



Master thesis on

Building consensus in a complex multi-actor setting between the agriculture and water sector

Reaching mutual gains, decreasing pressure on groundwater and improving livelihood of farmers.

By Elsa Stetinger





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Carl von Ossietzky Universität Oldenburg, Germany
Faculty of Mathematics and Natural Sciences

Environmental and Infrastructure Planning
Rijksuniversiteit Groningen, the Netherlands
Faculty of Spatial Sciences

Building consensus in a complex multi-actor setting between the
agriculture sector and the water sector.

Reaching mutual gains, decreasing pressure on groundwater and improving the livelihood of
farmers

STUDENT	Elsa Stetinger (elsa.stetinger@gmail.com)
STUDENTNUMBER	3260917 (Groningen) & 3322577 (Oldenburg)
SUPERVISOR	Dr. Elen-Maarja Trel
2nd READER	Ina Horlings
DATE	August 2017



District of Oldenburg (picture by author, 2017)

Abstract

Groundwater is contaminated with nitrate in many parts of Lower Saxony in Germany (NLWKN, 2015). In 45% of the groundwater measurement points, the limited value of 50mg/l nitrate in groundwater is exceeded (NLWKN, 2015; European Commission, 2015). Nitrates, among other substances, are released into the groundwater by means of agriculture land-use, and are the resulting nitrogen surpluses from manure and mineral fertilizers (NMU, 2016; BMEL, 2017a). Nevertheless, agriculture is highly essential for food production. In turn, agriculture requires a high amount of water for irrigation and has a problematic impact on groundwater and therefore on drinking water quality (NLWKN, 2015). Based on this fact, theory on *sustainable agriculture* is examined to find out how the impact on groundwater quality can be reduced.

Due to divergent interests between the water sector and agriculture sector, a high conflict potential arises. Thus, this research explores the interdependencies between the agriculture and water sector with the help of actor mapping method. The different positions, diverse perceptions, conflict of interests and mutual interests, values, measures, incentives and communication processes of the water sector and agriculture sector with regards to prevention of further groundwater contamination while focusing on farmer's livelihood are analysed based on the mutual gains approach. Because of this, theories on *actor-mapping* and *mutual-gains* are considered as fundamental for the analysis. Moreover, this research aims to find out how mutual gains can be reached in a multi-actor setting and how consensus can be built between the agriculture and water sector so that pressure on the groundwater quality can be decreased and the livelihood of farmers can be improved. The last key theory on *consensus-building* is used to elaborate how mutual interests and shared values between both sectors can be effectively merged. The findings of this research indicate that an effective cooperative or collaborative planning approach between both sectors can lead to sustainable agriculture practices that are protective to groundwater quality.

Key words: groundwater contamination, sustainable agriculture, actor mapping, mutual gains, consensus building, cooperative / collaborative planning approach.

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List of Abbreviations and translations

BfG	Bundesanstalt für Gewässerkunde	Federal Institute for Water Sciences
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe	Federal Institute for Geosciences and Natural Resources
BMEL	Bundesministerium für Ernährung und Landwirtschaft	Federal Ministry of Food and Agriculture
BMUB / BMU	Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
DVS	Deutsche Vernetzungsstelle Ländliche Räume	German networking site Rural areas
EU	Europäische Union	European Union
LV e.V.	Landvolk e.V.	Community of rural population
LWK	Landwirtschaftskammer	Agriculture chamber
ML	Beirat für Nachwachsende Rohstoffe am Niedersächsischen Ministerium für den ländlichen Raum, Ernährung, Landwirtschaft und Verbraucherschutz	Advisory Board for Renewable Resources at the Lower Saxony Ministry of Agriculture, Food, Agriculture and Consumer Protection
NLWKN	Niedersächsische Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz	Lower Saxony Water Management, Coastal Defence and Nature Conservation Agency
NMU	Niedersächsisches Ministerium für Umwelt, Energie und Klimaschutz	Lower Saxony Ministry for the Environment, Energy and Climate Protection
OOWV	Oldenburgisch-Ostfriesischen Wasserverband	Oldenburg - East-Frisia Water supply company
UBA	Umweltbundesamt	Federal Environmental Ministry
UNDP	Entwicklungsprogramm der Vereinten Nationen	United Nations development programme
WVT e.V.	Wasserverbandstag e.V.	Water association

1. Introduction

Groundwater is one of the most vital and indispensable assets for the society in Germany. 60-70% of drinking water is extracted from groundwater whereas the remaining is generated from surface and spring water (BGR, 2017; BMU, 2008). Intensive agriculture activities result in nitrate pollution in groundwater, damaging the quality of drinking water (NMU, 2016). Fertilizers used in agriculture are regarded as necessary for crop production, but nitrogen seeps through the soil into the groundwater, making groundwater contamination to an irreversible problem for various actors holding the interest of providing clean and healthy drinking water to the society as in this case study in Lower Saxony in the district of Oldenburg (NLWKN, 2015; Water board Peine, 2015). In recent years, high nitrate values have been frequently measured in groundwater in various locations across the federal state of Lower Saxony in Germany as in this case in the district of Oldenburg (NLWKN, 2015; BMUB, 2017). Recent research and statistics have shown that Lower Saxony demonstrates the highest and most expanded nitrate pollution in groundwater of all sixteen federal states across Germany (BfG, 2010). Previous assessments demonstrate that 205 out of the 1134 measurement points in Lower Saxony exceed the allowed nitrate value of 50 mg/l (NLWKN, 2012; European Commission, 2012).

In the future, a further increase of nitrate in groundwater is expected in further exceeding of limited values. One reason why such an increase of nitrate in groundwater could be expected is because of the contradictory interests and priorities of actors of the agriculture sector in providing food and water sector in providing drinking water. Water boards in Lower Saxony have the difficulty to remove nitrate from groundwater and provide clean drinking water for the society (Water board Peine, 2015). Farmers need to apply fertilizers and use groundwater for their animals and for growing crops, as they need to provide sufficient amount of food to the society and generate income for themselves (BVL, 2015). However, the application of fertilizers is a problem for sustainability, because nitrate-free groundwater resources decline (European Commission, 2012). Farmers, water boards, municipalities, institutions and the public are informed about the nitrate values in the groundwater and their damaging impacts on ecology, societal health and economic expenditure on drinking water production. Despite that, only limited actions on the regional or local level are undertaken even though European and national policies, measures and regulations are set (NLWKN, 2015; NMU, 2016, Water board Peine, 2015; OOWV, 2015; Council of the European Union, 2013).

European regulations, policies and measures for the improvement of groundwater quality are shared among multiple actors on the basis of formal and perceived or informal roles and responsibilities on different levels. On the local level, water supply companies and waterworks of each municipality arrange the drinking water quality in Lower Saxony, the biggest water supplier is the OOWV [*Oldenburgisch-Ostfriesische Wasserverband*] with more than 88 waterworks linked to the local municipalities throughout Lower Saxony and in particular in the district of Oldenburg. On the local scale, farmers have an important role in respect to groundwater quality, as they need to follow pre-defined measures and take the responsibility in preventing groundwater from pollution and protecting groundwater while continuing with their agriculture activities (LWK, 2017; Lower Saxony Ministry of Environment, Energy and Climate Protection, 2015, OOWV, 2017). On the regional level, water boards and water suppliers are responsible for the groundwater filtration into drinking water and for the provision of drinking water to the society (Water board Peine, 2015; OOWV, 2015). Regionally, the agriculture chamber has the role and responsibility to facilitate between the water sector and agriculture sector and to achieve a better groundwater quality (LWK, 2017). Next to that, also the Lower Saxony water management, coastal defence and nature conservation agency is independently responsible for measuring groundwater values and documentation of water legislation procedures which are based on concept planning (NLWKN, 2015). On the national level, federal offices, ministries

and water associations are responsible for the representation of interests in terms of good conditions of groundwater quality (NMU, 2016). On the European level, the European Commission has legal responsibilities in regulating the limited values of nitrate in groundwater and the limited amount of fertilizers by enforcing measures that need to be implemented throughout all levels (European Commission, 2012; Council of the European Union, 2013). This interconnectedness between the various levels and the interdependency of the different actors and their perceptions are important in order to understand the reasons of the existing conflict of interests between the water sector and the agriculture sector and how those could be resolved. Regardless of this interdependence, the actor's involvement in groundwater contamination across levels and the coordination across sectors is constrained. The conflict of interests related to groundwater contamination in Lower Saxony in the district of Oldenburg might have different reasons including lack of political power, lack of immediacy or pressure that serve as barriers to establish consensus. Steering actor's involvement is an essential move in solving conflict of interests and building consensus (Healey, 2006).

Research on multiple levels of the water sector and agriculture sector is limited in Lower Saxony in the district of Oldenburg. Existing analyses have not considered the perceptions of actors in the agriculture and water sector. Thus, there is a knowledge gap on how the groundwater quality could be improved by creating mutual gains between both sectors. What these mutual gains are is going to be discovered in this research through semi-structured interviews with actors of both sectors. Furthermore, it is figured out what kind of measures can increase the willingness and ability of agriculture to reduce impacts on groundwater quality. Next to that, it is aimed to discover what kind of incentives can be provided by the water sector to the agriculture sector to adapt their practice, feel involved and become more sustainable, with the goal to improve the groundwater quality and enhance the livelihood of farmers. Better groundwater conditions and better livelihood of farmers means that both parties have to come to an agreement. Agreements can only be made under the condition that actors of both sectors are willing and able to adapt. Formal and perceived or informal roles and responsibilities of farmers and water authorities are discovered for the reason to understand the decision-making powers in a planning concept and planning process and to evaluate how mutual gains and consensus can be established. Overall, figuring out the interdependencies including roles and responsibilities with the help of an actor-map, the mutual gains between the actors of both sectors, the measures and incentives that hinder and increase the willingness and ability of actors of both sectors are important to make feasible recommendations in how planning concepts and planning processes can improve the groundwater quality and create a better livelihood of farmers in Lower Saxony in the district of Oldenburg.

Nevertheless, being able to improve conditions of groundwater and farmers, it is important to consider what kind of influences and pressures exist. One aspect is the societal demand for food at a low price for consumers dictated by supermarkets that pressure farmers to produce more with a better quality. However, producing more and a better quality for a low price means production methods that impact the groundwater quality and lead to contamination (Lorenz, 2017). The pressure from supermarkets and consumers in requiring a low price for high quality products is leading to unsustainable agriculture practices resulting in groundwater contamination affecting the water sector and the environment, farmer's livelihood and societal health (Lorenz, 2017; Steinberg & Fan, 1996). Society does not only require food but also groundwater as drinking water and other human uses. Groundwater is a *common-pool* resource and rooted in the *tragedy-of-the-commons* idea where actors perform merely short-run and individual self-interests instead of considering long-run collective and common conditions (Foster et al., 2016).

1.1. Research objective and problem statement

The objective of this research is to investigate the perceptions of the actors from the agriculture and water sector and how both can contribute to more sustainable agriculture practices resulting in better livelihood of farmers and improved groundwater quality in the district of Oldenburg in Lower Saxony. The problem statement behind this research objective lies in the conflicting interests between the different actors of the agriculture sector and water sector and the top-down regulations enforced by the EU that need to be implemented by actors operating on diverse levels.

It is anticipated that an effective cooperative planning approach involving actors from both sectors can trigger such an improvement. Such cooperative planning approach requires a prior design of an actor-map in order to demonstrate the interdependencies among actors of both sectors. Conflicts of interests are addressed and agreements can be facilitated through a mutual gains approach. Mutual or common interests and shared values are explored and analysed as they can help in building consensus between both sectors. Facilitating agreements to steer effective cooperative planning to protect groundwater in the district of Oldenburg in Lower Saxony is connected to the societal relevance of this research.

1.2. Scientific and Societal Relevance

The consequences of groundwater contamination cannot only be hindered through legal enforcements including strict measures solely, because the participation and willingness of various actors is crucial. Theory on sustainable agriculture practices seem promising for a better groundwater quality (Horrigan et al., 2002; Dobermann & Nelson, 2013; Gomiero et al., 2011; Lampkin, 1994; Theocharopoulos et al., 2012; Sakadevan & Nguyen, 2017; Burton & Turner, 2003; Di & Cameron, 2002; Meisinger et al., 1990; Global Water Partnership, 2014; Shiva 1993; Alluvione et al., 2011; Huntley et al., 2013; Rigby & Caceres, 2001; Pang & Letey, 2000; Reganold et al., 1990; Lithourgidis et al., 2005; McSorely & Porarzinska, 2001; Al-Kaisi & Yin, 2004). However, since it is challenging for farmers to adapt to sustainable agriculture without compromising on the amount of yields and income, a compensation, support and incentives need to be offered to farmers on a local level in order to increase their willingness and ability in adapting their practices that are groundwater-friendly. This thesis aims to identify how the theoretical concepts of sustainable agriculture, consensus-building, actor interdependencies and mutual gains between actors, and how willingness and ability can be applied and realised in practice.

Results of the case study in the district of Oldenburg are aimed to be valuable for future development and long-term planning of groundwater protection management in other districts in Lower Saxony or other federal states struggling with the issue of groundwater contamination and conflicting interests of the water sector and agriculture sector. Facilitating agreements between actors of both sectors, the context regarding the interdependencies of diverse actors on different levels needs to be understood. This connects to the mutual gains and consensus-building among actors and relates to the scientific relevance of this research. This research contributes to the understanding of the complex multi-actor setting of cooperative planning processes.

1.3. Outline of the thesis

The outline of this master thesis is visualised in figure 1. After this introduction chapter including the contextual information with the research question in focus, the theory chapter follows. Focusing on long-term conditions, theory on *sustainable agriculture* is examined in order to understand how groundwater quality can be preserved. Sustainable agriculture practices contribute to groundwater protection from becoming contaminated and can foster farmer's livelihood to a better. Since

sustainable agriculture cannot be established by farmers only but requires the contribution of other actors such as the water sector, it is figured out what kind of incentives can be provided by the water sector for agriculture to adapt their practices. However, before that, the interdependencies of the actors of the agriculture sector and water sector based on formal and informal roles are evaluated in theory connected to an *actor-map* approach. Next to the theory on actor-map approach, also theory on *mutual-gains* are described in order to explain how mutual benefits can be created despite the differences of both sectors. The theory on mutual gains is closely connected with theory on *consensus-building* in order to figure out how common interests and shared values can help in establishing consensus and achievements in better groundwater quality and livelihood of farmers. This theory is applied in practice. The methodology chapter embraces the case study area in the district of Oldenburg in Lower Saxony, and semi-structured interviews with the actors involved, who are active in this specific area including farmers, employees of a biogas plant, the agriculture chamber LWK, the Lower Saxony agency for water management, coastal defence and nature protection NLWKN, the Oldenburg-East Frisian water supplier OOWV and the water association WVT eV. Next to the case study and the semi-structured interviews with actors, an actor-mapping method, mutual gains approach and a willingness-ability matrix are used. The results chapter is based on the outcomes of the semi-structured interviews, an illustrated actor-map, visualised mutual gains between the agriculture and water sector and an applied willingness-ability matrix including measures. The discussion and conclusion chapter focuses on answering the research questions and the reflection and future outlook chapter includes a reflection on theory and methods, and gives recommendations for future research.

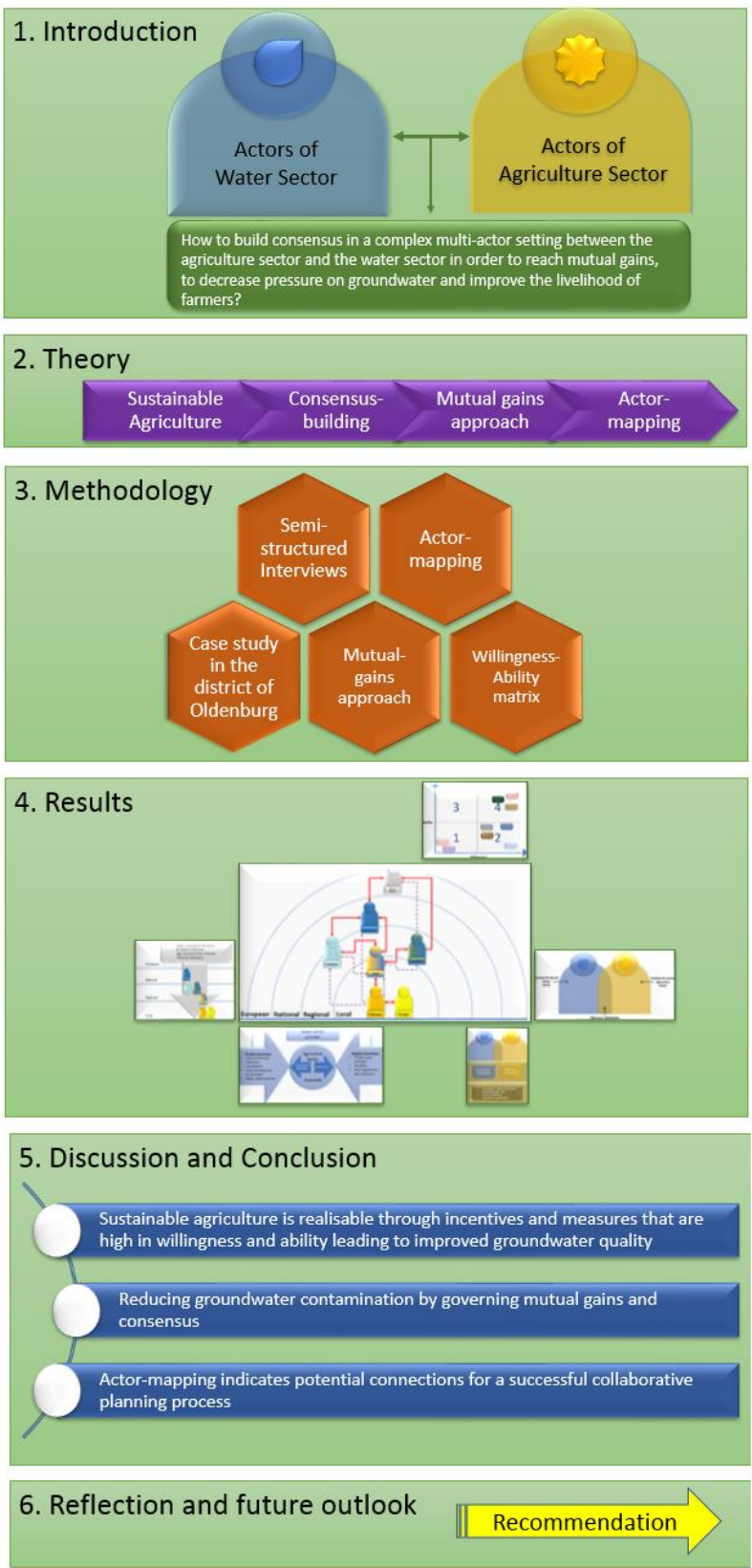


Figure 1 - Outline of the thesis (author, 2017)

1.4. Primary Research Question

How to build consensus in a complex multi-actor setting between the agriculture sector and the water sector in order to reach mutual gains, to decrease pressure on groundwater and improve the livelihood of farmers?

1.5. Secondary Research Questions

1.5.1. Theoretical Questions

1. What are the sustainable agriculture practices and how can sustainable agriculture practices help to improve the groundwater quality?
2. What is consensus-building and how can it influence willingness to adapt? How do perceived responsibilities provide barriers for reaching consensus and influence willingness to change?
3. What is mutual gain approach and how can it help to build consensus?
4. How can actor mapping create clarity on roles and responsibilities in the agriculture sector and water sector?

1.5.2. Empirical Questions

5. What are the interdependencies between the agriculture sector and the water sector in Lower Saxony?
6. What kind of mutual gains can be realized between the agricultural sector and the water sector with the ultimate aim to reduce the groundwater contamination in Lower Saxony?
7. Which measures hinder and increase willingness and ability of the agriculture sector to reduce the impact on groundwater quality in Lower Saxony?
8. What can the water sector do to provide incentives for the agricultural sector to adapt their practices?

2. Theory

Four theoretical questions are answered in this theory chapter. In figure 2, the first part focuses on sustainable agriculture and how it can help to improve the groundwater quality. The second part is about consensus-building and how it can influence the willingness to adapt and how perceived responsibilities provide barriers for reaching consensus. The third part explains what a mutual gains approach is and how it helps to build consensus. The fourth part concentrates on the actor map linked to actors' roles and responsibilities.

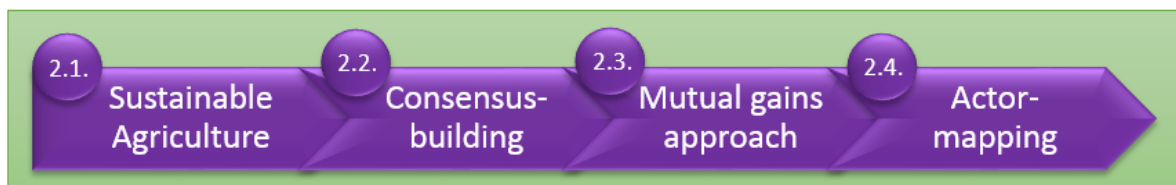


Figure 2- Overview theory (author, 2017)

2.1. Sustainable agriculture

What are the sustainable agriculture practices and how can sustainable agriculture practices help to improve the groundwater quality? (Q1)

2.1.1. Defining sustainable agriculture

Sustainable agriculture is defined as a system that improves the environmental quality and resources while satisfying human and societal needs by contributing to biofuel alternatives and maintaining the viability of agriculture economy with the focus of enhancement of farmer's quality of life and work ethic (National Research Council, 2010).

2.1.2. Comparison of sustainable agriculture to conventional agriculture in relation to groundwater quality

Goal of sustainable agriculture

The comparison of sustainable agriculture and conventional agriculture is complicated (Horrigan et al., 2002). Sustainable agriculture implies the environmental development goal to "increase the efficiency of natural resources consumed in agriculture (water, energy, fertilizer, soil) to lower the global warming potential of agriculture and reduce water and air pollution" and "stop unsustainable withdrawal of water resources [...]" (Dobermann & Nelson, 2013, p.7). Next to other goals, particular achieving the goal of reducing water pollution and stopping unsustainable practices of withdrawing water resources, requires a shift in actor's behaviour that are involved in the agriculture sector and water sector including farmers but also consumers (Dobermann & Nelson, 2013). In comparison to conventional agriculture, sustainable agriculture avoids the usage of synthetic chemicals or fertilizers, which prevents any pollution of groundwater (Gomiero et al., 2011; Lampkin, 1994; Theocharopoulos et al., 2012).

Livestock and manure management

Besides that, sustainable agriculture has rather a low number of livestock on a larger space, compared to conventional agriculture, resulting in a total lower amount of manure and nutrients used as fertilizer. In this way, no surplus of manure is produced that pollute the groundwater resources through leaching (Sakadevan & Nguyen, 2017; Burton & Turner, 2003; Di & Cameron, 2002). This means, livestock manure management in sustainable agriculture, compared to conventional agriculture, functions better due to low numbers of livestock, leading to low amount of manure on a

larger space and does not need to be transported to other regions, resulting in low amount of nitrogen in the soil and thus low impact on the groundwater quality (Burton & Turner, 2003; Robertson, 1997).

Land-use management

Sustainable agriculture encourages different land-use types that can improve the groundwater quality (Meisinger et al., 1990; Global Water Partnership, 2014). One way of land-use is to focus on croplands as winter cover crops have the ability to directly improve the groundwater quality by minimizing the quantity of nitrogen in soil, which would leach into the groundwater. Such winter cover crops are grown in autumn to ensure that nitrogen is captured in the root zone (Global Water Partnership, 2014). Moreover, non-legumes such as rye or oats, as grass and brassica, are considered as most suitable for removing nitrogen or immobilizing large quantities of nitrogen and thus improve the groundwater quality (Meisinger et al., 1990). Planning and establishing groundwater quality zones as part of land-use management priorities, enhances pollution control (Global Water Partnership, 2014). One way, is the re-organisation of grazing areas which contributes to groundwater conservation and soundness (Sakadevan & Nguyen, 2017).

Crop cultivation

Apart from that, sustainable agriculture fosters polycultures of plants or crops, compared to conventional agriculture which fosters monocultures of plants or crops, leading to more efficient and higher absorption capacity of nitrogen from the soil throughout all seasons decreasing the leaching rates through the soil into the groundwater bodies (Shiva 1993; Alluvione et al., 2011; Huntley et al., 2013; Rigby & Caceres, 2001; Di & Cameron, 2002). That means the supply and demand of fertilizers and nitrogen on plants and crops is synchronized and optimised avoiding the threat of surplus inputs seeping into the groundwater (Di & Cameron, 2002). This adequate balance between demand and supply of nitrogen on a regular basis is relevant to create high production and low groundwater degradation (Pang & Letey, 2000).

Motivation increases readiness of farmers to undertake groundwater-conserving measures

The groundwater quality can be improved if farmer's livelihood is increased, stimulating their motivation to undertake measures and agriculture activities that prevent groundwater contamination and lead to a better groundwater quality (Reganold et al., 1990). The livelihood of farmers and their motivation can be increased through sustainable agriculture because profits that are generated through diversification of crops and livestock in sustainable agriculture could exceed the profits of specialisation of crops and livestock in conventional agriculture (National Research Council, 2010). These higher profits give farmers the opportunity in engaging in multi-faceted types of crop cultivation that increase the natural fertility of the soil and prevent pollution into the groundwater (Lithourgidis et al., 2005).

2.1.3. Barriers to sustainable agriculture

Nevertheless, barriers of sustainable agriculture are the increasing population that demands higher amount of food products. However, since sustainable agriculture avoids mineral fertilizers and applies only a limited amount of organic fertilizers, the overall total yields could be lower compared to conventional agriculture (McSorely & Porarzinska, 2001; Al-Kaisi & Yin, 2004). In case of surplus of manure, the farmer has to transport the manure, which is produced by his livestock, to another location or region and has to organise and pay the costs for the transport (Burton & Turner, 2003). Furthermore, practices in agriculture demand a high amount of groundwater, however, with the current decrease of groundwater levels, the resources of clean groundwater resources are declining (Brown, 1997). The challenge of increasing consumption of agricultural products and food, demands

higher groundwater resources. Hence, as these demands are difficult to change a resource-efficient and sustainable agriculture system is required (Dobermann, 2013).

Such sustainable agriculture system contains the benefits as mentioned above. So, overall, the first research question of *What are the sustainable agriculture practices and how can sustainable agriculture practices help to improve the groundwater quality?*, can be answered by stating that the groundwater quality can be improved through the avoidance of mineral fertilizers and the reduction of organic fertilizers generated by a low amount of livestock on a large farm space (Horrigan et al., 2002; Sakadevan & Nguyen, 2017; Burton & Turner, 2003). That means sustainable agriculture is based on an optimised livestock manure management that prevents nitrate reaching the groundwater (Burton & Turner, 2003; Di & Cameron, 2002; Wicke et al., 2012). Furthermore, land-use management in sustainable agriculture including diversification of plants or poly-crop-culture cultivation throughout different seasons increase the absorption capacity of nitrogen and prevent pollution of groundwater (Meisinger et al., 1990; Huntley et al., 2013; Rigby & Caceres, 2001). Also, an adequate planning of groundwater protection zones and organisation of grazing-areas contributes to better groundwater conditions (Sakadevan & Nguyen, 2017; Global Water Partnership, 2014). Additionally, no-tillage method is a sustainable practice to prevent contamination of groundwater (Sharara et al., 2017; Xiao-Bin et al., 2006). However, without the motivation of farmers and benefits for them, the sustainable agriculture practices such as diversification of crops and crop cultivation, well-functioning land-use management, livestock and manure management cannot be realised to improve the groundwater quality (Reganold et al., 1990).

Chapter 4, elaborates on the measures for sustainable agriculture that improve the groundwater quality and how the measures hinder or increase the willingness and ability of agriculture to reduce the impact on groundwater quality. The findings are categorised in the matrix shown in figure 3.

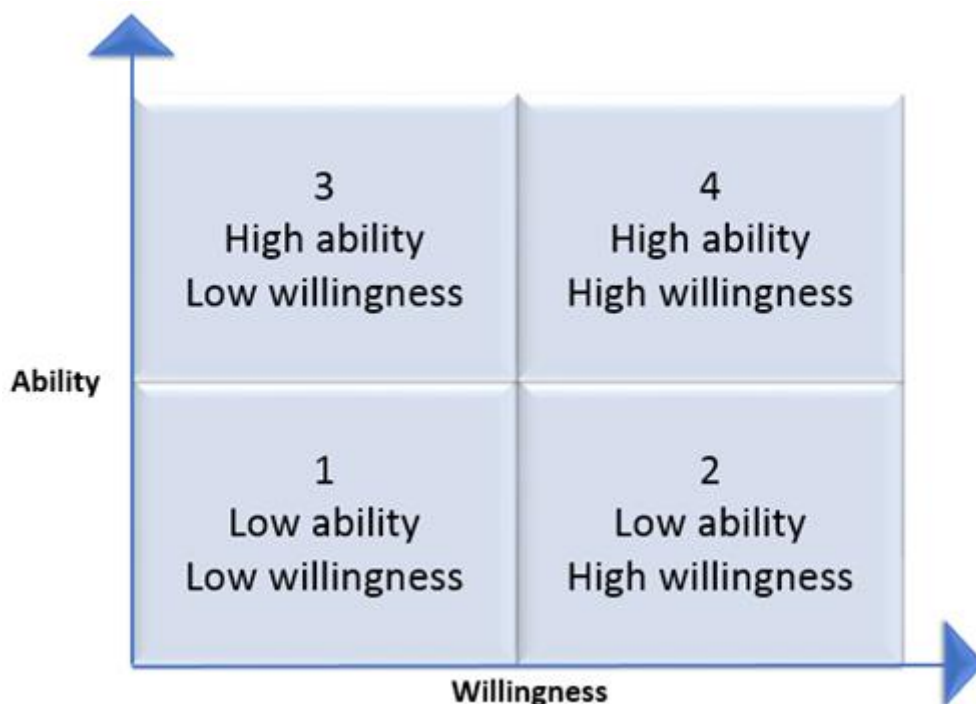


Figure 3 - Ability Willingness Matrix (adapted from Defra, 2008)

2.2. Consensus-building

What is consensus-building and how can it influence willingness to adapt? How do perceived responsibilities provide barriers for reaching consensus and influence willingness to change? (Q2)

2.2.1. Defining consensus-building

Consensus-building is defined as a way to address unfairness through a process with the intention to manage and solve conflicts of interests among actors involved in a certain topic (Susskind & Cruikshank, 2006). Consensus-building steers for a development of mediated actions striving for an *all-gain-agreement* between multiple actors (Susskind & Cruikshank, 2006).

2.2.2. Consensus-building influences the willingness to adapt

The willingness of actors to adapt is influenced by the consensus-building processes as it is time-consuming and demands efforts in training and skills (Innes, 2004). Especially in the situations of uncertainty and controversial perceptions, actors should have incentives that drive them and increase their willingness to get together and reconcile their priorities and interests (Innes, 2004). Saporito (2016) explains that the participation in planning practices can enhance the willingness of actors in case coordination and communication is attractively established. This *communicative paradigm* in Habermas' theory in relation to planning is especially important for consensus-building based on well-defined arguments in an interaction among actors (Forester, 1999). Planners have a crucial role in managing multi-actor participation and facilitating interaction between actors to ensure their willingness for mutual understanding, which is established collectively (Forester, 1989; Susskind, 2006; van de Riet, 2003). In planning practice, the planner could help to reduce, for instance, the complexity of groundwater issues by facilitating the interaction among various actors in the agriculture and water sector for the purpose to increase their willingness in exchanging information and in finding common ground. Nevertheless, power imbalances between actors in planning practices are important to consider, as they could hamper consensus-building (Fanstein, 2010; Flyvbjerg, 1998; Forester, 1989).

2.2.3. Perceived responsibilities provide barriers for reaching consensus and influence willingness to change

Different actors have different roles and responsibilities that are formally set or informally perceived. The purpose of consensus-building is to create a dialogue between the diverse actors holding different responsibilities, formally or informally. Such a dialogue is aimed to stimulate and encourage actor's willingness to cooperate, engage and express their ideas and jointly create suitable strategies for every actor which is agreed collectively (Innes & Booher, 2007). However, tensions can start in a dialogue at the moment when two or more opposing actors with diverse backgrounds attempt to establish a conversation about a certain issue and try to negotiate, which can have different understandings affecting situations differently (Susskind et al., 1999). Consensus-building requires a collaborative planning process based on actors' interactions and communications, and diverse perceptions in responsibilities can lead to tensions hampering the achievement of consensus and can influence the willingness of actors (Fainstein, 2000). Tensions can evolve from power distances, rights and identities that can lead to unmet interests, unrealistic aspirations or contingent agreements. *Unmet interests* mean that an actor cannot accept an agreement to which the majority of actors agree on. *Unrealistic aspiration* is the idea that an actor has to re-check a statement made before so that it meets the needs. *Contingent agreement* is when an actor cannot make a commitment before an assurance about the future has been made and risk is excluded (Susskind et al., 1999).

Moreover, perceived responsibilities provide barriers to reach consensus and influence willingness to change. Since actors have diverse perceptions of their responsibilities and those of other actors, the expectations in how to build and reach consensus is also diverse and might change in time and in collaborative planning process (Kerkhof, 2005; Fainstein, 2000). Perceived responsibilities could lead to wariness or suspicion, lack of confidence or distrust and become a barrier to reach consensus and can decrease the willingness of actors to alter. If trust is lost between actors having diverse perceived responsibilities, then this is very difficult and sometimes impossible to re-establish and it will hardly be possible to be successful in building consensus, collaborate or rely on each other (Mayer et al., 1995). Collaborative planning and consensus building means working together, which involves interdependence, actors have to depend on others in different ways to accomplish their personal goals and those of all actors (Mayer et al., 1995; Bressers et al., 1995). Perceived responsibilities and interferences about responsibility can lead to social responses such as anger and hinder the ability and willingness to make an effort (Weiner, 1993). Furthermore, the judgement of others responsible for an issue affects social motivation and perceived responsibilities in relation to ability and willingness, leading to success or failure, are linked with personal and social reactions in pride or guilt (Weiner, 1993). However, a clarity on perceived responsibilities and an understanding of trust by all actors can facilitate collaboration between actors through interpersonal communication and can raise their willingness and ability to make an effort (Farnham, 1989; Gottesdiener, 2002). A clarity of actor's perceived responsibilities is essential to establish a well-functioning communication and dialogue, and develop and implement strategies which are committed by multiple actors (Dredge, 2006). Clarity on responsibilities of actors help in developing goals in a collaborative planning process (Mattessich & Money, 1992; Fainstein, 2000).

In order to create a collaborative planning process where consensus could be built, a platform for actors is fundamental. In practices, Edelenbos (2012) proposes that a platform needs to be given for actors to express their interests and demands, provide knowledge and look for the creation of consensus by trying to preserve the different interests of participating actors. Consensus-building includes practices of "public participation, information sharing, discourse and negotiation, and emphasises the legitimacy of experiential, subjective, and collectively shared knowledge about many issues involving the public interest" (Berke et al., 2006, p. 48). The participation of various actors is highly important to gather information, create a discourse and come to a common ground through a fair negotiation where various sectors need to be involved, and mutual gains can be identified (CBI, 2015). Actors can build shared intellectual capital, create mutual understanding of the content and process of consensus building because of the mutual interaction (Innes & Booher, 1999).

2.3. Mutual gains approach

What is mutual gain approach and how can it help to build consensus? (Q3)

2.3.1. Defining mutual gains approach

Mutual gains approach is defined as a negotiation process which breaks the idea of winning-and-losing, and instead focuses on negotiation strategies to find fair solutions to problems (Hall, 1993). The central idea of this mutual gains approach is that mutual agreements can be made between the various actors holding various issues and goals in mind. This negotiation process gives actors the opportunity to make an agreement and resolve a problem rather than establishing a winning-or-losing status within the negotiation process (Fisher et al., 1991).

2.3.2. Mutual-gains approach helps to build consensus

Mutual gains or win-win situations are not always easy to establish because of administrative burdens or power differences between different interests of actors (Berger, 2003). Involving actors and reconciling different interests is important for policymaking and integration of actors (Baker et al., 1997). Despite conflicting interests, it is important to concentrate on fairness and mutual benefits for all actors involved by making agreements. Since mutual-gains approach is a collaborative approach it steers towards accommodating the interests of diverse actors in order to maintain their motivation and intend to reach a win-win outcome (Fisher et al., 1991). Multiple options should be presented for mutual gains before a decision or an agreement can be made (Grzybowski et al., 2010). Such multiple options for mutual gains can be developed with the means of bargaining tables or other forms of meeting spaces for collaborative interaction among actors involved in an issue (Susskind & Cruikshank, 2006). In this way, actors have the chance to collectively work, negotiate, build trust and stable coalition. The value of gathering diverse actors around a table implies the acknowledgement of mutual interests by providing admission for involvement and space for building consensus (Susskind & Cruikshank, 2006). Building consensus can be accomplished through a mutual gains approach by analysing the positions, interests and values of the diverse actors involved. Despite different positions, mutual interests and shared values can lead to mutual benefits or mutual gains that can help to build consensus among two different actors (Fisher & Ury, 2012). Creating mutual gains means dealing not only with mutual interests and shared values but also dealing with tensions or conflicting interests which requires consensus-building as a strategy to deal with such conflicts of interests (Fisher & Ury, 2012; Innes & Booher, 1999). Mutual gains can help building consensus through a negotiation process that requires cooperation and collaboration in planning between actors and can maximise the benefits for diverse actors that participate in such negotiation process (Grzybowski et al., 2006).

Mutual gains can help building consensus when looking at the three basis of mutual gains approach which is based on the actors' positions, interests and values. The first aspect is the position of actors which has rather a minor focus due to difficulty in applying positional negotiations for mutual gains because the substantive synergies are not clear. The second aspect is the interest of actors that can be examined and coordinated. It is aimed to create opportunities for constructive dialogue of solutions that have a beneficial outcome for all diverse actors involved. That means, focusing on the interest level in negotiation, that constructive solution or benefit finding and relationship building can be realised. The third aspect are values or needs that are deeply rooted and refer to the actor's personal preferences (Grzybowski et al., 2006).

Figure 4 illustrates two different actors having two different positions, interests and values. There is a wide range of interests that are conflicting each other, but in the middle part there are interests that overlap, are compatible and are mutually shared between the two opposing actors. When these two opposing actors identify mutual interests, and have shared values that benefit everyone, then a condition of mutual gains is reached. Next to the identification and separation of actors' positions from their interests and values, actors need to collaborate by considering mutual interests and common or shared values with other actors. Such collaboration means understanding how these actors' mutual interests and values are interdependent and that through collaboration there are more benefits for both parties (Bressers et al., 1995; Gottesdiener, 2002). Reconciling interests and values that are shared and compatible means creating mutual gains and help to reach consensus when each actor feels that the interests have been addressed through a collaborative planning approach (Engel & Korf, 2005).

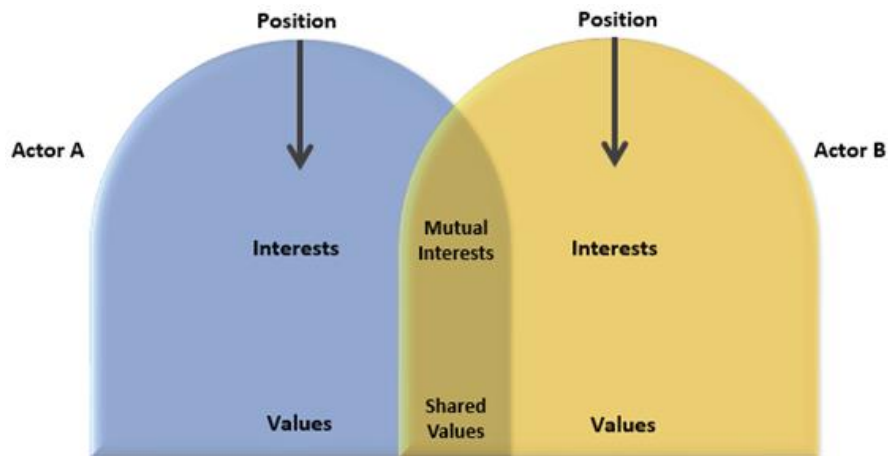


Figure 4- Mutual gains: actor's positions, mutual interests, shared values (adapted from Grzybowski & Morris, 1998)

In practice, there are a number of examples on agreements that are made by focusing on mutual interests and shared values where mutual benefits were realised as a result of cooperation. One example is an agreement between two actors, in this case France and Germany clarifying their positions. The water of the river Rhine is the common recourse of both actors indicating their positions and interests. Interests and values indicate the usage of the water from the river Rhine. France has the right to use the water of the Rhine to produce power, and in turn, Germany received 50% of the value of the generated energy. This created benefit for both actors, Germany and France, is an example that collaboration can positively affect both actors, create mutual gains by focusing on interests and values, and thus help to reach consensus (Grzybowski et al., 2006).

These three aspects of actor's position, mutual interests and shared values, will be analysed and discussed, and mutual gains that help to build consensus will be figured out in chapter 4 with the help of figure 4.

2.4. Actor-mapping

How can actor mapping create clarity on roles and responsibilities in the agriculture sector and water sector? (Q4)

2.4.1. Defining actor-mapping

Actor-mapping can be defined as an analysis reflecting interdependencies and influences of actors in decision-making processes (Brugha & Varvasovszky, 2000). Such actor-mapping has evolved into a systematic tool that represents the environment in which actors operate. Such actor-mapping can be used to analyse the interrelations, influences, intentions or perceptions of actors on decision-making processes. The knowledge about the interconnectedness, influences, perceptions or intentions can be useful to develop strategies in facilitating agreements or collaboration processes among these actors. Furthermore, it can also be useful to assess the feasibility of measures and can be helpful in facilitating the implementation of specific measures (Brugha & Varvasovszky, 2000).

2.4.2. Actor-mapping creates clarity on roles and responsibilities in the agriculture sector and water sector

The actor-map reflects the main roles of actors as individuals, as a group or as an organisation, who hold a particular interest and can influence actions in a certain situation or influence goals of a project (Walt, 1994). The collection and analysis of information on actors helps to identify objectives and

functions of actors that are directly or indirectly connected to a certain field (Mayer et al., 2004). Such actor maps and its analysis help to understand and clarify the roles and responsibilities of actors that influence the decisions that are made in a certain context (Brugha & Varvasovszky, 2000). The aim of an analysis of such an actor-map is to evaluate the actor's relevance of their positions and interests, their networks and interdependencies (Prell et al., 2009). The network of actors implies patterns of formal and informal connections that shape decision-making processes in a certain context (Smith, 1993). Actors can have multiple roles, being a source or seeker of knowledge or a coordinator between other actors. The roles of actors can change or new roles can evolve if circumstances change (Prell et al., 2009; Mayer et al., 2004). Moreover, the analysis of this actor map can give indications about which actor is willing and able to invest knowledge or resources with the intention of a beneficial return that the actor favours. In order to understand the interdependencies that are based on formal and informal roles and responsibilities and the network of interests in a certain sector, as the agriculture- and water sector, three elements have to be considered. First, the actors might depend on the same resources resulting in *tragedy-of-the-commons*, for example as in depletion of groundwater. Secondly, mutual interests can be shared among sectors such as in the agriculture or water sector, for instance good groundwater quality. Thirdly, rules and regulations can support or limit the actors in their activities, as those of the European Union (Benson, 1982).

Actor-mapping can be visualised with strong and weak ties clarifying how the roles and responsibilities are connected in the agriculture and water sector. Actors of the agriculture and water sector that share strong ties influence each other more than those being connected through a weak tie. Actors from the water sector that share a strong tie also share similar views, offer each other support and communicate frequently and effectively and their trust is stronger (Newman & Dale, 2004; Bodin et al., 2006; Cross & Parker, 2004). Actors from the agriculture sector have the same features when strong ties are shared. Furthermore, actors from the agriculture or water sector with strong ties are more influential on each other and can enhance mutual learning and share resources and advices. In general, actors having strong ties for a long time have the same knowledge. In contrast, a wide range of new knowledge and diverse ideas can be shared through weak ties. A weak tie among actors is described to have less frequent communication. And weak ties occur between diverse actors that offer diverse information and perform bridging roles between other disconnected actors (Burt, 2000). Within the context of groundwater quality, weak ties could make an actor map and its implied network more resilient and adaptive to changes in groundwater quality. However, weak ties are also easier to break than strong ties, and lack of trust and mutual understanding for a constructive dialogue over groundwater quality issues could be difficult (Burt, 2000; Newman & Dale, 2004). Through such a dialogue and in a collaborative planning approach, actors can develop strategies collectively and establish solutions that satisfy diverse preferences and interests of actors (Enserink et al., 2013).

Figure 5 shows an actor-map illustration in theory, which will be applied in practice to the interviewed actors of the agriculture and water sector to answer the empirical question and understand the interdependencies between actors. The actors' interdependencies include strong and weak ties in terms of formal and informal roles and responsibilities, the level they are operating on, their influences, positions and interests are analysed in chapter 4, by means of an actor-map method.

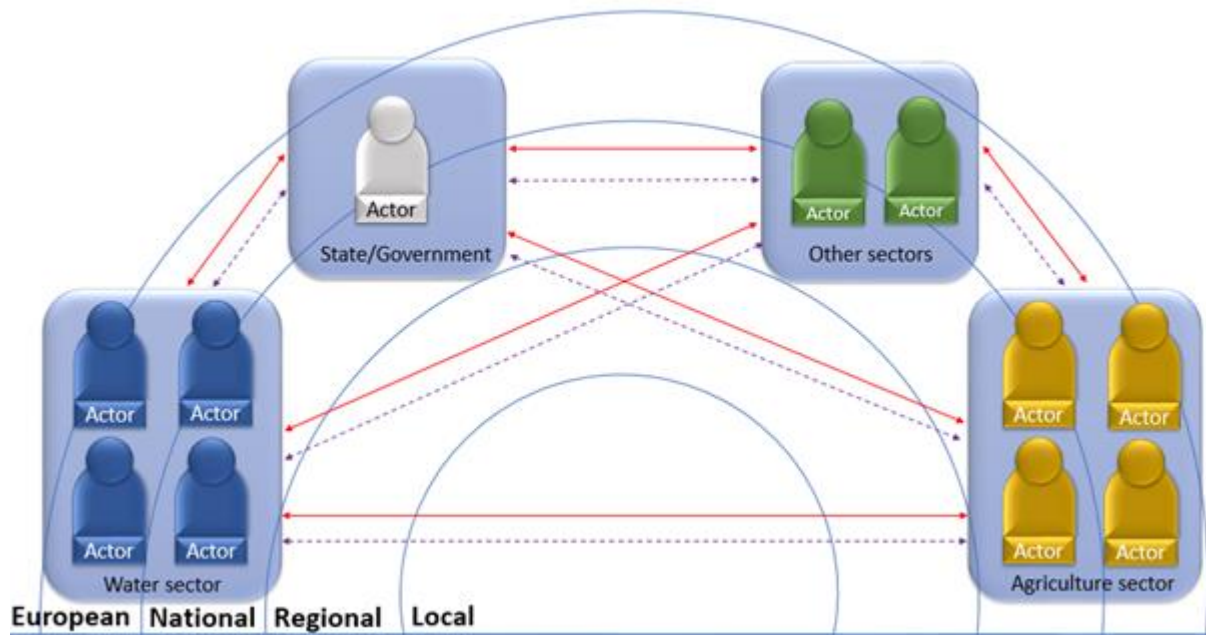


Figure 5- Actor Map (adapted from Advanced Digital Institute, 2012)

2.5. Synthesis and Conceptual Model

Consensus is the central focus point that needs to be built between the agriculture sector and water sector in order to form commitment for shifting towards an improved groundwater quality along with sustainable agriculture including the improved livelihood of farmers. Figure 6, demonstrates the conceptual model, starting from the left with the actors of the agriculture sector on one side and the actors of the water sector on the other side. Diverse interests and roles and responsibilities are derived from actors of both sectors. The reconciliation of interests can lead to mutual gains that can help to build consensus. The roles and responsibilities can trigger willingness and ability of actors to support each other and adapt their practices in order to establish consensus. Consensus or consensus-building can be realised in a collaborative planning approach, involving actors from both sectors. Consensus implies that agreements can be made in a collaborative planning approach between farmers and water experts. Such agreements refer to how the agriculture sector could feasibly adapt their activities with the help of incentives provided by the water sector. The result of established consensus can realise the outcome of sustainable agriculture including an enhancement of livelihood of farmers as well as an improvement of the groundwater quality. The context and situation is framed by the legal framework of the EU, embracing regulations and measures.

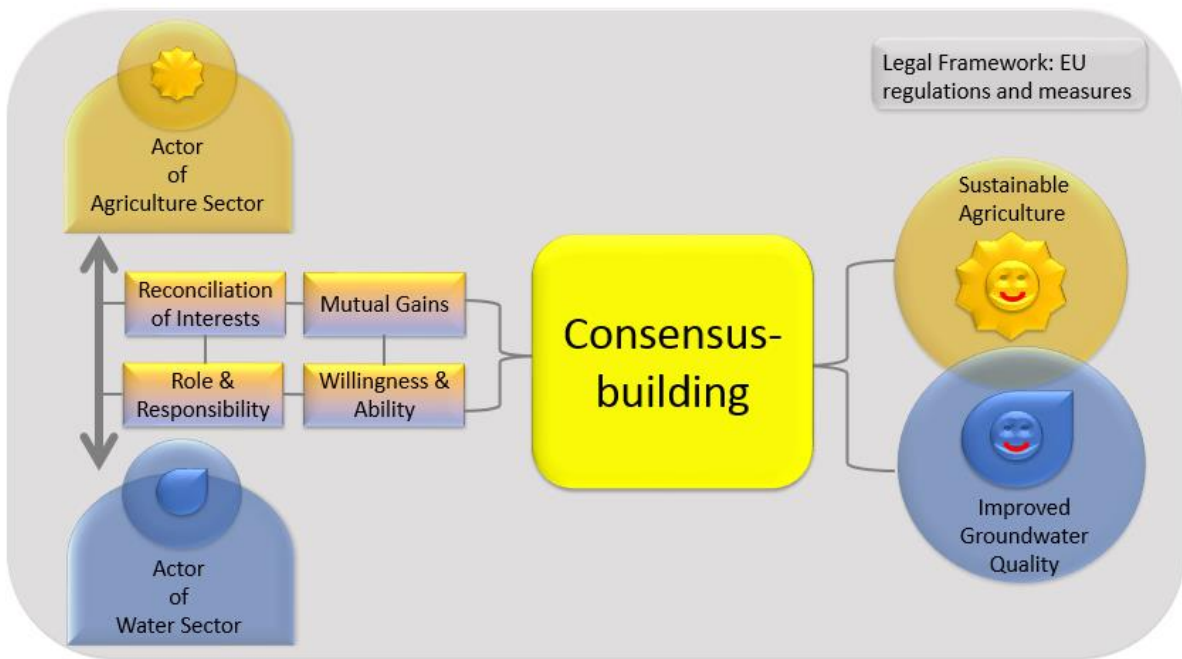


Figure 6- Conceptual Model (author, 2017)

3. Methodology

This methodology chapter refers to the case study approach linked to the district of Oldenburg. In figure 7, the first part of the methods, is about the semi-structured interviews including a list of interviewees. The second part focuses on the actor-mapping method. The third part focuses on the mutual gains approach, followed by the fourth part of a willingness-ability matrix.

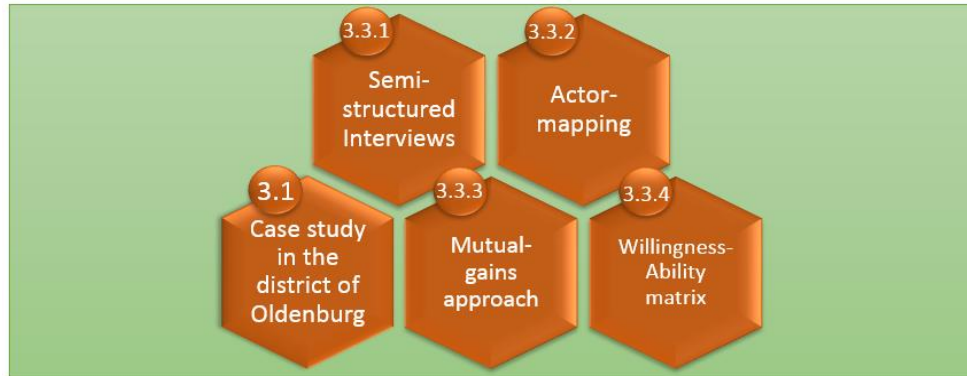


Figure 7- Overview methodology (author, 2017)

3.1. Case study as a research approach

3.1.1. Definition of a case study

In explaining what a case study is, Noor (2008) defines it as a strategic qualitative method with the focus on processes and meanings of insights, interpretations and discoveries on the social science field. Yin (2003) suggests that a case study refers to an entity, event or unit that needs to be analysed. It is based on empirical analysis that explores a current issue within a real-life situation with multiple sources considered as evidence. It is an approach that uses multiple methods for gathering empirical data from several sources, which gives the opportunity to look at the case at hand not only through one lens but various lenses and gives the chance for manifold facets of a certain situation (Baxter & Jack, 2008).

3.1.2. Reason for choosing a case study as methodology

Choosing the case study as a methodology for this context is suitable because of the intention to research in-depth about a complex real-life practice (Noor, 2008). This choice is related to the primary research question of: *How to reach mutual gains and build consensus in a complex multi-actor setting between the Agriculture sector and Water sector in order to decrease pressure on groundwater and improve the livelihood of farmers?* Because the purpose of this study is to understand *how* mutual gains can be reached and *how* it can help to build consensus particularly in a complex multi-actor setting, a case study approach is the best way to find an answer for a such *how* question.

Furthermore, a case study is rather about the interpretation of information and perceptions instead of finding one single truth (Yin, 2003). Anderson (1993) and Yin (2003) see a case study being concerned, next to the *how*, also with *why* certain situations occur. Anderson (1993) states that a case study allows for an investigation of contexts and differences between what should happen in theory and what happens in practice. Yin (2003) defines a case study as a research strategy that addresses the questions of *when* and *how* in respect to the context in which the researcher has limited control. In this research, a case study allows to focus and analyse the particular issue of groundwater contamination in the district of Oldenburg in Lower Saxony. Next to that, the case study enables to

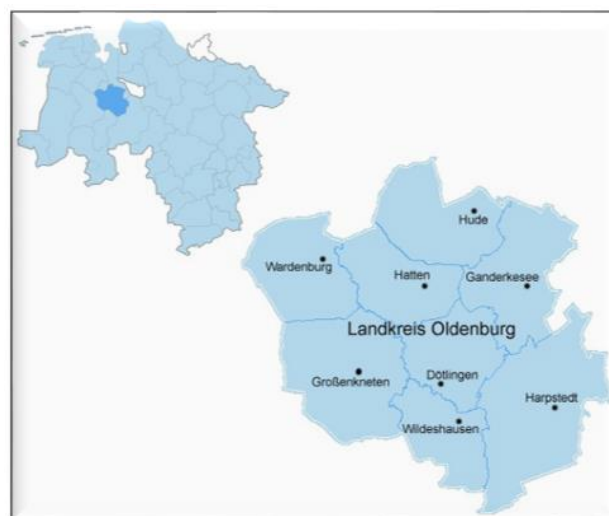
investigate and analyse the different perceptions and conflicting interests of diverse actors of the agriculture- and water sector. Furthermore, it is aimed to explore the willingness and ability of the actors from both sectors and discover how mutual gains can be reached through collaboration among the actors. Since it is tried to figure out how mutual gains can be reached in such a complex multi-actor setting, it is to find out how mutual gains can help in building consensus for the purpose to improve the livelihood of farmers and decrease the pressure on the groundwater quality in the district of Oldenburg in Lower Saxony.

There are three types of case study research namely exploratory, explanatory and descriptive (Yin, 2003; Creswell, 2003; Saunders et al., 2009). A descriptive case study might fail to capture different perceptions (Yin, 2009). In an explanatory study, the goal is to build an explanation with regards to a certain case. This explanation-building character of why a cause x leads to a consequence y, is already clear in this case study and does not need further evidences. Instead, exploration is more suitable for this case study, because any new empirical study has often the characteristics of exploratory study that focuses on validation and reliability of external expressions (Yin, 2013). Exploratory questions are often formulated as a *what* question. This is considered as “justifiable rationale for conducting an exploratory study” (Yin, 2009, p. 9).

This research is of exploratory character as the secondary questions are empirical questions that aim to figure out; *what the interdependencies are [...]?*; *what kind of mutual gains can be realised[...]?*; *which or what kind of measures trigger willingness and ability[...]?*; *what can sectors do to provide incentives [...]?*. The desire is to explore these aspects within this research. Moreover, this case study is of exploratory character, because the mentioned *what* questions lead to an ultimate exploration of the perceptions of multiple actors on *how* to reach mutual gains. The reason for exploring the perceptions of actors is to explore *how* actors of both sectors can mutually benefit each other and build consensus for the purpose to reduce the pressure on groundwater and improve the livelihood of farmers.

3.2. Area of analysis: District of Oldenburg in Lower Saxony, Germany

This area of analysis is set by declaring spatial boundaries, theoretical ambit and time window (Yin, 2003).



Map 1 - District of Oldenburg in Lower Saxony as the geographical unit for this analysis (Land Niedersachsen, 2017)

Such spatial boundaries of this case study are the district of Oldenburg in Lower Saxony, Germany. Choosing the district of Oldenburg in Lower Saxony has several reasons. The district of Oldenburg is a highly familiar area to the researcher because this rather rural space is the place of residence of the researcher. Secondly, due to life-time relations and trust with the communities and being part of the communities in the district of Oldenburg, great opportunities for a high quality of data collection are provided. Thirdly, the district of Oldenburg is an interesting case, because many developments in the agriculture sector have been undertaken particularly in this area, including the changes of agriculture practices, and the biggest water supplier is located in Oldenburg representing Oldenburg and the East Frisian districts of Lower Saxony. That means the district of Oldenburg can be regarded as a space where the agriculture sector and water sector are geographically and spatially close to each other. Map 1, demonstrates the spatial boundaries or the geographical unit of the analysis of this case study research.

The theoretical ambit is designated based on literature review. Sustainable agriculture, consensus-building, mutual gains and actor-mapping are the key theories used for this research case study. Sustainable agriculture is focused on due to its benefits for improvement on groundwater quality. Actor-mapping method is used to identify and illustrate the interdependencies among diverse actors and their strong or weak relationships based on formal and informal or perceived roles and responsibilities. Mutual gains approach has the purpose to elaborate on the actors' position, mutual interests and shared values that could lead to the achievement of mutual gains between different actors. It is focused on consensus-building between two actors. Consensus can be reached through mutual gains by the means of a collaborative planning approach involving actors from the agriculture and water sector. The findings are valuable to facilitate arrangements between such two different actors in a collaborative planning process. Because of the extensive interdependencies of actors on different levels, this study focuses on the key actors of farmers and employees of a biogas plant on the local level, the agriculture chamber (LWK) and the water management and nature protection agency (NLWKN), and water supplier (OOWV) on the regional level, the water association (WVT eV) on the national level and the EU in general on the European level. The reason for choosing these mentioned actors is because they have the main influence and are influenced by the nitrate contamination in the groundwater in the district of Oldenburg in Lower Saxony. Moreover, choosing these actors as interviewees is because their activities, roles and responsibilities are interdependent. The perceptions of actors are explored in order to understand how they can mutually benefit from each other so that the contamination of the groundwater can be reduced and the livelihood of farmers can be improved.

The overall research was undertaken from November 2016 until August 2017. The data collection took place from May 2017 until June 2017. The results and the analysis are based on the findings from the interviews with the mentioned actors in the mentioned time window. This time window for the data collection determines the specific time boundaries of this case study research.

3.3. Methods used in the case study

The aims in this case study research is to find out how mutual gains can be reached in a multi-actor setting and how consensus can be built between the actors of the agriculture and water sector in order to reduce the pressure on groundwater quality and livelihood of farmers. In understanding the interdependencies, influences and relationships between the actors of both sectors, the actors' formal and informal roles and responsibilities are important to be discovered and illustrated by the means of an actor-mapping. In understanding how mutual gains can be realised and how consensus can be

reached, the actors' positions, mutual interests and shared values need to be identified and analysed through a mutual-gains approach. Since there are measures to be followed, it is figured out what measures hinder and increase the willingness and ability of agriculture to reduce the impacts on groundwater and what the water sector could do to provide incentives for agriculture to adapt their practices.

In order to find answers to the secondary empirical questions, semi-structured interviews are used to compromise open and structured questions. Actor-mapping is used to illustrate the complex multi-actor setting in a simplified way including the relevant and interviewed actors. Mutual-gains approach is used to discover mutual interest and shared values among the actors of both sectors. A willingness-ability matrix is used to categorise the measures that increase or barriers that hinder the willingness and ability of agriculture to adapt. Overall, document analyses are undertaken in order to back up the findings through the data collection process. Each approach will be explained in more detail in the following sections.

3.3.1. Semi-structured interviews

Semi-structured interviews are described as a way of primary data collection (Clifford et al., 2016). Semi-structured interviews are based on the personal interaction, also online, with interview partners in an ordered and partially structured way. The method of a semi-structured interview is helpful and important for the investigation of perceptions and opinions, and for the collection of various experiences (Clifford et al., 2016). The intention for using the semi-structured interview in this research is to address the primary research question of; *How to reach mutual gains and build consensus in a complex multi-actor setting between the Agriculture sector and Water sector in order to decrease pressure on groundwater and improve the livelihood of farmers?*, as well as the secondary empirical questions of; *what are the interdependencies [...]?, what kind of mutual gains can be realised [...]?, what measures increase the willingness and ability [...]?, what can the water sector do to provide incentives [...]?*. Using semi-structured interviews in this research is important because of the possibility to gather in-depth, detailed and recent insights of interests, positions, values, perceptions and personal opinions of actors from the water and agriculture sector about the groundwater contamination in the district of Oldenburg. The character of semi-structured interviews gives the opportunity to ask customized questions and further clarifications or explanations on aspects for more comprehension. To answer the primary and secondary empirical research questions, a variety of open and structured questions are formulated for the interview with actors of both sectors (appendix I).

Semi-structured interviews are based on the interviewer-interviewee interaction and can be methods on its own, a complement to other methods and an option "for triangulation in multi-method research" (Clifford et al., 2016, p.146). Dunn (2005) explains that semi-structured interviews could be informal in tone and be flexible. This flexibility gives room for open answers in the interviewee's personal words instead of only yes or no responses. The interviews are steered by an interview guide (appendix II), which follows the design and structure of the theoretical framework and is also customized to the interview partner. Realising a qualitative and insightful data collection including a variety of perceptions from different actors of the water and agriculture sector, 10 semi-structured interviews are conducted. These 10 actors are four farmers owning family-farms with diverse specialisations, one employee of a biogas plant who is also a farmer, one water expert from the agriculture chamber (LWK), two water experts from the water management, coastal defence and nature conservation agency (NLWKN), one water expert from a water supplier company (OOWV) and one water expert from a water association (WVT eV). It has been aimed to undertake more interviews with more actors. Due to time constraints however, this is not feasible. Interview partners who prefer their information and insights to be treated confidentially are fully respected. The interview

transcripts are attached in appendix III, which is only used for this thesis and will not be provided to third parties.

Data analysis and interpretation

The data analysis and interpretation is necessary to convert the qualitative data collection into credible and valid knowledge that is useful for answering the empirical research questions (Yin, 2003). The data analysis of the findings takes place in chapter 4, the interpretation and discussion of the findings takes place in chapter 5, in order to keep a clear pattern.

The qualitative data which is gathered through semi-structured interviews is transcribed based on the recordings and coded with the help of a coding manual book titled as *The Coding Manual for Qualitative Researchers by Johnny Saldana*. Coding is based on the content of the theory which is elaborated in chapter 2. Keeping the focus on data analysis, the structure is based on theories following a logical path in chapter 4. First, the data is analysed through an actor-map that indicates the interdependencies of actors. After that, a chart shows overlapping and mutual interests leading to mutual gains, and finally a matrix is used to categorise measures and barriers that hinder or increase the willingness and ability of actors. Additionally, tabulations are used throughout chapter 4 for recapturing the analysed data. In chapter 5, the interpretation or discussion of the data is undertaken in terms of *explanation-building* (Yin, 2003). In this way, the causalities between theoretical and empirical data are assessed and explained.

Selecting interview partner

The actors of the agriculture- and water sector active in the district of Oldenburg in Lower Saxony are central in this research. The list of interview partner is shown in table 1.

Name	Function	Age	Code
Farmer 1	Agriculture master of family-farm enterprise: arable land and turkey.	~50 years	EW
Farmer 2	Agriculture family-farm: dairy cows, crops.	~30 years	MH
Farmer 3	Farmer and employee of a biogas plant.	~30 years	HP
Farmer 4	Agriculture family-farm: dairy cows and crops, professional training, student in agriculture economist.	~20 years	BF
Farmer 5	Agriculture master of family-farm enterprise: arable farm and pig farm.	~40 years	RD

Table 1 - Interview partner of the agriculture sector (author, 2017)

Selecting the interview partner as listed in table 1, is based on various reasons. Looking at family-farms located in the district of Oldenburg and exist for over generations, sometimes over 500 years, is interesting in order to understand what kind of changes in their agriculture practices and livelihood has occurred in the recent decades. Choosing family-farms with different focus, for instance in dairy

cows, arable land, pig farm, turkey, biogas, is to figure out what they have in common in terms of sustainability and what kind of common challenges they have despite their different agriculture practices. Moreover, it is to find out how these farmers perceive the issue of nitrate in the groundwater and what they are willing and able to do to prevent further contamination of groundwater. Besides that, interviewing family-farmers of different age groups is crucial to understand if agriculture practices and perceptions towards certain measures are diverse due to age or even educational pathways or if perceptions are similar. Additionally, interviewing an employee of a biogas plant, who is also a farmer, provides insights about innovative and renewable ways of how management techniques have changed and what kind of improvements or impacts biogas plants could have on the groundwater quality. The reason to interview the listed interview partner in table 1, is to understand the existing interdependencies of farmers with actors from the water sector such as water experts from water associations, water supply company, water management and nature conservation agency, and agriculture chamber.

In the following table 2, these interview partner from the water sector are listed.

Name	Function	Age	Code
Water expert 1	Leader of the water association in Lower Saxony - WVT eV	~50 years	GH
Water expert 2	Agriculture-engineer , water protection and water pollution control in the Lower Saxony water management, coastal protection and nature conservation agency - NLWKN	~50 years	HS
Water expert 3	Leader for the drinking water supply in Lower Saxony - OOWV	~60 years	EH
Water expert 4	Water expert from the agriculture chamber, responsible for surface and groundwater protection - LWK	~55 years	ES
Water expert 5	Prior farmer, water protection & pollution control in the Lower Saxony water management, coastal defence and nature conservation agency - NLWKN	~50 years	GK

Table 2 - Interview partner of the water sector (author, 2017)

Selecting the water experts as listed in table 2 is because a wide range of reasons. It is aimed to figure out how groundwater contamination is dealt with and what kind of measures and techniques are feasible in reducing nitrate concentration in the groundwater. Since, the different water experts work for different organisations and operate on different levels, it is figured out how they are interconnected and who has what kind of relations to the agriculture sector. The reason for selecting water expert 1, who is the leader of the water association WVT eV in Lower Saxony, is because of the importance to represent the interest of a good groundwater quality from the EU level to the local level. Water expert 2, who has an agriculture engineer working for the water management and nature conservation agency NLWKN, is important because of his understanding for agriculture practices, his function for groundwater pollution control and groundwater protection in connection to nature conservation. Water expert 3, as the leader of the most represented drinking water supply company

in the Oldenburg-East Frisian regions in Lower Saxony OOWV, is highly important because of the responsibility in groundwater extraction and drinking water provision to the society. Water expert 4, who works for the agriculture chamber is essential for this research because of the facilitating or mediating function between the agriculture sector and water sector, and can be regarded as the connecting link between farmers on the local level and water authorities from the local level up to the national level. Water expert 5, who has been a farmer several years ago and is working now for the NLWKN, is important to interview in order to figure out what kind of challenges farmers have and to what extent the given measures and regulations from the EU can be feasibly adapted by farmers in space and time. Due to personal farming experiences, water expert 5 can provide information regarding challenges and pressures that farmers have.

Overall, all interview partners from both sectors are essential and valuable in providing indications about how a better livelihood of farmers can be established along with an achievement of a better groundwater quality in the district of Oldenburg in Lower Saxony.

Conducting the interviews

The interviews follow an interview guide (appendix II). Due to ethical reasons, the interviewees are asked for permission on citing them with their names, functions or anonymous. The interviewees are asked to be recorded for this research only and these recordings will not be given to any third parties. All recordings are deleted after this research is accomplished. The interview is conducted in the preferred location of the interview partner. Each interview partner has the opportunity to add further unthought-of remarks and comments that can have an added value for this research. Each interview is transcribed in German language (appendix III) and will be partly translated for the content of the findings. The transcriptions are not provided for any third parties, except for the supervisor of this research. Each interview partner will receive a full version copy of this thesis if wished.

3.3.2. Actor-mapping approach

This research aims to explore the perceptions in a multi-actor setting. The actors of agriculture and water sector including their functions and the interdependencies between them are illustrated in order to answer the secondary empirical research questions as well as the primary research question. Through this actor-mapping method the complexity of the multi-actor setting can be simplified as it can be figure out what kind of positions the actors hold (De Booij & Hermans, 2012; Cventinovic et al., 2017). Furthermore, it can be figured out if relations among actors are strong or weak and if these relations are based on formal or informal roles and responsibilities. Moreover, it can be visualised on what level the actors operate in order to understand what kind of influence they have on other actors. The actor-mapping method implies various ways of conducting an analysis. The precise way depends on the aim of the analysis and the context (De Booij & Hermans, 2012). The aim of this analysis is to figure out where conflicts of interests are rooted between the actors of the diverse sectors, and how these conflicts could be reconciled. The analysis of the interlinked actors is important for the understanding of the social environment and important to emphasise the positions that each actor holds, so that afterwards the perceptions of interests can be emphasised on (Bos et al., 2013). The actor map is illustrated in chapter 4 and the secondary empirical question of: *what are the interdependencies between the agriculture and water sector?*, is answered.

In practice, being able to design the actor-maps, the interviewees in the semi-structured interviews are asked to briefly sketch on a blank sheet of paper an overview about their interdependencies to other actors in the context of agriculture practices and groundwater quality. Moreover, the interviewees are asked about how they perceive the strong or weak, direct or indirect connections to other actors and what kind of measures, regulations, guidelines or laws are defined by the EU that

these actors have to follow or consider. The various actor-map drawings are synthesized into one actor-map in total that embraces all actors of both sectors. To identify the interdependencies of actors the criteria in terms of formal and perceived roles and responsibilities, the actors' position and function in an organisation, and the level on which actors operate are considered. The actors, who are at the same time the interview partners from the semi-structured interviews are given the freedom to decide how to draw the actors and interconnections between the agriculture sector and water sector based on their personal knowledge, experience, perception and interpretation. Moreover, the interviewed actors are asked to specify on regulations set by the EU that they perceive as support or barrier for working in their field and with other actors. The formal roles and responsibilities are figured out through policy document analysis, the informal or perceived roles and responsibilities are based on statements of the interviewed actors. The collection of the various actor-maps is attached (appendix IV).

3.3.3. Mutual-gains approach

Discovering the interests and the underlying values of actors, each interview partner is asked directly about the interests and reasons behind the interests. Afterwards, a list is created which contains all mentioned interests and values of each interviewed actor in the semi-structured interview.

In practice, each actor is visualised in a figure in chapter 4 including all mentioned interests. As a next step, the actors of the agriculture sector, including the LWK, biogas plant and farmers are categorised into the agriculture sector. The NLWKN, WVT eV, and OOWV are categorised to the water sector. Based on the mentioned interests and values of the actors from the agriculture sector and the water sector, similarities or mutual interests are investigated. These mutual interests between the agriculture sector and water sector are elaborated and conflicts of interests or tensions are described. Moreover, the shared values of both sectors are elaborated in a more general way since values are more deeply rooted and are based on personal preferences (Engel & Korf, 2005). However, it needs to be aware that accepting mutual interests of actors does not necessarily mean that it leads directly to an agreement. Besides that, the conflicting interests or tensions might be so strong that it blocks mutual interests. One way is the reframing of interests, which helps to shift towards more concrete and clear statements, which can help in solving problems successfully (Moore, 2003). Essential in reframing is to unravel the interests and values in a way that is acceptable to all actors (Engel & Korf, 2005). Overall, these discovered mutual interests and shared values could be a basis to reach mutual gains between the agriculture and water sector and help to build consensus among these two sectors.

3.3.4. Willingness-ability matrix

Next to mutual interests and shared values, also a high degree of willingness and ability of actors is important to adapt. There is a wide range of measures and regulations that can increase but also hinder the willingness and ability of agriculture to adapt. A willingness-ability matrix is established with four quadrants (Defra, 2008). The first quadrant is signified with low willingness and low ability. The second quadrant is based on a high willingness and low ability. The third quadrant is based on low willingness and high ability. The fourth quadrant demonstrates high willingness and high ability (Defra, 2008). In chapter 4, the various measures and barriers, which are mentioned by the interviewed actors during the semi-structured interviews, are categorised in these four quadrants and two dimensions of willingness and ability based on the perceptions of the interviewed actors. It is anticipated that with the awareness and reduction of barriers, an increase of measures in willingness and ability of agriculture to adapt their practices could exist.

4. Results

Four empirical questions are answered in this result chapter. In figure 8, after unravelling the case study, the first part refers to the interdependencies between the agriculture and water sector. The second part discovers the mutual gains between the actors of both sectors. The third part is about measures that hinder or increase the willingness and ability of the agriculture sector to reduce groundwater contamination. The fourth part looks at the incentives of the water sector for the agriculture sector. The findings are demonstrated, analysed and discussed in the district of Oldenburg in Lower Saxony. Every section is concluded with a recap that answer the research question.

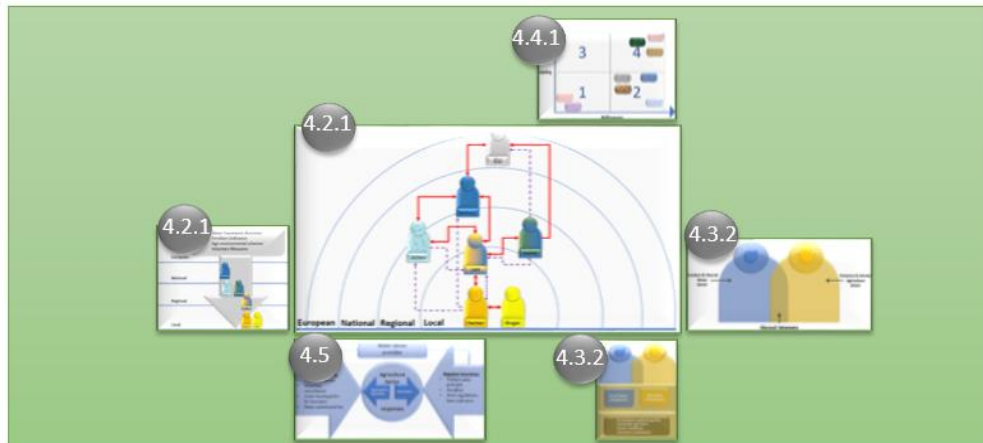


Figure 8- Overview results (author, 2017)

4.1. Unravelling the case: District of Oldenburg, Lower Saxony, Germany

The district of Oldenburg is the *green heart* of Lower Saxony and is located in the central-north-western part of Lower Saxony as visualised in map 2. The district of Oldenburg consists of the city of Oldenburg and various municipalities and the attached villages with a total population of 292.438 (163.830 on 102,99km² people in the city of Oldenburg and 128.608 people on 1.063,16 km²) (Oldenburg-Kreis, 2015; Landesamt für Statistik Niedersachsen, 2015). The district of Oldenburg and Oldenburg city are well-known for their green and blue natural and cultural landscape (Weber, 2017). As the major tributary of the river Weser, the river *Hunte* flows through the district of Oldenburg (Oldenburg-Kreis, 2017a).



Map 2 - District of Oldenburg in Lower Saxony (Oldenburg-Kreis, 2015)

Relevance of the district of Oldenburg as a case

The district of Oldenburg is relevant as a case because of its enormous water and nutrient supply in the most valuable agricultural land (Heidemann, 1999). This area has the most important drinking water extraction areas in Lower Saxony. The issue is that the area is threatened by drainage and eutrophication as substances from fertilizers used in agriculture have been found in drinking water in this area (Heidemann, 1999). As this research focuses on the connection of agriculture and groundwater quality in Lower Saxony, this area of the district of Oldenburg is the most suitable for this research case. Around eighteen nature conservation areas are located throughout the district of Oldenburg and five drinking water extraction territories [*Trinkwassergewinnungsgebiete*] are part of the water protection area (NLWKN, 2017).

These water protection areas are highlighted in the light blue areas in map 3 (Oldenburg-Kreis, 2017b). The area for agricultural land-use is of 65.187ha around the district of Oldenburg and highlighted in light green (Oldenburg-Kreis, 2017a). The agricultural activities have an increasing impact on the groundwater quality causing an exceedance of limited value of 50 mg/l of nitrate in some measurement points in the district of Oldenburg and throughout Lower Saxony (NLWKN, 2016).



Map 3 - Five water protection areas in the district of Oldenburg (Oldenburg-Kreis, 2017b)

Nevertheless, agriculture and water is equally important to the society in the district of Oldenburg due to economic and cultural value and are regarded as two mainstays of quality of life (Grecksch & Wings, 2015). Agriculture is the largest economic activity in this area and farmers own the largest space or land in the district of Oldenburg, that is why farmers have increasing interests in topics

regarding water or groundwater topics (Grecksch & Wings, 2015). This area is marked by farming above the surface and with a high groundwater resource storage underneath the surface. Based on this fact, water and agriculture follow different interests in spatial planning that trigger tensions among each other. This requires a combination of interests of both, water and agriculture, in order to establish mutual gains, build consensus and follow a collaborative planning.

4.2. Interdependencies between the agriculture sector and water sector

What are the interdependencies between the agriculture sector and water sector in Lower Saxony? (Q5)

After giving an overview of the case in the district of Oldenburg and highlighting the relevance of agriculture and water, the interconnectedness of these two sectors is elaborated further in this section. The interdependencies between the main actors in this case, agriculture and water sectors, are identified and visualised based on the method of actor mapping.

Before such actor map is illustrated, the formal roles and responsibilities of both sectors are described in correspondents to the goal of groundwater quality improvement. Groundwater protection in Lower Saxony is embedded in the agri-environmental schemes [*Agrarumweltmaßnahmen*], the water framework directives [*Wasserrahmenrichtlinien*] and the nitrates directive [*Nitratrichtlinie*] (UBA, 2017; DVS, 2009; NLWKN, 2010; Hodge, 2001; Matzdorf & Lorenz, 2010). The goal of a good groundwater status in 2015 has not been achieved due to high nitrate concentrations released through agriculture. Therefore, the interdependency of agriculture and water has been enforced more strongly in formal institutional frameworks. The interdependencies of both sectors in terms of perceived or informal roles and responsibilities, identified through semi-structured interviews, are included in the actor map.

Formal roles and responsibilities of the water sector and agriculture sector

Formal institutions in the water sector and agriculture sector have formal responsibilities in groundwater management and farmers as landowners have a formal responsibility in agricultural management (DVS, 2009; Brunner & Kinzelbach, 2008). For the water sector, three institutions have been selected; NLWKN, OOWV, WVT e.V., that follow certain legal responsibilities. For the agriculture sector, three actors have been chosen; farmers as landowners, biogas plant and LWK. Their formal roles and responsibilities are elaborated based on policy document analysis.

The water association, *Wasserverbandstag e.V. – WVT e.V.*, has the role and responsibility in zoning and designation of water protection areas for groundwater abstractions (WVT e.V., 2017a). The water supplier company, *Oldenburgisch-Ostfriesischen Wasserverband – OOWV*, has the role extract groundwater from this designated water protection areas (OOWV, 2017a). The Lower Saxony water management, coastal defence and nature conservation agency, *Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz – NLWKN*, has the responsibility of measuring and collecting data about the nitrate concentrations throughout the network in Lower Saxony and delivers these data to the OOWV, WVT and LWK (NLWKN, 2017a). The agriculture chamber, *Landwirtschaftskammer – LWK*, is the facilitating actor, and is responsible to develop and implement concepts about how to protect the groundwater and how to reduce the nitrate value in the groundwater by close interaction and consultation with the agriculture sector, meaning with individual farmers (LWK, 2017a). Farmers, according to the Lower Saxony Regional Farmers' Association, *Landvolk Niedersachsen or Landesbauernverband e.V. – LV e.V.*, have the responsibility

of livestock management and land-use management and have the role to preserve the cultural landscape and cultivate crops (LV e.V., 2017a). Crop cultivation in particular is the task of farmers who operate biogas plants, as their role is to serve the society with renewable energy through the usage of agricultural energy crops (ML, 2012).

Informal roles and responsibilities of the water sector and agriculture sector

In comparison to formal roles and responsibilities, informal roles and responsibilities are rather many-faceted (Colardyn & Bjornavold, 2004). Based on semi-structured interview results, the context of informal institution is represented based on how each actor described the own perceived roles and responsibilities and how they are interdependent to other actors.

The actor of the *WVT e.V.* describes his responsibility in the coordination of various association and is responsible in giving legal consultation to these associations. Also, the planning and management of water cycles and implementation of the new fertilizers ordinance belong to their responsibilities in order to achieve a reduction of nitrate in the groundwater. The actor explains that his work is dependent on the agriculture sector and the way farmers apply fertilizers and either increase or decrease the nitrate concentrations in the groundwater. Furthermore, he adds that:

The entire society in Lower Saxony is dependent on the agriculture but in turn agriculture is dependent on clean groundwater as the food production could not exist without it.
Water expert 1, WVT e.V



The actor of the *OOWV*, explains his responsibility in the groundwater protection, groundwater extraction and purification, and supplies drinking water to the society. The actor highlights that it is in his responsibility to prevent water treatment plants of becoming chemical treatment plants. Related to his interdependence with the agriculture, the actor depicts that both, groundwater and agriculture are dependent on the condition and cultivation of the soil and the agriculture practices impact his work in the *OOWV*.

Above the soil, this is the production horizon of the agriculture, and underneath the soil, this is our production space, this is where we generate our resource from.
Water expert 3, OOWV



The actors of the *NLWKN*, explain the roles and responsibilities related to the water economy and nature protection. In relation to groundwater quality, their responsibility is to establish a monitoring network and collect data about nitrate substances and provide an overall image about the groundwater quality in Lower Saxony. Additionally, they create water protection measures to improve the groundwater quality as well as balance the groundwater level. Next to that, they follow their role

The water economy is strongly dependent on the land-use management of the agriculture. There is an absolute interdependence and the quality requirements in relation to water limits the agriculture sector and agriculture experiences this water protection as a barrier but also sees that we requirements have some subsidies in the water economy for the agriculture and thus they make an effort by participating in voluntary measures in order to improve the water protection, so the agriculture notice this as a chance not only as a barrier.
Water expert 2 & 4, NLWKN



in nature conservation and focus on the preservation of biodiversity. The actors explain their strong interdependency with the agriculture sector and state that:

The actor of the LWK - the agriculture chamber, explains he has the role and responsibility to facilitate and communicate between the agriculture sector and the water sector. Their role is also to advise individual farmers in their agriculture practices that have a lower impact on the groundwater quality and help farmers to implement certain measures and understand given regulations and measures. He describes the interdependencies between the agriculture sector and water sector depends on the work of the LWK. The LWK receives the order from the water suppliers OOWV or from the NLWKN they have to find a way to adapt farming practices. The water expert explains it:

We receive order from the waters suppliers, or from NLWKN, these are our clients and our consultation addresses individual farmers. And this is paid by the water suppliers for instance, but this interdependence is a little bit complicated. It is called the Lower Saxony water withdrawal fee for a water-friendly cultivation.

Water expert 4, LWK



Farmers explain that their role and responsibility in agriculture is to provide farming services, farming practices, land-use management, tillage, cultivation of the cultural landscape, livestock management and of course food production. In relation to interdependency, farmers explain that that they are not really dependent on the water sector, except from the fact, that they receive drinking water from the water supplier OOWV as every other household.

I'm involved in the voluntary consultations that the agriculture chamber offers as this is very helpful and I see the connection more to them. [...] I'm not directly dependent on the water sector. I buy water, of course, for the house here for the animals also, but they have no right to give me any tasks or set any rules. But, what the water sector does is to enforce regulation through politics that derive it to me and this impedes me in certain production methods or make my production more expensive and thus of course they impact on my business.

Farmer 1, Agriculture



Another farmer explains the interdependency between agriculture and water by referring to rules set by the water sector beneficial for extracting water from agricultural land.

We have to follow the regulations for what we are allowed to apply on our agricultural land. But the water is removed underneath the surface of our agricultural land. So, we get prescribed what to do so that the groundwater is not contaminated so that the water sector has an easier job in purifying it. [...] We are more dependent of the LWK as they support us and explain how we can adapt our farming.

Farmer 2, Agriculture



With regard to the interdependency, the employee of a biogas plant states that there is no interdependency between them and the water sector:

We have nothing really to do with the water sector. The only connection I can see is the new fertilizer ordinance that has an influence on us, and the Lower Saxony water act.

Employee of a biogas plant 3, Agriculture



4.2.1. Actor Map

In figure 9, the illustrated actor map includes the actors of the agriculture and water sector. This actor map depicts the relationships that actors have based on their formal and perceived roles and responsibilities. The sectors in which the different actors act is distinguished based on the colours and the levels in which the actors operate are indicated. The selection of these actors is based on the explanations given in the methodology chapter 3, which is based on the interview partners for this research. This actor map is a composition of the different actor maps provided by the interviewees.

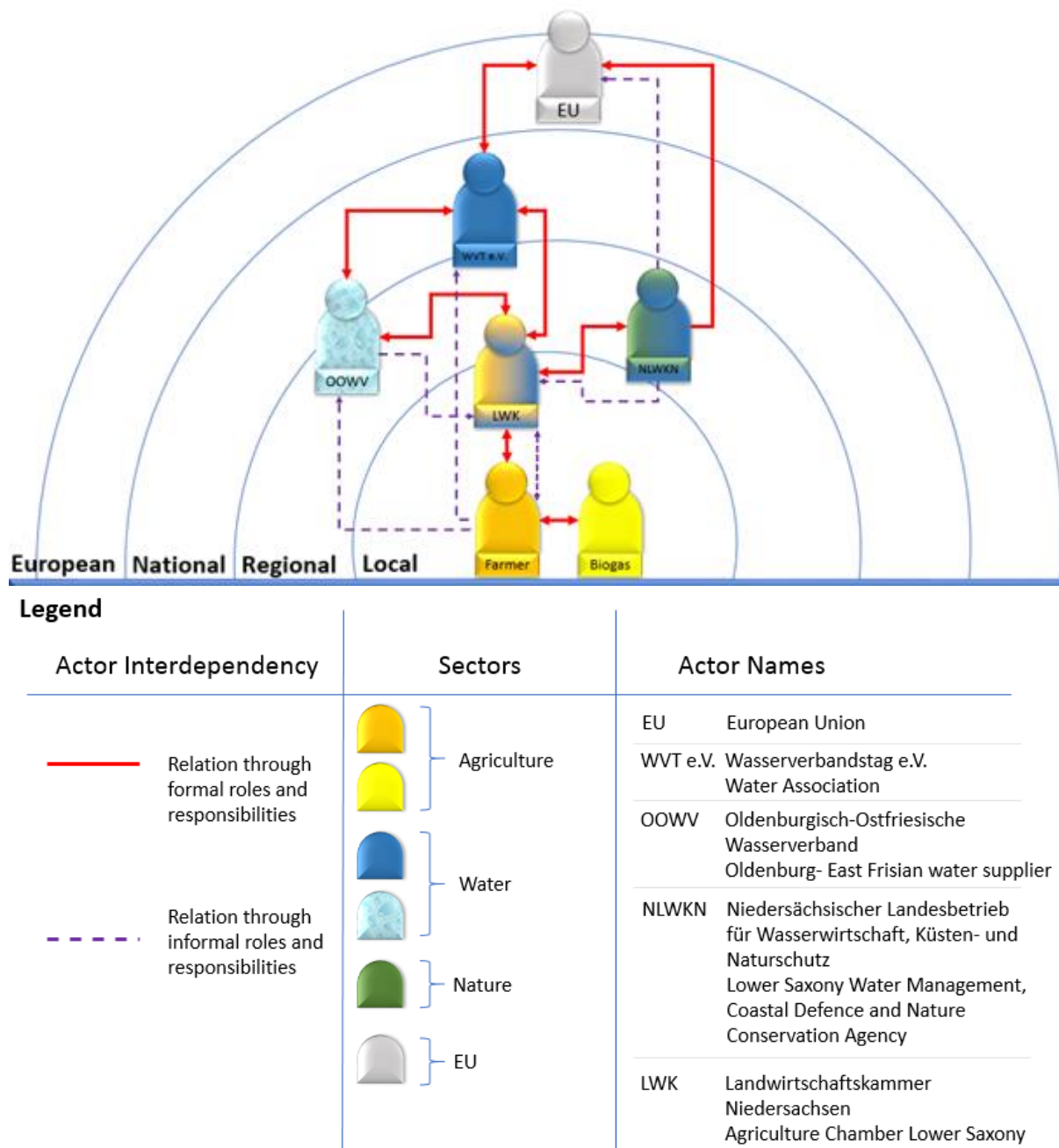


Figure 9- Actor map (author, 2017). This actor map represents the interdependencies between the actors of the agriculture and water sector on different levels. The red lines are the formal roles and responsibilities connecting the actors. The purple lines are the informal or perceived roles and responsibilities.

In the district of Oldenburg, diverse actors represent the agriculture sector. Part of the agriculture sector are farmers themselves, employees or farmers operating a biogas plant on a local level, and the agriculture chamber LWK on a local and regional level. The agriculture chamber is highlighted in orange and blue, which demonstrates their function of mediating between the agriculture sector and water sector. Diverse actors represent the water sector. The OOWV as the water supplier on regional level, the NLWKN as an agency for water management and also nature conservation on the regional level, and the water association WVT e.V. working on the national level. The EU as an actor acts on the European level having a top-down role by providing rules and regulations, such as the water framework directive, agri-environmental scheme or nitrate directive. The red lines represent the interdependencies between the actors of both sectors based on formal roles and responsibilities derived from policy document analysis. The purple lines demonstrate the interdependencies in formal or perceived roles and responsibilities expressed and drawn by each interviewed actor.

Legal framework and regulations influencing the interdependencies between actors

The interdependencies between actors of the agriculture sector and water sector are influenced by a legal framework (Bukowski, 2005). Regulations such as the water framework directive, nitrates directive, agri-environmental schemes, fertilizer ordinance and also voluntary measures influence the interconnectedness of the actors (European Commission, 2010). The regulations are forwarded and mainly communicated in top-down process starting on the EU level released by the European Union and are passed on to national level to the water associations WVT e.V. or water supplier OOWV, and Forwarded to the regional level to the agriculture chamber LWK and the water management and nature conservation agency NLWKN. The consultants from the LWK then try to implement and apply these regulations together with farmers on a local level. Such top-down communication processes of regulations are visualised in figure 10.

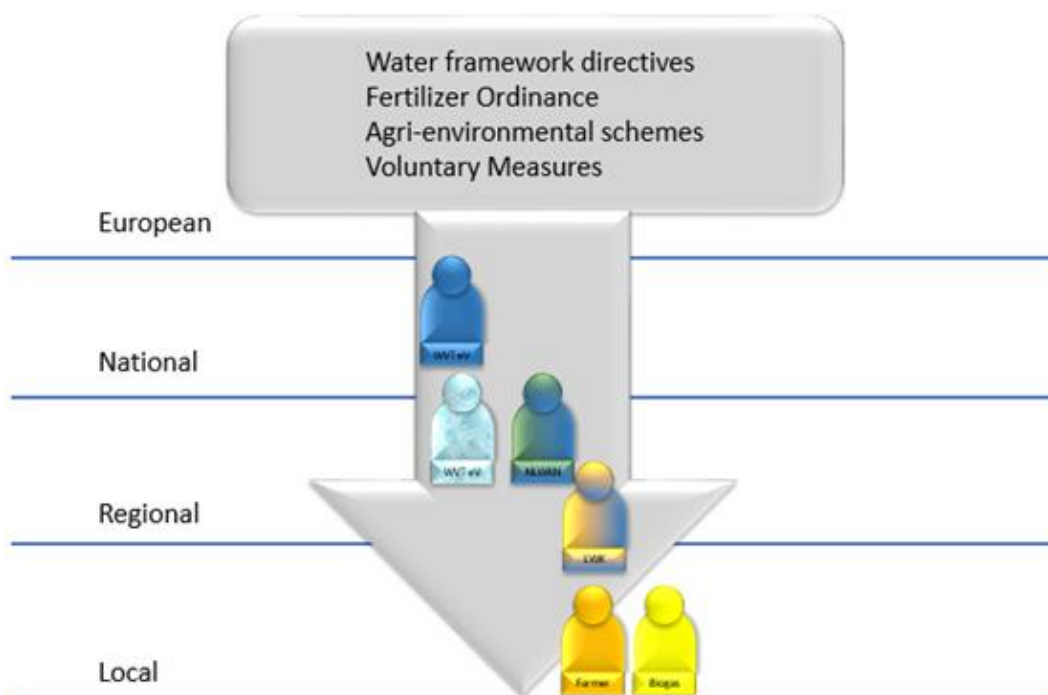


Figure 10- Legal Framework (author, 2017). Measures and regulations of the EU are forwarded in a top-down approach.

4.2.2. Recap: Interdependencies of agriculture and water

Actor map indicates that the interdependency between water experts and farmers is weak

Analysing the results of this chapter the interdependencies, between the water sector and agriculture, are based on the formal and perceived roles and responsibilities of actors involved. The analysis reveals that responsibilities in the formal sense often overlap with the perceived roles that were expressed by the interviewees. The most striking finding is that in the issue of groundwater contamination; there are no clear formal or informal connection between farmers and water experts. Informally and through the perceptions of the farmers and water experts, it has been found out that the water sector is strongly dependent on the agriculture practices of farmers. That means in short, that the work of water experts is impacted by the work of farmers. Strongly mentioned in the semi-structured interviews is that the agriculture chamber LWK serves the function on a mediator or facilitator between the agriculture sector and the water sector. The entire communication flows mainly through the agriculture chamber LWK and their consultants that try to adapt and implement the orders given by the water supplier OOWV to the LWK. Farmers express that the only communication from the water supplier goes through politics and media which affects farmers negatively. Due to that, farmers express that it would be highly necessary to get everyone on board to talk to the water suppliers personally.

Regulations play a role in the interdependencies between the actors

Besides the interdependencies in the formal and informal sense, the regulations of the EU have an effect on the connections of the various actors. The established rules and regulations by the EU such as the water framework directive, nitrate directive, agri-environmental schemes and voluntary measures passed on the hierarchical line from top to down. Visible here is that there is no bottom-up communication where farmers have options in taking part of a decision-making process and there are no design possibilities for certain directives or measures. Farmers, at the local level, receive the regulation and, with the help of the consultants provided by the LWK, trying to turn these regulations into practice. Combining the results from policy documents and gathering qualitative data from semi-structured interviews indicates that the rules and regulations impact the interdependency of both sectors which creates tensions between them.

4.3. Realisation of Mutual Gains between actors of the agriculture sector and water sector

What kind of mutual gains can be realized between the agricultural sector and the water sector with the ultimate aim to reduce the groundwater contamination in Lower Saxony? (Q6)

The question two focuses on the realisation of mutual gains between the agriculture sector and the water sector with the ultimate aim to reduce groundwater contamination in Lower Saxony. To figure out what kind of mutual gains can be realised, the positions, interests and values of different actors are analysed. It is analysed how these actors collectively support the improvement of groundwater quality and enhancement of livelihood of farmers in Lower Saxony. Focusing on the mutual gains approach and on consensus-building, three aspects are examined including the actors' positions, actors' interests and actors' values. An essential part of consensus-building and realisation of mutual gains, is the aspect of collaborative planning (Innes & Booher, 1999; Healey, 2006; Fainstein, 2000). Important for mutual gains, collaborative planning and consensus-building is that despite the

differences in actors' positions, interest and values, a certain agreement and co-existence can be created in a common space (Healey, 2006; CBI, 2015). In practice, mutual gains but also tensions can be seen between the diverse actors in Lower Saxony. The substantive idea is that when consensus on actors' positions, actors interest and actors' values can be built, and mutual gains between the diverse actors of the agriculture sector and water sector can be realised, then the groundwater quality can be improved and the livelihood of farmers can be enhanced. Figure 11, shows an overview of the actors' positions, interests and values.

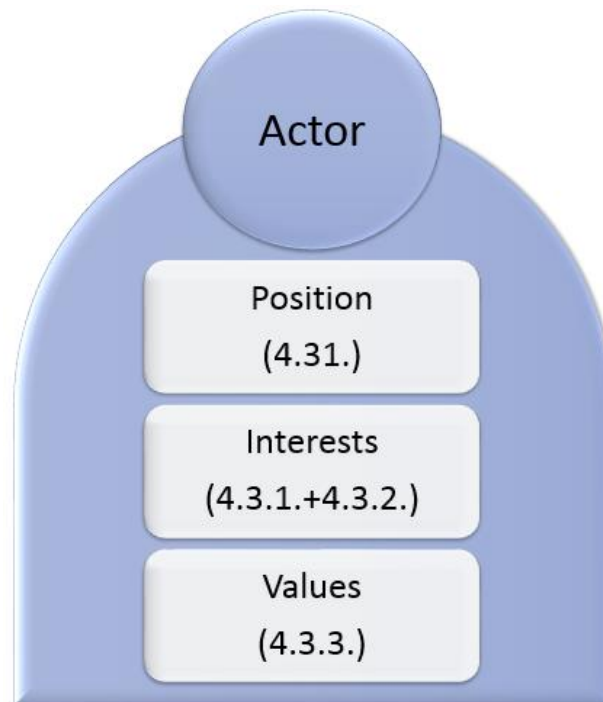


Figure 11- Overview of the actors' piv's and mutual gains (author, 2017). The positions, interests, values of the actors from the agriculture sector and water sector are discussed in (4.3.1). The focus is on mutual gains but also tensions between the diverse actors. The analysis refers to synergy and separation of interests of actors (4.3.1.+ 4.3.2). The values concerning the improvement of groundwater quality and livelihood of farmers is elaborated (4.3.3).

4.3.1. Actors Position

A selection of actors from the water sector and the agriculture sector in Lower Saxony are chosen and interviewed for this analysis. In the district of Oldenburg, ten interviewed actors are part of the analysis and evaluation of actor support for the improvement of the groundwater quality and enhancement of livelihood of farmers. These ten actors are based on four farmers of family-farms, one employee of a biogas plant, two water experts from a water economy and nature protection organisation, one water expert from the agriculture chamber, one water expert from the drinking water supply company and one water expert from a water board. The reason for selecting these ten actors is because they are important for collaboration planning and consensus building. In addition, two conferences, one for the drinking water extraction area and one for the water framework directive area, have been attended and observed which are analysed in paragraph 4.3.4.

Description of the positions and interests of each actor involved in groundwater quality

As depicted in figure 12, the positions of each actor are represented as semi-circles that are distinguished in different colours. The rectangles represent the interests and values of actors. The colours of the semi-circles and rectangles are in accordance with the colours of the actor maps, visualised in figure 9.

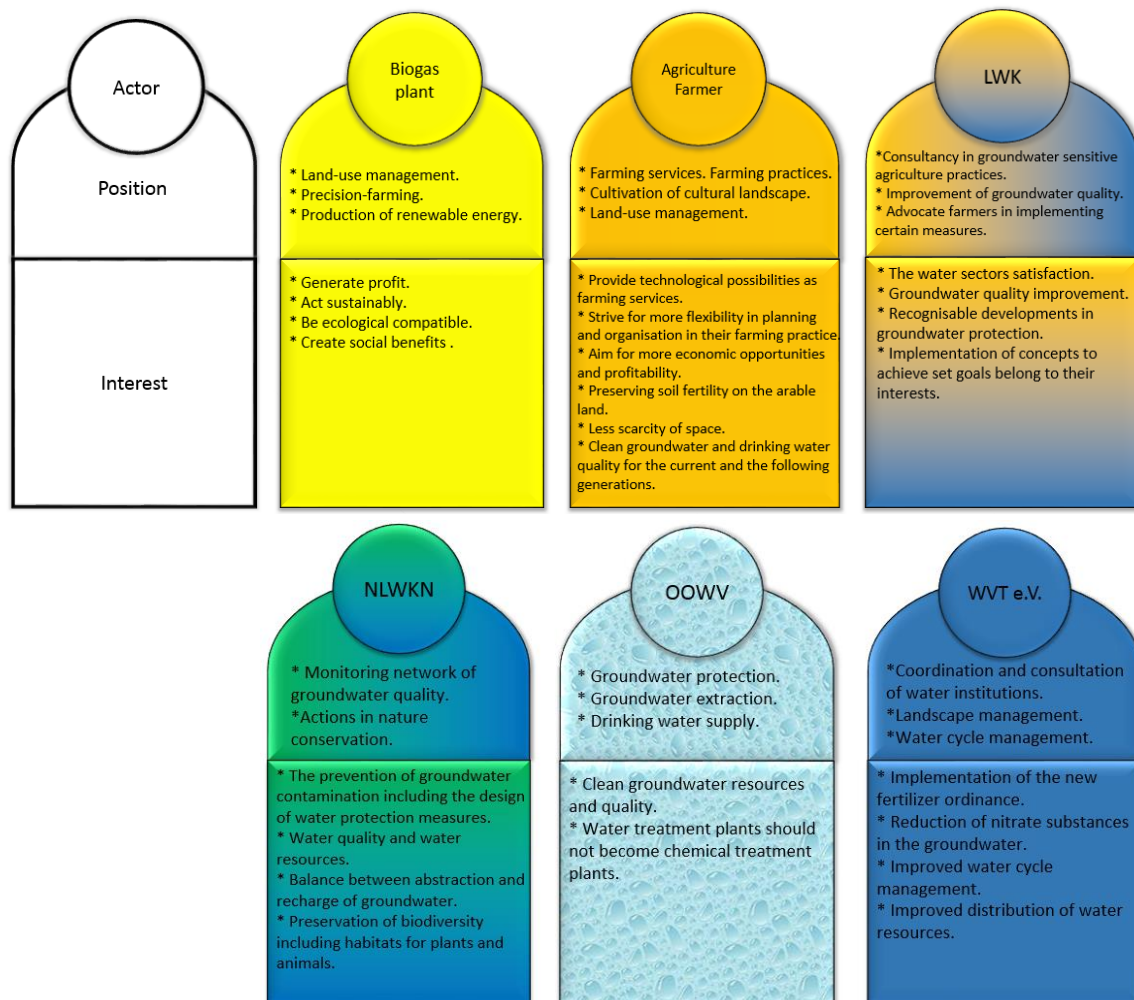


Figure 12- Actors' positions and interests (author, 2017). The circles indicate the actors. The semi-circles represent the actor's position and the rectangles refer to the actor's interest.

The *Biogas-plant* as an actor has the responsibility of land-use management, precision farming, production of renewable energy requiring the growth and cultivation of mainly maize. The main interests of the biogas plant are to generate profit, act sustainably, be ecological compatible and create social benefits.

Agriculture, including farmers, is responsible for farming services, farming practices, land-use management and cultivation of the cultural landscape. Farmers are interested in offering technological possibilities as part of their farming services, strive for more flexibility in planning and organisation in their farming practices, aim for more economic opportunities and profitability, have an interest of preserving the soil fertility on the arable land despite the scarcity of space or increasing shortage of farmland, and are interested in clean groundwater and drinking water quality for the current and the following generations.

The *LWK* as the agriculture chamber has rather a two-folded position and functions as a mediating link between the agriculture sector and the water sector by means of consultancy in terms of groundwater sensitive agriculture practices that improve the groundwater quality and advocate farmers in implementing certain measures. The water sectors' satisfaction, groundwater quality improvement,

recognisable developments in groundwater protection and implementation of concepts to achieve set goals belong to their interests.

The *NLWKN*, as an organisation has a two-folded position in water economy and nature protection holding the responsibility for establishing a monitoring network of groundwater quality and take actions in nature conservation. The prevention of groundwater contamination including the design of water protection measures, water quality and water resources, the balance between abstraction and recharge of groundwater on the one hand, and the preservation of biodiversity including habitats for plants and animals belong to their interests.

The *OOWV* as the water supplier is responsible for the groundwater protection and groundwater extraction and purification, and drinking water supply for the society. Avoiding water treatment plants of becoming chemical treatment plants belong the highest priorities of the *OOWV*.

The *WTV e.V.* as the water board is mainly concerned with the coordination and legal consultation of various water institutions and is responsible for landscape management and water cycle management. The implementation of the new fertilizer ordinance with the aim to reduce nitrate substances in the groundwater and an improved water cycle management and an improved distribution of water resources belong to their most important interests.

4.3.2. Interests: Realization of mutual gains or conflicts of interests leading to tensions?

Realising mutual gains between the agriculture sector and the water sector requires the findings of aspects that are mutually interlinked representing consensus or dissent. Several mutual gains and some conflicting interests leading to tensions have been discovered. In the case study, three principles of mutual gains and conflicting interests are highlighted: water and agriculture; groundwater quality and agricultural land-use management, groundwater quality and consultancy for sustainable agriculture practices, groundwater quality and agriculture in respect to nature conservation. These are elaborated one after the other as follows. Figure 12 demonstrates that the water sector and agriculture sector have different positions and interests from each other; however, some interests are also mutual and overlap.

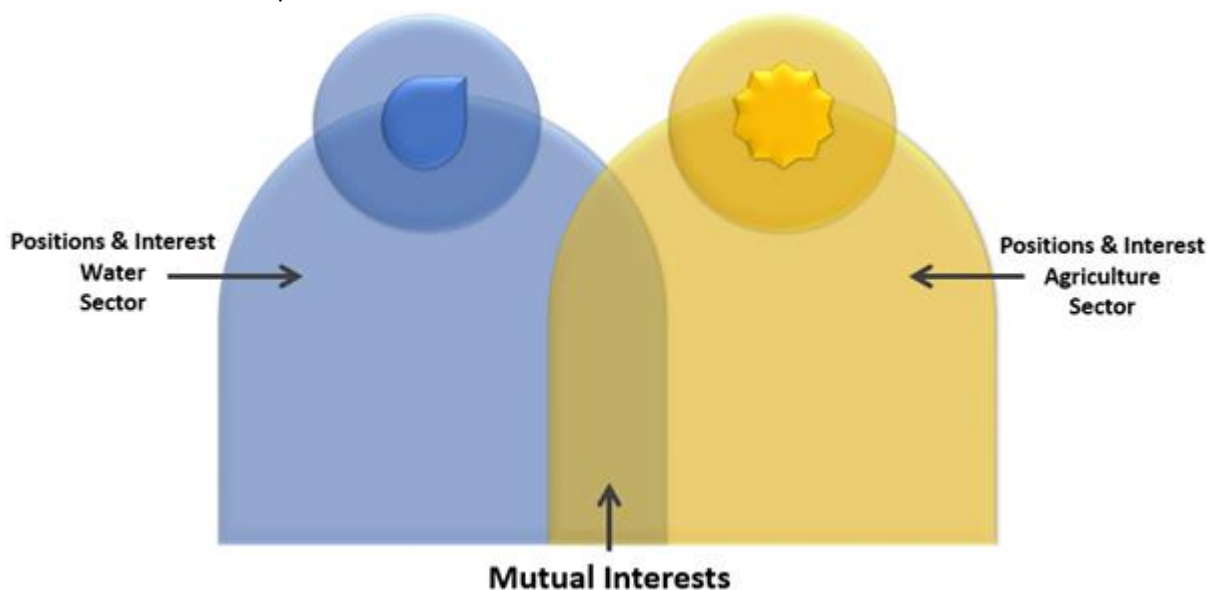


Figure 13- Mutual Gains Overview (author, 2017). The blue figure represents the position and the interest of the water sector. The orange figure represents the positions and interests of the agriculture sector. The interests of both sectors overlap in the middle part.

Water and Agriculture: Groundwater quality and agricultural land-use management

The first mutual gain consists between the groundwater quality and agricultural land-use management. The NLWKN and the LKW support farmers in adapting measures into their land-uses that avoid groundwater contamination. A variety of measures in land-use management can lead to benefits for groundwater quality such as the usage of grassland as a form of land-use management that does not require any mineral fertilizer containing nitrogen and saves costs for farmers. The exclusion of such potential harmful substances benefits the groundwater quality. Another possibility of land-use management is the cultivation of intermediate crops capable of absorbing nitrogen, preventing nitrate leaching into the groundwater (Di & Cameron, 2002). Also, riparian strips or riparian zones are a possibility to prevent groundwater from contamination. Overall, in accordance with the new fertilizer ordinance, fertilization corresponding to the nitrogen requirement of crops and plants avoid surpluses and serve to protect the groundwater (BMEL, 2017a).

There is a wide range of ways to protect the groundwater quality that we support the farmers with, and they appreciate that – from ecological farming, to cultivation of intermediate crops, greening of the land's surface, environmental-friendly manure application with advanced techniques, extensification of grassland, flowering riparian stripes, these are some of the classical examples.
Water expert 2, NLWKN

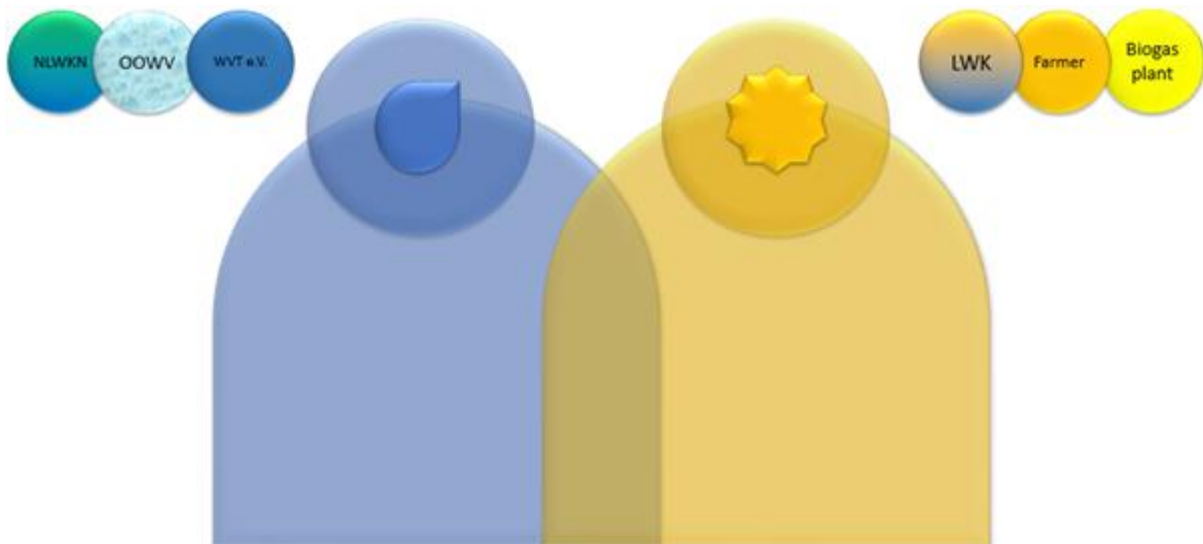


Figure 14- Mutual gains between groundwater quality and agricultural land-use management (author, 2017). The blue figure represents the water sector. The three small round blue figures represent the actors from the water sector. The orange figure signifies the agriculture sector. The three small orange and yellow figures represent the actors from the agriculture sector. The green overlapping part in the middle demonstrates the common interests and consensus between the two sectors.

Nevertheless, the riparian zones have caused some tensions between the water sector and the agricultural land-use management, because the riparian zones were planned to have a width of 5 meters on farmer's land, meaning a reduction of farmer's space and a limitation of land-use management. The statements of the farmers make this tension clear.

We had the discussion the Lower Saxony Water Act about 5-meter riparian stripes, meaning how much distance the farmer has to keep from the water bodies when fertilizing. For us farmers these 5 meters are missing, which is almost an expropriation. And if someone is surrounded by water areas, as in the Wesermarsch or Ostfriesland where the water density is high, then this is threatening to our existence.

Farmer 1, Agriculture



Another farmer adds;

This discussion about the 5-meter riparian zone means for me a loss of 2 hectares of land that I would not be allowed to use. No landowner has an understanding for that when your space or land is just taken away. The lease for the land would be still the same but I would not be able to use the land.

Farmer 4, Agriculture



A third farmer explains;

It has been agreed that the riparian zones of 5-meter width are temporarily reduced to 1 meter. This is still a limitation for us farmers, but if the nitrate values get worse, then the 5 meters width of riparian stripes come into force.

Farmer 2, Agriculture



This example shows that consensus and mutual benefits can exist for both the water sector and agricultural land-use management. However, looking more into detail into a specific type of land-use management, it becomes clear that dissent exists leading to tensions.

Water and Agriculture: Groundwater quality and consultancy for sustainable agriculture practices

A further mutual gain between the groundwater quality and sustainable agriculture practices can be reached under the condition of consultation and financial reward for farmers for their sustainable agriculture practices. Since the water sector aims for an improvement of the groundwater quality and farmers fear loss of profits when changing from conventional agriculture practices to sustainable agriculture practices, a financial reward is offered by the EU to farmers for undertaking sustainable agriculture practices. Consensus exists, as water experts and farmers appreciate the consultation offered by the LWK and NLWKN and see benefits in economic opportunities for farmers. This financial reward is an additional source of income and benefits farmers in saving costs. The water sector benefits from the shift towards more sustainable agriculture practices as these prevent groundwater from contamination.

We can participate in this voluntary consultancy. I participate because it is very interesting and very important in my view. That the nitrate leaches into the groundwater does not take place is also important for me. The consultancy costs me nothing, the additional consultancy is good and I can learn how I can reduce the nitrate in my farming practices as low as possible.

Farmer 1, Agriculture



The advice of the chamber is always pragmatic and I find it very important. And if we have a common goal; to optimize the fertilization, to protect the groundwater, and at the same time also to save money, then this is something really precious I would say. This consultancy means to strengthen our knowledge and improve ourselves. I also advice other farmers to take this consultancy because it is very helpful for one's own.

Farmer 5, Agriculture



A water expert confirms this appreciation of farmers;

The consultancy is voluntary and without any costs for farmers. The agriculture takes additional measures for the benefit of the groundwater. The consultants come on the farm and discuss all the questions about groundwater together with the farmer – I believe that this changes something in the consciousness or mind of farmers, they find acceptance, receive financial reward and make a contribution to the groundwater protection.

Water expert 2, NLWKN



Another water expert is satisfied with the effort of farmers;

Everyone has taken the consultancy seriously. You could see, farmers wanted it because they can increase their efficiency. It is a nice win-win situation, when the farmer increases the efficiency and has less work to do and generates more yields for less use.

Water expert 1, WVT e.V

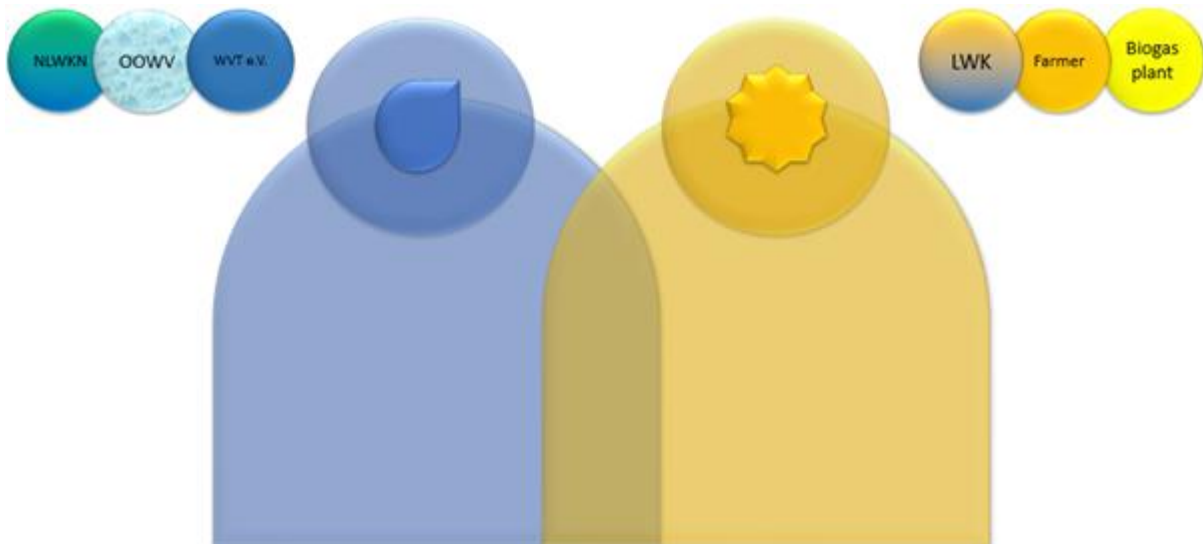


Figure 15- Mutual Gains between groundwater quality and sustainable agricultural practices based on the conditions of consultancy and financial reward (author, 2017).

On the basis of consultation and financial reward the water sector and the agriculture sector can build consensus and create mutual benefits, because more sustainable agriculture practices are realised by farmers that support the water experts in having nitrate-free groundwater resources and clean groundwater quality.

However, being able to receive financial reward from the EU, the sustainable agriculture practices must be declared by farmers to the EU which requires a high amount of bureaucracy and administrative burden for farmers and for consultants working for the LWK and NLWKN. The aspect increasing bureaucracy is a challenge for the agriculture sector leading to frustration and decrease of motivation.

Difficulties are currently in a financial perspective. We are very broad with 3 branches of agriculture business, but it does not fit at the moment, and we also have a lot of bureaucracy and constraints.

Farmer 4, Agriculture



This is half an office job already. I'm almost no outside worker anymore but half of my time is in the office, but I have to be finished outside. I have to do this paperwork after work, in the evening, or when the weather is bad. There is no pleasure to be in the office because I have learned to be a farmer, outside on the field and not sitting at the desk!

Farmer 2, Agriculture



Additionally, the farmer and employee of the biogas plant can confirm this burden of bureaucracy:

Every year there is always something new, new regulations and I'm just bound to the office for 80%-85% of my time.

Farmer 3, Agriculture, Biogas plant



The water experts confirm this bureaucratic burden;

There are a lot of regulations which means a lot of bureaucracy and high administrative burden also for us. This whole thing is always complained about. Also, the financial resources and financial compensations are limited, not infinitely. In agriculture, the biogas boom with high maize content, make it more difficult for the groundwater quality.

Water expert 2, NLWKN



Another water expert adds;

The farmers have to declare their sustainable agriculture practices in advance to get a bonus of money for it. This is also very complicated with these different applications. Very complicated and quite extensive. They are also very strictly controlled.

Water expert 3, OOWV



Next to the bureaucratic burden, tensions can be recognised between farmers and water experts in adaptations of more sustainable agriculture practices. Water experts from the OOWV and WVT e.V. require farmers to adapt their agriculture practices that benefit the groundwater quality. On the other hand, farmers question the feasibility in changing their agriculture practices leading to dissent.

Agriculture has to do their job now. There are 50mg/l of nitrate in the groundwater now. Since 1991 a directive for groundwater protection against nitrate from agriculture. This is 26 years ago and now we get the new fertilizer ordinance – a quarter of a century later. Now the farmers have to understand that the patience of us water authorities is at its end.

Water expert 1, WVT e.V.



The agriculture must learn to produce in accordance to the law. There are different kinds of laws, environmental law, social laws, natural laws, animal welfare laws, and so on. And if agriculture were to simply adapt their agriculture practices to these laws, then there would be no conflict between agriculture and water.

Water expert 3, OOWV



On the other hand, farmers are concerned with certain requests:

I think the other parties just want to realise their interests without wanting to understand that some requests are hardly possible to achieve for us farmers. Not the interests of the farmers but of them [water sector] are enforced instead of thinking about what is feasible for us. Farmers then simply try to arrange their practices and manage it somehow, we rather accept and resign.

Farmer 2, Agriculture



In support to that is the argumentation of another farmer, who states that:

These things [requests] have to be realisable and feasible, only then we can really adapt. If the broad mass of agriculture is to remain, then the steps towards a more sustainable agriculture must be small and feasible. If the requests are placed too high, then only a few big agriculture businesses can survive and no one benefits from that in my opinion.

Farmer 1, Agriculture



These examples show that farmers make an effort in order to shift towards more sustainable agriculture practices for the intention of maintaining good groundwater quality. Farmers appreciate the support in terms of consultation offered and undertaken by the LWK and NLWKN and appreciate the financial reward from the EU for their effort in adapting their agriculture practices and improving the groundwater quality. Nevertheless, farmers are struggled with a sense of frustration due to the burden of bureaucracy and administrative load and feel their working place shifts from *outside to inside* or in other words, their vocational tasks change from agricultural activities on the land towards vocational tasks at the desk, which is not in their preference. Besides that, tensions exist between the water sector and agriculture sector due to the fact that water authorities are not satisfied with the groundwater quality even though a directive for groundwater protection has been enforced a quarter of a century ago. Due to that, water experts see the responsibility now in the agriculture sector to change and prevent nitrate leaching into the groundwater. This tension maintains as the farmers highlight that not all requests are feasible to realise and a transformation from current conventional agriculture practices to sustainable agriculture practices takes time.

Water and Agriculture: Groundwater quality and agriculture in respect to nature conservation

The water sector, in particular the drinking water supplier OOWV, buys agricultural land and converts it into ecological-friendly organic farms with *Biohof Bakenhus* as an example. Moreover, the OOWV leases out the farmland to farmers at a lower price under the condition of following an organic farming-style aiming for groundwater protection and nature conservation. In this way, mutual gains are established for the water sector because the groundwater quality remains at a good status as no impacts of fertilizers pollute the groundwater. Benefits for farmers exist in terms of economic stability by renting farmland to lower price, compared to the price the OOWV purchased it in the first place, economic opportunities by cultivating organic products and applying organic production methods. Organic farming has also a strong advantage for nature, because water protection means also nature protection.

A water expert from the NLWKN, as partly the nature organisation states that;

We have to understand that we deal with the nature, and nature cannot be shaped and not be pressed into forms.
Water expert 5, NLWKN



The water expert from the OOWV combines nature conservation with agricultural practices that are protective to the groundwater.

We buy land in the water protection areas and rent it to farmers, with the condition that the farmer switches to organic farming, low fertilization, no plant protection products allowed. This is the conditions in the contract. So, we determine the rules of the games. If we have converted an area to organic farming in the water protection area, then all problems are solved all of the sudden.
Water expert 3, OOWV



The farmer's share the common interest of groundwater protection and nature conservation.

We are all interested in a clean environment. Priority is clean water also for the next generations.
Farmer 5, Agriculture



In combination of groundwater protection, nature conservation and agriculture is explained by the water expert from the WVT e.V.

The service and effort that the agriculture provides for the society has to do not only with protection of water, but also with nature protection or landscape. Agricultural services range from cultivating landscape, serves environmental protection and they receive premiums from the EU.
Water expert 1, WVT e.V.



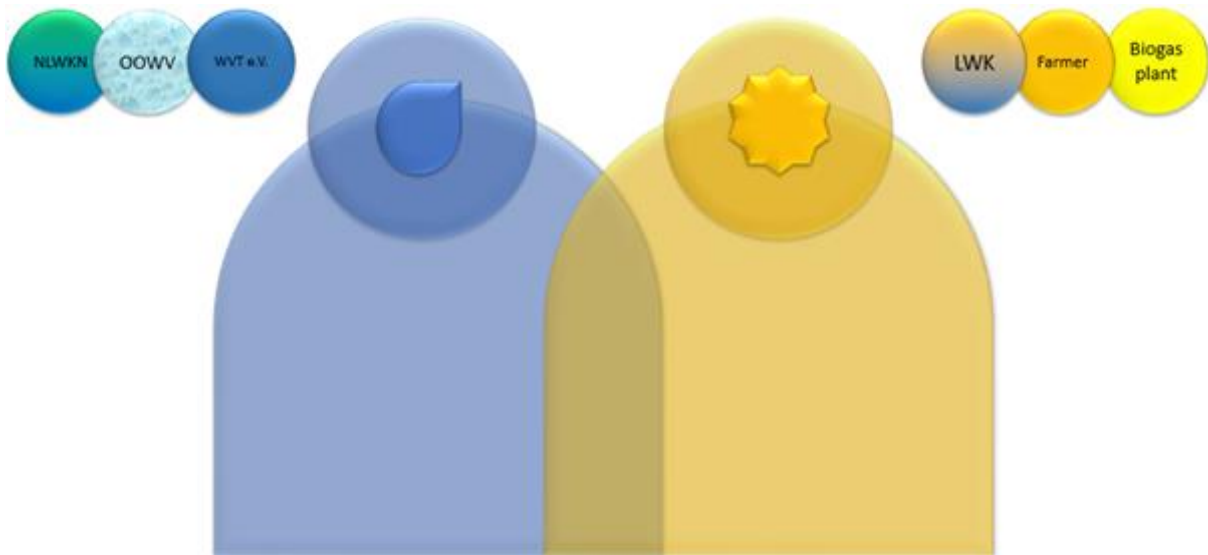


Figure 16- - Mutual Gains between groundwater quality and agricultural sector in relation to nature conservation (author,2017).

However, despite these mutual benefits of the water sector and agriculture sector of striving for nature conservation, maintaining a good groundwater quality and offering economic opportunities for the farmer, tensions evolved in the method of purchasing and leasing out farmland.

The leasing agreements in this area are terminated and traditional farmers cannot deal with it anymore. The OOWV wants to have the areas for himself. He has his own organic farm Biohof Bakenhus and it does not go well with each other. The OOWV buys the land to push out the traditional farmers out of this area, certainly to reduce the nitrate values, but this is undertaken with foreign money which is always easier. The organic farm, Bakenhus, would not be able to exist without the OOWV.

Farmer 1, Agriculture



Despite the tensions between the agriculture sector and the water sector, the intermediate link the LWK tries to harmonise by stating;

The organic farming is certainly good for the reduction of nitrate values and the groundwater protection. However, it needs to be thought of in what kind of style organic farming is implemented in an area.

Water expert 4, LWK



This example of mutual gains shows that benefits can exist for groundwater and nature protection on the one hand and create economic opportunities for farmers on the other hand even though under the conditions that farmers need to follow the rules set by the water sector. Farmers are strongly connected with the nature and share the common interest of protecting nature and groundwater with the water sector. However, the tension is provoked because farmers feel to be pushed out of the area where they live and work for many generations.

4.3.3. Values

Besides the positions and interests, also values have been derived from the semi-structured interviews with farmers and water experts. Values of actors are rather hidden features, as they are linked to emotions and relate to personal preferences for a situation (Susskind & Field, 1996). It is very difficult to phrase values of each actor and complex to compare them. Due to this, the values discovered

through the semi-structured interviews are expressed more generally. Consensus on values of actors are described and analysed in the categories of: clean groundwater resources collected on agricultural land, stabilisation of sustainable agriculture to assure livelihood of farmers, consumers financial contribution for realisation of sustainable agriculture practices and clean groundwater quality.

Clean groundwater resources collected on agricultural land

Groundwater resources are necessary for the water sector to generate drinking water for the society and essential for the agriculture for irrigation and livestock. For this reason, consensus exists between the farmers and water experts in regards to regenerating clean groundwater resources on agricultural land. Since the groundwater level has lowered in recent years due to climatic changes and water distribution, efforts are made and values are shared in terms of groundwater regeneration.

50 years ago, the groundwater level was here by 1 meter, now the groundwater level is by 6-7 meters, it has decreased a lot and this is of course a problem for us. Generating groundwater is part of my responsibility. I manage more than 70 hectares and the groundwater regeneration takes place on my farmland. Groundwater is essential to grow my fruit, for my animals, and I need clean drinking water like all other people. Water is a precious good and perhaps groundwater should be more expensive so it is treated better and not wasted.

Farmer 1, Agriculture



In the consensus with the farmer is also the water expert when referring to the value of groundwater resource:

The quantity of the resources, meaning the water groundwater abstraction and the groundwater regeneration rates must be in a reasonable ratio. Groundwater resources need to be preserved to maintain living space for animals, plants, and develop this habitat further.

Water expert 2, NLWKN



Our responsibility is of course the management of groundwater resources. Most suitable for that is sandy soil which has a high regenerative capacity. The sandy soil in some areas guarantees a high groundwater recharge for us a high groundwater recharge.

Water expert 3, OOWV



The value of having sufficient groundwater resources is visible in the answers of farmers and water experts. The responsibility in regeneration groundwater resources is a matter for both actors. Farmers and water experts are concerned about the water cycle. The groundwater, which is recharged in Lower Saxony, is extracted and distributed to different areas and delivered to industries. This is regarded as a mismanagement from the view of the farmers but also from the view of the water experts from the WVT e.V.

The distribution of the groundwater that we generate here in other regions is what worries me and has become a problem. High amounts of groundwater that we generated here are delivered to industries such as Kronos Titan GmbH in Nordenham that use water for production factors. We don't get our groundwater back from them of course.

Farmer 1, Agriculture



The titanium plants in Nordenham need for the production very clean water and there is no clean water up there in the Wesermarsch region. It has most saline groundwater, so they get the groundwater from us.

Water expert 3, OOWV



We have a groundwater distribution problem. Back in the years, we had small and local water cycles. Nowadays, we have global, regional and local water cycles. Other areas need to look at how they deal with their water cycles themselves and there is no purpose to safe water in Lower Saxony. The water cycles will shift, but the water cycles must be closed again.
Water expert 1, WVT e.V.



This example shows that the water and agriculture sector share the value of clean groundwater resources as they are both dependent on them for their activities. Moreover, both actors indicate the preference of managing water cycles on a more local level and manage the distribution of generated groundwater in Lower Saxony better.

Stabilization of sustainable agriculture to assure livelihood of farmers

Consensus exists in the value that agriculture is of great importance for the society, since agriculture is the key actor in cultivating land and establishing the cultural landscape in Lower Saxony. Farmers

I appreciate that the farmers strive to become more sustainable and want to be eco-friendlier. But I'm worried that the agriculture is no longer competitive maybe because of the economic pressures. But we cannot let agriculture disappear completely as we value farmers in managing the land. This means the farmers need to be paid more for their provision of services to the society, for the protection of water bodies, for the protection of groundwater, for preserving biodiversity in our cultural landscapes or returning them. For all these performances, the agriculture needs to be rewarded. In this way, they [agriculture] should be able to become more sustainable and produce excellent products that can be sold well on the market.

Water expert 3, OOWV



orient themselves towards more sustainable agriculture by focusing on greening-strategies, growing intermediate fruit trees, change to advanced technologies, alter their tillage practices, precision-farming, needs-based fertilization and more that contribute to a better quality of life. For a better livelihood of farmers, also the water sector, in particular the actor OOWV, sees a need in supporting agriculture in developing and improving its activities to become more stable in its sustainable agriculture practices. The stabilisation of sustainable agriculture practices could guarantee a better quality of life for farmers by becoming more competitive on the world market, in the view of the water sector.

The farmers express this value of cultural landscape that the contribute to the society and make an effort in developing more sustainable agriculture practices:

We [farmers] value what we do and the society can profit from us. We cultivate the cultural landscape. I think if farmers would not be here to cultivate the fields, then weed would grow here. [...]. I constantly develop myself in becoming more sustainable. I use advances technology. I cultivate intermediate fruit crops in autumn to absorb nitrogen residues, after I have harvested crops in the summer. Then I have some crops for winter to store the remaining nitrogen from the soil. Then I sow plants suitable for spring. In this way, the soil fertility is improved naturally and sustainably.
Farmer 5, Agriculture




The shared value for cultural landscape is indicated in the answers of water experts and farmers. Furthermore, farmers implement a variety of alternatives in their farming practices that equals sustainable agriculture practices. The sustainable farming efforts of farmers are appreciated by water

experts. However, water experts declare that sustainable agriculture practices need to be much more stabilised, particular because it prevents groundwater from contamination, but would also increase farmer’s competitiveness and could enhance farmer’s livelihood.


Consumers financial contribution for realization of sustainable agriculture practices and clean groundwater quality

Being able for farmers to develop sustainable agriculture practices without suffering from economic loss and being able for water experts to provide clean groundwater quality for human purposes, both actors indicate that they would value the involvement of consumers. The water experts acknowledge that the choice of consumers on agricultural products has an effect on the feasibility of farmers to realise sustainable farming, which then has a beneficial effect on the groundwater quality. Consensus exists in the need of consumer involvement and objective and factual communication between farmers and water experts.


The farmers are lacking in money to be able to manage their agricultural practices fully sustainably. This is perhaps because we, as consumers, are too little willing to pay more for food products and because of our tide-is-right-mentality [Geiz-ist-geil-Mentalität] in connection to the retail stores or supermarkets. I believe that a system has emerged which leaves farmers with no other chance.
Water expert 3, OOWV



Bringing it to the point, who decides for cheap meat and the production methods that are associated with it, will inevitably be asked from us the water supplier to cash, because we have to pick up nitrates and pesticides out of the groundwater, and then the consumer has to pay for the repair over the drinking water price.
Water expert 3, OOWV




The society profits from the fact that we produce food here to a very high quality. But if we have to reduce and become smaller, then the people have to aware that this must be borne by society.
Farmer 5, Agriculture




At the same time, farmers acknowledge that the water sectors are challenged due to nitrate substances in the groundwater and also points out that consumers contribution, for instance in form of a Water-penny [Wasserpennig], could be a valuable contribution in realising clean groundwater quality.

The water-penny could be a contribution for a win-win situation.
Farmer 3, employee Biogas plant, Agriculture



If some farms cannot bring the nutrient balances in order, and this can happen. Well, then that must be borne by the consumer or the society, via a water penny for example. The groundwater or drinking water is too cheap and this is why it is consumed without worries. Tax for consumers using water would not be wrong.
Farmer 1, Agriculture



The final shared value expressed by both actors related to an objective and factual communication and a face-to-face personal contact to each other and to consumers. Through the semi-structured interview with farmers and water experts it became clear that the personal contact to each other is rather weak or even non-existent but is a strong common value. The only occasion where a spokesperson of the agriculture and water experts can have a dialogue is the organised cooperative meeting that are facilitated by the intermediate actor LWK. These cooperative meetings are highly valued by both actors as information can be exchanged. However, despite the fact that the consumer is an influential player in influencing the feasibility and realisation of sustainable agriculture that also has an impact on groundwater quality, no spokesperson of consumers is involved in the cooperative meetings. Moreover, these cooperative meetings only take place between farmers and water experts that are located in the drinking water extraction areas and not in water framework directive areas. That means the personal connection between water experts and farmers and with consumers is non-existent anymore but this existence is a strongly shared value. Five out of five interviewed farmers have answered that they have no contact to the water sector. And five out of five interviewed water experts have stated to have no direct contact with farmers. This is striking, particular because agriculture and water is so closely interlinked.

Nevertheless, farmers and water experts have the desired common value of objective and factual communication with each other:

We really have only the way through these cooperation meetings to talk to spokespersons of the farmers, but not to the farmer each individually.
Water expert 5, NLWKN



The conflicts are exposed rather through the media instead of that water authorities talk us. I read just one-sided negative information about agriculture in the newspaper.
Farmer 2, Agriculture



Information is missing in my view. A more personal and objective dialogue is necessary and not the fight through the media and the political games.
Farmer 1, Agriculture



This whole thing needs to get back to a functional level. I think it is the worst thing that the factual and objective level has been left and it is simply about hammering down. [...] I would value it to get everyone on boat, not only the agriculture chamber [LWK] but also the water supplier so that we can have a personal conversation. I think that would help a lot if we understand each other better.
Farmer 5, Agriculture



Communication is the key and a platform is highly important where everyone speaks the same language. The water sector has to learn something about agriculture and farmers have to learn about water economy to understand what kind of actions have an impact on the groundwater.
Water expert 4, LWK



In addition to that, not only the objective communication between farmers and water experts would be valued but also persona contact to consumers is lost and would be valued by both actors.

Back in the years the people came directly on our farm to buy our products. That was great.
Farmer 4, Agriculture

Consumers have to think that products need to be produced and not simply fall from the shelf of Aldi or Lidl.
Farmer 1, Agriculture

Back in the years we gave milk, potatoes, meat directly to consumers because we have done everything by ourselves, from making sausages, to growing vegetables, milking and providing it to the people ourselves. This is all over now. [...]
Many things are also not allowed anymore to do it yourself, and growing food is rather a hobby - we cannot live of that anymore. We even buy food in the supermarket ourselves as it is much cheaper compared to growing it on our own. [...]
Even if the consumer would say he would pay 1 Euro more, this money would not reach us as the discounter puts that money into his own pocket.
Farmer 2, Agriculture

The shared values of objective and factual communication and dialogue between farmers and water experts are indicated. Also, the involvement of consumers seems to be of high value from both sides so that awareness can be raised about the influence that the consumer and his buying behaviour has on the agriculture practices and the impacts on the groundwater.

4.3.4. Recap: mutual interests and shared values

Analysing and elaborating the actor's positions, interests and values, this recap sections provides a tabular overview (table 3). Subsequently synergies about the mutual gains based on common interests and values are described.

Mutual Interests	District of Oldenburg in Lower Saxony
Groundwater quality and agricultural land-use management	Various types of land-use management, i.e. usage of grassland, save costs for farmers and benefit groundwater quality.
Groundwater quality and consultancy for sustainable agriculture practices	Consensus and appreciation for consultation and financial reward benefits in economic opportunities for farmers and shift towards sustainability prevents groundwater pollution.
Groundwater quality and agriculture in respect to nature conservation	Consensus in economic stability for farmers due to lower rent for farmland and no fertilizers due to organic farming that contaminates groundwater.
Shared Values	
Clean groundwater resources collected on agricultural land	Consensus exists between the farmers and water experts in regards to regenerating clean groundwater resources on agricultural land.
Stabilisation of sustainable agriculture to assure livelihood of farmers	Consensus exists in the value that agriculture is of great importance for the society, since agriculture is the key actor in cultivating land and establishing the cultural landscape sustainably.
Consumers financial contribution for realisation of sustainable agriculture practices and clean groundwater quality	Consensus exists in the need of consumer involvement and objective and factual communication between farmers and water experts.

Table 3 - Overview of mutual interests and shared values of farmers and water experts (author, 2017).

Table 3 shows that various mutual gains on actor's interests and values can exist. Even if some tensions evolve due to conflicting interests, a compromise can be formed because an understanding of each other's situation has been expressed by both actors. Additionally, shared values make it possible for both actors to build consensus.

Combination of interests despite differences in positions

Despite the differences that the various actors of the water sector and actors of the agriculture sector have, various interests could be combined and mutual gains could be formed. The agricultural orientation towards sustainable farming with the usage of a wide range of land-use management types that also serve a nature conservation function were triggered through consultation and rewarded with financial means. These developments were beneficial for the water sector as the groundwater quality can be sustained and even improved as agriculture develops its practices and mitigates its impacts on the groundwater. The examples show that consensus-building can be successful when interests are combined, common values are discovered and collaborative planning can be realised (Innes & Booher, 1999; Healey, 2006). This is in accordance to the consensus that is established between the farmers and water experts, particular with the help of an intermediate actor, the agriculture chamber LWK, that facilitates, communicates and consults farmers and water experts and shows support for a common direction to strive for. Nature conservation is connected to a fertility of soil, growing of various types of crops and plants and the cultivation of cultural landscape that is highly essential for agriculture, but simultaneously is a great contribution for a clean groundwater quality. Also, tensions evolve due to scarcity of space, bureaucratic or administrative burden.

Shared values in objective communication supporting sustainable agriculture and clean groundwater resources

The mutual gains approach explains that interests of actors imply deep-rooted values that are essential to find joint gains (Susskind & Field, 1996; Hopmann, 1995; Sebenius 1992). Farmers and water experts share the value of regenerating groundwater resources on agricultural land which is a significant point in collaborating and combining interests. This helps to understand that a variety of sustainable farming alternatives need to be supported that help groundwater level to be recharged and both, water suppliers and farmers can benefit from the clean groundwater resources. The second shared value is the stabilisation of sustainable agriculture practices that is conducive to the quality of farmers but also beneficial for groundwater. This explains why water suppliers such as the OOWV support sustainable agriculture or organic farming. Another common value, which is rather a need, is the involvement and contribution of consumers. Since sustainable agriculture and groundwater quality is influenced by consumers' choices or consumption behaviour their involvement into the communication process is important.

The following figure 17, shows that the water sector and agriculture sector reach agreement because of the most important common interests and shared values that help to build consensus and create mutual gains.

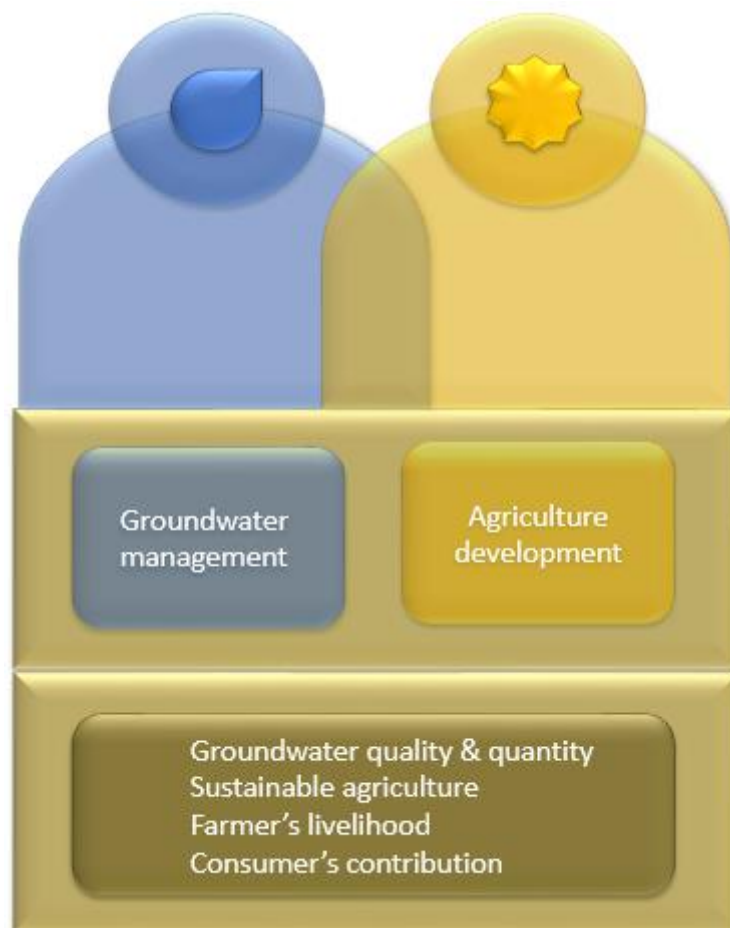


Figure 17- Mutual interests and shared values between water and agriculture (author, 2017).

Analysing the positions, interests and values, the improvement of the groundwater quality is always the recurring aspect. However, without the connection to sustainable agriculture and an increase of farmer's livelihood the improvement of groundwater quality is difficult to achieve. Furthermore, such

a shift to sustainable agriculture and enhancement of farmer's livelihood can be achieved not only by the water and agriculture sector but also requires the involvement of consumers in the communication processes and the contribution in monetary terms (Nuttavuthisit, 2010).

4.4. Measures affecting willingness and ability

Which measures hinder and increase willingness and ability of the agriculture sector to reduce the impact on groundwater quality in Lower Saxony? (Q7)

As indicated in the previous section, the feasibility in regards to certain measures, is often a concern of farmers. Question three focuses on the willingness and ability of the agriculture sector to reduce the impacts on the groundwater quality. To find out what kind of measures hinder or increase the willingness and ability, the measures mentioned in the semi-structured interviews are analysed. The various measures, in relation to groundwater protection, are listed, distinguished and analysed based on the perceptions of the interviewed actors from both sectors. These measures are categorised based on the two attributes of *willingness* and *ability* in order to indicate what is possible and how it is possible to improve the groundwater quality (de-Graft Acquah & Onumah, 2011; Arbuckle et al., 2013). Barriers are added that give an indication about the hindrances to adapt agriculture practices. In practice, a wide range of well-functioning measures but also barriers have been discovered during the semi-structured interviews with farmers in the district of Oldenburg. The integral idea is that if such barriers could be removed or mitigated, then the groundwater quality could be improved as the groundwater protection could be intensified and the livelihood of farmers could be changed for a better.

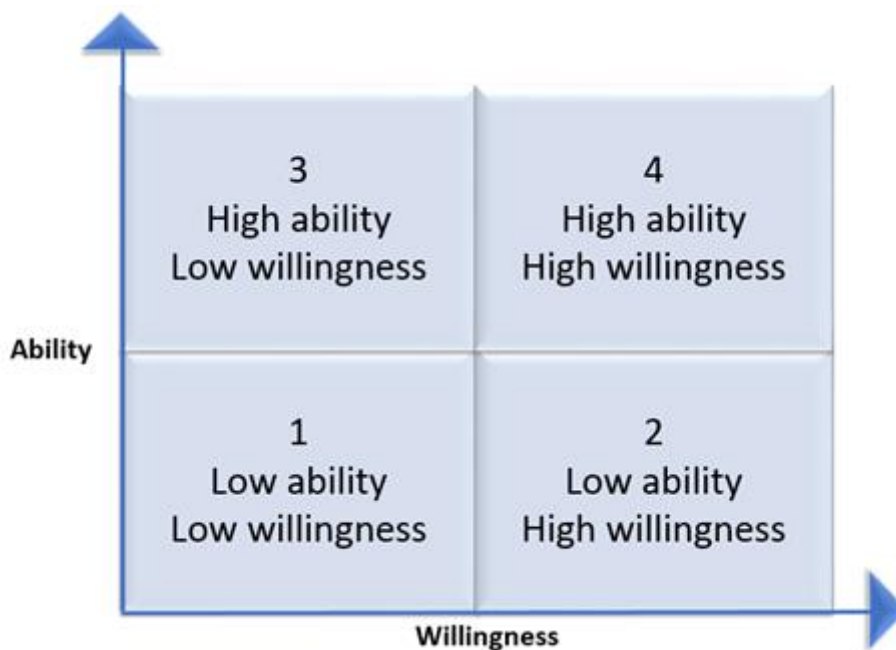


Figure 18- Ability-Willingness Matrix (adapted from Defra, 2008). This matrix represents two dimensions of ability and willingness. It is analysed which measures can hinder but also increase the willingness and ability of Agriculture to adapt. The measures influencing the ability and willingness of farmers are placed in these quadrants.

4.4.1. Measures mentioned in the semi-structured interviews

Farmer willingness and ability to adapt to measures is a social process based on the social construction. The farmer is a critical decision-maker if agricultural lands are to be effectively managed to adapt to changing conditions (Arbuckle et al., 2013). In practice, farmer's willingness and ability to adapt to measures depends on various factors such as climate, economic factors and political aspects. A variety of measures have been mentioned by actors in terms of protecting groundwater. These different measures are illustrated and placed in the matrix in figure 19 with a legend indicating the measures affecting groundwater protection and have been pointed out by the actors in the semi-structured interviews. In figure 19, each measure is explained briefly based on the findings from policy documents and supported with the actors' perceptions connected to each measure. It is elaborated whether these measures are perceived to hinder or to increase the willingness and ability of farmers to adapt their agriculture practices for the purpose to contribute to better groundwater quality. Some aspects of these measures are closely interlinked due to the fact that they have the same goal: improvement of groundwater quality.

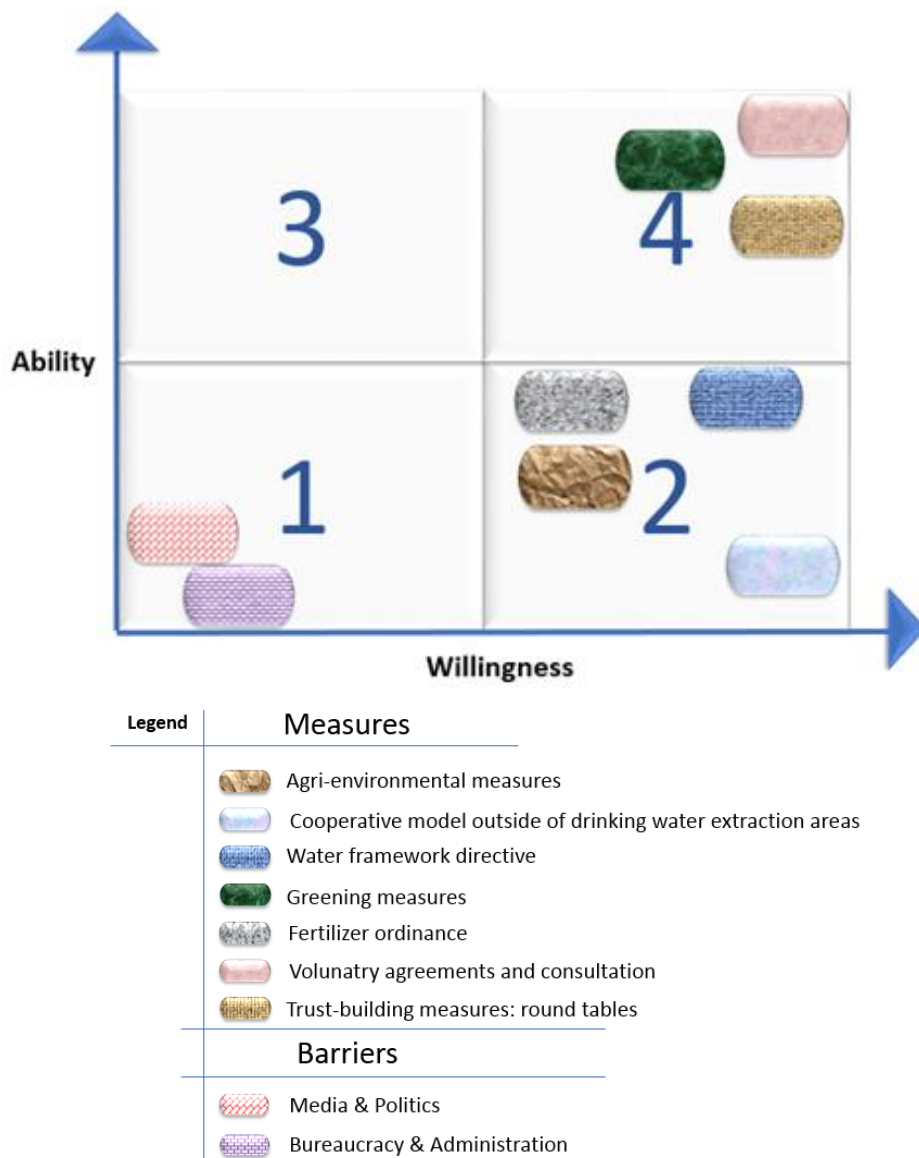
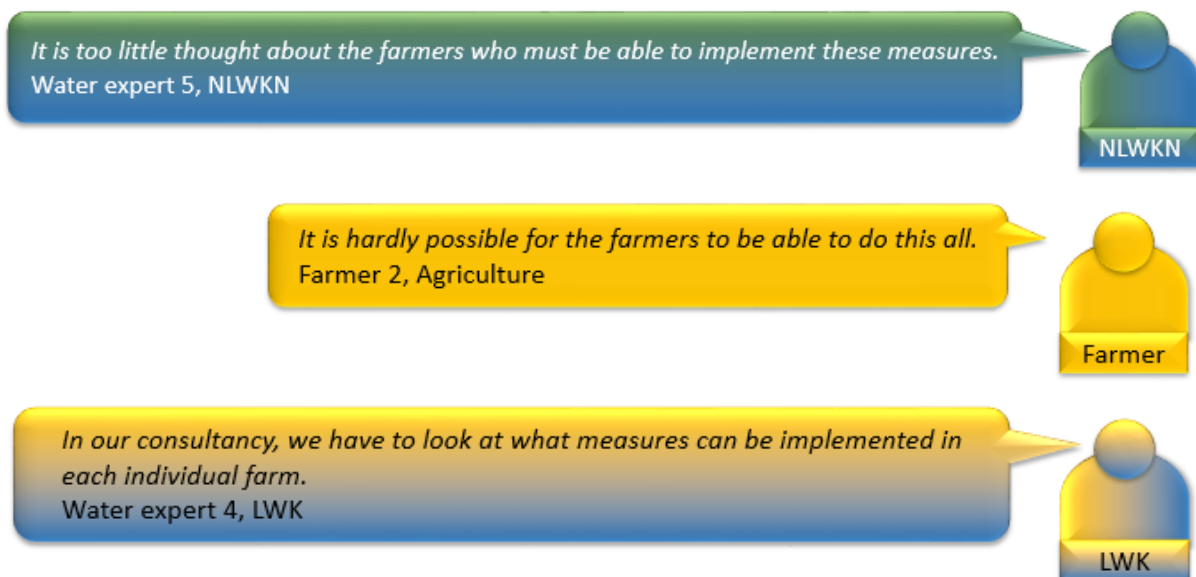


Figure 19- Ability-Willingness Matrix (author, 2017). This matrix represents two dimensions of ability and willingness. It is analysed which measures can hinder but also increase the willingness and ability of Agriculture to adapt. The measures influencing the ability and willingness of farmers are placed in these quadrants.

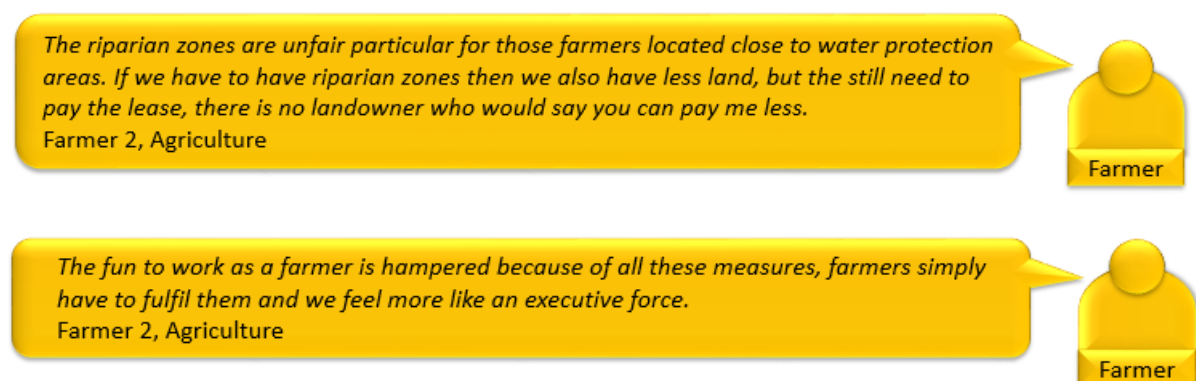
Agri-environmental measures

The first measure is the agri-environmental measures, which an essential component of the national framework for the development of rural areas applicable to Lower Saxony (Ministry for environment, energy and climate protection, 2017). This agri-environmental scheme is based on six pillars, whereas mainly the second and third pillars are important for this case. The second is about sustainable production methods on arable land. The third pillar is about planting of flowering zones and conservation of land and landscape elements on arable land. The focus in the second pillar is the cultivation of a variety of plants, winter greening with intermediate crops and nurse crops, proceedings and application of mineral fertilizer, no-tillage after canola, no-tillage after maize (Hall & Doraj, 2010; Hodge, 2001; Lockie, 2006). The third pillar includes riparian zones of one year or more, conservation zones for several, green zones as a protection for water erosion of water bodies (ML, 2017).

Figure 19 shows that agri-environmental measures are placed in the centre-right of the second quadrant indicating agriculture's low ability but moderate willingness to adapt this measure. The reasons for placing this measure is based on the answers and perceptions of the interviewed actors.



But not only the ability is rather limited to implement this wide range of agri-environmental measures, also the willingness plays an important role, specifically in the case of riparian zones.



Greening measures

The greening measures, also closely linked with the agri-environmental measures, are based on the requirement that the cultivation of plants must be more versatile and include at least two crops

whereas no culture may account for more than 60% of the mixture. To achieve this, the farmer receives a greening premium. Additionally, the permanent greenland needs to be preserved and 5% of arable land and riparian zones should be identified as ecological priority areas (LWK, 2017g). Figure 19 displays that the greening measures are placed at the centre-top of the fourth quadrant suggesting that the ability and willingness of farmers in implementing greening measures is relatively high. This high ability and willingness is confirmed in the statements of farmers to plant two or more different intermediate crop types in autumn to prevent nitrate leaching.

Every autumn I plant intermediate crops. It has been made compulsory by the EU, but this is actually already what farmers have been doing anyways.
Farmer 5, Agriculture

I have also made intercropping and I also do constant greening because there is some support for that. I try out different things to see what is the best possible to get out of it.
Farmer 1, Agriculture

We follow the three-intermediate crop-rule in ratio of 60/40, and plant them in autumn so that nitrogen gets out of the soil and is not in the soil during the winter. In this way, I minimise the nitrate. The cultivation of intermediate crops allows us to have to some grants.
Farmer 2, Agriculture

Fertilizer ordinance


The fertilizer ordinance is derived from the fertilizer act and has been revised and exacerbated in June 2017 (BMEL, 2017b). It specifies exactly how much, by whom, to whom and how and when a fertilizer is to be applied on the land, declared and transported to another location (BMEL, 2017a). The rules of application of the fertilizer on agriculture area must be followed by farmers if farmers want to avoid financial sanctioning (LWK, 2017h). Figure 19 demonstrates that the fertilizer ordinance is placed in the top-left of the second quadrant proposing that the ability is low and the willingness is also rather low to moderate. This has various reasons elaborated by the farmers.

The new fertilizer ordinance brings some difficulties for us, and various other farmers, for our economy, it [new fertilizer ordinance] has an impact on us especially for our cultivation of maize.
Employee 3, Biogas plant, Agriculture

This fertilizer ordinance means more costs for us because our animals produce manure which we must transport somewhere else as we are not allowed to apply them on our own field, at least not everything. We have to deliver our good and natural manure to other regions that have a low number in livestock. We have to find a way how to get our manure there and we have to pay for it. [...] Everything is calculated and controlled – they calculate how many animals you have and then how much manure each animal produces. The surplus has to be transported to another region and paid by us.
Farmer 2, Agriculture


Also, a water expert confirms that farmers have a problem in implementing the new fertilizer ordinance.

They [farmers] have problem now with the amendment of the fertilizer ordinance. All of them [farmers] have too little space but a high number of livestock farms. And these costs have not taken into account.
Water expert 3, OOWV


A blue icon of a person's head and shoulders, with the text 'OOWV' written below it.

The willingness is moderate because farmers express their acceptance of the stricter fertilizer ordinance.

We would and we try to comply with the new fertilizer ordinance.
Farmer 4, Agriculture


A yellow icon of a person's head and shoulders, with the text 'Farmer' written below it.

The fertilizer ordinance has to be followed but there is no support or appreciation if we comply with the rules. If we do something good, then no one shows appreciation in form of support, but we do a mistake then we are punished straight away. It is not that I want to follow this, but I rather accept it.
Farmer 2, Agriculture

A yellow icon of a person's head and shoulders, with the text 'Farmer' written below it.


However, willingness differs in the aspect of technical measures.

It is important to develop oneself. In every job, a development has to take place. Many people think the world goes down with the new fertilizer ordinance but you have to find your way. I think it possible to adapt the farming practices, for instance to apply the manure precisely at the right time with the right technology. [...] I provide agricultural services with advances technologies.
Farmer 5, Agriculture

A yellow icon of a person's head and shoulders, with the text 'Farmer' written below it.

Additionally, farmers state that advanced technologies helps in meeting the requirements of the new fertilizer ordinance.

The development goes more and more into precision-farming.
Employee 3, Biogas plant, Agriculture

A yellow icon of a person's head and shoulders, with the text 'Biogas' written below it.

Cooperative model

The cooperative model in the context of drinking water protection is regulated by the Lower Saxony Water Act (NWG) (Ministry for environment, energy and climate protection, 2017b). This cooperative model embraces different actors such as water authorities, spokespersons of farmers and water protection consultants in order to build a cooperation. Such a cooperative model is a must in drinking water extraction areas, however, it does not exist in water framework directive areas where

groundwater is also regenerated and extracted from. At the current status, farmers who are not located in the drinking water extraction areas, are not able to participate in any cooperative meetings. However, during the semi-structured interviews farmers are willing to take part in such a cooperation. Figure 19 shows, that the cooperative model is placed in the bottom-right in the second quadrant indicating that farmers outside of the drinking water extraction areas have a low ability in being involved in a cooperation but are highly willing to participate and get together with actors from the water sector. This argument is supported by the statements made by farmers.

Unfortunately, we have no direct contact with water authorities. I'm not part of the cooperation. We are here in the water framework directive area, middle Hunte [river]. We are not directly the drinking water protection area. In the town, there is the boarder.
Farmer 1, Agriculture



A water expert supports, that these cooperation function well in the drinking water extraction areas.

In the drinking water areas goes win-win. Because, as a result of the ordinance policy, we still work there with the farmers cooperatively. But without such cooperative meetings, it does not work.
Water expert 1, WVT e.V.



However, also farmers outside of the drinking water extraction areas are willing to talk to actors from the water sector.

There is also cooperation in the water protection areas, where water works and farmers work together cooperatively. But I don't know how this works in detail. But it would be great to work together with everyone, of the course the agriculture chamber and other farmers, but perhaps also the water supplier so that we can exchange information in personal conversation. I think that would help a lot to understand each other better.
Farmer 5, Agriculture



The issue is that such a cooperative model requires high financial means that are limited and shared.

The financial means are distributed among the cooperation between farmers and water suppliers. EU funds have a lot of regulations and these funds are limited. The financial resources are not unlimited and sometimes hinders the work.
Water expert 2, NLWKN




Water framework directive

The water framework directive is a sustainability measure that considers social, ecological and economic impacts on people and geographical and climatic conditions. One of its goals is to achieve a good status of groundwater by 2015 (Ministry for environment, energy and climate protection, 2017a). However, this goal has not been achieved and the groundwater in Lower Saxony and in particular in the district of Oldenburg has been declared to be in a bad condition due to the exceeding nitrate concentration above 50 mg/l (NLWKN, 2015). Nevertheless, achieving this goal in the future, the water framework directive considers farmers as essential in preventing nutrient inputs from leaching into the groundwater. Besides that, the water framework directive aims to reduce entries of plant protection products released by agriculture and aims to implement and maintain specific water

protection measures in drinking water protection areas (NLWKN, 2010). Figure 19, shows that water framework directives are placed at the top-right of the second quadrant indicating that the ability of farmers is rather low to moderate in reducing entries of plant protection products or nutrient inputs that seep into the groundwater. The non-achieved goal of a good status of groundwater by 2015 is only one sign that the ability is low to moderate. The statement of water experts points out that the ability of agriculture is limited.

The water framework directive is in force since 1991, pointing out the 50 mg/l already, and it [water framework directive] stands for the protection of water bodies including groundwater against pollution from nitrates coming from agriculture. Since then, the agriculture has not been able to achieve this goal.
Water expert 1, WVT e.V.




However, ability is different from willingness. The willingness of farmers to reduce the nitrate concentration in the groundwater is relatively high because the improvement of the groundwater quality is also in their interest and previous efforts of farmers show their willingness to achieve a better status of the groundwater quality. This willingness of farmers to reduce nutrients and implement water protection measures can be justified with the help of statements made in the semi-structured interviews.


Clean groundwater is also important for me and everything I have on my farm, my plants, my animals.
Farmer 1, Agriculture



We all have an interest on clean groundwater, we optimise our fertilization to reduce nitrate entries, we plant intermediate crops to reduce nitrate, we nurture a natural soil loosening. Additionally, I sow other plants and crops such as green rye on a voluntary basis because I know that they absorb the nitrogen and help the soil fertility.
Farmer 5, Agriculture




We do everything possible to make a contribution in preventing the groundwater from pollution. It is really shocking how we are presented in the media as the spring-poisoners, this thought can also be felt in the contact with the people, despite our daily effort to prevent pollution in the groundwater.
Farmer 2, Agriculture



The water expert from the agriculture chamber LWK confirms the willingness of farmers.


The farmers themselves have the motivation to realise these measures, because they want to drink the water, and they also don't want to have the position of environmental or groundwater polluters in the society.
Water expert 4, LWK




A wide range of voluntary agreements with the help of the agriculture chamber and the consultation can be made. Those voluntary agreements are based on diverse measures including different methods of fertilization, the growth of various intermediate crops for different seasons, water protection zones or erosion protection zones, no-tillage, extensification of grassland (LWK, 2017)). Figure 19 shows that the voluntary agreements are placed on the top-right of the fourth quadrant proposing that the willingness and ability are both high. This understanding has been confirmed by all actors from the

agriculture sector and water sector. Farmers express their appreciation for the voluntary consultation and agreements that is free of costs for farmers, and in turn, the water experts see this as a great contribution for the groundwater protection.

I can participate in the voluntary consultation. I'll do it because it's very interesting and very important in my eyes.
Farmer 1, Agriculture



Farmers are able to carry out these voluntary agreements and get a financial reward in return. The measures on the voluntary basis also change consciousness when farmers undertake them for the groundwater protection. I think with order and force only the results cannot be achieved, but with additional voluntary agreements combined with financial support the motivation of farmers can be increased and particular if they have a right to have a voice and design certain measures. The voluntary agreements are strongly in favour higher than in the case of agri-environmental measures, particular also because they are more suitable for the individual farm.
Water expert 2, NLWKN




Trust-building measures

Trust-building measures are supported by the agriculture chamber in order to bring the water sector and agriculture sector together. A platform in form of a round table is provided so that actors of both sectors can exchange information, build trust and mutual understanding. The aim of the LWK is to raise awareness and increase consciousness on both sides (LWK, 2017k). Figure 19 demonstrates that the trust-building measures are added at the very centre-right of the fourth quadrant indicating that the willingness in communication and trust-building is high in agriculture, however, the ability is rather moderate. This placement is explained based on the answers of all interview partners. While actors from the water sector see it as highly positive and interpret that farmers are willing and able, however, the ability is regarded as sceptical.

Communication is a very important key, because this also about their personal motivation and they [farmers] do not see us as controllers. Farmers see us, and this is what we are, as intermediaries between agriculture and water management and they [farmers] have confidence and trust for the operations and data we need to work closely together with them. However, we must have trust on the water sectors side as well so that the communication, facilitation and trust works well.
Water expert 4, LWK



The trust of farmers and advice is always a praise, mutual recognition despite of sometimes hard professional disputes. If there is trust on both sides farmers are willing to give information, if there is no trust they don't do it. So trustworthy collaboration is the key. A round table where we can talk is always good, not harmful because an understanding awakens through a dialogue.
Water expert 5, NLWKN



Immensely necessary are trust-building measures so that an exchange takes place.
Water expert 2, NLWKN



The round tables are good as a trust-building measures. They take place round the regions with not 37 round tables in Lower Saxony.
Water expert 1, WVT e.V.



Yes, a round table is useful. Discussion is always good for information exchange, consensus and transparency and of course builds trust to the water authorities.
Farmer 4, Agriculture



However, another perception of such round tables exists because farmers have the impression that the water sector wants to assert their interests instead of finding a compromise through such round tables.

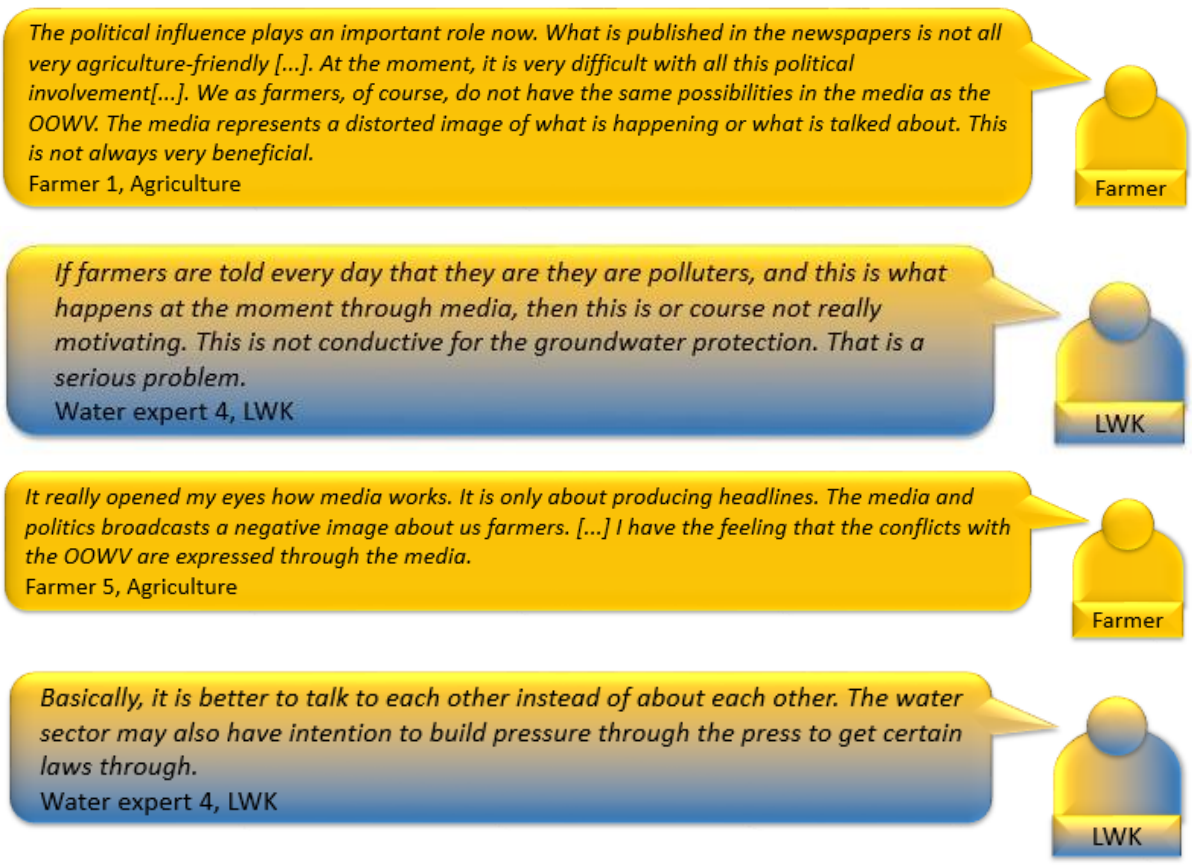
I rather say that farmers take things as it is prescribed and given to them. In such round tables, there is a lot of talking and discussing, however, I believe the other party [water sector] rather wants to pass on their interests on us. Instead that someone speaks up for farmers in these round tables and states that certain requirements are simply not doable, it is always contested with arguments like „the consumer wants this and that“ and then their wishes are enforced on us farmers instead of understanding that some things are hardly feasible for farmers to do.
Farmer 2, Agriculture



Looking at the willingness-ability matrix with the various measures placed at different quadrants, it can be seen that the cooperative model outside of drinking water extraction areas, agri-environmental measures, water framework directives, and the fertilizer ordinance are placed in the second quadrant representing low ability and high willingness. Measures such as voluntary agreements and consultation, trust-building measures in form of round tables and greening measures are placed in the fourth quadrant standing for high ability and high willingness. It can be interpreted that farmers are highly willing in adapting a variety of measures, even though the fertilizer ordinance is rather moderate in willingness. The placements of the diverse measures create an understanding that measures with a notion of voluntariness, involvement, flexibility in crop cultivation, and trust are those that increase the willingness and ability of agriculture the most. In comparison, measures having the notion of enforcement and compulsion are rather hindering the willingness of farmers. It can be interpreted that measures giving space for farmers in the decision-making process about what happens on their land is favoured by farmers. In turn, measures that exclude farmers to participate the decision-making process about the measures that should take place on their land, and only inform farmers about what has to be implemented, comes across resistance.

4.4.2. Barriers hindering the increase of willingness and ability of agriculture to adapt practices

Besides that, also other barriers have been mentioned by the interviewees that hinder the willingness and ability of agriculture to adapt practices leading to a reduced contamination in groundwater. These barriers are mentioned to be, first, bureaucracy and administrative burden, and second, media and politics. These reasons why these aspects are barriers and hinder the willingness and ability are further elaborated. Figure 19 illustrates that media and politics as well as bureaucracy and administration are placed in the bottom-right of the first quadrant suggestion low ability and low willingness of agriculture to adapt practices because these two aspects are perceived as barriers. This perception is stated several times by the interviewees.



Next to the barrier of media and politics, also the barrier of bureaucracy and administrative burden hampers farmers in their willingness and ability to adapt practices that prevent groundwater pollution.

There are constantly new regulations, new laws that we farmers have to follow. We have document everything, control everything with certain forms to a certain time. Actually, we are losing the overview.

Farmer 2, Agriculture



The water expert confirms such load of bureaucracy.

A variety of regulations means also a lot of bureaucracy and high administrative burden for farmers and also for us. This is a common complaint.

Water expert 2, NLWKN



These examples give an impression about the indirect communication through the media, triggered by the water sector. Farmers perceive media and politics as a vehicle for pressure release so for the purpose to change their practices and reduce the impact on groundwater quality in Lower Saxony. However, this exerted pressure through media and politics is rather contra-productive because the motivation and willingness of farmers is held back. Bureaucracy and administration is recognized as a barrier for farmers due to the increasing regulations connected to application for financial reward. It is assumed that if these two described barriers can be minimized or changed, then the willingness and ability of farmers to undertake measures for the purpose to reduce groundwater pollution could increase.

4.4.3. Recap: Combination of enforced and voluntary measures

After discussing all seven measures and two barriers that have been mentioned by the interviewed actors from both sectors, this recapturing paragraph concentrates on formulating conclusions of the measures that hinder and increase the willingness and ability of agriculture that reduce the groundwater protection in Lower Saxony. Before formulating the results in a brief synthesising conclusion, the results are summarised in table 4, providing an overview of the measures and barriers affecting willingness and ability of agriculture and the connected reasons for the high or low willingness and ability.

Measures & Barriers	Willingness & Ability	Reasons
<ul style="list-style-type: none"> Trust-building measures Greening measures Voluntary agreement & consultancy 	<p>High willingness High ability</p>	<ul style="list-style-type: none"> Farmer's involvement in decision-making processes Farmer's flexibility in crop cultivation Financial reward for farmers
<ul style="list-style-type: none"> Agri-environmental measures Water framework directive Fertilizer ordinance Cooperative model outside of drinking water extraction areas 	<p>Moderate- High willingness Low ability</p>	<ul style="list-style-type: none"> No possibility, no involvement in designing measures Farmers feel as an executive force Measures result in high costs Require financial means/ funds (limited)
<ul style="list-style-type: none"> Media & Politics Bureaucracy & Administration 	<p>Low willingness Low ability</p>	<ul style="list-style-type: none"> Broadcast of negative image of farmers leading to demotivation & unwillingness Loss of overview due to constantly increasing regulations

Table 4 - Summary of measures & barriers affecting willingness and ability due to various reasons (author, 2017).

Table 4 shows that trust-building measures, greening measure and voluntary agreement and consultancy increase the willingness and ability of agriculture to reduce impacts on groundwater. The reason is based on the involvement of farmers in the decisions regarding measures that should take place on the farmer's farmland. Moreover, these measures provide flexibility for farmers in deciding what kind of crops they want to cultivate and what is suitable for farmers on their land. Additionally, farmers are financially rewarded for the measures that they implement for a better groundwater quality.

The second row of table 4 includes the agri-environmental measures, water framework directive, fertilizer ordinance and cooperative model outside of drinking water extraction areas. These measures moderately to highly increase the willingness of agriculture to reduce impacts on groundwater. However, it indicates that agriculture has a low ability in implementing these measures because of lack of possibility and lack of involvement in shaping or designing measures that are suitable for farmers and their land.

Additionally, farmers feel that they are losing control about their decision-making power and feel as an executive force that follows measures and regulations that have been developed by other actors. Besides that, the given measures result in high costs for farmers that occur because of transportation of manure to another region or loss of revenue due to a decrease of yields. A cooperative model triggers a high willingness of farmers to exchange information with water experts about how to reduce the impacts on groundwater. However, such a cooperative model requires a high amount of monetary means and funds that are limited and distributed among the already established cooperative meeting groups that are located in the priority areas; the drinking water extraction areas. Overall, it can be understood that neither strict measures alone, nor voluntary measures only, are efficient in increasing the willingness and ability of the agriculture. Thus, it can be supposed that a combination of both enforced and robust measures and voluntary and flexible measures can increase the willingness and ability of agriculture the most. In regards to an increase of willingness and ability, the last row of barriers is highly important.

The last row contains the barriers of media and politics, bureaucracy and administration, which cause low willingness and low ability of agriculture to make a contribution in reducing impacts on groundwater. The reasons for that imply the negative images that are broadcasted about the agriculture affecting farmers and leading to demotivation and unwillingness of making a greater effort for groundwater improvement. Besides that, bureaucratic and administrative burden based on an increasing amount of regulations and forms that farmers need to follow, fill out and submit result in a loss of overview and hinder their ability in implementing measures in their agriculture practices that are groundwater-friendly. It is anticipated that if the barriers of media and politics could be mitigated and the bureaucratic and administrative burden could be re-organised more efficiently, then the measures have a higher potential in increasing the willingness and ability of agriculture to adapt and implement which will reduce the impact on groundwater in the district of Oldenburg.

4.5. Incentives for the agriculture sector to adapt their practices

What can the water sector do to provide incentives for the agricultural sector to adapt their practices? (Q8)

Question four focuses on the incentives that are provided by the water sector to the agriculture sector to adapt their practices. That means that in this paragraph the currently provided incentives of the

actors from the water sector are analysed. In theory, increased prices, stricter rules and government involvement lead to more efficiency of water management and more sustainable agriculture practices including a decrease of pollution because water is promoted as an economic good (Rogers et al., 2002). In practice, water is not only promoted as an economic good but the most essential resource that needs to be protected through a wide range of means and ways. The underlying assumption is that if the water sector of Lower Saxony including the water supplier OOWV, the water association WVT e.V., the water management and nature conservation agency NLWKN, together with the help of water protection consultants of the agriculture chamber LWK can stimulate the agriculture sector and farmers to adapt their practices then the groundwater in Lower Saxony, in the district of Oldenburg can be improved. As shown in figure 20, there are two different types of incentives, positive and negative incentives provided by the water sector and triggers certain responses of the agriculture sector. Positive incentives encourage farmers to choose by rewarding them with something of their own choice. Negative incentives encourage farmers to take actions as otherwise they are charged with a fine, tax or penalty (Mohamed & Savenije, 2000). A proposed strategy is a combination of negative incentives including taxes and positive incentives including subsidies, framed with enforced regulations and advanced technologies.

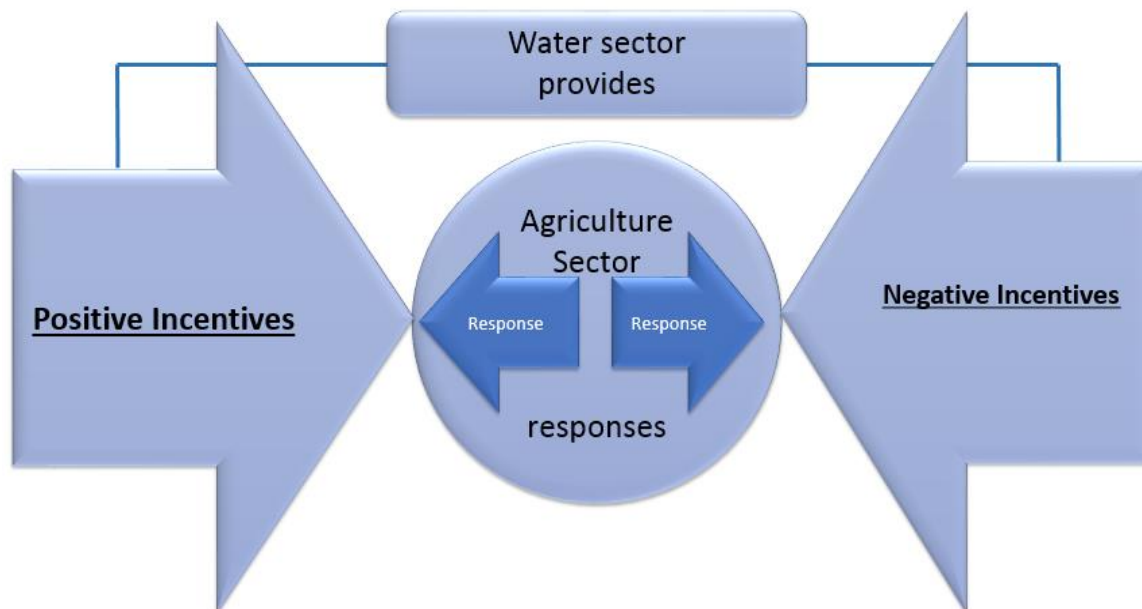


Figure 20- Overview: incentives of the water sector (author, 2017). In the section, the positive and negative incentives of the water sector are discussed and the responses of the agriculture are laid out.

4.5.1. Negative Incentives provided by the water sector to the agriculture sector

The water sector tries to follow the prevention-principle, meaning preventing the groundwater from being contaminated with nitrate in the first place, before nitrate needs to be taken out with expensive means and advanced technologies afterwards. However, since the nitrate already exceeds the limit value of nitrate in the groundwater the polluter-pays-principle is enforced.

We need a groundwater-conserving agriculture, and the agriculture knows that for more than 25 years, but agriculture has not proven itself to be groundwater-conserving, at least in this area. And that's why it [agriculture] has to take the consequences for it now. That means: polluter-pays-principle - those that contaminate also have to pay. Otherwise, we would need to make the customer pay, that cannot function, we cannot punish the drinking water customer who did not contaminate the water. [...] We could build nitrate elimination plants now, but then the drinking water price will double or triple and it is not possible to shift it on the consumers.

Water expert 1, WVT e.V



However, the water association also states that they want to stick to the preventive approach. Thus, the water experts add;

We want an agriculture that works well with the groundwater protection and not against it.

Water expert 1, WVT e.V.



The fertilizer ordinance, must be respected and followed. This cannot be rewarded anymore. Farmers have to comply with these rules.

Water expert 2, NLWKN



Farmers response to negative incentives

The negative incentives based on sanctions are perceived as a constraint in deciding about what kind of crop type farmers want to grow on their lands. Not only the decision-making power of farmer is limited in terms of land-use management or crop cultivation, also their creativity and freedom is rather narrowed.

Incentives? What are incentives? I don't receive any support or incentive. The only thing that we experience are deductions if we don't do what they want. [...]

There are certain crops that I would like to grow, but I cannot grow too much of it or not at all if I want to have financial rewards. If I want to get any financial support I need to follow the given strict rules and do what they want me to do. But without these financial funds it is difficult to survive. And if I don't do what is asked from me I get a deduction or a penalty in the future.

Farmer 2, Agriculture



Moreover, the farmer refers to the motivation that decreases due to negative incentives.

The more incentives there are to support us, the more effort I can give. My motivation is then also higher I know I did something good instead of getting punished.

Farmer 2, Agriculture



4.5.2. Positive Incentives provided by the water sector

Nevertheless, there are also positive incentives that are mainly on the voluntary basis and which are also highlighted by the water experts.

What farmers can do is to do something beyond the strict regulations which is on a voluntary basis, they can choose between measures and receive a financial compensation for that. Farmers can choose between organic farming, intercropping, greening of land, spreading fertilizer with improved technologies, grassland extensification, planting flowering strips or riparian zones and more.

Water expert 2, NLWKN



Furthermore, the water supplier OOWV also explains their incentives that they provide to the agriculture, by explaining that a water withdrawal fee is charged for every cubic meter of groundwater that is extracted by the OOWV.

The water abstraction from groundwater but also from rivers and lakes, a fee is paid. We pay around 4 ½ million euros each year to Hannover and get around 2.2 million back. And then we use these 2.2 million euros to advice farmers or to agree with farmers certain environmental-oriented measures.

Water expert 3, OOWV



Moreover, the water supplier OOWV buys land and leases it to farmers under the requirement to focus on organic farming. This incentive is highly supported by the OOWV which provides a lower lease to farmers and at the same time prevents contamination of groundwater. The water supplier OOWV justifies it by explaining:

We have a very likable partner within agriculture and this is the organic farmer. The organic farmer does exactly what the water economy expects: he does not use plant protection products, he operates in a very narrow nitrogen cycle, he has no nitrogen which leaches into the groundwater. If we change from conventional agriculture to organic farming in the water protection area or drinking water extraction area, then all problems are solved at once.

Water expert 3, OOWV



The agriculture chamber LWK adds that depending on the farm and the operational factors the one or the other incentive can be suitable. The water expert from the LWK adds that the communicative way to provide any incentives is highly important.

Incentives through consultation and the implementation of measures will in any case improve the groundwater quality. It always depends on how you to talk to them [farmers].

Water expert 4, LWK



Moreover, a water expert states that positive incentives are obligatory and it cannot only work with negative incentives.

Nothing works without voluntary incentives. Farmers also want to have an advantage for what they do. We cannot always expect that every farmer is enthusiastic when it comes to groundwater protection. They need to be rewarded if we expect them to perform well. Simply requesting from them to do things for the groundwater protection otherwise they are punished does not work and is also not fair.

Water expert 5, NLWKN



Farmers response to positive incentives

The response of farmers towards positive incentives is appreciative and stimulates them to follow the given advices.

The support from the agriculture chamber is good, their consultation really helps me and I feel like learning more. They also do soil samplings and give me a good advice what I can do. I like because I learn something about my own soil and land and think about how I can develop myself.

Farmer 4, Agriculture



The voluntary consultation is a good incentive. However, there should be more flexible solutions, but that is probably difficult to realise. Otherwise, there are no real incentives from the water sector.

Farmer 5, Agriculture



These examples show that negative incentives in form of strict laws and ordinance, polluter-pays-approach and penalties are considered as necessary incentives by the water sector in order to improve the groundwater quality. Nevertheless, there are also several positive incentives including the voluntary consultancy or agreements, and a lower lease price for organic farming that provides support and motivation for farmers. Based on this knowledge, it can be comprehended that neither strict regulations, laws or ordinances are efficient solely, nor incentives on the voluntary basis only, but rather a combination of both. That means positive incentives are important so that farmers have the chance to decide between a variety of measures and can choose what is suitable for their farm together with the consultancy and dialogue of water protection consultants. Combined with that, a legal framework with clear and transparent requirements is meaningful for the groundwater protection.

4.5.3. Recap: Combination of positive and negative incentives

After discussing the negative and positive incentives provided by the water sector and the response of the farmers, this paragraph provides a summary of both types of incentives in an overview in figure 21.

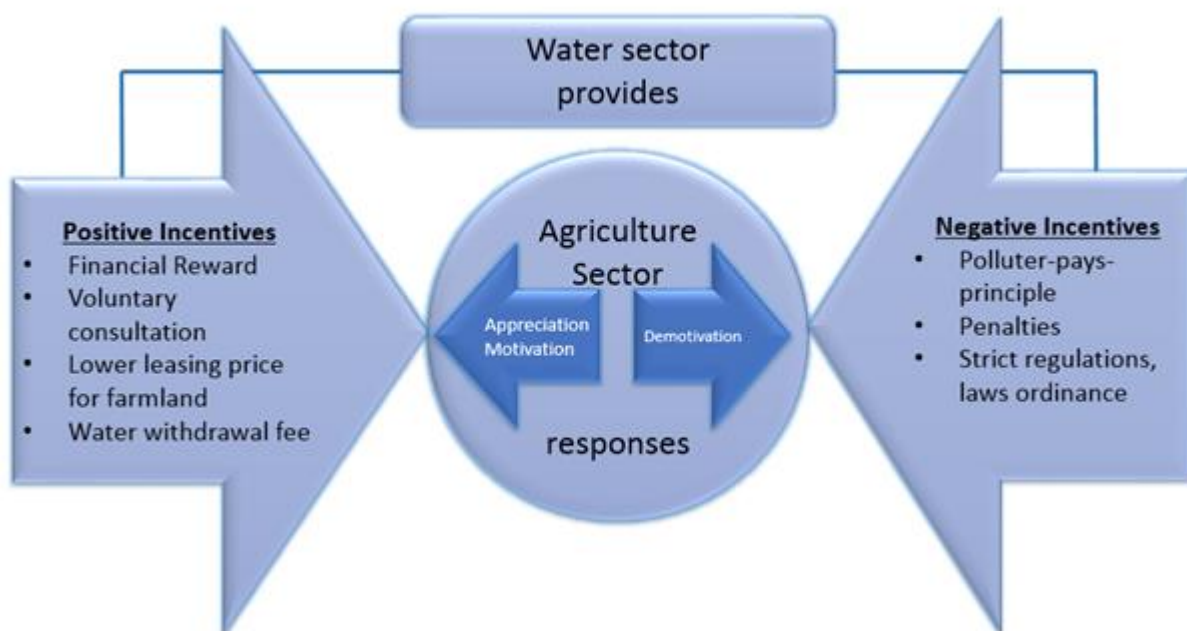


Figure 21 - Negative and positive incentives (author, 2017). The positive and negative incentives provided by the water sector and responses of the agriculture sector are shown.

The figure 21 represents positive incentives that are provided by the water sector and are responded by the agriculture sector with appreciation and motivation to adapt their practices. Next to that, the water sector also follows negative incentives, which are responded with demotivation by the agriculture sector. To answer the research question, it can be said that a combination of both, negative

and positive incentives is the most efficient way. Based on these differences but also the need for a legal framework, a combination of both incentives is proposed as a strategy. To achieve great results, negative incentives such as the ordinance including strict laws and regulations can be combined with positive incentives such as financial reward and subsidies if farmers have complied with the legal framework. In this way, farmers have to adapt to certain regulations that are essential for the groundwater protection and the groundwater quality, and at the same time they have a choice in undertaking additional groundwater-conservative actions with the motivation of being remunerated. One way is to formulate strict and robust goals, but giving farmers the flexibility and control to decide how they can achieve these goals based on their chosen or designed measures.

5. Conclusion and Discussion

In this concluding chapter, the secondary research questions and the primary research question are answered. The conclusions are derived from the results of chapter 4 and connect to the theory of chapter 2, and a discussion is ensued (figure 22). The primary research question of *How to build consensus in a complex multi-actor setting between the agriculture sector and the water sector in order to reach mutual gains, to decrease pressure on groundwater and improve the livelihood of farmers?*, can be answered based on the following sections.

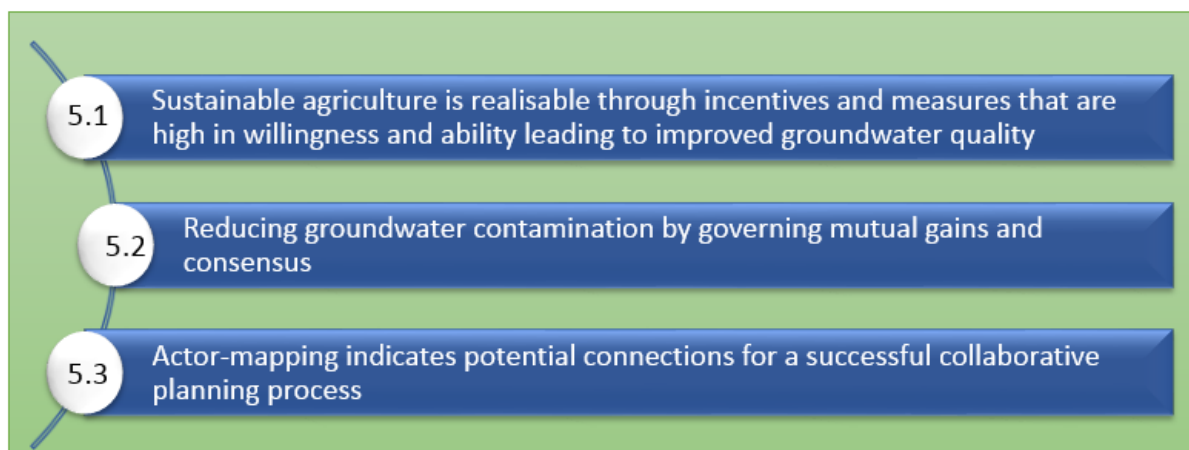


Figure 22- Overview discussion and conclusion (author, 2017).

5.1. Sustainable agriculture is realisable through incentives and measures that are high in willingness and ability leading to improved groundwater quality

Sustainable agriculture is a system that improves the groundwater quality while maintaining the viability of agriculture economy and enhancing farmers' quality of life (National Research Council, 2010; Dobermann & Nelson, 2013).

In theory, there are various measures that can realise sustainable agriculture such as an optimal livestock and manure management, resulting in low amounts of nitrogen (Sakadevan & Nguyen, 2017; Burton & Turner, 2003), no-tillage method and a diversifying land-use management that enhances pollution control (Meisinger et al., 1990; Global Water Partnership, 2014; Sakadevan & Nguyen, 2017; Sharara et al., 2017), polyculture crop cultivation that decreases leaching rates of nitrogen into the groundwater (Huntley et al., 2013; Rigby & Caceres, 2001; Di & Cameron, 2002; Pang & Letey, 2000). These measures that protect groundwater from pollution can only be undertaken effectively if the motivation of farmers is high, which is established through incentives that increase their livelihood (Reganold et al., 1990; Lithourgidis et al., 2005). Adapting groundwater-conserving measures bear

some barriers such as higher demand of food products due to an increase in population, and overall lower yields (McSorely & Porarzinska, 2001). Additionally, the costs for transportation of a surplus of manure to another region are borne by the landowner or farmer are regarded as barriers (McSorely & Porarzinska, 2001; Burton & Turner, 2003) and the depletion of clean groundwater resources (Brown, 1997).

The case study has shown that various measures exist. A wide range of measures have been mentioned by the interviewed actors including the agri-environmental measures, cooperative model outside of drinking water extraction areas, water framework directives, greening measures, fertilizer ordinance, voluntary agreements, consultation and trust-building measures such as round tables. Based on the statements of interviewed farmers and interviewed water experts, these measures have been placed in a matrix indicating their increase or hindrance in willingness and ability of agriculture. Overall, the measures implying flexibility and involvement in decision-making processes score the highest in willingness and ability and thus can be interpreted to be most successful measures that lead to groundwater protection. Barriers have been pointed out by the interviewed actors such as the media, politics, bureaucracy and administration.

As stated in theory and confirmed in practice, the motivation of farmers is highly essential. This means farmers need to be willing and be able to implement or adapt any kinds of measures. In theory, several sustainable agriculture practices are elaborated which are mirrored in the different measures mentioned by the interviewees. However, something which is not visible in theory but becomes clearer in practice, are barriers that make the situation for farmers difficult and triggers a resistance instead of any readiness of farmers to undertake any groundwater-conserving measures. In practice, the water sector provides incentives to the agriculture sector in terms of a water withdrawal fee and offers land to farmers to a lower leasing price under the condition of following an organic farming system. However, what becomes clear through practice during the semi-structured interviews is that these provided incentives by the water sector are not perceived by the agriculture sector as supportive to them in realising such measures of sustainable agriculture.

Overall, based on the insights gathered through the interviews, it is expected that if these barriers can be removed then the agriculture can develop more willingness and become more able in realising further measures that improve the groundwater. However, not only removing barriers but also certain incentives that are provided by the water sector can result in an effective adaptation of the above-mentioned measures that lead to better groundwater quality.

5.2. Reducing groundwater contamination by governing mutual gains and consensus

Consensus-building is a way to manage and solve conflicts of interests through mediation striving to establish an all-gain-agreement (Susskind & Cruikshank, 2006).

In theory, consensus-building influences willingness to adapt because of the time and effort that needs to be invested into (Innes, 2004). Additionally, power imbalances can hamper the consensus-building that can be derived from perceived responsibilities (Weiner, 1993; Fanstein, 2010; Flyvbjerg, 1998; Forester, 1989). However, since consensus-building is about creating a dialogue between diverse actors, the involvement of actors is necessary so that strategies can be developed collectively. Participation in a decision-making and a collaborative planning process can increase the willingness of actors to strive for consensus (Saporitio, 2016; Forester, 1999; Kerkhof, 2005). Collaborative planning and consensus building requires trust to be successful (Mayer et al., 1995). Moreover, mutual gains

can help in building consensus, because mutual interests and shared values and the potential to gain benefits for all, can stimulate the collaboration between different actors (Innes & Booher, 1999; Fisher et al., 1991). Mutual gains help in building consensus through a negotiation process being based on cooperation and collaboration in planning between actors (Grzybowski et al., 2006). A platform to establish such collaborative planning is essential where actors can come together and express their interests (Edelenbos, 2012). Essential is to consider the actor's position, interests and values that gives the chance to identify mutual interests and stimulate consensus-building and accomplish a certain goal (Engel & Korf, 2005).

The case study has shown the positions, interests and values that have been discovered in the context of improving groundwater quality. Mutual interests and underlying shared values have been merged to figure out mutual gains. In order to build consensus with the aim to reduce groundwater contamination, three principles of mutual interests between the water and agriculture sector have been discovered through semi-structured interviews: groundwater quality and agricultural land-use management, groundwater quality and consultancy for sustainable agriculture practices, groundwater quality and agriculture in respect to nature conservation. Consequently, three underlying shared values have been identified: clean groundwater resources collected on agricultural land, stabilisation of sustainable agriculture to assure livelihood of farmers, consumers financial contribution for realisation of sustainable agriculture practices and clean groundwater quality. Based on these mutual interests and shared values, mutual gains can be reached that help in building consensus. As elaborated in theory and applied in practice, mutual gains can be determined based on identifying actors' positions, mutual interests and shared values. Such mutual gains can help to create a successful negotiation process involving actors of the agriculture sector such as farmers and employees of biogas plants and agriculture chamber together with actors from the water sectors such as water experts from water management agencies, water supplier, water associations to cooperate and collaborate. However, such collaborative planning process can be realised on the basis of a platform (Edelenbos, 2012). In practice, such platform in form of a *round table* is provided to farmers and water experts operating the drinking water extraction areas. However, such a platform is non-existent for farmers or water experts in water framework directive areas which are located outside of the water extraction areas as in the case of the district of Oldenburg.

Overall, the theory in establishing mutual gains has provided guidelines that could be implemented in the practice in order to investigate mutual gains between actors of both sectors that could help in building consensus. A platform for negotiation and collaboration, as mentioned in theory, is an essential feature in practice as expressed by the interviewees. One reason why such platform does not exist outside of drinking water extraction areas is due to the limits of financial resources. Thus, it can be interpreted that if financial funds or financial support is provided by the European Union to the district of Oldenburg, which is marked in culture and landscape by agriculture as well as is an essential base for groundwater resource collection, then a chance can be given to actors of the agriculture and water sector to come together, exchange information, reach mutual gains and build consensus for the benefits of an improved groundwater quality and an enhanced livelihood of farmers.

5.3. Actor-mapping indicates potential connections for a successful collaborative planning process

Actor-maps reflect the interdependencies, influences and relations of actors in a decision-making process and collaborative planning process (Brugha & Varvasovsaky, 2000; Bressers et al., 1995). The positions of actors on different levels are demonstrated as well as their formal and perceived roles and responsibilities within a special context (Prell et al., 2009; Smith, 1993). Collaborations models

also highlight the planner's role and responsibility in facilitating and mediating between actors within the planning context and situation (Fainstein, 2000).

In theory, understanding the interdependencies, three elements need to be considered. First, the tragedy-of-the-commons idea which says that diverse actors depend on the same resource. Second, mutual interests exist and are shared between diverse actors. Third, rules and regulations support or limit actors' activities (Benson, 1982). Moreover, the actor-map indicates strong and weak ties. Strong ties indicate a stronger influence of actors, whereas weak ties indicate a rather weak influence of actors. Strong ties represent similar views, support and frequent communication and trust among actors, whereas weak ties represent diverse ideas, low frequency in communication, bridging roles of disconnected actors (Burt, 2000; Newman & Dale, 2004; Bodin et al., 2006; Cross & Parker, 2004).

The case study has shown that the *tragedy-of-the-commons* reflects the situation that the water and agriculture sector are dependent on clean groundwater resources as in the case of the district of Oldenburg. The belonging of actors to the agriculture or water sector is demonstrated based on the highlighted colour. The mutual interests are not clearly shown in the actor-map but rather discovered through the mutual gains approach. Rules and regulations are provided by the EU and the EU is represented as an actor placed on the European level indicating a top-down process that forwards the regulations to the lower levels. The strong and weak ties in the applied actor map refer to the formal and perceived roles and responsibilities as expressed by the interviewed actors during the semi-structured interviews.

Contested is the claim in theory that mutual interests or tensions can be seen in the actor-map. It is not clear which specific interests each actor holds in such actor-map but rather their positions only. The mutual interests, shared values as well as conflicting interests or tension become visible via a mutual gains approach. Another difference in theory and then applied in practice are the ties or connections between the various actors. In theory, strong and weak ties are referred to frequency of communication, views and support, and bridges between actors. In practice, the strong ties or connections demonstrate formal roles and responsibilities that create the interdependency between actors, and weak ties stand for the perceived roles and responsibilities based on what interviewed actors have drawn and explained.

Closing up, a summarised answer to the primary research question of: *How to build consensus in a complex multi-actor setting between the agriculture sector and the water sector in order to reach mutual gains, to decrease pressure on groundwater and improve the livelihood of farmers?*, can be shortly given.

Consensus can be built by the means of a platform which invites farmers, employees of farms, owners and employees of biogas plants, water experts, the agriculture chamber, consultants of water protection and agriculture practices, water experts of water suppliers, water authorities of water associations, water and agriculture engineers, in general actors of the agriculture and water sector in order to establish a dialogue, negotiation and a collaborative planning process that involves all these actors in the district of Oldenburg. Since the actors of the agriculture sector and water sector clearly have the same interest in protecting the groundwater quality as both sectors depend on this common resource of groundwater, various other mutual interests and shared values can be discovered through a collaborative planning approach. Such collaborative planning approach is valuable in its function as it removes barriers such as media or political involvement. It engages the various actors located in the district of Oldenburg in a common communication platform that is personal and factual and provides the chance to exchange information and discover more mutual gains that can help in developing strategies collectively that decrease the pressure on groundwater and improve the livelihood of farmers. This collaborative planning approach serves the function to support each other in feasibly

implementing, adapting measures and providing incentives as a reward. Since motivation of farmers is a key in order to implement measures, such collaborative planning process provides the chance for farmers to participate in decision-making processes, become more flexible and allows them to be in control of the agricultural practices on their farmland by following the goal of groundwater quality improvement. Such participation in decision-making processes, dialogue with actors of the water sector and appreciation and reward for their work can strongly stimulate the willingness and ability of farmers to develop their practices for the benefit of improved groundwater quality and enhanced livelihood of farmers in the district of Oldenburg, in Lower Saxony, Germany.

6. Reflection and future outlook

The reflection on the research process is described in this chapter (figure 23). The objective of this research was to investigate the perceptions of actors from the agriculture- and water sector and how both can contribute to more sustainable agricultural practices resulting in better livelihood of farmers and improved groundwater quality in the district of Oldenburg in Lower Saxony.



Figure 23- Reflection & Recommendation (author, 2017).

Achieving the research objective to investigate the perceptions of actors from both sectors has been the most insightful task and has brought the most valuable and interesting knowledge into this master thesis. The literature research and conceptual model was merely for the purpose to establish a basis to be able to achieve the research objective. The right scope has been found at the moment of data collection. The conceptual model has been proven to be useful in building the connections of the theory in order to give a basis of what is analysed in practice. Sustainable agriculture, consensus-building, mutual-gains and actor-mapping, provided a good composition in researching about how the groundwater quality and livelihood of farmers could be improved in the district of Oldenburg.

Because of the qualitative notion of this research, the empirical data collection has been undertaken in-depth. 10 semi-structured interviews have been conducted and 2 conferences have been visited in order to analyse and observe the perceptions of the actors on the groundwater contamination situation in the district of Oldenburg. The response rate was more than 100%. More actors have been highly interested in participating in the semi-structured interviews to be able to have a say and were willing in explaining their perceptions, experiences, knowledge in respect to nitrate in the groundwater that affects the quality, about the developments in agriculture and water management, and about the situation of farmers and their quality of life as well as about the nitrate contamination in the future. Unfortunately, due to the extensive time used for the theory, only limited time remained for conducting more interviews. However, the semi-structured interviews have been proven to be a good method because it follows a strict structure in one way, gives room and space for more open questions and more extended and qualitative answers for the interview partner. In this way, specific aspects could be compared and additional value data could be added. Only specific aspects could be analysed and discussed in this thesis. However, much more insights and valuable knowledge have been given by the interviewees.

Next to that, the method of creating an actor-map has proven to be a good way to illustrate the complex multi-actor setting in a simplified way and give a good understanding of how the diverse actors are interdependent on the various levels. The method of mutual gains has been interesting,

particularly in discovering and revealing the mutual interests between such diverse actors by following the processes in practice of what has been explained in theory. The willingness-ability, was useful to visualise and make clear of what measures increase the willingness and ability and what kind of barriers exist that hamper the willingness and ability of actors.

Mutual interests that have been discovered could be a good step in facilitating an agreement between the two sectors. Agreement could be best made on a platform involving and inviting the actors from different levels. Such a platform does not exist yet in the district of Oldenburg due to missing financial support by the EU or other institutions. Thus, it is questionable if arrangements for the purpose of groundwater improvement and livelihood of farmers can be effectively made without a meeting point that provides a chance to establish a collaborative process in order to exchange information, create trust and build consensus.

Regarding generalisability, the main aim of this research was to generate in-depth understandings of this research. However, the discovered findings can also be generalised for other areas that face the same issue and that have the same institutional set-up and legal requirements.

The theoretical foundation has added to the validity of this research. The various data sources and the different methods have contributed strongly to the validity of this research. The findings have been presented through different loupes which provides an all-around image of the nitrate issue in the groundwater, conflicting interest, effects on farmer's work and work of water authorities. The results are organised in a structured way based on the logic of the researcher, representing the reliability of the findings with the help of each interviewee. This topic has a high potential for further future research as more developments in agriculture and water sector are progressing fast.

Therefore, several suggestions for future research could be for instance, a comparative research on how an implemented collaborative planning processes works and how measures can be applied effectively. Furthermore, exploring what kind of agreements could be made and facilitated and how strategies could be collectively established. Finally, research on how financial support could be created through awareness-raising in the public space.

7. Reference

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