal of the Province of Overijssel, Vitens, and LTO Noord is to recruit as many farmers as possible for the projects. This would result in a maximisation of the positive effects of the implemented mutual-gains measures on the quality of the groundwater; ideally all farmers participate. As participation is voluntary, farmers need to be enticed to participate (Representative of Drinking water company Vitens, 2018; Representative of LTO Noord, 2018; Representatives of the Province of Overijssel, 2018).

Scope rules	Explanation
Measures are implemented as a custom approach for each individual business	Physical limitation make implementing generic measures impractical, thus measures are

	implemented as a custom approach for each business.
The measures should decrease the outwash of the agricultural chemicals to a level that meets the norms from the EWFD	One of the primary goals of the mutual-gains measures approach in the action situation is decreasing the emission of agricultural chemicals to the groundwater supply; this is a large part of the wished outcome.
The measures should provide financial benefit for farmers who implement them	As the farmers need to be stimulated to participate on a voluntary basis, a financial incentive for participation is the second goal of the mutual-gains approach in the action situation.
The measures should ensure long term continuity for both the agricultural practices and for the decreased outwash of agricultural chemicals to the groundwater	The measures that are implemented should provide a continuous financial benefit, otherwise the measure could be reversed as soon as the financial incentive is gone. This would negate the positive effect of the measure on the quality of the groundwater.
All farmers in the groundwater protection areas should participate in the action situation	The more farmers participate in implementing measures to reduce emission of chemicals to the groundwater supply, the larger the effect will be. Increasing the number of participants therefore is a big goal in the action situation.

Table 7 : Scope rules. Source, author

Enabling institutional elements for long-term benefits

The scope rules (featured in table 7) are sufficient and provide opportunities for stimulating the transition towards optimisation in agricultural practices on the farms in groundwater protection areas. Even though optimising agricultural practices in the groundwater protection areas is primarily a means to an end for Vitens and the Province of Overijssel (Representative of Drinking water company Vitens, 2018; Representatives of the Province of Overijssel, 2018), the scope rules provide flexibility to do so and a tool to link it to their goals of protecting and increasing the chemical groundwater quality to agricultural innovation. Besides this, the scope rule focussing on long-term continuity also ensures that the applied “mutual-gains” measures provide a benefit on the long-term, decreasing the risk that the transition will bounce back due to a lack of incentive. The “mutual-gains” approach focusses on long-term continuity and consequently provides opportunities to help the agricultural sector in the groundwater protection areas in order to transition to an optimised form. Hence, this will likely decrease the impact on the groundwater quality.

Noteworthy in this situation is, that some of the interviewees fear that the voluntary “mutual-gains” measures might not be sufficient enough to bring the groundwater quality to the norms set in the EWFD. The scope rules do not take this possibility of failure into account (Academic expert Wageningen 1, 2018; Academic expert Wageningen 2, 2018; Representative of Drinking water company Vitens).

4.6 Information rules

This group of rules influence the provision of information that is available to the different actors in the action situation. This is based upon the openness of the involved actors in sharing the information. Also, this is based upon how the different actors use this information; what information is shared in what way, and what information matters to whom (Ostrom, 2011)? Important to this element is the focussing on the parties that generate knowledge, since those parties share new information. Three questions were formulated in chapter two to operationalise this rule;

- Which actors are involved in the knowledge generation of suitable measures to optimize farming in groundwater protection areas?
- Which actors have access to this information, and which do not (on what basis)?
- Is there a shared sense of urgency?

Four rules can be distinguished namely; 1) There is weakened sense of urgency due to uncertainty and conflicting interests, 2) The generated knowledge and needed knowledge to implement mutual gains measures is highly complex, and 3) The right transmitter or “medium” has to be used for communication, and 4) There is a need for clarity of responsibilities and restrictions to overcome uncertainty.

Weakened sense of urgency

A sense of urgency exists in the action situation, since the stated norms in the EWFD are to be met before the year 2027 (Unie van Waterschappen, 2008). Several interviewees stated their doubts on the acknowledgements of this sense of urgency by a large part of the agricultural businesses (Academic expert Wageningen 1, 2018; Academic expert Wageningen 2, 2018; Representative of drinking water company Vitens, 2018). The choice of the national government to protect the agricultural market position and not to enforce measures to reach the norms of the EWFD or give other governmental layers the power to do so, has a key role in this. Farmers do not have to take these norms into account (Velthof et. al., 2018). This means that they are likely to perceive are a decreasing need to do so, as the sense of urgency push from the European union is weakened on a national level. The slowness of the system, meaning the long time needed for effects on the groundwater to be measurable, likely decreases the sense of urgency as well (Representative of drinking water company Vitens, 2018).

High complexity impedes diversion of knowledge

Another rule in the action situation is that the generated and needed knowledge is highly complex, primarily on a technical level. This hampers the sharing of this knowledge, and the sharing of results of implemented measures within the agricultural community. This in turn hampers the ability of enticing the non-participating farmers to participate in projects to implement mutual-gains measures; the costs and benefits are not clear because the knowledge related to them is difficult to understand. For the specific action situation this entails that a supporting organisation is needed to make calculations and to translate the knowledge on a project level scale in a way that a participating farmer can understand what the effect of the applied measures would be (Academic expert Wageningen 2, 2018; Cattle farmer 1, 2018; Cattle farmer 2, 2018, Representatives of the Province of Overijssel, 2018).

Using the right medium to improve cooperation

Some interviewees have mentioned that it is very important to find the right medium to communicate with farmers that already are participating in projects to reduce the emission of agricultural chemicals (Academic expert Wageningen 2, 2018, Cattle farmer 1, 2018; Cattle farmer 2, 2018; Representative

of LTO Noord, 2018; Representatives of the Province of Overijssel, 2018). According to the Koninklijk Nederlands Waternetwerk (2016) there is a language barrier between governmental agencies and organisations, and farmers. This language barrier needs to be acknowledged and needs to be considered within the effort of enticing farmers to participate and motivate participants. Out of the interviews no clear “right medium” could be deduced however. Some of the interviewees stated that the farmers who act as frontrunners could do this (Representative of Drinking water company Vitens, 2018; Representative of LTO Noord, 2018), while others said that they might be less inclined to do so since it would take a lot of effort (Academic expert Wageningen 2, 2018, Cattle farmer 1, 2018; Cattle farmer 2, 2018). Other interviewees perceive Wageningen University, the project managers of “Farmers for Drinking Water”, or the Province of Overijssel as suitable mediums (Cattle farmer 1, 2018; Cattle farmer 2, 2018; Representative of Drinking water company Vitens, 2018; Representative of LTO Noord, 2018). It is clear is that there is no single right medium, for the diverse target groups. (Oreszczyn et. al., 2010).

Uncertainty of responsibilities and restrictions

The final rule that can be distinguished related to sharing information is the following: the involved actors are searching for clarity in responsibilities, jurisdictions and restrictions. In short, there is the desire to have clear distinction in those themes. On a national level there is a conflict of interest between protecting the market position of agriculture and on the increasing effort to reach the norms set in the EWFD. The norms are not enclosed in an overarching national policy, yet existing laws and regulations are used as tools to reach them. This spread among policy levels results in fragmentation. Even though the national government made reaching the norms a shared responsibility between all governmental layers, the choice of not directly implementing them in a coherent policy, increased uncertainty about jurisdiction and responsibilities; there is no clear line that the lower governmental layers can follow. This uncertainty a lack of a clear goal likely creates uncertainty for famers about the need to participate in projects like “farmers for drinking water” (Academic expert Wageningen 1, 2018; Velthof et. al., 2018).

Information rules	Explanation
There is an infraction on emphasising the sense of urgency	The sense of urgency generated by the norms in the EWFD are diminished by the national choice to protect the economical position of the agricultural sector, and therefore is not strongly relayed to the farmers.
The generated knowledge and needed knowledge to implement mutual gains measures is highly complex.	As the generated knowledge requires a lot of calculations, both the implementation of the measures and the generated results are difficult to perceive. This means that help of a support provider is necessary to calculate effects and interpreted results.
The right transmitter or “medium” must be used for communication	Farmers might not be willing to listen to each “transmitter of information” in the same way. Therefore, the right person must be found to entice and motivate them.
There is a need for clarity of responsibilities and restrictions to overcome uncertainty	The fragmented implementation of the EWFD generates a lot of uncertainty for the lower governmental layers, and results in the lack of a clear policy goal.

Constraints due to uncertainty and high complexity

The information rules (see table 8) act as restrictions in stimulating the action situation and in stimulating the agricultural sector to transition into an optimisation oriented smart-farming approach. Communication of knowledge is key (Forrester, 1982), since this could stimulate enticing more farmers to participate. However, the technical complexity of the gathered knowledge simultaneously limits this communication of knowledge; help is needed to calculate measures and to show their benefits (Academic expert Wageningen 2, 2018; Cattle farmer 1, 2018; Cattle farmer 2, 2018; Representatives of the Province of Overijssel, 2018). This makes it more difficult to “sell” the measures as an investment to other farmers and makes it more difficult for the Province of Overijssel to justify the effect of the measures taken.

As it appeared based on the interviews, the stimulation of the sense of urgency by the European Union is arguably diminished by the actions of the national government (Academic expert Wageningen 1, 2018), yet still is noticeable; the norms must be met in 2027 (Bij 12, N.d.). The unclarity of responsibilities due to the fragmentation of responsibilities and the protection of the economical agricultural benefits, increase uncertainty about what actions to undertake (Academic expert Wageningen 1, 2018). This hampers the transition from the agricultural sector, as it is unclear how and to what extent the adaption of business practices is needed. Additionally, the sense of urgency is not as strongly perceived as likely is needed (Academic expert Wageningen 1, 2018).

The Province of Overijssel, Vitens and LTO Noord do experience the sense of urgency, because of their responsibilities in the action situation (Representative of Drinking water company Vitens, 2018; Representative of LTO Noord, 2018; Representatives of the Province of Overijssel, 2018). For the national department of the LTO, it was a reason to create their Agricultural Water Management Programme and to sign the sixth nitrate agreement. In this agreement they took responsibility in the effort of decreasing the output of agricultural chemicals to the groundwater supply (Deltaplan agrarisch waterbeheer, 2016; Representative of LTO Noord, 2018). However, the organisations do not share the sense of urgency with the farmers in groundwater protection areas. This became apparent from the interviews. It was mentioned that farmers might perceive relaying this as threats which could decrease the likelihood of them participating in projects like “Farmers for Drinking Water”. Uncertainty about jurisdictions and responsibilities between each actor influences this as well. (Academic expert Wageningen 1, 2018; Representative of LTO Noord, 2018).

The information rule regarding the use of the right medium to communicate is sufficient, albeit that it remains unclear what the right medium is. As explained before in chapter 4.5 no consensus exists on what the right “medium” is, neither with the senders nor the recipients of information. The only similarity between the answers of the different interviewees is that the medium needs to be linked to the process and needs to know both how the linked organisations operate and how agricultural businesses operate (Cattle farmer 1, 2018; Cattle farmer 2, 2018; Oreszczyn et. al., 2010; Representative of LTO Noord, 2018). Therefore, it likely would prove valuable if someone or some organisation filled in the position of networker and facilitator. This function would be linked to the action situation and the corresponding focus would be translation of the gathered knowledge and the communication of information.

4.7 Aggregation rules

Within these rules it is determined who acts as decision-maker in the action situation regarding the deciding which actions and efforts should be made. In this specific action situation, the elements on which must be decided upon are what research to stimulate, which measures to pursue and what measures to apply (Ostrom, 2011). In chapter two, three operationalisation questions were determined, namely;

- Which actors are involved in deciding on which measures are “groundwater proof” or not?
- Which actors are involved in deciding on which research into new measures is to be pursued?
- Which actors decide which of the approved groundwater protection measures are to be implemented on what location or business?

Three aggregation rules can be distinguished based on the analysis of the interviews; 1) Farmers decide to participate or not, 2) The Province of Overijssel and Vitens can choose which research to stimulate or not, restricting it to mutual-gains, and 3) The individual farmers choose which measures to implement.

Decision to participate can only be made by the farmers

As participation is voluntary, farmers decide if they want to participate in projects to implement mutual-gains measures. There are multiple reasons why they might not want to participate, as became apparent from the interviews. A lack of trust in cooperation with the province or other governmental agencies was mentioned. Restrictions in time for participation and money for investments, or a lack of interest could all be reasons to decide not to participate. The voluntary nature of participation gives farmers the right to abstain from involvement in the action situation (Academic expert Wageningen 1, 2018; Academic expert Wageningen 2, 2018, Cattle farmer 1, 2018; Cattle farmer 2, 2018).

The provincial government has power over the decision element in allowing in which areas participation will be stimulated. As described in the preface and the problem statement the focus lies on the groundwater protection areas. This means that farmers who want to participate, yet are located outside of these areas, even if it is on the borders, must appeal to the province to be allowed to participate. In this way the province can control who can participate (Cattle farmer 2, 2018, Provincie Overijssel, 2017).

Decision on what to research to pursue mutual-gains

The organisations that finance the projects decide what is researched, albeit that the researchers have some flexibility as long as the mutual-gains are pursued. This is especially important for the Province of Overijssel and for the drinking water company Vitens, since their main interested is in the results of the measures on the chemical quality of the groundwater (Representative of Drinking water company Vitens, 2018; Representatives of the Province of Overijssel, 2018). As mutual-gains are the goal however, the participating farmers have a significant steering role as well; especially relating to which measures to pursue. If a measure is particularly expensive or difficult to implement, it is unlikely that a large group of farmers implements these. Even if the long-term benefits in the form of continuous gains are high, the likelihood of implementation decreases if the investment costs are high. Relating this to which measures are further pursued in research and implementation, the farmers have decision-making capabilities as well. If they do not want to implement certain measures, they are not enforced to do so (Academic expert Wageningen 2, 2018, Cattle farmer 1, 2018; Cattle farmer 2, 2018).

Decision on what measures to implement can only be made by the farmers

As is elaborated upon in the previous rules, farmers decide upon whether or not they decide to implement certain measures, this gives them a lot of steering power. The fact that the implementation of measures is unenforceable on a provincial governmental level, places the decision-making power of implementing measures with the ones that implement them; the farmers. It is less likely that both costly and difficult measures and innovations are to be implemented by the farmers. The project managers and support providers in the project (such as the Wageningen University) do have some steering power as well because they advise participating farmers in the implementation of certain measures (Academic expert Wageningen 2, 2018, Cattle farmer 1, 2018; Cattle farmer 2, 2018).

Aggregation rules	Explanation
Farmers decide to participate or not	As participation is voluntary, farmers can decide to participate or not.
The stimulated research is restricted to mutual-gains measures	The Province of Overijssel and Vitens as financers of the research decide that the measures that are to be pursued and research should provide a benefit for both the groundwater quality and for the agricultural practice.
The individual farmers choose which measures to implement	As participation is voluntary, the farmers decide which measures they want to implement or not.

Table 9:: Aggregation rules. Source, author

Constraints due to uneven decision-making power and lack of top-down enforcement

The three rules related to aggregation (as featured in table 9) provide some restrictions in relation to the stimulation of the transition into a more optimised form. Since the farmers decide if they want to participate or not, and which measures to implement or not, reaching the goals hinges both on the number of participants and on the effectiveness of the measures those participants are willing to implement. Farmers do get a lot of power in the action situation based on these rules, yet the goal of getting all the farmers that manage their businesses in the groundwater protection areas to transition is less likely to be reached (Academic expert Wageningen 1, 2018).

The aggregation rule regarding the generation of "mutual-gains" does provide opportunities with regard to gaining benefits. These opportunities entail are that the different types of measures do provide an incentive for participation, while it provides a benefit for the quality of the groundwater supply. However, it could be a difficulty because of the possible insufficient nature of these measures. If these types of measures prove to be insufficient with regards to reaching their goals, this aggregation rules impedes research into measures that might provide large benefits for the groundwater quality, yet do not provide benefits (or even result in costs) for agricultural businesses.

4.8 Payoff

The final rules relate to the payoff actors have in the action situation; who benefits and who pays (Ostrom, 2011)? Based on the operationalisation in chapter two, these rules are characterised by four questions:

- What incentives are in place to stimulate agricultural businesses to implement “groundwater proof” measures
- What deterrents are in place to discourage unwanted actions and outcomes?
- What are the costs of implementing optimisation focussed measures in agricultural practices?
- What are the benefits of implementing optimisation focussed measures in agricultural practices?

Three payoff rules in the contemporary action situation can be distinguished; 1) There is a penalty on farmers for participation, in the form of time, costs, and/or image, 2) Benefits of participation are difficult to prove and somewhat uncertain and, 3) The benefits of the mutual-gains are long term due to the “slowness of the system”.

Penalty for participation

For farmers to participate in the action situation, several penalties occur. The first penalty has a financial impact; the measures can require substantial financial investments. Besides this, the implementation of measures is a trial-and-error process which means that it takes time and effort to correctly implement the right measures. Some measures might not be applicable or even might have negative effects on the business practices (Academic expert Wageningen 2, 2018, Cattle farmer 1, 2018; Cattle farmer 2, 2018; Representative of Drinking water company Vitens, 2018). One of the interviewed farmers stated that the applied measures to his agricultural business resulted in a near depletion of his soil. This implied that further measures would damage his business practice, or would need very large investments (Cattle farmer 2, 2018).

Another penalty for participating farmers that emerged from the interviews, is that despite their efforts, the image of farmers still can be influenced negatively. This image should be interpreted as how the participant were perceived in (mostly) the agricultural community and the news outlets. For example, in articles, subjected about nature, biodiversity and water quality degradation, the blame is often placed at the agricultural sector (Academic expert Wageningen 2, 2018, Cattle farmer 1, 2018; Cattle farmer 2, 2018; Representative of LTO Noord, 2018). This possibly results in the unwillingness to participate of farmers, since their image is perceived as negative whether or not they participate and invest time and money in measures to better their practices (Cattle farmer 1, 2018; Cattle farmer 2, 2018). Besides this, the participation of farmers as frontrunners in these projects could be frowned upon by other farmers as well. The interviewee perceived this as: “putting your head out of the parapet” (Cattle farmer 1, 2018). This rise of relational problems within the agricultural community could emerge because of the non-participating farmers. They fear that the voluntarily applied measures implemented by participating farmers might become obligatory if proven to be successful (Academic expert Wageningen 1, 2018; Academic expert Wageningen 2, 2018).

Uncertain and difficult to perceive benefits

In the current situation the farmers benefit the most. They are guided in finding measures and innovations according to the “mutual-gains” principal described earlier (section 4.2). The participants are aided in creating and developing custom measures that improve their business practices towards optimisation. However, a problem with the financial benefits is that a lot of them are uncertain due to

the trial-and-error approach of implementation some measures need; the costs are often more visible than the benefits (academic expert Wageningen 2, 2018; Cattle farmer 1, 2018; Cattle farmer 2, 2018).

In short, the gained benefits of the participating farmers is receiving guidance to find the right measures. Besides this, the farmers also get payoff in the form of an increased understanding of sustainable agricultural practices by participation and increasing knowledge about the nutrient cycle. This can provide incentive for some farmers to participate in projects like “Farmers for Drinking Water” as well, as became evident from interviews with participants. The final benefits these participating farmers perceive is the increase in contact between farmers by the means of the projects: through the project they are enabled to discuss, meet and learn from each other. This is perceived as very valuable by the interviewed farmers, as it provides a stimulant to work together and learn from like-minded people that understand how their businesses operate (Cattle farmer 1, 2018; Cattle farmer 2, 2018).

Time limits the visibility of benefits for groundwater

The mutual-gains approach is beneficial for Vitens and the Province of Overijssel (and to an extent also for the national government), yet these benefits are not yet easily measurable. This is due to the slowness of the system and the high costs of taking measurements to proof the effectiveness of the measures taken (Representative of Drinking water company Vitens, 2018). It takes up to twenty-five years for water that infiltrates in a ground water protection area to reach the extraction site (Digitale richtlijn, 2009). This means that the mutual-gains measures can have a long-term positive effect, yet proving this on a short-term is difficult and costly. A large amount of new measurements would be needed to be able to prove an effect (Representative of Drinking water company Vitens, 2018). Therefore, the benefits for groundwater quality are uncertain. The mutual-gains approach on the voluntarily basis might be sufficient on the long-term if enough farmers participate and the measures prove effective; the benefits for Vitens and the Province of Overijssel hinge on the number of farmers willing to participate and on the effectiveness of the measures the participating farmers are willing to implement.

Payoff rules	Explanation
There is a penalty on farmers for participation	There are multiple penalties for farmers in participating in the projects, related to high investment costs, high costs in time and effort, and costs in a damaged image.
Benefits of participation for farmers are difficult to show and somewhat uncertain	The financial benefits are hard to show due to the trial-and-error way of implementing them, yet there are obvious benefits for farmers to participate in the form of increased knowledge, aid from actors to find the right measures, and in increase collaboration with other farmers.
The benefits of the mutual-gains on groundwater quality are long term due to the slowness of the system	As groundwater flows are relatively slow, the results of the measures will not likely be perceived on a short term, unless high cost measurements are taken.

Table 10: Payoff rules. Source, author

Constraints due to clear costs and unclear benefits

The payoff rules (see table 10) provide restrictions in stimulating the transition towards optimisation-oriented agriculture in groundwater protection areas. There are obvious costs for farmers to participate in projects to reduce groundwater pollution, which decreases the willingness of some farmers to participate. This results in a stagnation of the recruitment of participants and the slowing

down off the transition towards smart-farming. The restrictions are diverse and being categorised in three types; investment costs, investment of time and effort, and damage of image (both internally in the group farmers as external). Besides these restrictions, the influence of the periphery likely impedes the flexibility of farmers to participate as well as stated by some of the interviewees. To further the transition, it is of importance that these costs are removed or at least decreased (Academic expert Wageningen 2, 2018, Cattle farmer 1, 2018; Cattle farmer 2, 2018). This is especially true if participation in the action situation remains voluntary for farmers.

Besides clear costs for participation, another difficulty is formed by the uncertainty of the benefits; the trial-and-error nature of the implementation of the mutual-gains measures creates uncertainty regarding their financial benefits. this forms an obstacle in furthering the action situation. There are benefits for participation in projects like "Farmers for Drinking Water"; in the form of increased understanding of sustainable, continuity-based business operations, and in the form of personal assistance to find custom measures for their farms however. The project-based approach creates an environment in which farmers can find fitting measures to apply on their farms. Furthermore, they receive assistance from external experts to perform calculations. According to two of the interviewees, advertising the benefits more clearly could provide an opportunity for furthering the action situation (Cattle farmer 1, 2018; Cattle farmer 2, 2018).

4.9 Defining the rules, building the framework

In this final paragraph, the rules are combined into the institutional framework. Besides this, the identified constraining and enabling institutional elements are elaborated upon. Enabling elements are considered to provide a possible positive stimulus for the transition towards optimisation. Constraining elements are considered as institutional complications that possibly slow down the transition towards optimisation. The interpretations of the enabling and containing elements, and of the rules from the IAD framework are featured in table 11. In the left column, the rules are categorised in line with Ostrom’s IAD framework. The middle column features the rules in relation to the context of this report. The right column provides the opportunities and restrictions for each of the categorised rules. The action arena is considered the transition towards optimised agriculture in groundwater protection areas in the Province of Overijssel. The implementation of mutual-gains measures through projects like “Farmers for Drinking Water” is instrumental in this action situation.

Type of rules	Rules	Enabling and constraining institutional elements
Position	<ol style="list-style-type: none"> 1. Government acts as stimulator of mutual-gains 2. Farmers in groundwater protection areas are target of the innovation effort 3. Other involved actors act as support provider 	<ul style="list-style-type: none"> • There is no enforcer, which restricts the ability to enforce.
Boundary	<ol style="list-style-type: none"> 1. Landownership 2. Responsibilities related to (the use of) groundwater 3. Jurisdiction 4. Knowledge related to the generation of mutual-gains measures 5. Peripheral influence over agricultural behaviour 	<ul style="list-style-type: none"> • There is an opportunity to increase peripheral involvement more
Choice	<ol style="list-style-type: none"> 1. The norms from the EWFD must be reached 2. Participation of farmers in projects to implement mutual-gains measures needs to be voluntary 3. No direct financial stimulation may be given to farmers 4. Any enforceable restrictions imposed on farmers limiting their emission of chemicals and limiting their growth must be met by them 5. The periphery limits the flexibility of agriculture to participate 	<ul style="list-style-type: none"> • There is no basis for enforcement of restrictive measures. • The periphery impedes flexibility to participate.

Scope	<ol style="list-style-type: none"> 1. Custom measures instead of generic ones (due to physical restrictions) 2. The measures should decrease the outwash of the agricultural chemicals to a level that meets the norms from the EWFD 3. The measures should provide financial benefit for farmers who implement them 4. The measures should ensure long term continuity for both the agricultural practices and for the decreased outwash of agricultural chemicals to the groundwater 5. All farmers in the groundwater protection areas should participate in the action situation 	<ul style="list-style-type: none"> • There is an opportunity to implement long-term, continuity based beneficial mutual-gains measures.
Information	<ol style="list-style-type: none"> 1. There is a weakened sense of urgency 2. generated knowledge is highly complex 3. The right medium of communication must be used 4. Uncertainty due to fragmentation, which must be overcome 	<ul style="list-style-type: none"> • The sense of urgency is impeded by conflicting interests, which restricts the transition. • The high complexity of generated knowledge impedes diversion, which hampers the transition.
Aggregation	<ol style="list-style-type: none"> 1. Farmers decide to participate or not 2. The stimulated research is restricted to mutual-gains measures 3. The individual farmers choose which measures to implement 	<ul style="list-style-type: none"> • The high degree of flexibility makes that both the number of participants and the type of measures implemented are uncertain. This impedes the transition.
Payoff	<ol style="list-style-type: none"> 1. Penalty for participation in cost, time, image 2. Benefits of participation for farmers are difficult to show and somewhat uncertain 3. The benefits of the mutual-gains for the groundwater are long term due to the slowness of the system 	<ul style="list-style-type: none"> • A restriction is formed by the easier perception of farmers of costs, than of benefits of participation.

Table 11: The seven rules, and the related opportunities and restriction. Source, author

5: Conclusion and discussion

In this final chapter the research conducted in this report is reviewed. The main institutional restrictions and opportunities for reaching the goals of the action situation are given, thus answering the main research question:

How do institutional constraints and possibilities influence the transition to smart-farming and agricultural optimisation in groundwater protection areas in the Province of Overijssel?

After answering the main research question, a critical reflection will be given on the used conceptual model and on the research design. After this, some implications for further research are provided, based on deficiencies in information which became apparent while performing this research. After this a reflection is provided on the functioning of the author in the research process.

5.1 Main findings and their implications for planning practice

The IAD framework is operationalised by formulating questions in order to pinpoint both the enabling and constraining institutional rules for the action situation. The primary added value of analysing the case with this theoretical framework is the uncovering of both enabling and constraining institutional elements. Based on the analysis in chapter four, these main enabling and constraining institutional rules can consequently be identified for each rule. These translate into specific points of improvement for the action situation under study. However, in order to generalise for a national governmental context three overarching dilemmas are identified. These dilemmas are: 1) lack of communication, 2) lack of enforcement, and 3) lack of peripheral involvement.

Linked to these dilemmas, concrete contributions can be provided for planning practice. It is necessary to acknowledge that actions have to be taken on multiple different scale levels, due to the fact that the action-situation is influenced by multiple governmental layers; it is multi scalar. This encloses the regional scale, provincial scale, national scale and finally the supra-national scale (European Union). Within this multi-scalar context, three concrete steps can be distinguished that should be undertaken if the innovation effort is ought to be stimulated. 1) The role of communicator and facilitator has to be filled, 2) enforcement has to be enabled, and 3) peripheral involvement has to be stimulated. These steps are described in relation to the dilemmas.

Lack of communication

Firstly, as became apparent from the analysis conducted in chapter four and five, a communicator and facilitator in the process is missing. This results in uncertainty and a lack of communication of both knowledge and information. Especially in the contemporary situation where participation is voluntary and farmers need to be enticed to participate, it is key that someone focusses on the flow of information and on building trust. The tasks of the communicator and/or facilitator (if this position would be created), would be to communicate clearly about benefits of participation and about the responsibilities. Clear communication of benefits is especially important since the costs for transitioning in time, effort, and investments are significant for farmers.

The slowness of the system of water infiltration in the groundwater hampers the development of a strong sense of urgency. Allowing the sense of urgency from the EWFD to be diminished on a national governmental level has a negative influence as well; it must be emphasised instead. This could result in a heightened sense of urgency in the agricultural community, since the need to implement innovations to reach the set norms would become more apparent. This possibly decreases the perception of the considerable expense of participation and could enforce the benefits. Focussing on

the context of the case study, this could increase the willingness to participate in projects to transition to a more optimised oriented farming approach by the means of the mutual-gains measures. These types of measures provide benefits in collaboratively finding custom measures for agricultural business, with professional support for calculations and research of measures and.

Lack of enforcement

Secondly, there is a lack of both enforcement and of someone to enforce (enforcer). While the voluntary mutual-gains approach may provide incentives for farmers that are open for participation to participate in projects like “Farmers for Drinking Water”, yet farmers that are more difficult to entice will be much less likely to be attracted. Besides providing rewards for participation, it is necessary to be able to penalise negative behaviour. In the contemporary situation this is not possible due to the protection of the free-market position of the agricultural sector on the food market on a national level. Furthermore, fragmentation of responsibilities and jurisdiction are playing a role in this. However, enforcement is a necessity if all farmers in the action situation are to be involved, even the ones that are not willing to participate. Because participation in projects like “Farmers for Drinking Water” and implementation of measures is completely voluntary in current situation, the success of the mutual-gains approach hinges on participation. This remains an uncertainty.

Lack of peripheral involvement

Thirdly, the agricultural periphery needs to be more involved in the action situation. These chain partners can place restrictions on the flexibility of farmers. Therefore, it is key to deliberate with them; what is needed to gain more flexibility for the farmers? The periphery is a heterogeneous group with various approaches and scale of practice. The periphery is categorised as; agricultural support (primarily contractors) suppliers (fodder companies for example), produce buyers (Friesland Campina as example) and financiers (Rabobank as example), as described in chapter 4.3. Advisory and representative organisations like the LTO also could be categorised as a part of the agricultural periphery. Furthermore, this diversity is transparent in the effect each partner has on the agricultural community: each partner can influence farmers. this influence can differ from economic to practical business operation. That a strong influence exists needs to be acknowledged to be able to overcome the flexibility restraints for farmers to transition to an optimised focussed agricultural practice. Therefore, finding a way to mobilise the periphery provides an opportunity in furthering the transition.

5.2 Reflecting on the conceptual model and research design

The method of research is an instrumental case study in this report. While this allowed for an in-depth analysis of the context which is helpful in unearthing the formal and informal institutions in play, it made making generalisations more challenging. This is the case due to the context specific nature of the findings. To strengthen the generalisations, analysing multiple cases and comparing their contexts proves valuable. The outcomes of the research conducted in this report should therefore be treated as a description on how this specific context works, and as hypotheses on how the general structure of comparable action situations functions in similar contexts.

Focussing on the theories used: There were benefits of using the IAD framework as a basis for the analysis conducted in this report. The framework allows for a systematic analysis of institutional constraints that otherwise are less likely to be uncovered, especially informal institutions. The situation would be at risk to become a “tragedy of the commons” if no rules were presented, which is exactly the purpose of the IAD framework. Analysing the situation by the means of the seven rules provided in the IAD framework allowed for a more in-depth specification on which institutional elements were

enough or would lead to conflicts if the situation were to change. In other words, the IAD framework allows the researcher to highlight which institutional elements are enough, insufficient or provide opportunities. Besides this, the seven rules of the framework help in structuring the gathered information which has proven to be helpful in analysing the information.

However, as is one of the goals in applying an instrumental case study, some points of improvement are identified. The first point of improvement is that the theory does not take the factor time in account, which is important in this case since it relates to a transition. Besides this the theory interprets an action situation as a primarily self-organising structure. Thirdly, external factors and influences are not specifically incorporated in the model, while they have a considerable influence in the action under research in this report. Agriculture as a system is nested in many other systems which have considerable influence on its operation. Examples of these external factors are the influence of the agricultural periphery and of notational and supra-national policies. A final point of improvement of the IAD Framework, is that the rules need to be treated as separate from each other, while some strong links or even overlap can exist between them. In other words, while the rules do provide structure, they sometimes force strongly interlinked institutional elements to be describes separately or force an overlap in descriptions.

To deal with the shortcomings of the method, two suggestions can be made. Firstly, external influences could be incorporated in the model via the choice rule (as is done in this report). These influence namely often place external restrictions on the behaviour of actors in the action situation. Secondly, overlap can be minimised through specific operationalisations per rules in questions. This helps in structuring the gathered data into answers to these questions. Creating a code tree (Appendix I) has proven to be helpful as well and thus is recommendable.

The IAD framework functioned as a suitable basis for the research, despite the described shortcomings. The inherent complexity of the action situation because of mixed and conflicting interests and its interconnectedness with other systems, made using the framework a valuable tool. The method proved valuable in structuring the research and in defining the different formal and informal institutional elements of the action situation.

In reflection upon the outcomes, the author argues that the gained outcomes are realistic. This is due to the empirical nature of the gathering of data. By the means of semi-structured interviews the interviewees were able to provide additional insights to the subject. Due to the unbiased nature of data gathering, the results are trustworthy and therefore realistic. From the gathered data, new insights occurred. However, the previous argument can be considered as a double-edged argument. This is because of weaknesses that occurred in the data collection. Hereby is meant that a portion of a group is representing its entirety. Two farmers were interviewed as gatekeepers for their community: the provided information is treated as representative for the entire group of farmers. Please note, this is only valid for the groundwater protection areas in Overijssel. The interviewed farmers are considered gatekeepers, due to the extensive nature of their knowledge. This is with regards to the specific context of the action situation. Hence, there occurred overlap between the information provided by the farmers in relation to the rules of the IAD framework and the other interviewees. Especially, the different approaches to the implementations of innovations seems to exist between the involved farmers and the organisations regarding the main rules and dilemmas. However, due to the diversity of farmers within the group, differences in perspectives could possibly occur. Additional data could be gathered within the group of farmers to strengthen the validity of this element of the analysis. The type of agricultural business, and whether or not the respondent participates could support the sampling of additional respondents (note, only farmers within the action situation should be recruited). Another consideration in relation to the outcomes is about the used research method.

Instead of a qualitative approach, a quantitative approach can be applied to the action situation in regards to data gathering within the agricultural community. The advisable method would entail the distribution of a questionnaire that is based on the specific interpretations of the rules and the institutional dilemmas within the IAD framework. Due to the closed-ended nature of questionnaires, the results are less likely to be placed within someone's own interpretation. Consequently, the collected data could be generalised more easily if this quantitative data collection method is used.

5.3 Suggestions for future research

Implications for future research are provided in this paragraph. The aim of this report is to identify the institutional difficulties and possible opportunities through Ostrom's IAD framework. Consequently, no concrete steps of action are provided. Therefore, it is suggested to research concrete steps to overcome the identified difficulties. The three identified problems can act as a starting point for future research.

As an in-depth description of the external influences on the action situation fell out of the scope of the research, the specific role of the diverse chain partners in the agricultural periphery on the action situation is not thoroughly researched. Therefore, a suggestion for future research is conducting an in-depth analysis of the influence the agricultural periphery has. This influence can be researched in relation to agricultural behaviour in transition. Another suggestion for future research relates to one of the main findings of the analysis conducted in this report; filling the role of communicator and facilitator. Even though the analysis provided grounds for suggesting the creation of this position in the action situation, it did not make clear which organisation or person would be most suitable to fill this position. Research could be conducted into which actor would be best equipped to fill the role based on the availability of resources in the form of a network and based on acceptance of the agricultural community.

5.4 Reflection on process

While conducting the research some elements developed more desirable than others. For instance, one element that went well was the arrangement of the meetings with the supervisors. Other positive developments were: establishing the operationalisation of Ostrom's IAD framework, and structuring the report. The meetings were well prepared due to the pre-established themes that acted as guidelines during the interviews. Therefore, these meetings yielded valuable information and guidance on the elements that provided difficulties. Besides this, a summary was made after each meeting. This summary focussed on the discussed action points. These action points were used as a guideline in order to develop the process of this report. Furthermore, these points were agenda points for the following meeting(s). Especially the operationalisation of the IAD framework went well, because multiple interpretations of the framework were consulted. Besides this, feedback was asked when rules remained unclear. This process resulted in the presented operationalisation in the report. Structuring the report developed effectively, because developing a clear structure was the first step before the formulation of each chapter. Besides this, the structure's refinement was a continuous process throughout the development of this report.

In hindsight, two elements of improvement can be identified. The first element of improvement is the way of conducting the interviews. A substantial part of the interviews is conducted by telephone rather than face-to-face. Albeit that this arguably does not have a significant effect on the validity of the gathered data, face-to-face interviewing would have been preferred in most situations. This is due to the personal setting of a face-to-face interview. It is more likely that the interviewee shares additional information. This can be improved by contacting possible interviewees earlier in the research process. The second element of improvement is providing more information with regards to the data

management. For the author, this entails to be more transparent to the interviewee with regards to their conducted interview(s). This is mostly concerning the storage and processing of the gathered data. Unclarities could result in frictions, which are avoidable if the author provides more clarity.

Summary

The transition from a maximisation oriented agricultural practice towards an optimisation oriented agricultural practice can also be defined as a transition to smart-farming. This means that despite the pursuing of maximal production, the amount of chemicals and fertilisers is minimized to reduce economic costs and environmental pollution. This is particularly relevant for groundwater protection areas, because pollution in the groundwater supply could negatively affect the drinking water.

The Provinces are responsible for the protection of the groundwater quality by the means of Water Law. It is in the interest of the Provinces to stimulate the transition towards smart-farming and an optimized practice, because it is likely that this decreases the amount of agricultural chemicals infiltrating into the groundwater. An additional incentive for the Provinces to stimulate the transition is the EWFD, which is a policy of the European union in which the norms to improve groundwater quality and groundwater quantity have been set. These norms must be met in 2027 (Unie van Waterschappen, 2008). Consistent to this, the Province of Overijssel stimulates farmers to participate in projects to reduce their outflow of chemicals, while optimising their business practices; a mutual-gains approach. While recruiting participants went well at the start of the projects, the number of new participants joining is not going as fast as was hoped for.

In this report an analysis is made of the institutional situation, to determine institutional opportunities and restrictions. These restrictions might be the cause of the stagnation of new participants in the projects. This is researched by conducting semi-structured interviews with interviewees that are involved with one of the projects in the Province of Overijssel: 'Farmers for Drinking Water'. The analysis is based upon the IAD framework. The IAD framework consists of seven rules that influence the institutional framework for the situation; the action-situation. These rules are the; position rules, boundary rules, choice rules, scope rules, information rules, aggregation rules and payoff rules. These rules form a framework restricting on what grounds actors are present in the action situation, how they can enter or leave, which responsibilities and restrictions they have, what outcomes are wanted, how information is shared, who can make decisions and who pays or benefits.

The findings of the analysis reveal that the transition to agricultural optimisation is obstructed within the following rules: position rules, choice rules, information rules, aggregation rules and payoff rules. Within these rules, three overarching institutional hurdles have been identified that hamper the transition towards smart-farming. Firstly, there are difficulties in communication. For the farmers, the necessary investments are clearly definable: economic investments, time and effort investments and image damage within (mostly) the agricultural community. However, the benefits are unclear due to a weak communication and a weakened sense of urgency. High technical complexity of measures does have an influence in this as well. The benefits could be explained more clearly as an opportunity to collaboratively find custom measures with professional support.

Secondly, there is a lack of enforcement and of the possibility to enforce. Since the position of agriculture on the food-market is protected on a national governmental level, the provinces lack jurisdiction to enforce measures. In the researched case this protection on a national level restricts the measures the Province of Overijssel can take. The measure that the Province has taken to stimulate farmers to participate in projects is to reward participants by the means of indirect incentives. These incentives are indirect because direct financial incentives are considered state support and is not allowed. The stimulation of participation results in the mutual-gains approach.

Thirdly and final, the agricultural chain partners are almost not involved in the action situation while they do have a considerable influence on agricultural behaviour. The diverse chain-partners in this group limit the flexibility of farmers in choosing to participate or not. Even though the periphery is

diverse (from contract worker to buyer of produce) and thus is the influence its different members can have on furthering the transition, increased involvement could aid the transition towards optimized agriculture. However additional researched is needed to thoroughly explain the role of the diverse chain partners in the transition.

Nederlandse samenvatting

De transitie van de op maximale productie georiënteerde agricultuur naar geoptimaliseerde agricultuur, kan ook worden gedefinieerd als “smart-farming”. Dit betekent dat het economische voordeel wordt gemaximaliseerd door een maximale oogst te realiseren met minimale toepassing van landbouwchemicaliën. Naast de verminderde kosten voor de boer, vermindert hierdoor de emissie van chemicaliën naar het grondwater. Dit is zeker van belang voor grondwaterbeschermingsgebieden, omdat het grondwater hier bestemd is voor drinkwaterwinning.

De provincies zijn verantwoordelijk voor de grondwaterkwaliteit via de drinkwaterwet. Hierdoor is de transitie naar geoptimaliseerde landbouw in hun belang. Een extra reden voor de provincies om de kwaliteit van het grondwater te verbeteren is de druk vanuit de Europese Unie. In de Europese kaderrichtlijn Water zijn chemische normen voor het grondwater opgesteld, die in 2027 behaald moeten zijn. Om deze redenen stimuleert de Provincie Overijssel boeren om te participeren in projecten om te innoveren. Deze innovaties moeten de boeren helpen in de transitie naar “smart-farming” door een vermindering van de verspilling van landbouwchemicaliën. Dit wordt door de provincie “mutual-gains” maatregelen genoemd, omdat er economisch voordeel is voor de participerende boer en voordelen zijn voor de kwaliteit van grondwaterkwaliteit. Ondanks dat er aan de start van de projecten voldoende boeren wilden participeren, blijkt de aanwas van nieuwe participanten minder snel te verlopen dan gehoopt.

In dit rapport is een analyse uitgevoerd naar de institutionele situatie, om mogelijkheden en beperkingen voor de transitie naar geoptimaliseerde landbouw te achterhalen. Dit onderzoek is uitgevoerd aan de hand van semigestructureerde interviews met de betrokken partijen binnen het project “Boeren voor Drinkwater”. De analyse is gebaseerd op het IAD framework, welke bestaat uit zeven regels. Dit zijn de; position rules, boundary rules, choice rules, scope rules, information rules, aggregation rules en payoff rules. Deze regels vormen samen het institutionele kader, welke binnen de IAD framework theorie de “action-situation” wordt genoemd. De regels hebben betrekking op; de positie van actoren, hun mogelijkheden om betrokken te zijn of niet, hun beperkingen en verantwoordelijkheden, de doelen die ze hebben gerelateerd aan de genomen acties, de beschikbaarheid van informatie, de mogelijkheid om beslissingen te nemen, en de voor- en nadelen van acties.

De uitkomsten van de analyse maken inzichtelijk dat er binnen vijf van de zeven institutionele regels van het IAD Framework belemmeringen zijn voor de transitie naar geoptimaliseerde landbouw. Dit zijn: de position rules, choice rules, information rules, aggregation rules and payoff rules. Er kunnen drie conclusies worden getrokken aan de hand van de belemmeringen binnen deze regels. In de eerste plaats is er een probleem met betrekking tot communicatie. De kosten voor de boer zijn zichtbaarder dan de voordelen. Dit komt vooral doordat de voordelen onvoldoende worden gecommuniceerd en omdat dat er onvoldoende druk wordt ervaren om te optimaliseren. Hiernaast zijn de maatregelen vaak technisch ingewikkeld, wat het moeilijk maakt om de voordelen te communiceren. De voordelen zouden sterker gecommuniceerd kunnen worden als een mogelijkheid om gezamenlijk met andere boeren maatwerkoplossingen voor bedrijven te onderzoeken. Hierbij is professionele steun aanwezig.

Ten tweede zijn er nauwelijks mogelijkheden om dwingende maatregelen te stellen, omdat er geen partij is die deze handhaaft. Het landsbelang om de marktpositie van de boeren te beschermen beperkt de mate waarin de provincies maatregelen af kunnen dwingen. Deze nationale restricties beperken de mogelijke maatregelen die de Provincie Overijssel kan nemen. De maatregelen die de provincie nu neemt zijn gericht op indirect stimulatie (door middel van financiële middelen) met betrekking de participanten. Dit is het geval, omdat directe financiële stimulatie niet mogelijk is, aangezien dit kan

worden geïnterpreteerd als staatssteun. Deze participatiestimulering leidt tot de “mutual-gains” aanpak.

Ten slotte worden de organisaties uit de agrarische keten onvoldoende betrokken bij de transitie, ondanks de grote invloed die ze uitoefenen. De flexibiliteit die boeren ervaren om te kunnen participeren in mutual-gains projecten wordt waarschijnlijk geremd door de diverse ketenpartners. Door de organisaties uit de keten te betrekken zou in overleg naar oplossingen kunnen worden gezocht om de flexibiliteit om te participeren te vergroten (of zelfs te stimuleren). Hoe dit zou kunnen worden uitgevoerd is echter een aanbeveling voor vervolgonderzoek. De mogelijke diversiteit aan invloed die de verschillende ketenpartners hebben (van loonwerker tot productopkopers en voederbedrijven) moet beter worden onderzocht voordat er concrete aanbevelingen kunnen worden gedaan.

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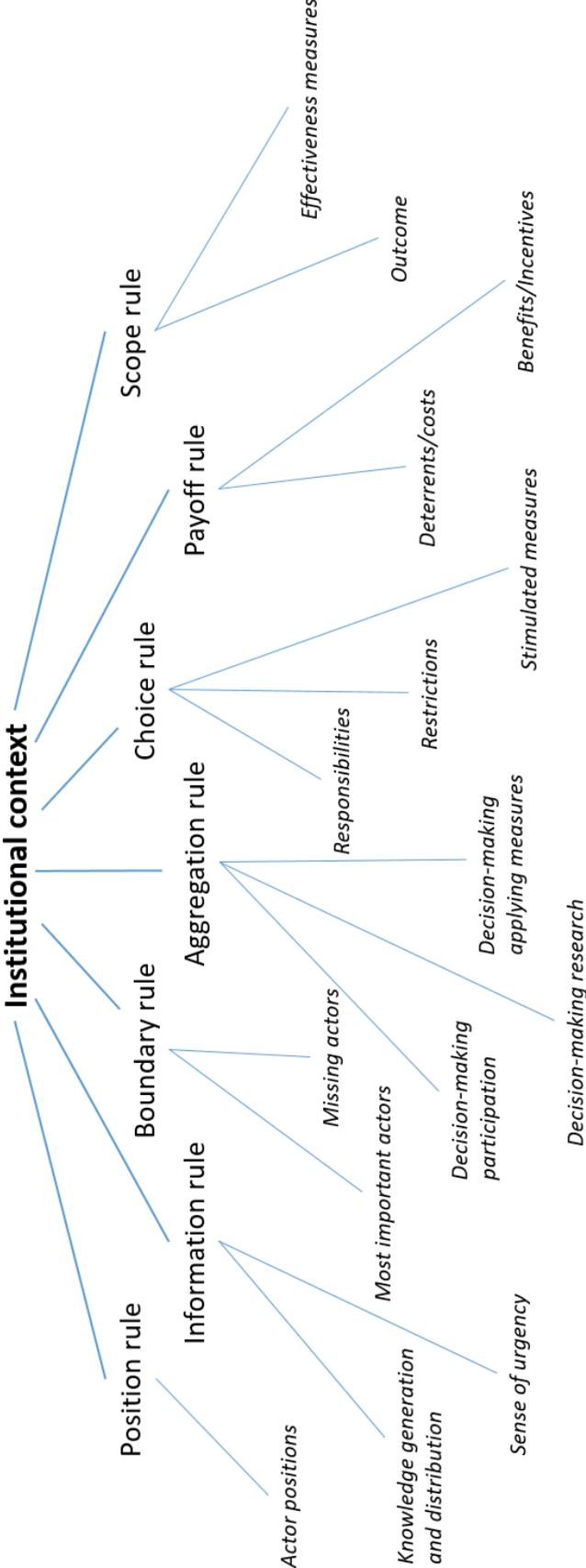
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Appendix I: Code tree



Appendix II: Academic literature database

• Literature document	Key concepts used	Used for
Adam C., Hurka S., Knill C (2017). Four Styles of Regulation and their Implications for Comparative Policy Analysis, <i>Journal of Comparative Policy Analysis: Research and Practice</i> , 19:4, 327-344	Regulation types, government approaches	Sub-question 4: explanation of government approach in position rule
Flyvbjerg, B. (2006). Five misunderstandings about case-study research. <i>Qualitative Inquiry</i> , 12 (2), 219-242	Case study methodology, exemplification	Methodology
Forester J (1982). Planning in the Face of Power, <i>Journal of the American Planning Association</i> , 48 (1), 67-80	Importance of knowledge sharing, knowledge is power	Sub-question 2: operationalising information rule in the IAD framework
Hall, P. A., Taylor, R. C. (1996). Political science and the three new institutionalisms. <i>Political studies</i> , 44(5), 936-957.	Historical institutional approach, path-dependency	Introduction, Sub-question 1: framing the research, defining the context
Helmke G., Levitsky S. (2004). Informal institutions and comparative politics: a research agenda, <i>Perspectives on Politics</i> , 2(4), 725-734	Formal institutions, informal institutions	Sub-question 1: framing the research, defining the context and institutions
Hijdra, A., Woltjer, J., Arts, J. (2015). Troubled Waters: An institutional analysis of ageing Dutch and American waterway infrastructure. <i>Transport Policy</i> , (42), 64-74.	IAD framework	Sub-question 2: operationalising the IAD framework
Hodgeson (2006). What are Institutions? <i>Journal of Economic Issues</i> , 40 (1), 1-25	Formal institutions, informal institutions	Sub-question 1: framing the research, defining the context and institutions
Koppenjan J., Groenewegen J. (2005). Institutional design for complex technological Systems. <i>International Journal of Technology, Policy and Management</i> , 5(3), 240-257	Formal institutional design	Sub-question 1: framing the research, defining the context and institutions
Lane M.B., McDonald G. (2005). Community-based Environmental Planning; Operational Dilemmas, Planning Principles and Possible Remedies. <i>Journal of Environmental planning and management</i> . 48 (5), 709-731	Transparency, information sharing	Sub-question 2: operationalising information rule in the IAD framework

Li R., van den Brink M., Woltjer J. (2016). Rules for the governance of coastal and marine ecosystem services: An evaluative framework based on the IAD framework. <i>Land Use Policy</i> . 59, 298-309	IAD framework	Sub-question 2: operationalising the IAD framework
Loorbach, D. (2010). Transition management for sustainable development: a prescriptive, complexity-based governance framework. <i>Governance</i> . 23(1), 161-183.	Transition theory, S-curve	Sub-question 1: framing the research, defining the context
Oreszczyn S., Lane A., Carr s. (2010). The role of networks of practice and webs of influencers on farmers' engagement with and learning about agricultural innovations. <i>Journal of Rural Studies</i> . 26, 404-417	Communication with farmers	Sub-question 4: Analysis of the information rules
Ostrom E., (2011). Background on the institutional analysis and development framework. <i>Policy Studies Journal</i> . 39 (1), 7-27	IAD framework	Sub-question 2: operationalising the IAD framework
Ostrom E., Basurto X. (2011). Crafting analytical tools to study institutional change. <i>Journal of Institutional Economics</i> . 7 (3), 317-343	IAD framework, Tragedy of the commons	Sub-question 2: operationalising the IAD framework
Van der Brugge, R., Rotmans, J. & Loorbach, D. (2005). The transition in Dutch water management. <i>Regional Environmental Change</i> , 5(4), 164-176	Transition theory, S-curve	Sub-question 1: framing the research, defining the context

Appendix III: Policy database

Policy document	Used for
Deltaplan agrarisch waterbeheer (2013). Deltaplan Agrarisch Waterbeheer. LTO Nederland, Den Haag	Defining policy approaches LTO
European Commission (2008). Groundwater Protection in Europe; the new groundwater directive, consolidating the EU regulatory Framework. European Commission , Brussels	Defining European policy approach
Freriks A., Keessen A., Korsse D., van Rijswick M., Bastmeijer K. (2016). Zover het eigen instrumentarium rijkt; Een onderzoek naar de positie van de Provincie Noord-Brabant en de Noord-Brabantse waterschappen bij de realisatie van Kaderrichtlijn waterdoelstellingen, met bijzondere aandacht voor de omgevingswet; Onderzoek in opdracht van de Provincie Noord-Brabant en de Noord-Brabantse waterschapbond. Universiteit Utrecht/Universiteit van Tilburg, Utrecht/Tilburg	Defining jurisdiction possibilities for the lower governmental layers
Kloosterman R. (2016). Veerkrachtig vooruit Langetermijnvisie op onze infrastructuur 2016-2040. Vitens, Zwolle	Defining policy approach Vitens
Ministerie van Infrastructuur en Milieu (2012) Werkprogramma Stroomgebiedbeheerplannen 2015. Ministerie van Infrastructuur en Milieu, Den Haag	Defining national governmental policy approach
Van den Brink C., van Grootheest J.H., Hans I., van Lienden A.R., Steinweg C. (2010). Gebiedsdossiers drinkwaterwinningen Overijssel; Deel 2: Witharen. Provincie Overijssel, Overijssel	Defining provincial policy approach (this document was used as an example for all other "gebiedsdossiers drinkwaterwinningen " for the 22 drinking water-collection areas in the province
Van Vugt A.C., Phernambucq I., Biesheuvel A., Pompe L., Klijn R., van Lienden A.R. (2017). Gebiedsdossiers drinkwaterwinningen Overijssel Deel 2: Gebiedsdossier Nijverdalen. Provincie Overijssel, Zwolle	Defining provincial policy approach (this document was used as an example for all other "gebiedsdossiers drinkwaterwinningen " for the 22 drinking water-collection areas in the province
Velthof G.L., Kistenkas F.H., Groenendijk P., van Boekel E.M.P.M., Oenema O. (2018). Wettelijk instrumentarium voor landbouwmaatregelen om waterkwaliteit te verbeteren; Realisatie van nutriënten doelstellingen uit de Kaderrichtlijn Water. Wageningen University and Research, Wageningen	Defining jurisdiction possibilities for the lower governmental layers, focussing on the provincial capabilities to adjust their policy and on the role of the national government.

Appendix IV: outcome analysis interview data using Atlas Ti.

Document Group	Codes	Code	Times mentioned	Comments
Position rule	1	Actor positions	23	Support by the means of investments and knowledge, hindrance, governance, frontrunners, other farmers, networker, project team
Information rule	2	Knowledge generation and distribution	13	scrum sessions, contact between farmers is used. Some of the information is very difficult however, and it is difficult to share and carry out to other potential participants. Frontrunners or other "right" mediums like local leaders have to be found to do this. personal approach is of importance
		Sense of Urgency	13	Slowness of the system, conflicts of interest at national level results in uncertainty. End of pipe solutions for Vitens are always possible (yet not in line with EWFD). Political choices are necessary. Unwillingness and mistrust may hamper it. LTO has a positive effect however, since the programme creates a push from within the sector (primarily for LTO members however). There is a huge need for clarity.
Boundary rule	2	Missing actors	10	Missing actors are primarily the periphery, and to some extent the water boards and municipalities as well (albeit that those two are under discussion) local leaders to carry the attempt
		Most important actors	7	Most important are: Farmers, Wageningen, Vitens and the Province, Countus, LTO
Aggregation rule	3	Decision-making applying measures	5	Farmers decide which measures to apply, as participation is voluntary
		Decision-making participation	12	Farmers decide participate or not to participate. Knowledge generation, interest, a sense of urgency and continuity based financial gain are the most mentioned reasons to participate, a lack of trust, lack of a clear goal, lack of insight in the profits of participation, hindrances of the periphery and uncertainty about applicability of the measures (are they cost-effective) are reasons not to participate. Negative framing also plays a large role.
		Decision-making research	4	the Province of Overijssel and Vitens influence what to research by the means of financing for mutual-gains measures. Wageningen (and other research institutes) can influence which research too pursue as well, since they perform the research. Farmers influence this as well
Choice rule	3	Responsibilities	12	Reaching the norms, the province has to find out how in a fragmented policy and jurisdiction landscape. Vitens needs to deliver clean drinkable water. LTO stimulates participation. Province could be more of a

				facilitator. National government doesn't enforce. Farmers need to comply to the fragmented policies and have inherent restrictions due to location.
		Restrictions	42	Farmers need to comply to the fragmented policies and have inherent restrictions due to location; even within the Province of Overijssel. Generic approach to a complex problem with environmental norms. Slowness of the system. Can't enforce farmers to participate. can't provide state support. LTO has difficulties to set out a line, since it is a representative of the collective. State has to balance environmental protection and agricultural protection. There is unwillingness to participate, due to time and costs and actors blaming them.
		Stimulated measures	5	Reducing pollution is in line with the WFD, Mutual-gains. Voluntary as long as possible, yet obligations might become necessary to make the painful decisions if the voluntary basis is insufficient.
Payoff rule	2	Benefits/incentives	16	Mutual-gains approach; knowledge expansion continuity in financial gain, efficient farming, incentives from the periphery and chain partners, cleaner groundwater (so reduced cost for Vitens) Bottom-up, voluntary approach. Contact between farmers is seen as a gain by participants.
		Deterrents/costs	24	Possible ineffectiveness of measures (either for problem or for business, uncertainty. Slowness of results occurring due to systems slowness, costly measures (beyond mutual-gains). Steps are generally easy to make though. Strong need for custom approaches. Implementation costs time, and money. Periphery is currently a hinderance for the most part. effectiveness is difficult to measure.
Scope rule	2	Effectiveness measures	1	If all farmers apply measures, they are sufficient (probably), yet again this hinges on participation. Compulsory participation might be necessary in the long run if the "easy pickings" are used up.
		Outcome	15	Sustainable agriculture as an optimized, continuity focussed way of practice. Generic approaches where possible, with custom approaches where needed. A clear line from national government down, perhaps with obligations for the uncooperative farmers (yet voluntarily should be the first approach, and participants should be exempted from having to apply these obligatory measures if they can show the emission is up to par). Win-win approach, and less sectoral, yet integrally focussed on quantity and quality of water.