Master's Thesis Internship – master Sustainable Business and Innovation

Developing an individual actor perspective on Collective System Building activities: A set of Case studies in New Zealand's Nutrient management

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Masters:
Sustainable Business & Innovation
Year:
2
Date:
31-03-2017

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Executive summary

To solve global issues of unsustainability requires the development of sustainability innovations as well as collective goal setting at international, national and even company level on implementing such innovations. From an Innovation sciences perspective, this requires changes at a systemic level, while simultaneously (individual) actors are needed to participate in reinforcing innovation systems around existing innovations and building up an innovation system around developing innovations. Planko and co-authors from the University of Utrecht developed a collective system building framework to identify a set (or clusters) of system building activities for entrepreneurial actors to do so. Henceforth, they identified ways for actors at the micro level to intervene at a systemic level.

However, since actors need to collaborate instead of compete to a certain degree, with regard to their goals and resources to achieve results, it is argued that not just the activities, but also the factors for them to engage in the activities are important for setting in motion changes at a systemic level. Therefore a more individual actor oriented perspective is needed to include individual factors for actors to engage in building up the innovation system. Whereas the CSB framework focusses on "What needs to be done?" for entrepreneurs to collectively build up an innovation (system), in this research the focus is put on: "Why would actors be inclined to do so?". The relevance of this question is found in the fact that there is not always a clear mutual benefit, more often than not, in a sustainability innovation for all parties involved at the start. And often interest in large sustainability issues is only carried partially by a variety of different actors, thereby spreading responsibility and spreading the interests in solving the issues. For example, for most entrepreneurial actors sustainability is just one out of many issues, whilst it is not often perceived as a single big issue for all actors individually, hence together.

The research provided a conceptual framework for understanding and approaching larger sustainability issues than single actors have to or can deal with and therefore have to tackle through collaboration between a variety of different actors. This framework is tested in the field of more sustainable nutrient management at 19 dairy farms (3 case-studies). By providing an individual perspective this research provided insights into the reasons for the main actors, being mainly entrepreneurs (in these cases farmers), to become involved. In the research is hypothesised upon a set of factors, based on the interests, goals and resources held or obtained by individual actors, being mainly farmers but network-level actors (knowledge providing organisations) and system level actors (policy makers), with regard to the innovation. Henceforth, the developed individual actor-level factors incorporated systemic goals and resources at a network and system level, meanwhile addressing these from the individual level. The research thereby provided a link between the stimulating and hampering factors for individual actors (entrepreneurs) and actors working at a network or system level (policy makers, industry organisations) with the final goal of implementing innovations relevant at the innovaton system level. The factors and their interrelations are depicted in the conceptual model (chapter 2.5 p.12).

When looking at the interests of individual actors leading up to the alignment of actor's goals with the goals set at the innovation system level, for all cases strong empirical evidence was found for the presence of individual interests, the congruence (compatibility) of individual interests of the actors in the innovation and their engagement in a participatory approach. Individual interest and interest congruence played a large role, either through their engagement in a participatory approach or directly through the alignment of actor's goals with the goals set at the innovation system level. While the engagement in a participatory approach was to differing degrees related to the alignment of goals of individual actors within the empirical data, the largest part of the empirical data showed it to be highly related to the relevant coordination of resources, those factors are on their turn related to the implementation of successful innovations. This confirms the hypothesised role of engagement of individual actors in a participatory approach and the factors individual interest and interest congruence as important factors for developing innovations relevant at a system level.

When looking at the configurations of resources as identified at the three different levels, strong evidence was found in the cases for the hypothesised relations. First and foremost, the availability of individual resources for individual farmers, being finances and knowledge, proved to be highly important in order for them to be complemented with relevantly coordinated resources that allowed them to take up the innovation with relevance at the systems level. It is often stated that without such individual resources farmers were not able to understand (knowledge-wise) or to apply (financially) the coordinated resources. Secondly, also resource dependency between actors was found to be related to the coordination of relevant resources. Overall empirical evidence was found for the role of the individual factos. This evidence is provided within the limits of its empirical generalisability, being the on-farm more sustainable nutrient management.

1. Introduction

When looking at global sustainability issues, we see that depletion of the earth's resources, emissions of CO_2 and other greenhouse gases as well as the overall effects of global climate change are causing serious threats to the social, environmental and economic spheres (Folke, et al., 2002; Watts, et al., 2015). Countering the threats requires substantial mitigation as well as adaptation measures. On the mitigation part, authors show that if climate change is to be impeded within reasonable limits, a combination of currently existing technologies and reduction measures is able to achieve this (Pacala & Socolow, 2004; Blok, et al., 2012). However, this requires the collaboration of various leading organizations, a tight cooperation between businesses and legislative parties and other non-state stakeholders in forming agreements, targets and initiatives on emission-rates and sustainable alternatives (Blok et al., 2012; Soosay et al., 2008). Yet, while sustainability transitions are often found to be technically possible, the need for coordination of collective activities between such diverse groups of actors can limit success. Not only effective coordination (and thus management) determines successful implementation of sustainability innovations, also collaboration between individual actors is found to be key in achieving results (Clarke & Roome, 1999; Lozano, 2008). The recognition of the importance of individual actors, their collaboration and coordination thereof also resounds in research on Sustainability & Innovation sciences, as a growing amount of researchers are paying attention to the interaction between the micro and macro level of development and diffusion of sustainability innovations (Hansen & Coenen, 2017; Mignon & Bergek, 2016; Warnke et al., 2016).

Planko et al. (2016) present a so-called collective system building (CSB) framework, which, in combination with the Technological Innovation System approach as developed by Hekkert et al. (2007), aims at collaboration of organisations that are involved in developing, implementing and diffusing sustainability innovations. Because important actors in the transition process towards sustainable development are often entrepreneurs (Hall et al., 2010; Teece, 2010), the CSB framework strives to interconnect individual companies and turn them into 'nodes in value chain networks' that work towards a shared goal of collective system building (referred to by Planko et al. (2016) as a system-building goal). One of the topics that is of specific importance in this research concerns the issue how resources and goals of individual actors (entrepreneurs) can be useful input when trying to achieve innovation as a system-building goal. As Planko et al. (2016: 2336) mention: 'Many actors make resources available for system building, however the system as a whole benefits most if the resources are combined and efforts are aligned.'

While the CSB framework creates a useful link between different levels of analysis, it remains at a systemic explanatory level of factors and does not address factors that are of importance for individual actors to effectively engage in CSB activities. In other words, it presupposes that all actors involved in sustainability innovation, especially entrepreneurs, are willing and able to collaborate and

have a common interest in bringing a sustainability innovation about and to the market. In Planko et al.'s approach there is no attention for conditions incentivizing or hampering individual actors (including entrepreneurs) to engage in such CSB activities and take up an innovation relevant and in line with goals at the system level. Individual actors may have different or conflicting interests in an innovation or simply lack resources, thereby hampering their engagement in that innovation. Conditions and behaviour of actors involved in sustainable innovation projects (entrepreneurs, users, policy makers etc.) should be treated as heterogeneous characteristics of individuals (Warnke et al., 2016). In other words, all factors for individual actors involved in sustainability innovations should be investigated at the individual level (including their dyadic network relations) and not at the system level (in terms of systemic functions) as done by Planko et al (2016). This thesis proposes an individual actor approach that will help to understand more clearly the relationship between individual factors, that is the interests, goals and resources of entrepreneurial actors, and their relations with the system level in terms of the implementation of an innovation relevant at the system level. The research question will therefore be: *What stimulating and hampering factors are important at the individual level for the development and application of sustainability innovations that are relevant at the system level?*

These factors will be identified in the next section in order to assess their role in the success of innovations relevant at a system level where the theoretical framework of the individual actor approach is developed. The insights derived from this approach will be empirically evaluated via a set of case studies within the agricultural sector. The research focuses on the individual actors (independent farmers) that are involved in the development and implementation of sustainability innovations through collaboration with other actors. The field of sustainable agriculture is found to be highly applicable, as innovation settings within this sector often entail a large variety of involved actors with varying interests (Zwartkruis et al., 2012). Furthermore, it is mentioned that the differences in goals towards agricultural sustainability between farmers and other system level oriented actors, such as conservation organisations, create problems with regard to the efforts needed towards more sustainable production practices (Reed et al., 2006). This lack of congruence between the individual actor's goals and system level goals, together with the large varieties of actors involved, lends for a perfect opportunity for understanding discrepancies between the different levels and studying their consequences for results in the development and application of sustainability innovations. Thereafter the obtained individual actor level insights will be fed back into existing collective system building literature in order to assess the usefulness and applicability of this approach for CSB. Though this research takes an approach applied specifically to the agricultural sector, it aims to provide a broader framework for identifying causal relationships between the entrepreneurial actor as individual actor level and success of CSB in general.

In the next section an individual actor approach to collective system building will be presented and complemented with hypotheses. After that the methodology will describe the data collection, -gathering, -quality and -analysis. Thereafter, the results of the case studies will be discussed. Finally, a combined conclusion and discussion chapter will be provided.

2. Theoretical Framework

In order to present a clear framework it is useful to first identify conceptual distinctions and approaches used to address the concepts of interests, goals and resources from an individual perspective. Doing so will provide a first clear overview of the **theoretical framework**individual actor perspective to be presented.

Since this perspective is specifically based around individual actors it is important to approach such issues solely from an individual level. However, these individual actors (innovating

entrepreneurs) are often dependent on other actors at different levels (network, or system level actors) to achieve such goals, for example through provision of resources. Therefore, in order to identify the effect and role of individual factors, an approach is needed that addresses the individual interests, goals and resources of actors as well as system-wide goals and resources available at a network and/or system-level. When looking at system-building from an individual perspective it is therefore important to pay specific attention to the individual level actors involved with regard to all the concepts just mentioned.

Since it is the individual actor that finally has to implement the innovation it, first of all, is important for the actors to have a personal interest in the innovation. Therefore this research will first look at the interests of the involved individual entrepreneurial actors in CSB activities, thereby borrowing a stakeholder approach as applied by Freeman & Mcvea (2001), in order to thereafter identify the fit of these actors with actors involved at a network or system level. The main stakeholders are in this case the entrepreneurial actors henceforth these terms are used interchangeably.

Thenceforth, since CSB activities often involve a large variety of actors involved in different levels (Benouniche, Errahj, & Kuper, 2016; Planko, Cramer, Chappin, & Hekkert, 2016), their interests might differ from those of the entrepreneurial actors. When looking at the concept of interests, translated into goals in the CSB process, these goals might differ between actors having interests at different levels (individual, network or system level). For example, actors involved at a system level are more inclined to uphold goals related to the system level. Therefore, a distinction is made between actors working at an individual level (e.g. entrepreneurs), at a network level (e.g. consultancies, researchers, intermediaries, knowledge providers, sector organisations) and at a system level (e.g. policy agencies).

When looking at relevant resources needed for system building from an individual perspective, it is found that often needed resources are not sufficiently available or directly accessible for individual actors but are found at a network or system level (Musiolik & Markard, 2011; Musiolik, Markard, & Hekkert, 2012). Therefore, it is important to take not just the resources available at the individual level into account, but also the resources located at the network and system level and the ways to appropriate those resources through coordination (Foss & Eriksen, 1995). Combining a perspective of different levels of resources with an individual actor approach of the parties involved having responsibilities at the firm level, network level and system level, their goals and interests and differences therein can be more clearly identified.

2.1 Towards a participatory approach that relates to individual stakeholders' interests

If actors with interests at different levels are involved in the development and implementation of sustainability innovations, they will need to collaborate in order to achieve results. This means that goals, interests and resources must be aligned in order to aim efforts towards collectively building the new system. This principle resounds in research conducted in agriculture studying the formation of coalitions of key actors, including entrepreneurs, researchers and other actors, whose interests converge sufficiently in order to focus efforts and resources and set changes at a system level into motion.

Two conditions need to be fulfilled in order to start to collaborate towards CSB. First, an initial interest of individual entrepreneurial actors in the CSB activity is required. Without such an interest, these main stakeholders will not be inclined to engage in the collaboration and the implementation of innovations relevant at the system level, which will consequently not be realised. On the other hand, taking into account all the different interests of the stakeholders involved can also lead to a difficult collaboration, bearing conflicting interests and leaving less room to build a constructive dialogue. What often happens is that stakeholders that do not have a legitimate claim or interest, are highly vocal, taking attention away from less vocal actors with a higher urgent stake to

be heard (Freeman & McVea, 2001; Mitchell et al., 2014). Therefore, as a second condition, a certain amount of interest congruence is needed between stakeholders. Regarding this point it is found that 'a diverse set of stakeholders can only cooperate over the long run if they share a set of core values' (Freeman & McVea, p.12, 2001) reflected in a common goal or interest. When core interests or values of stakeholders are opposing one another, no constructive conversation will occur, thereby making a fruitful collaboration close to impossible. Therefore, in order for individual entrepreneurs to cooperate successfully, a certain amount of individual interest and interest congruence is required.

That being said, while interests at first sight might not seem to overlap, they are often not mutually exclusive by itself. Applying individual recognition of stakeholders' interests also creates further insight into the stakeholder's wants and needs and with that the opportunity to more clearly identify mutual benefits in order to come up with creative solutions to seemingly inherent problems faced in collaborations (Freeman & McVea, 2001; Hart et al., 2003). In response to that, participatory approach are useful ways of achieving this. By having conversations (back-and-forth discussions), trials and group meetings about the innovation in focus, or even applying the innovation together with farmers onsite, suggestions with regard to their interests can be discussed and addressed (Dougill et al., 2006; van de Fliert & Braun, 2002). The result of which is that relevant interests can be taken into account more effectively and get aligned in the process of CSB.

This leads to the following two hypotheses:

H1a: Individual actors will need to have an initial interest in order to become involved in a participatory approach.
H1b: Interest congruence between individual actors is needed in order to collaborate in a participatory approach.

2.2 Alignment of individual actors' goals with system goal

After looking at the interests of the main stakeholders, and the participatory approach on the way to goal alignment, the goals themselves require attention in terms of forming connections between different levels of involved actors. Hence, the second element of collaboration towards CSB is the alignment of individual- and system-level goals. Because the main stakeholders ultimately have to implement the collaboration as well as the innovation it is of key importance for CSB to make sure they agree with the system goals (meaning they have an interest in it) and in that sense align with goals at the system level (Freeman & McVea, 2001).

This can be clarified through an example by Buysse & Verbeke (2003) on environmental strategies. After researching the use of environmental policy with regard to stakeholder management perspectives in companies, one of their main findings was that when setting limits on pollution this policy was not achieving proactive strategies applied by firms, since these were mainly focused on achieving environmental performance as a source of competitive advantage. Buysse & Verbeke (2003) also mentioned how firms are more likely to cooperate with legislators when attention is paid to their firm-specific needs. The other way around, a specific example from the field of sustainable agriculture, namely deer farming, shows that deer farmers that applied a progressive approach with more system-level oriented goals also found it easier to cooperate with legislators and to cope with their demands towards sustainable production practices. This resulted in positive changes in their relation with legislators, not only towards themselves but also towards the whole industry. The alignment of goals between the individual and system level is therefore seen as an important element of collaboration within CSB.

Nevertheless, despite its ultimate benefits, it is found that system level goals with regard to sustainability rarely play a role in decisions at the individual actor level (Pahl-Wostl, 2002). Essential is that goals of individual actors are mainly focused on the farm or firm, whereas goals of system level actors are focused more on the effects of the innovation at the level of the industry or nation. Regarding this issue it is also found that individual entrepreneurial actors are often unable to address systemic issues of sustainability (e.g., within the market or the institutional system) and this is often not their direct goal (Pahl-Wostl, 2002).

When looking at the alignment of the goals of individual actors in CSB, this means on the one hand that it is important for individual actors to align their goals with system level goals. As Planko et al (2015: p.2337) mention: 'To increase the effects of collective system-building, entrepreneurs would need to detach themselves from the primary aim of selling their company's product or service, and instead consider which role they can play in building the new system.' On the other hand, this means for actors focussing more on the system level that it is important to take the interests and goals of other individual actors into account. In other words, because individual actors play such an important role and in their role may require extensive changes in day to day practice, it cannot be expected that all relevant actors will automatically be in line with system-building goals towards sustainability innovations or have an interest in it (Pahl-Wostl, 2002; Markard & Truffer, 2008; Farla et al., 2012). Therefore, as mentioned by Planko (2016: 2337): 'A balance needs to be found between achieving the company objectives and common system objectives.'

Overall, it can be concluded that CSB activities must be able to address agricultural sustainability problems on a system-wide scale with its goals and meanwhile take into account the interests of individual actors that contribute to the development of innovative practices. When looking at relations with the earlier mentioned concepts this means that, first of all, an individual interest should be apparent for individual actors to engage towards reaching this goal. Secondly, when interests of individual actors (entrepreneurs) are congruent, this stimulates the possibility for identifying a mutual goal.

For instigating such alignment and inclusion of interests, the individual engagement of actors in a participatory approach is useful. It enables actors to address individual issues as well as those on the larger agenda towards CSB. By using a participatory approach the continuous back-and-forth dialogue between actors with interests at different levels can help identify mutual benefits and therefore facilitate the alignment of goals between actors operating at different levels (Pahl-Wostl, 2002). This (also) shows the need for participatory approaches to include both system and individual level oriented actors and the inclusion of their specific interests in order to further alignment .

This leads to the following hypotheses:

H2a: The interests of individual actors in an innovation have a positive effect on the alignment of the goals of individual actors and the goals at the system level.
H2b: Interest congruence has a positive effect on the alignment of goals between individual actors and the goals at the system level.
H2c: The involvement of individual actors and system-level or oriented actors in a participatory approach has a positive effect on the goal alignment of goals between individual actors and the goals at the system level.

2.3 Provision of multi-level relevant resources

After taking into account the specific interests and goals of individuals in relation to system-wide goals, it is also important to connect the individual actor level to the system level in terms of the resources that are necessary to achieve the goals. In terms of resources, first of all the ways wherein

such resources are strategically addressed is important for CSB. For example, Farla et al. (2012) take a brief look at what strategies and resources actors deploy to shape sustainability transitions and they identify how strategies with regard to collective action of individual actors and the coordination of their resources are key in this. Moreover within the framework of CSB, as proposed by Planko et al. (2015), the coordination of resources is identified to be important since without such coordination individual entrepreneurs alone are often not able to successfully launch a technological innovation on the market (Garud & Karnoe, 2003; Planko et al., 2016; Ven, 2005). As Planko (2016: 2337) describes: 'These actors make resources available for system building. Yet, the system as a whole benefits most if the resources are combined and efforts are aligned.'

Although collective efforts are needed with regard to the development of relevant resources it is often seen that individual actors refrain from such collective action (Farla, Markard, Raven, & Coenen, 2012). A reason for this, as Schuitmaker (2012) explains, is that 'changing these broader institutional structures is very difficult exactly because they represent valuable resources for those actors that benefit from the existing system.' The prior indicates the relevance of focussing coordination of CSB activities in such situations on managing and coordinating resources in a way that it becomes relevant to individual actors (Musiolik, 2012). This means two things in terms of conditions. Firstly, a certain amount of resource dependency is necessary between individual actors in order to stimulate the actors to collaborate in coordinating the resources to become relevant at the individual actor level and break away from the existing system. Secondly, the actors involved in CSB should have relevant resources available to replace the resources of the existing system. These conditions are described in more detail below, focusing on the availability and relevance of resources to the individual actor.

With respect to the relevance and availability of resources at the individual level, the resource-based view of the firm suggests that a corporate strategy will only lead to sustainable competitive advantage if it is supported by firm-level competencies and resources (Barney, 1991; Rugman and Verbeke, 2002). This means, from an individual actor perspective, that entrepeneurial (and other) actors should not just have an interest in the situation but must also be sufficiently resourced in order to take up the innovation and to effectively contribute to the CSB activity. It can be stated that relevant resources at the individual entrepeneurial level comprise mainly financial resources and knowledge (Gulati et al., 2000).

However, this only describes the availability of resources at the company level and not at the level of multiple companies and stakeholders that CSB is aiming for. Resources may not always be available at the firm level, but at the network level they may. From a resource perspective, this is a key reason to engage in networking activities, such as CSB (Das and Teng, 2000; Lavie, 2006; Musiolik, 2012). By working at a network level, this opens up possibilities to obtain necessary resources to innovate. This may stimulate joint R&D in order to share risks and acquire economies of scale thereby limiting the costs of development of tools and practices (Gulati, 1999; Möller, 2010; Musiolik, 2012). Actors at the network level mainly provide an entrepreneurial actor with access to information (Musiolik, Markard, & Hekkert, 2012).

Resources might also be located at the system level. Such resources are broader than those available in the network of CSB engaged actors and provide collective benefits for the innovation in the whole market or industry (Musiolik, 2012; Musiolik, Markard, & Hekkert, 2012). The relevance of systemic resources to the individual level is mainly that they provide a better environment for individual actors to implement the innovation. Relevant resources for individual actors that are available at a system level are institutional arrangements in the form of protection measures or a better fit with regulation (legislative fit) (Mignon & Bergek, 2016; Musiolik, 2012).

In sum, within CSB, system- and network level actors need to be able to provide such resources in a way that is relevant to actors at the individual level. It is in coordinating and pooling

such resources that these become relevant to the other actors. Whereas an entrepreneurial actor is able to contribute by having enough financial resources to implement the innovation relevant at the system level, a system (or network) level actor will have to be able to contribute by providing complementary knowledge and/or legal arrangements in a way that it becomes relevant to individual innovating actors. When there are sufficient 'pooled' resources, the coordination of these resources (on a network and system level) can make resources available and relevant to all actors involved and with that allow them to take up the innovation relevant at the system level.

Considering the second condition of resource dependency against this background, such a resource analysis does not only provide a first overview of the relevance of different actors and the resources developed or made available within a CSB activity, but it also indicates where incentives and disincentives for collaboration lie (Markard & Truffer, 2008). Entrepeneurial actors overall tend to reach for collaboration when they are in a vulnerable strategic position, such as a resource dependent position (Das, 2016; Eisenhardt & Schoonhoven, 1996). Whereas in the case of high resource dependency individual actors require resources, this will stimulate them to work together in a CSB activity, and take up the resources as coordinated through the CSB activity aimed at developing the new system. Therefore, if such resources are not available in an actor's own network, this encourages him or her to break away from the existing system and by doing so work more towards the achievement of system level goals. On the other hand, when all resources are available within a individual actor's own network, he or she will not be stimulated to collaborate. Actors will not tend to implement the innovation or will do so, but not in a way that it is relevant at a system level.

In sum, resource dependency can have a positive effect on the availability of individual as well as network and industry level resources and stimulate the actors to become involved in collaborations focusing on a certain innovation (Markard & Truffer, 2008). Altogether, when individual actors are dependent on system level or network level actors for resources, because they need institutional arrangements or knowledge about the technology, it will stimulate them to work together in a CSB activity and take up its goals. This means that the dependency of individual actors on resources does not just stimulate coordination of resources but it also stimulates actors to be engaged in other elements of the collaboration towards CSB. That is, firstly, by being dependent on resources stemming from (presumably) system- or network-level actors for their resources they will be more inclined to align their goals and interests with those at a system level. Secondly, if actors are strongly dependent on one another in terms of resources this will also stimulate them to engage more closely in a participatory approach with system or network level actors in order to provide themselves with a better pooling of resources stemming from those actors.

This leads to the following hypotheses:

H3a: The availability of relevant resources on an individual level is conditional for the coordination of resources.
H3b: Resource dependency amongst individual actors is conditional for the coordination of resources.
H3c: Resource dependency has a positive effect on the engagement in a participatory approach.
H3d: Resource dependency has a positive effect on the alignment of goals.

2.4 Relations between different elements of collaboration within CSB

After identifying the individual factors, that is the goals, interests and resources, leading up to the configuration of the three elements of collaboration within collective system-building, it is also important to look at the interrelations between those elements. It is argued that these elements might also strengthen or hamper one another in different ways than previously described.

On the one hand (from goals to resources), the alignment of goals between actors oriented at the individual, network and system level will have a positive effect on these actors to more readily coordinate their resources in order to reach those goals. A similar positive relationship is found for the participatory approach. When individual actors are involved in participatory approach with network and/or system level actors this will enable those actors involved to provide themselves with a better pooling of resources. For these reasons the coordination of resources to become relevant at an individual level will be stimulated if individual actors work closer together in a participatory approach and when they have aligned their goals.

On the other hand (from resources to goals), if individual actors are to adhere to system level goals they will need resources in order to be able to achieve goals at a system level, that is to implement an innovation that is relevant at the system level. It is therefore argued that when such resources are provided through the relevant resource coordination, this will stimulate individual actors to align their goals with those of the system level. Furthermore, if the coordination of resources provides individual actors with the necessary relevant resources they will also be stimulated to bring in their own goals and interests, henceforth become part of the participatory approach focussing on aligning such goals and interests. Yet, when such resource coordinations are not in line with the goals and interests of individual actors towards system level goals, the engagement of actors in goal alignment and a participatory approach can be hampered and with that limit the implementation of the innovation. It is therefore argued that the alignment of individual actors with system goals is an important element of collaboration which will stimulate the coordination of resources and accordingly provide the opportunity for individual actors to successfully implement the innovation.

In sum, it is additionally hypothesized that:

H4a: Coordination of resources has a positive relation with the engagement in a participatory approach.
H4b: Coordination of resources has a positive relation with the alignment of goals.

Now when actors on different levels have sufficiently altered or instigated their interests towards the alignment of goals as well as sufficiently built up the resources relevant to individual actors for implementing a sustainability innovation of relevance at a system level, it is argued that the alignment of goals and coordination of resources is stimulating the implementation of innovations relevant at the system level.

It is therefore hypothesised that:

H5a: The alignment of goals between individual actors and those at a system level has a positive effect on the development and implementation of innovations relevant at the system level.
H5b: The coordination of resources to become relevant at an individual level has a positive effect on the development and implementation of innovations relevant at the system level.

2.5 Conceptual model

The concepts and their hypothesised positive relations stated before are summarized in the conceptual model depicted below.

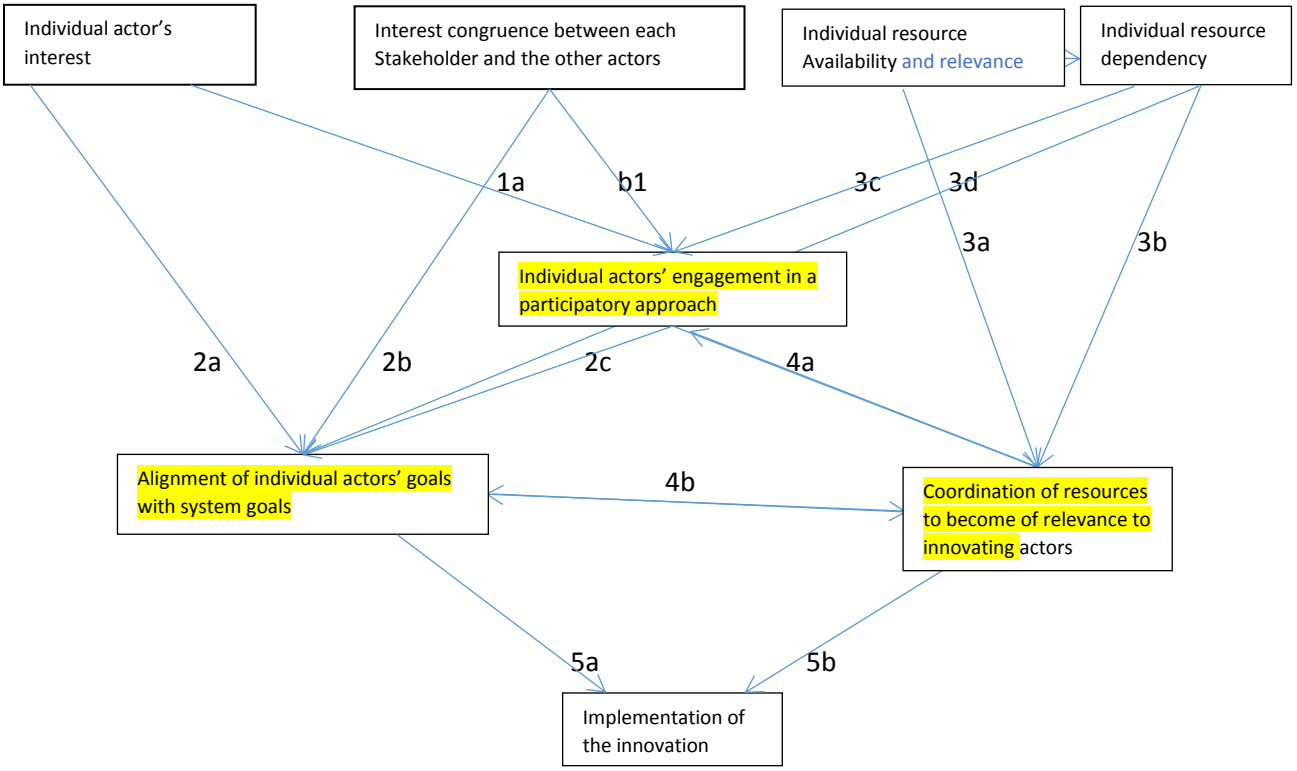

Figure 1. Conceptual framework __ = element of collaboration towards CSB; 1a = hypothesis 1a

In order to evaluate the presence of the hypothesized relations depicted above in practice, a comparative case-study of three Nitrogen leaching projects in New Zealand's agriculture has been carried out. The methods applied in this empirical study are explained in the next section.

3. Methodology

3.1 Research design

After developing an individual actor perspective on CSB, as depicted in the conceptual framework, the usefulness of this perspective is tested in three comparable cases within agriculture in New Zealand evolving around the implementation of a sustainability innovation in order to reduce Nitrogen leaching. For each case approximately 6 innovating farmers involved have been investigated.

Since no investigations have been done before on CSB activities at the individual actor level, generalisations are not of the most importance. A higher relevance lies in understanding the relations first. A comparative case study design is therefore used in order to identify and provide a deeper understanding of the relations between the concepts identified in the previous section being relevant in the context of the cases studied (Yin, 2003).

This comparative case study approach enables to empirically investigate the relations between the concepts as posed in the theoretical framework. Insights from these case studies will lend support to the hypotheses posed in the theoretical framework or not. This will result in an evaluation and alteration of the conceptual framework with regard to the identified weaknesses (hampering factors) and strengths (stimulating factors) related to collaborations of individual actors aiming at collectively moving towards the implementation of sustainable agricultural innovations that are relevant at the system level.

3.2 Operationalization and measurement of concepts

The conceptual framework forms the basis of the operationalisations applied. The concepts, as depicted in figure 1, are transformed into measurable concepts (indicators). These concepts are cross-checked with the measurable concepts to make sure that they are measured well and no conceptual inconsistencies appear. Since the interview questions are derived from the hypotheses as well as the measurable concepts in the conceptual framework, this means that a direct relationship exists between the interview questions and the conceptual framework (Babbie, 2012). Some of the concepts are straight forward to operationalise whereas others require more attention (see Appendix A).

Individual interest:

The interests of individual actors can be seen as their reasons to become part of a project. This is based on their own perception of such an interest, e.g. 'Farmer A lives close to a lake and therefore tries to avoid nitrogen leaching in order to be able to produce legally.' In order to effectively identify such interests, three dimensions of sustainability are identified in literature: economic, social and environmental sustainability. These dimensions are proven to be an effective method for the identification of such interests in agricultural settings involving a variety of stakeholders (Dougill et al., 2006). While in broad lines interests towards sustainability innovations might resemble one another, individual actors might for example look especially for social and economic sustainability instead of overall sustainability (Reed et al., 2006). Interests of the main stakeholders may also bear differences between economic sustainability and social issues. Such issues of sustainability might then be treated in disproportion to one another, e.g. certain stakeholders might want to develop sustainability innovations, but are bound to profit margins implying that their economic sustainability stands in the way of ecological sustainability (Ikerd, 1993; Hopwood et al., 2005).

Furthermore, a systemic view of sustainability is important. This provides an integrated view, as the concept does not treat the elements as separate entities but looks at them as constituting elements of the system (Hopwood et al., 2005). In sustainable agriculture the social dimension is dependent on the environmental dimension as the farm exists within the natural environment and is dependent on it (Giddings, et al., 2002; Hopwood et al., 2005). The same applies for the economic

dimension, which falls within the social dimension as a farmer needs to be able to produce economically sustainably in order to provide a healthy way of life for the farmer and his/her family. Since such dimensions are nested it is argued that the more that a farmer's interest in the innovation reaches sustainability based on all three dimensions, the higher their interest in the sustainability innovation is. Therefore, if actors had an interest in the economic sense, that is to implement the innovation in an economically sustainable manner, this was marked with a 1; for social sustainability this was a 2; and for environmental sustainability a 3. The appearance of their interest was asked directly to the actors themselves (Appendix A: Question 1.4).

Interest congruence:
Interest congruence depicts the congruence of individual interests with those of the group of other individual farmers involved. The interest congruence is, again, conceptualised based on the 3 dimensions of sustainability. It is identified as interests that were shared by other interviewed farmers. The more farmers share their interest in the specific dimension, the higher their interest congruence is. The interest congruence is indicated in terms of percentage, e.g. If the interest in a dimension is high it is shared with all the other farmers in the case and is 100 %.

Engagement in participatory approach:
The engagement in a participatory approach refers to the influence that an individual actor (farmer) can have on the project in terms of the set-up of the innovation. The individual engagement in a participatory approach can, however, be found in different intensities: 1 indirectly via a spokesperson or coordinator that talks with all actors; 2 by directly engaging actors and including them in the conversation; and 3 by directly including actors and giving them the power to make decisions about the direction of the activities. By making a numerical distinction, the effects of different levels of intensity of individual engagement within a participatory approach can be identified. The intensities of the engagement are depicted by the farmers' own perceptions (Appendix A: Question 2.10).

Additionally, the engagement of individual actors in such a participatory approach is measured in terms of frequencies of their individual appearances at participatory activities, such as group discussions and feedback talks. This helps to obtain clear differences between individual actors. This was measured by the turn-up of individual actors at the activities relative to the total amount of activities organised. Such data is retrieved from the project documentation or from coordinators and actors own recall about their presence, measured in high (3), medium (2) and low (1) (Appendix A: Question 2.10). Lastly, the appearance of both of the indicators are also strengthening one another. It is argued that when the increased engagement of an actor in terms of frequency is combined with a more direct participation this also increases the total engagement. Therefore, the multiplication of both of the earlier mentioned indicators is used to represent the actor's engagement, going from 1 (1x1) to 9 (3x3).

Goal alignment:
In order to compare the individual goals towards the sustainability innovations of the different actors involved with the system goals, these are again identified by the appearance and overlap of social, economic and environmental sustainability related goals. Whereas interests are the reasons to engage, system goals are specific future goals with regard to the innovation itself, e.g. 'To remain a highly profitable dairy unit and comply with regulations.'

However, it is not possible to indicate the appearance of such an alignment directly, for one must again be an expert on the specific topic. Such alignment is therefore best identified indirectly by

identifying whether the goals of individual actors and the project goals were set on similar dimensions.

The appearance of goals at different dimensions is identified by the innovating and involved (coordinating) actors themselves (Appendix A: Question 3.16). The project goals were identified by the coordinating actor and/or through project literature, whereas the goals of individual actors were asked directly in the interviews and are thereafter compared on their fit with the system level goals. The alignment is then seen as an overlap between goals. That is, whether actors had goals set on the same dimensions as the project had. Identically to the 3 dimensions of sustainability, the alignment of individual and system goals is measured from 1 to 3. When alignment in all three dimensions is identified this indicates a high goal alignment (3), going down to medium (2), low (1), and nil (0).

Individual resource availability:

The individual resource availability is measured by the notion whether farmers had enough individual resources available to implement the innovation at start. Such resources at the individual level are finances and knowledge. Whether these resources were available to the individual actors prior to the project started, is directly asked from the individual (innovating) actors (Appendix A: Question 4.18). This is measured by the connotation if such resources were available, yes (1) or no (0).

Resource dependency:

Resource dependency is describing the dependence of individual actors on resources stemming from network or system level actors in the project, i.e. knowledge and institutional arrangements, in order to implement their innovation. Whether the actors needed the project's resources to implement the innovation was dependent on how easily such knowledge and institutional arrangements were available to them in their own network/reach. This is measured by the question to farmers whether they had enough knowledge and institutional arrangements available in their own network to implement the innovation (Appendix A: Question 4.19a). When actors needed resources stemming from a network level (knowledge) this is noted as 2. When actors needed resources from a system level (knowledge or institutional arrangements) this was noted as 3. When actors did not require resources besides those stemming from their own network this was noted as 0.

Coordination of relevant resources to enable innovation:

The coordination of relevant resources is measured by the notion if the resources knowledge and institutional arrangements are effectively coordinated within the project, in the sense that they become useful for farmers in order to implement an innovation of relevance at the system level. This is conceptualised as the availability of the knowledge and institutional arrangements present at the network and systemic level to the individual actors. In other words, for individual actors the relevant resource coordination is translated to individual actors in terms of the availability of such resources (knowledge and institutional arrangements) to those actors. The relevance means that the resources were coordinated or managed for the project in such a way that they became useful to the individual innovating actor. The availability of resources means that the individual actors in the project gained sufficient access to those resources.

Since the individual actors (farmers) are actually implementing the innovation it is argued they thereby have the best knowledge about whether such resources were actually made relevant to them. If these resources were made available to the individual actors is therefore identified by the individual actors, in terms of resources made available to them through the project (Appendix A: Question 4.20;22). For network level resources this is identified with (2) and for system level resources with (3).

Implementation of the innovation:

The field of study, nutrient management, is characterised by a clear indicator for the negative environmental effects caused by excessive nutrient losses, namely Nitrogen leaching. The implementation of the innovation relevant at the system level is therefore measured by the realised reduction of Nitrogen (N) leaching by farmers. When the involvement in the project resulted in nil or negative leaching reductions the innovation was taken up unsuccessfully. When the innovation was resulting in leaching reductions between 1 and 5 kg N/hectare, this was low. A score of 6 to 10 kg N/ha was identified as average and above 10 kg N/ha was identified as a highly successful implementation of the innovation relevant at the system level. Zero or below was identified as an unsuccessful implementation.

3.3 Data collection

The empirical data collection is done through qualitative data collection from three different case studies. The cases are selected on the following selection criteria. First, the innovation has to be in a stage that it is possible to determine whether it was implemented successfully or not.

Second, it is important to have a rather clear innovation or set of innovations. Whereas innovations in agriculture often consist of multiple changes in practices (Kaye-blake, 2015), such as a package of nutrient leaching reduction measures, a single innovation is often not possible. Hence, it is key for those innovations to have clear implications in terms of Nitrogen leaching, thereby enabling the innovations to be effectively measured and compared. Furthermore, it is important for the projects to have a similar timeframe, being 3 years, in order to effectively compare the differences in achieved Nitrogen reductions and investigating the relations leading up to those differences.

Third, the cases are based on their fit and representativeness of a CSB activity. This means, first, that the projects investigated in the case studies have a distinct goal of building a favourable environment for their sustainability innovation or at least to stimulate their uptake. Second, the cases are selected based on their large number and diversity of engaged stakeholders, thereby including a variety of industry actors (public and private) in order to have a substantial part of the market involved that would be representative for system building activities (Farla et al., 2012; Planko et al., 2015).

Fourth, it is important that these case studies are coordinated or initiated by one or a few focal actors. By focusing on (and having access to) a few coordinating actors attention can be paid to understanding the collaborative structures and the variety of stakeholders, the levels of stakeholders' engagement in the collaboration and interest congruence throughout the set of case studies in a simple and efficient way. At the same time, focusing on CSB activities with one or a few coordinating actors allowed to create a clearer picture about what system level goals were tried to be achieved and to afterwards cross-check such goals with those of the other actors involved.

The selected cases are three projects based on the stimulation of sustainable nutrient management practices, namely: the Rerewhakaaitu Individual Nutrient Management plans, Meeting nutrient loss targets on dairy farms in the Lake Rotorua catchment and the Sustainable Milk Plans Upper-Waikato. Within each case at least 6 farmers are interviewed with a variety of degrees of implementation of the innovation relevant at the system level. This diversity in implementation increases the likelihood to identify differences between the appearance of the concepts, e.g. high versus low goal alignment. Due to this diversity in implementation it becomes possible to see how differences between the appearance of concepts can result in the hypothesised effects.

Apart from the 6 innovating actors (farmers) also 3 other actors involved in each case study have been interviewed. These other involved actors were selected based on a trade-off between the importance of the role they had in the project as well as the accurate representation of various groups of involved stakeholders holding interests at different levels, e.g. intermediaries and policy

actors. In order to define such key actors it is important to identify the main stakeholders that are dependent on their decisions as well as those actors that contribute to the CSB activity in terms of resources prior to the gross data collection. Therefore, prior to each case study an early stakeholder analysis has taken place, as a result of an initial orientation with the coordinating actor(s). This positively influenced the effectiveness of interviewing as well as provided a comprehensive image of the relevant actors involved in the innovation at an early stage.

The interviewees are interviewed in a semi-structured way because insights about the interests and goals that play a role in the CSB activities can only be discovered by asking in depth about actors' experiences. This form of interviewing gives room for person-specific insights and gives the possibility to further understand the person's point of view without being restricted to a predetermined set of questions (Bryman, 2004). The concepts were the set topics for the questions posed, which were elaborated further upon in order to retrieve a better understanding about the relations between concepts.

3.4 Data analysis

The qualitative data is analysed in several subsequent stages. The interviews are first recorded and then transcribed. After that the data are analysed using open and axial coding. The open and axial coding are applied in the manner used in social research to identify and prove the representativeness of different concepts that are in interrelation with one another, namely through comparison of concepts on different levels of analysis (Boeije, 2002; Fram, 2013). First the individual interviews are coded using open coding, thereby seeking to identify the key concepts in the statements. This will help to create clarity about the presence of concepts within a single interview (Boeije, 2002).

Secondly, through a comparison of interviews taken within each case study, the validity of the hypothesised relations between the concepts is evaluated. Axial coding is used at this stage to see if the hypothesised conceptual relations accurately represent the observations made. The step from open coding to axial coding will help in recognising and evaluating the relationships amongst the different appearances and non-appearances of the concepts. Since differences might occur within the relations between concepts this will help in providing a deeper understanding of the concepts and their interrelations (Mills, Chapman, Bonner, & Francis, 2006). This will ultimately provide a coherent in-case image of the conceptual relations as occurring for the different innovating actors.

Finally, in order to further strengthen this comparison, the results of the different case studies will be compared, resulting in a cross-case evaluation of the hypotheses. Since cross-case comparison is important in this study in order to provide useful insights into the relations between the concepts, the chosen case studies are relatively closely related, namely in the field of sustainable nutrient management practices in agriculture. This will lead to a better comparability and therefore a better understanding of the relations.

3.5 Data quality

As mentioned, the cases have not been selected in order to generalise, but to accurately identify the relations applied in CSB within nutrient management. Since the data is qualitative in nature this decreases the external validity of the research and therefore makes generalizations more difficult, which is already very limited with qualitative studies based on a small sample size, such as case studies (Bryman, 2004). Nevertheless, Boeije (2002) mentions: 'When the sampling has been conducted well in a reasonably homogeneous sample, there is a solid basis for generalizing the concepts and the relations between them to units that were absent from the sample, but which represent the same phenomenon'. Therefore, the results of the selected cases in this study are possibly similar to other cases of sustainable nutrient management. Furthermore, the external validity of the case studies is increased by applying cross-case and within-case examination (Soy, 1996). In order to extend the external validity, a large amount of case studies with variations in size,

places, procedures and actors is required. This will preserve the external validity of the research in the field of more sustainable nutrient management.

Internal validity in case studies is mainly about accurately identifying and measuring the (causal) relationships that are hypothesised between the different concepts. This means that multiple sources of information are required for the verification of such relations. On the other hand variety within cases is important in order to provide internal validity. As Boeije (2002) describes: 'One criterion for qualitative research is that the researcher tries to describe and conceptualise the variety that exists within the subject under study.' Adding up on that, it is often within the exceptions that the concepts are to be proven, specified or dismissed. In this respect the variety in the degree of implementation of the innovations will help to increase the internal validity regarding the identification of relations between the concepts as becomes apparent for collaborating and innovating actors within as well as between the cases.

Furthermore, since the data is qualitative, the quality of the collected data as well as its analysis is dependent on observer and interviewee biases (Kirk & Miller, 1986). As sustainability is a subject that is contested by different stakes and interpretations, an observer as well as an interviewee bias is possible. A researcher or actor involved in agricultural production might for example be biased towards the need of resources for him/herself and its surrounding sustainability oriented actors. Therefore, triangulation is applied throughout the data collection by not just interviewing the (innovating) farmer in question but also a variety of other stakeholders other than the innovating farmer, meaning that different types of actors are interviewed regarding the same innovation. Such actors are asked as much as possible about the same issues to rectify or disprove the statements of the other actors. This prevents the creation of a bias stemming from the innovating actors as well as from the coordinating actor. Accordingly, the construct validity of the measured concepts is safeguarded.

4. Case study Results

Context of case studies:
New Zealand is characterised by an upcoming Nutrient legislation. Since the country allows for different policies in different regions, which are again divided into catchments, this results in a different legislative push towards nutrient management for different locations. The different locations of the projects also make for differences in the phase, stringency, and shape of the process. The three projects that were selected were set up around the development and stimulation of the uptake of an innovation that would reduce Nitrogen leaching.

The projects are predominantly set up by an intermediary in collaboration with farmers and other organisations. The intermediary is DairyNZ, the Dairy industry's sector organisation of New Zealand. This organisation played a role in all three projects, either through instigation or support of the activities. All projects are funded by the Ministry of Primary Industries (MPI). In two of the three cases this is done through a Sustainable Farming Fund. This fund provides the initiators with money necessary to develop and/or diffuse a sustainability innovation in collaboration with farmers.

Since these projects require the provision and extension of knowledge or the quantification of the environmental impacts of innovations, researchers were involved. The most important organisation for these tasks was AgResearch. Since most of the cases included a research and an extension component, AgResearch personnel was engaged in all cases. Furthermore, AgResearch is the main knowledge provider with regard to the quantification of the impacts in terms of N leaching and other environmental sustainability indicators. AgResearch provides the computerprogram Overseer, which models the on-farm elementary flows. This tool is used in New Zealand's nutrient regulations regarding on-farm environmental impacts. AgResearch thereby provides a direct link between science, regulatory bodies and farms.

The projects concern innovative approaches and new production practices that allow the reduction of N leaching on-farm. The innovations are often based on distinct farming practices and the changes in practices and environmental impacts as a result of the innovation are therefore easily identifiable through modelled N Leaching figures. However, due to differences in rainfall the locations also make for differences in leaching levels, meaning that direct comparisons of leaching levels are often insufficient. Therefore, the reductions in modelled N leaching, instead of the overall leaching levels, present a better image for direct comparisons.

4.1 Case study 1: Rerewhakaaitu Individual Nutrient Management plans

Introduction and background:
The Rerewhakaaitu Individual Nutrient Management plans was a Sustainable Farming Fund (SFF) project that was focused on the increase in water quality (TLI) of lake Rerewhakaaitu on the North Island. With the population around it being mainly dairy farmers mitigating nutrient losses on all catchment farms needed to occur to achieve water quality targets. The project, initiated by farmers and an independent coordinator, took a participatory approach to achieve this. This project aimed to demonstrate how farmers can work in partnership with local authorities to develop their own nutrient management plans and produce a catchment plan that will achieve agreed water quality outcomes. Mitigations based on farmer-led plans were implemented on-farm. This cooperative approach, audited and documented, ought to serve as a template for other catchments.

The actors involved in the project were predominantly the dairy farmers in the catchment. An independent coordinator (facilitator) coordinated the project. Furthermore, knowledge provider AgResearch supported the project mainly through two consultants that were responsible for measuring the farms individual impacts and providing consultancy for mitigation options. The

regional council appointed two council-members to oversee the project and engage in the collaborative activities. Funding was provided by MPI through the SFF and the Regional Council.

Case context:
The Rerewhakaaitu catchment was characterised by a group of 20 farmers that directly surround a lake. For this reason, water quality targets were important. The project was, however, not yet inflicted by regulations as the participatory approach aimed to provide ways to self-mitigate the nutrient leaching to the lake, reduce the TLI of the lake and by doing so make regulation unnecessary.

The innovation:
In concrete terms the project proposed the development of individual farm nutrient management plans for all farmers in the catchment on how to reduce N losses. The plan consisted of on-farm mitigation methods enacted over a timeframe of 3 years. Examples are: changes in effluent system, reduction and timing of Nitrogen application. The innovations were distinct practices that resulted in the reduction of N leaching.

The interviewees:
The interviewees represented a large variety of involved actors related to all three levels. The interviewees mainly represented the main stakeholders, being the farmers, including the chairman of the project. The council was represented by a Farm Sustainability advisor (interviewee 9). Furthermore, the coordinator of the project was an independent intermediary between the prior actors. And finally, a research associate was representing AgResearch with regard to the provision of knowledge on the on-farm changes and scientific underpinnings of the project (interviewee 10).

1	Farmer
2	Farmer
3	Farmer
4	Farmer
5	Farmer
6	Farmer
7	Farmer & chairman
8	Coordinator/facilitator
9	Research associate (AgResearch)
10	Farm Sustainability advisor (Council representative)

Table 1: Interviewees

Individual interest:
The farmers held a strong interest in the innovation. The farmers had a strong connection to the lake and the community around it. Furthermore, they were well aware of the leaching targets that were coming up in the country and possibly for their catchment, which provided a stimulus according to the coordinator and council representative (Farm Sustainability advisor, interviewee 7).

All farmers mentioned to have an interest in the innovation. With regard to the individual economic sustainability interests there was the reason to 'just keep farming'. This same interest was held by all farmers in the catchment. Farmer 6, for example, mentioned: 'It has to be economically sustainable to farm here without affecting the quality of the lake. That's all I care about. If they

wanna go put caps on us and barriers on us, then that is gonna become unsustainable.' All farmers were therefore identified with an economic interest.

With regard to the social sustainability interests farmer 1 mentions: 'Rerewhakaaitu is a big part of our community and we would like to keep it that way. We hold the quality of the lake very high as you can go swim in it, catch a fish.' This point resounded, again, in all of the interviews apart from 6. The farmer had less interest in the social sustainability implications as he lived relatively far from the lake: 'I don't really go to the lake. But that's where everyone swims, in the summer all the locals hang out there. So the people closest to the lake probably want to do more.'

With regard to the environmental sustainability all farmers again mentioned to have an interest, which was their livelihood and direct environment being at stake if they remained polluting the lake. Only farmer 6 mentioned to have merely an economic sustainability interest. He said that: 'There is probably no scientific evidence that N and P are affecting that lake. There is a lot of things that contribute to the quality of the lake other than just fertilizer. What about the run off out of the forestry and run off out of the mountain catchment. You got all the black berry and brume shrub around the lake breaking down, that is all contributing to decline of water quality.' His disbelief of the positive environmental sustainability implications resulted in his statement that he had no environmental interest in the innovation. Table 2 shows how everybody had high interests in the innovation, apart from farmer 6.

Farmer	1	2	3	4	5	6	7
Interests (0/123)	123	123	123	123	123	1	123

Table 2

Interest congruence:

The interest congruence in the project was high, according to the coordinating and all other actors involved (interviewee 7 and 8). When looking at interest congruences in the economic dimension, all actors mentioned a mutual interest, which was to prevent regulations on N leaching entering the catchment. The interest congruence was revolving around the mutual interest of increasing the lake quality and meanwhile maintaining their independent position. For example, farmer 3 mentioned: 'My goal was always to get lake Rerewhakaaitu in a position of reasonable water quality, so that the council was not gonna come up with regulation.' This same congruence was reflected in the economic sustainability dimension. Since, as mentioned, if the lake is not environmentally sustainable, legislation will result also in economic unsustainability.

Farmer 6, however, did not share this interest as he believed that the effects of farmers are insignificant because of his reasons mentioned earlier. He therefore did not share the interest that was carried by all, being that the activities around reduced N use were going to result in reduced legislative issues, nor the positive effects for environmental sustainability in general.

In sum, the high economic, social and environmental sustainability interests were reflected in high interest congruence. Since the interests were shared by all farmers, except by farmer 6, this resulted in a high interest congruence. The interest (in)congruences of farmers are depicted in Table 3.

Farmer	1	2	3	4	5	6	7
Interests (0/123)	123	123	123	123	123	1	123
Interest congruence	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/0%/0%	100%/83%/83%

(0/100%)							

Table 3

Engagement in participatory approach:

The project was characterised by a fully participatory approach. The actors at different levels were all involved in the participatory approach. With regard to the farmers/individual actors, the project was characterised by a steering committee consisting of farmers and a chairman (farmer) who lead the meetings. According to farmer 7 and 8 the committee was an important part of the project as it stimulated farmers that had interests but were not vocal enough to be outspoken to be heard (Interview 1). As mentioned by interviewee 1 'Some were less involved because of this. I think that is why the committee was formed, to take other views of people along.' The committee members were tasked to gather the feedback from the other farmers and then report this back to the committee. Also the council appointed two persons to oversee the project and engage in the collaborative activities. Furthermore, an independent facilitator was involved to facilitate the discussion. Regular meetings (3-5 times per year) were held with the council, facilitator and all farmers involved. There were bimonthly meetings of the committee, together with monthly meetings of all farmers involved.

When looking at the engagement of individual actors it was identified by all farmers that they were included in the conversation and had a direct say about the direction of the innovation (3). This was verified by the AgResearch consultant 8.

The individual appearance of actors at the project's participatory activities was also found to be relatively high. The coordinator as well as project documentation showed the medium presence of farmer 1 (2), high presence of the farmers 2 to 5 and 7 (3) and low presence of farmer 6 at such participatory activities (1).

In sum, it is found that all actors were involved in a highly participatory approach (3). Multiplied by the high turn-up rates of all actors involved, this was reflected in high levels of engagement of all other farmers (6-9) apart from farmer 6 (3).

Farmer	1	2	3	4	5	6	7
Interests (0/123)	123	123	123	123	123	1	123
Interest congruence (0/100%)	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/0%/0%	100%/83%/83%
Participatory approach (0/9)	6	9	9	9	9	3	9

Table 4

Relations between concepts:

The high interests in the innovation were reflected in their involvement in the participatory approach. Only farmer 6, who had a low interest in the innovation, was not engaged in the participatory approach. Between the engagement in a participatory approach and interest congruence a strong positive relationship is found as well. All farmers that were found to have congruent interests were simultaneously highly or averagely engaged in a participatory approach. The findings are therefore in line with hypothesis 1a and 1b.

Goal alignment:

The project's goals were to achieve water quality (TLI) targets while allowing profitable farming to continue. At the same time the project put a large emphasis on the societal values of the lake to the community and incorporated this as part of their mission statement. It therefore included environmental, social and economic sustainability goals. The project, however, only held distinct goals with regard to environmental sustainability. Therefore, a mere alignment of environmental sustainability goals (3) already meant a high goal alignment with the project as a whole.

All farmers mention similar sustainability goals with regard to the project that coincided with reducing the TLI of the lake. Farmer 1's goal was: 'trying to develop a catchment plan to monitor the N loading of the lake and try to reduce it.' Also farmer 2 mentioned: 'Our ultimate goal was to try and do what we can to keep the lake in good spirit and condition. If we do what we can it's gonna help further on valley and lake and we can keep on with our business.' The farmers incorporated environmental goals and they were therefore noted to have a high goal alignment (3).

A variety was found between actors having both economic and environmental sustainability goals. Farmer 3 mentions: 'We want first and foremost profitability and productivity and second comes environmental sustainability. So we've started with nothing and tried to build an intergenerational farm business, so part of that is farming sustainably and with that a low nutrient footprint. But we want to grow our business at the same time. There is a lot of stress and balance going on between those.' Since farmer 3 did put concrete goals around the environmental sustainability implications of the innovation his goals were mentioned to be in highly in line with those at a system level (13). Farmer 5 is, however, more focused on the environmental sustainability as he mentions: 'My goals are that 1) we keep water quality paramount and 2) if I can improve my use of nutrients I can benefit as well'. The only farmer that did not mention to have an environmental sustainability goal was farmer 6. The overview of goal alignment of individual actors is depicted in Table 5.

Farmer	1	2	3	4	5	6	7
Interests (0/123)	123	123	123	123	123	1	123
Interest congruence (0/100%)	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/0%/0%	100%/83%/83%
Participatory approach (0/9)	6	9	9	9	9	3	9
Goal alignment (0/123)	3	13	13	3	3	1	13

Table 5

Relations between concepts

The high interest, interest congruence and the high involvement of the farmers in the participatory approach was reflected in a high goal alignment of those farmers. All farmers, except for farmer 6 had a high interest, interest congruence and a high involvement in the participatory approach. They were identified with a high goal alignment. Simultanueosly, farmer 6 was characterised by a low goal alignment. This means that the concepts, just mentioned, were positively related with the alignment of individual goals with the system level goal for all farmers. The results are therefore in line with the hypotheses 2a, 2b and 2c.

Individual resource availability:

The availability of resources at the individual level was deemed to be high in the project. When looking at individual level resources, being knowledge and finances, farmers largely mentioned to be sufficiently equipped to implement the innovation. Through previous projects in the catchment a good understanding was developed of the behaviour of nutrients in the soil. This knowledge was deemed important for understanding changes in farming practices and the effects of these changes.

The lack of individual resourcing was, however, an issue for some. Farmer 1 did have not enough financial resources because of the downturn in dairy prices. She also mentioned to not have enough knowledge in order to have a comprehensive understanding of the science to implement the innovations. She was therefore indicated with a low resource availability (0). Also farmer 2, who was struck by the 3 years of economic downturn in the milk industry, was unable to finance a large part of the practices. He was therefore indicated as having only knowledge in terms of resource availability (2).

The other farmers mentioned to have enough individual resources in place to implement the innovation (12). Also farmer 6 mentioned to have enough resources available to implement the innovation, as he mentioned: 'We probably had all the resources on farm.' The overview of farmer's availability of resources is shown in Table 6.

Farmer	1	2	3	4	5	6	7
Interests (0/123)	123	123	123	123	123	1	123
Interest congruence (0/100%)	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/0%/0%	100%/83%/83%
Participatory approach (0/9)	6	9	9	9	9	3	9
Goal alignment (0/123)	23	123	123	23	23	1	123
Individual resources (0/12)	0	0	12	12	12	12	12

Table 6

Resource dependency:

When looking at the individual dependence of individual actors on knowledge a high dependency was found. Farmer 1 did mention the need for knowledge at a network level. When asked if her own network provided her with enough resources her response was: 'I don't think so. Fonterra as a cooperative doesn't seem to do large things towards individual areas, I don't think enough at least. I think the coop should be more vocal in times to help find the resources to survive at least the environmental impact.' This was reflected in a high dependence on network level resources for 1 (2). Farmer 3 though was able to acquire such resources as he mentioned: 'I didn't have the resources to implement the innovations. But I knew where to get them. For example a fertilizer company is very well able to provide you with information on your leaching or help you set up a nutrient plan.' All

other farmers, however, mentioned resources to be insufficiently available in their own network to implement the innovation. This was noted as a dependency on network level resources for those farmers (2).

With regard to the system level all the farmers mentioned to be dependent on the council for their legislative arrangements. And since the farmers were not able to directly liaise with the council, therefore, all farmers were noted to be dependent on system level resources (3). Farmer 7, for example, mentioned the need for legislative arrangements stemming from the council: 'Just what and when to implement comes back to money plus a bit of science and understanding. But I also need a recognition of the value of what we have done. Like we know that it should work, but is it being recognised by Overseer and the council.' The high dependency of farmers on network- and system level resources is depicted in Table 7.

Farmer	1	2	3	4	5	6	7
Interests (0/123)	123	123	123	123	123	1	123
Interest congruence (0/100%)	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/0%/0%	100%/83%/83%
Participatory approach (0/9)	6	9	9	9	9	3	9
Goal alignment (0/123)	23	123	123	23	23	1	123
Individual resources (0/12)	0	0	12	12	12	12	12
resource dependency (0/23)	23	23	3	23	23	3	23

Table 7

Relations between concepts:

The resource dependency of farmers on knowledge or legislative arrangements is positively related with the goal alignment and the engagement in the participatory approach. This held a less strong, however, still positive relationship for the farmers 1 and 3. Accordingly, the results are highly in line with hypothesis 3c and 3d.

Coordination of relevant resources to enable innovation:

The network provided individual actors with a variety of sources of knowledge. The network level resources were meetings and lectures by experts that provided new information about leaching reduction options. The network provided access to scientists that identified the impacts of N leaching on the lake more clearly. Also one-on-one time was provided with consultants to identify mitigation options. With regard to the network level the project was mentioned by the coordinating actor as well as the largest part of the involved actors to be highly resourced. The way network level

resources were managed was key in the project. For absent farmers there was a newsletter. Also through the committee knowledge was shared in a structural way (interview 5). In this way everybody was kept up to date. In sum, the relevance of resources was deemed high.

However, when looking at coordinated resources to become available to individual actors differences were found. Farmer 1 and 2 were identified with not sufficient coordinated resources/knowledge becoming available to them. 1 mentioned: 'AgResearch and all the budgets were quite restricting. Especially to the end of the project as science came in. And putting it in Overseer, I don't think there was enough knowledge in that regard. So that was on the one side not finding out enough about Overseer and on the other side not having enough money for people who knew Overseer to teach us what it actually involved.' Farmer 2 also mentioned not having obtained enough network level resources because of the high resource needs of his particularly leaching sensitive farm.

All other farmers, however, indicated the high availability of resources. Farmer 3 mentioned the high relevance of coordinated resources: 'Resources were effectively managed in the project. Some of those resources came straight from the regional council.' Also 4 mentioned that there were abundant resources: 'I believe if you try you can certainly source such information. We had a direct link to AgResearch to ask for this also in relation to our own farm plans.' The same high availability of resources stemming from the network level was mentioned by farmer 5, 6 and 7. In sum, the coordination of resources within the project generally provided farmers with the relevant network level resources, as depicted in Table 8.

With regard to the system level, the resourcing was about making sure there was a fit with legislation. Since the farm nutrient management plan was a relatively new concept, still in a developing stage at the time being, there was an aim to make sure this fitted legislation in the project. Also because of the position of Rerewhakaaitu, that was to avoid further legislative action, the validity of the individual farm plans was of high importance. As 1 mentioned: 'The regional council's role is mainly to look at TLI and I suppose we put pressure on the science to prove us what is actually worth having.' Also the chairman (interviewee 7) mentioned: 'It is important to know what practices are actually making a difference, and if this is also taken up and accepted by the council.' In sum, the system level resources were mainly around validating the effects of the innovations put in place by the farmers and making this fit with the regulations of the council in order to replace legislation.

When looking at the availability of such system level resources farmer 1, however, mentioned to be supplied insufficiently: 'The farmers were doing it. But whether it was accepted by the council, I don't know. 2015 was the end of it. So what happened to the catchment plan and whether they accepted the plan, I am not sure. So far it seems like they didn't. I guess it is just ongoing.' With regard to the knowledge, it was also found that the system level resources were often not deemed to be sufficiently available to accurately identify the impacts of the practices. According to farmer 5: 'I think there is probably not enough work done to find out where exactly was our exact position to the political environment. And therefore if these changes in practices were actually relevant and to be acknowledged by the council. As to what is best practice, what is actually worth having.' Such issues with regard to the system level resources were found for all other farmers, resulting in a low availability of legislative fit to all farmers. In sum, the lack of system level resources limited the formal acceptance of the project in legislation thereby reducing the availability of such resources to the individual actors. This was shown in the Table 8.

Farmer	1	2	3	4	5	6	7
Interests (0/123)	123	123	123	123	123	1	123
Interest	100%/83%/	100%/83%/	100%/83%/	100%/83%/	100%/83%/	100%/0%	100%/83%/

congruence (0/100%)	83%	83%	83%	83%	83%	/0%	83%
Participatory approach (0/9)	6	9	9	9	9	3	9
Goal alignment (0/123)	23	123	123	23	23	1	123
Individual resources (0/12)	0	0	12	12	12	12	12
resource dependency (0/23)	23	23	3	23	23	3	23
Resource coordination (0/23)	0	0	2	2	2	2	2

Table 8

Relations between concepts

The conditional relationships of individual resource availability and resource dependency with the coordination of relevant resources were found to be positively related to varying degrees. Farmers that had a high resource availability and dependency upon actors involved in the CSB activity also, to some degree, found relevant resources to be coordinated within the network level of the project. For the farmers 1 and 2, who had no individual resources available, also network and systemic resources were not provided sufficiently. This confirms the conditional relationship between individual resource availability and the coordination of relevant resources. The results are therefore largely in line with the hypothesis 3a. While the farmers were dependent on system level resources/actors for regulatory arrangements, these were not sufficiently provided. The farmers were, however, provided with relevant network level resources. This indicated that the relation between resource dependency and resource coordination does exist in the case to some degree. The results are therefore found to little in line with the hypothesis 3b.

Furthermore, when looking at relations between the concepts representing elements of collaboration within CSB, the high goal alignment with the goals at the system level and high engagement in a participatory approach were also positively related to the high relevance of coordinated resources to farmers. For the farmers a high alignment with the goals at the system level is positively associated with the provision of network and systemic resources made available by the network and system level actors in the project. This was however, found in varying degrees. For the farmers 3, 4, 5 and 7 their high goal alignment was reflected in the provision of relevant network level resources.

The same positive relationship was true for the participatory approach. Farmers that were engaged in a participatory approach deemed the network level resources to be relevant, apart from farmer 1 and 2, who did not have sufficient individual resources to implement the innovation in the first place. Furthermore, farmer 6, who was characterised by a low engagement in the participatory

approach, was still provided with relevant knowledge stemming from the network level. The results are thereby highly in line with the hypothesis 4a and 4b.

Implementation of the innovation:
Since the nutrient management plans were based on practices that are specifically aimed at reducing N leaching, this is an effective indicator for identifying the successful implementation of innovations with relevance at a system level. The variety of on-fram changes is therefore measured through the reduction in N leaching for each farm over the project's lifespan (3 years). This is measured by means of the modelling provided by AgResearch staff. An overview of which is provided in Table 9.

Farmer	1	2	3	4	5	6	7
Interests (0/123)	123	123	123	123	123	1	123
Interest congruence (0/100%)	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/83%/83%	100%/0%/0%	100%/83%/83%
Participatory approach (0/9)	6	9	9	9	9	3	9
Goal alignment (0/123)	23	123	123	23	23	1	123
Individual resources (0/12)	0	0	12	12	12	12	12
resource dependency (0/23)	23	23	3	23	23	3	23
Resource coordination (0/23)	0	0	2	2	2	2	2
N loss reduction	-8	-1	15	3	15	1	5

Table 9

Relations between concepts
The high goal alignment and relevant resources coordination were reflected in the results of the implementation of the innovation relevant at the system level in varying degrees. While in varying degrees, the farmers, who were provided with knowledge stemming from the network level, were characterised by a successful implementation of the innovation. Farmers 4, 6 and 7 who were provided with relevant knowledge, however, achieved a low successful implementation of the innovation. The farmers 1 and 2, who were not provided with relevant knowledge, implemented the innovation unsuccessfully. Because of the on average positive relation, this is partially in line with hypothesis 5a.

The goal alignment was also related in varying degrees to the success of the innovation. Apart from farmer 1 and 2, a positive relation was found between the goal alignment and the reduction in N losses. While for farmer 2 and 5 their high goal alignment was reflected in a highly successful implementation of the innovation, the high alignment of farmers 4 and 7 only resulted in a a low success of the innovation. Furthermore, farmer 6, who was aligned with the system level goals to a low degree, did achieve a low success of the innovation. The results are therefore only partially line with the hypothesis 5b.

Summary:

The positive relations between the different concepts leading up to goal alignment were strongly present in the case. The high interests and interest congruences of farmers was reflected in a high engagement in a participatory approach. This was also reflected in the high alignment of individual farmer's goals with the goals at the system level. This means that altogether for hypotheses 1a, 1b, 2a, 2b and 2c, leading to goal alignment, empirical evidence was found in this case.

When looking at the relations between concepts leading to relevant resources coordination, lesser positive relations were found. It was found that the individual resource availability was highly related to the coordination of relevant resources. The dependency on resources was just little related with the coordination of resources, as it only provided farmers with relevant network level resources. Whilst resource dependency was related to coordination to a low degree it did have a positive relation with goal alignment and the participatory approach for most of the farmers in the case. Therefore, in sum, also for hypothesis 3a, 4a, 4b evidence was found in this case.

When looking at relations between the elements of collaboration within CSB overall positive relations were found. Goal alignment and relevant network level resources coordination was mainly positive related in the case. Also for the positive relation between the engagement in a participatory approach and coordination of relevant resources overall evidence was found. This resulted in empirical evidence for the hypotheses 4c and 4d.

When looking at the relations leading up to the implementation of the innovation positive relations were found. The case found overall relatively positive relations between goal alignment and the implementation of the innovation, however, this was not deemed a strong effect. A similar little positive relation was found between the coordination of relevant resources and the successful implementation of the innovation within the case. The case therefore found only partial evidence for the hypotheses 5a and 5b.

Decisive factors for farmers regarding to the build-up of a successful implementation of the innovation were the availability of individual level resources and an interest in the innovation. It was shown that the farmer that had low interests and interest congruence with the other farmers did not engage in a participatory approach, hence did not adhere goals with the system level and altogether did not successfully take up take up the innovation. Likewise, the farmers that had a low individual resource availability were not provided with relevant network and system level resources, which was reflected in their low success in the innovation.

4.2 Case study 2. Meeting nutrient loss targets on dairy farms in the Lake Rotorua catchment

Introduction and background:

From 2011 to 2014 a SFF project was carried out with the purpose of meeting nutrient loss targets on dairy farms in the Lake Rotorua catchment. The project was instigated by farmers, the intermediary DairyNZ and the regional council that were engaged in the process of meeting the N-leaching targets of the lakes district's council. The goal was to promote the adoption of on-farm N mitigation methods using three approaches: (i) application of different N fertiliser rates through on-farm trials; (ii) farm system modelling; and (iii) farmer engagement in the reduction measures. The first two strands of work were led respectively by AgResearch, DairyNZ and PerrinAg. PerrinAg is a knowledge provider, mainly through consultancy. Furthermore, the project aimed to identifying and farmers' interest fostering engagement in reduction measures presented a collective measure that involved not one clear actor.

The council appointed two persons to engage in the project to control their funding. Furthermore, the project team was made up of staff from DairyNZ, AgResearch and a council-based environmental consultant. Finally, staff of the farm where the project was held was involved: the consultant of the farm, the chair of organisation and the farm manager. Two other farms were involved for modelling the impacts, but required no further participation. The actors that provided funding are MPI, the Regional Council and the agrochemical company Balance nutrients.

Case context:

The Rotorua catchment is holding roughly 30 farmers surrounding the Rotorua lake and city. Rotorua is characterised by a relatively far developed nutrient allowance policy system. The catchment's farmers were presumably to adhere to a strong N reduction as their losses were feeding into the lake. However, at the time the project took place the specific allocation rules were still largely unknown. Because of this context project members have been actively engaged and involved with the Regional Council's collaborative Stakeholder Advisory Group (StAG) which was tasked with developing a 'rules and incentives' package to achieve the pastoral share of the catchment targets. Furthermore, the Primary Producers Collective was brought to life that was aiming to give a voice to dairy farmers in the catchment with regard to the upcoming legislation.

The innovation:

The innovation concerned a low Nitrogen way of farming that starkly reduced leaching to waterbodies and meanwhile only slightly reduced farm-profit, The reduction measures and environmental impacts were identified and quantified by AgResearch and PerrinAg staff. The research component provided farm-based results, which identified the effects of strong reduction in Nitrogen fertilizer applications. The result of which was a lower milk production, and strong Nitrogen leaching reductions.

The interviewees:

The interviewees represented actors at all three levels. The main-stakeholders being 6 individual farmers, of which farmer 14 was a StaG- and Federated Farmers committee member and farmer 16, who was simultaneously a farm consultant. The other three involved actors were part of the project team, These were the coordinator of the project (AgResearch) and an environmental consultant Simon (Regional Council related), both having mainly intermediary roles. Furthermore. a council related Sustainable Farm advisor directly represented the council (Interviewee 19).

11	Farmer
12	Farmer
13	Farmer
14	Farmer & StAG member & Federated Farmers committee member
15	Farmer
16	Farmer & consultant
17	Coordinator (AgResearch)
18	Environmental consultant (council)
19	Sustainable Farm advisor (council)

Table 10

Individual interest:

The interests of farmers, also referred to as the reasons to become part of the project, were relatively low at the start of the project. The farmers in the catchment had no strong incentive to enter the project. This was also confirmed by farmer and simultaneously involved consultant 16: 'So at the time the project was going on, there was to my mind little to no immediate incentive for farmers to reduce the N loading, because they did not know what their allocation was going to be.' This is Whereas interests were sometimes economic, because reducing N would cut on buying in, there was no clear reason.

This was shown when looking at individual interests of individual farmers in the innovation. Farmer 11, for example, did not have an interest in the innovation as he mentioned he did not believe that N reductions would be an economically viable way and found there was the need to look for solutions other than reducing N. He mentioned: 'For nitrogen there are no solutions up to this time other than going broke. And I would be delighted if you can tell me otherwise.' Farmer 11 was therefore identified to have no interest (0). The other farmers however saw the economic benefits in reducing their levels of Nitrogen usage and therefore mentioned to have an interest with regard to environmental sustainability. Farmer 14, for example, mentioned: 'Yes, you can starkly reduce your leaching by just cutting on fertilizer input and saving money.' Economic interest could also be found indirectly. For example, farmer 12 encountered: 'Less health issues of cows when applying lower levels of Nitrogen.' It is therefore noted that those farmers had an economic interest in the innovation (1). This interest was also confirmed by the environmental consultant who mentioned: 'There was a reduction because farmers realised they were wasting money.' Farmers were therefore largely noted to have an economic interest in the innovation. This was also stipulated by the coordinator and involved actors. However, also mentioned how this interest was relatively low with regard to the full application of the innovation. This was also verified by the council related consultant. However, he identified this created interests. Since the total implementation of the innovation was aiming for an extensive reduction that generally results in losses instead of benefits.

The farmers in Rotorua did not have a social sustainability interest because they did not have a strong social connection with the lake. Whereas farmers around Rerewhakaaitu were sole contributors to the lake's state, Rotorua's farmers were part of a larger community of non-farmers. This showed in their lack of interests in the social dimension. Most farmers mentioned to have no interests with regard to social sustainability of the innovation. Only farmer 15 mentioned to have a social sustainability interest because of her side-business in hospitality. This lead her to see the importance of having a prospering community around the lake. This resulted in that she had interests in both the economic and social dimension with regard to the innovation (12).

The environmental interests in the innovation were deemed very low because of the earlier mentioned lack of certainty about the regulations. An example comes from farmer 12 who

mentioned: 'I think to myself that is fine but why would I do these things while there is no financial potential gain, and there is no recognition from the council to do these things yet. So, I think I will wait with implementing such practices [the innovation] until we need a couple of more points for our leaching targets.' Farmer 13 was the only one that had an interest in all three dimensions, as he mentioned: 'I'm gonna have to sell it in the market at some stage so a good part of the goal is something that is attractive in an environmental sense as well as an economic sense. And I want to live in an attractive situation as well.' Because he wanted to pass on his farm, together with his own social sustainability interests, his interest extended to environmental sustainability. Farmer 13 was therefore indicated to have interests in all 3 dimensions (123). Farmer 14 also held an interest in the environmental side, since his farm was leaching relatively highly, he almost certainly needed to reduce his leaching levels. In sum, the interests were mainly focused on economic sustainability and environmental sustainability was not often mentioned. The interests of the individual actors are summarized in Table 11.

Farmer	11	12	13	14	15	16
Interests (0/123)	0	1	123	13	12	1

Table 11

Interest congruence:

The interest congruences between the farmers was deemed very low. Whereas the farmers 12 to 16 held an economic sustainability interest in the innovation, the social sustainability interest were found to be shared by only 2 persons. The environmental sustainability interest was solely held by one. An overview of the interest congruence found for the individual farmers is provided in table 13.

Farmer	11	12	13	14	15	16
Interests (0/123)	0	1	123	13	12	1
Interest congruence (0/100%)	0%/0%/0%	80%/0%0%	80%/20%/20%	80%/0%/20%	80%/20%/0%	80%/0%0%

Table 13

Engagement in participatory approach:

The SFF project was initially based on farmer engagement. However, this was not deemed strong according to those engaged in it. Farmer 16 mentioned: 'I don't know if it was as strongly farmer lead as it should have been. It was more strongly focused on delivery at the industry level. And the regional council saw that there was a potential need for farmers to meet eventual mitigation targets. So, these people at a theoretical and industry level realised that there was a need, but for the farmers it wasn't there.' Furthermore, it is mentioned that the actors directly involved in the project team consisted mainly of network level actors (knowledge providers and intermediaries). Farmers were only indirectly represented via spokespersons including one farmer, a farm consultant and people holding an indirect interest relation with farming within the project team. The farmers were, however, engaged through a series of discussion groups and field days (6 in total). During the field days the farmers 13, 14 and 15 were involved in conversations about the direction of the innovation. However, suggestions of the farmers with regard to the development of the innovation were often not taken into account in the decisions of the project team (14, 18**).** This was also identified by the farmers themselves. Their intensity of engagement was therefore identified as medium (2). All other farmers mentioned, however, there was no direct involvement in the conversation or a direct way of indicating their interests and preferences about the development of the innovation to the project team. The intensity of their engagement was therefore deemed low (1).

When looking at the frequency of farmers' engagement this was also found to be low. The individual representation of farmers at such meetings was deemed relatively low. Whereas farmer 13 always showed up (3) and farmer 14, 15 and 16 were only present at a part of the meetings (2). The rest of the farmers were mostly not present at all (1;0). This resulted in a relatively low engagement for those farmers as depicted in Table 14. For farmer 13, 14 and 15 this resulted in a medium engagement (4;6).

Farmer	11	12	13	14	15	16
Interests (0/123)	0	1	123	13	12	1
Interest congruence (0/100%)	0%/0%/0%	80%/0%0%	80%/20%/20%	80%/0%/20%	80%/20%/0%	80%/0%0%
Participatory approach (0/9)	1	1	6	4	4	3

Table 14

Relations between concepts:

A positive relation was found between the individual interest of farmers and their involvement in a participatory approach. The majority of farmers in the project was characterized by a low interest, which was also shown in their low engagement in the participatory approach. As mentioned, farmer 11, had no interest in the project. This was reflected in a low participation in the participatory approach. The farmers who did see a benefit in reducing their levels of Nitrogen usage were more engaged in the participatory activities, namely farmers 13, 14 and 15. However, since these farmers were only involved to a medium degree this is partially in line with hypothesis 1a.

Also the interest congruence between farmers was positively related to their engagement in the participatory approach. It showed that by having a certain amount of interest congruence in several dimensions actors were still engaged in a participatory approach. The farmers that were mostly incongruent with the interests of the other actors found at the different dimensions also did not engage in a participatory approach. This is in line with the hypothesis 1b.

Goal alignment:

The goals of the project were focused mainly on reducing environmental impacts, being the reduction of Nitrogen leaching to the lake. However, also attention was paid to the economic sustainability of the farm in terms of aiming for a workable economic situation for the farmers. The farm-related economic impacts were therefore quantified in the study, however, no distinct goals were set. A high goal alignment therefore emerges for farmers that had both goals with regard to the economic and environmental sustainability implications of the innovation.

The goal alignment of farmers with system level goals was found to be varying largely, however, relatively low. Farmer 11 was not in line with sustainability goals of the project, since he claimed to have no sustainability goals with regard to the innovation whatsoever. His alignment with the goals at the system level was therefore nil (0).

Farmer 12's goals were based around: 'Making sense for the business. Try to find the balance or the synergy between environment and economics.' However, since she set no distinct goals for environmental sustainability, this was not regarded as environmental sustainability goal alignment and therefore resulted in a low goal alignment (1).

Both farmer 13 and 14 had, apart from economic sustainability goals, also environmental sustainability goals with regard to the innovation: 'I personally aim for reducing N. I don't think anyone would agree with a dirty lake. I don't want to go backwards but to hold or improve it. And reducing N use is a big part of that'. He was therefore highly aligned with system level goals (3). The same was true for farmer 14, who mentioned that his goal in the project was: 'Just to upscale myself

in nitrogen management, be compliant with the council and reduce my N leaching.' This resulted in a high alignment (3) with both of their goals with the system level goals aimed at improving the water quality of the lake.

Farmer 15 mentions to have economic as well as environmental goals with regard to the innovation, which was: 'To try and make the most profit for the least amount of N.' 'Low N is one thing, but our driven is to make a profit. So I try to use as low N as possible with the highest profits possible.' Farmer 15 thereby identifies a trade-off in economic and environmental sustainability goals (13).

Farmer 16 mentions merely mentioned to uphold economic sustainability goals with regard to the project: 'The decisions we put in place, were just made to make more money. They resulted in reducing output. So reducing N input was just because otherwise you would put in more than is useful. So, the goals that required a lot of resources were not implemented.' His goal alignment with the system level was therefore deemed low (1).

In sum, while goals were often only revolving around economic sustainability, several farmers mentioned to have environmental goals and therefore be highly aligned with the system level goals. The alignment of goals is mentioned in Table 15.

Farmer	11	12	13	14	15	16
Interests (0/123)	0	1	123	13	12	1
Interest congruence (0/100%)	0%/0%/0%	80%/0%0%	80%/20%/20%	80%/0%/20%	80%/20%/0%	80%/0%0%
Participatory approach (0/9)	1	1	6	4	4	3
Goal alignment (0/123)	0	1	13	13	13	1

Table 15

Relations between concepts:

The low engagement of farmers in a participatory approach was reflected in a low alignment of their goals with those at the system level. The farmers 11 and 12 who were not or barely involved, did not align strongly with system level goals. Farmers who were involved in a participatory approach to larger degree did however put up more system level goals. Farmer 13, who was involved most, was found to have the highest alignment with system level goals. The involvement in a participatory approach therefore seems to be positively related with the alignment of goals, hence in line with hypothesis 2c.

Furthermore, the lack of interest and interest congruence of the majority of the farmers was reflected in a low goal alignment. When looking at the interests of farmers it was found that the actors that had no or a low interest did not align with the goals. Farmer 13, who did have a strong interest, was also highly aligned with the goals of the project. Similarly, farmers that held low congruent interests in relation with the other farmers were not or only to a small degree in line with goals at a system level, whereas farmers that had more congruent interests did align with the systemic goals. These findings are highly in line with the hypotheses 2a and 2b.

Individual resource availability:

When looking at the necessary resource availability, the innovation didn't require much resources according to farmer 17, as the only thing one needs to do is to lower its N application. That being said, the reduction of N application did result in a substantive reduction in yield, which often needed to be compensated financially. It was therefore identified that the individual resource availability posed a problem for farmers implementing the innovation. As mentioned by the farmer 16: 'Most of

the changes that had to occur were resulting in a loss of income. So, it was about the magnitude of reduction. See, all of the research that has been done on low N applications points to small reductions in profitability. Or it provides the same profitability but still results in negative changes because more debts were required.' The individual resources needed for farmers to implement the innovation were therefore mainly revolving around the availability of financing to back up such losses. Also other knowledge was required as mentioned by farmer 13: 'It requires possibly a high level of management but certainly a structural change. You might have to alter the farm in some way. Some of the practices might require a higher degree of management. Particularly when lower N applications show up in pasture quality, that is a bit of an unknown.'

The availability of individual resourcing proved to be an issue for some farmers. Farmer 11 mentioned to have no resources in place (0). Also farmer 12 mentioned to have insufficient finances to implement the practices: 'It is about resources. If I would have it I would do it tomorrow.' She did, however, have knowledge to implement the innovation (2). Farmer 13 mentioned to have enough resources: 'For me there is probably enough other tools to use. And with regard to finances, I think we have to face up to the challenge that it brings. The bankruptcy challenge is all about your financial position.' The farmers 14 to 16 also mentioned to have sufficient financing to implement the innovation. In terms of knowledge these farmers mentioned to be sufficiently equipped as well (12). Farmer 15, for example, gained knowledge from earlier involvement in research trials about pasture quality and composition. Farmer 16 also had such knowledge, being a farm consultant. An overview of the resource availability is provided in Table 16.

Farmer	11	12	13	14	15	16
Interests (0/123)	0	1	123	13	12	1
Interest congruence (0/100%)	0%/0%/0%	80%/0%0%	80%/20%/20%	80%/0%/20%	80%/20%/0%	80%/0%0%
Participatory approach (0/9)	1	1	6	4	4	3
Goal alignment (0/123)	0	1	13	13	13	1
Individual resources (0/12)	0	2	12	12	12	12

Table 16

Resource dependency:

According to the farmers 13 and 16, apart from the individual finances and knowledge, the innovation also required a substantial share of other resources. These were mainly identified as knowledge on how to replace the decreased production deficit. With regard to such, the other (non-innovating) actors involved mentioned the resources necessary for providing solutions to this problem was largely available. As mentioned by the coordinator: 'A large variety of resources is available in the industry.' It was noted that the knowledge often was out there in non-project related DairyNZ meetings and other gatherings concerning the provision of knowledge.

This was reflected in a low resource dependency of farmers towards the resources made available in the project for farmers as they often mentioned to be sufficiently supplied with resources stemming from their own network. Farmer 11 mentioned to have such knowledge, acquired from companies providing alternative fertilizer products. Also farmer 12 mentioned she was able to find much knowledge through group activities: 'So all of the N reduction things have come from companies and from seminars in Palmerston and Taupo.' She was therefore not dependent on the resources stemming from the project, resulting in no resource dependency (0). Farmer 14 was also not dependent on resources as he mentions: 'Overall such resources were there but you just had to look for it.' Also farmer 15 was able to find much knowledge online, as well as by applying her own

on-farm trials in cooperation with other researching parties. She therefore mentioned to have no resource dependency (0). The low resource dependency on knowledge was shown in Table 17.

According to the involved actors 18 and 19 the system level resource dependency was low. Throughout the project it became clear that no rules were going to be formed. This reduced the dependency of actors on system level resources, to gain knowledge on extensive N reduction practices. This low dependency was reflected in the findings of the individual farmers on a legislative fit. Most farmers mentioned no need for regulatory arrangements. The farmers 13 and 14 did, however, mention the need for such practices to show where they were relative to the rules in order to bring that knowledge to the council, which resulted in a high dependency of both farmers (23). In sum, when looking at the farmers on average a low dependence upon the network and system level resources, as provided through the project, was found. This is showed in Table 17.

Farmer	11	12	13	14	15	16
Interests (0/123)	0	1	123	13	12	1
Interest congruence (0/100%)	0%/0%/0%	80%/0%0%	80%/20%/20%	80%/0%/20%	80%/20%/0%	80%/0%0%
Participatory approach (0/9)	1	1	6	4	4	3
Goal alignment (0/123)	0	1	13	13	13	1
Individual resources (0/12)	0	2	12	12	12	12
resource dependency (0/23)	0	0	23	23	0	2

Table 17

Relations between concepts:

The dependency on resources had a positive relationship with goal alignment and the engagement in a participatory approach for the largest part of the farmers. Farmer 13 and 14, who needed relevant network and system level resources from the project, also were aligned with its goals. Whereas for farmers 11 and 12 their low dependency was reflected in a low goal alignment. For 16 and 15 there was, however, no positive relation found. Furthermore, the farmers dependent on resources were more engaged in a participatory approach. This again did not hold for farmers 16 and 15. The results are therefore little in line with hypothesis 3c and 3d.

Coordination of relevant resources to enable innovation:

The coordination of network level resources was revolving mainly around delivering the science on N application reductions to the individual farmers. The knowledge on the reduction practices were collected through the research practices that were held to support the innovation. With regard to the relevant coordination of network level resources farmer and consultant (interviewee 13) mentions: 'It are the advisors that are important to come to the farmers. So perhaps that is where AgResearch might pick up for farmers on the results and relevance of that study. That study is one of many, and its value depends on how well it is used by others. So in some way it is not just up to advisors to be informed, but up to the producers at AgResearch to make knowledge easily available so that they can help farmers be informed.' In other words, the results should have been made relevant to individual farmers through the network actors involved in the project. According to several involved actors this was something that happened in the case insufficiently. The lack of relevance of such network resources was mentioned by the consultant 16: 'So a large part about reducing N can be quite difficult for farmers to get. They are representations of reality, not reality

itself. Whereas farmers were much more keen to see farm trials or trials more resembling a working farm.' This point was verified by farmer 18: 'It was all abstract, out of the network not a farmer involved was an example of a true case of innovation. So no farmers that were doing it themselves with good effect, or farms that weren't representative in the first place, that is not a situation that a farmer would go for.' Another lack of the resourcing stemming from the network level was that the timeframe was too small, according to farmer 16: 3 Years is in my mind not enough time to set up a good system of research. So this is a complex system change, you would only see the outcome of these changes until the project is already ended. 6 years would be far more valid. Not just for scientific point of view, but also for farmers to go into it.'

When looking at the relevance of network level resources in terms of becoming available to individual farmers large varieties were found. Farmers 11 and 12 mentioned the unavailability of the resources with regard to the earlier points mentioned. It was mentioned by farmer 11 that the time frame was too small. As an answer upon the question whether the project provided him with network level resources he responded: 'Very little, a whole lot of more research is needed. Science is what's missing.' He was therefore noted to have obtained no relevant coordinated resources (0). Farmer 14, however, found the network resources to be available, as he mentioned: 'Well you take it all in and it's not just that, it's all the other information that comes to you. That is part of it, because I've been quite involved with the local collective that we have. I have never understood the nitrogen pathways, no one knew where nitrogen went. By now I have a reasonable understanding of what it is and I can apply this knowledge.' Therefore, farmer 14 was noted to have gained relevant network level resources (2). In sum, the resources on a network level were often not deemed to be made relevant to individual actors, yet a variety occurred.

Since in Roturua the rules were being made, this meant that an important element of the system level resourcing with regard to the innovation was its fit with legislation and therefore the involvement of system level oriented actors (AgResearch staff) to contribute through their resources towards this. In terms of system level resources the project aimed to provide a legislative fit in two ways. Firstly, the project needed to provide an accurate measurement and modelling of the proposed changes in practices in order to measure these accurately for the Rotorua. In order to do so, Overseer was being calibrated to the practices as implemented in the project, thereby taking in account the area and rainfall. Secondly, the project needed to show how achievable those practices were for farmers, and dependent on that, how stringent the rules would have to be. The StAG provided ways to do so, as mentioned by the farmer and StAG member (interviewee 13): 'The proposed farming practices require a higher level of management. It is a matter of informing policy that takes into account the farmer's aspirations and situation. Now those organisations that we are involved with help. That is PPC but also in the StAG you are involved in defining the way forward.' This provided the possibility to influence or advice the council on the implications of such practices.

Because of the presence of the resources, just mentioned, farmer 13 indicated that the project provided him with system level resources in order for him to take up the innovation (12). Farmer 14 also mentioned that the project made clear what was the achievable for farmers with regard to implementing the practices to other actors involved with setting the rules. Such system level resources were, however, mentioned to be insufficient in terms of relevance for the other farmers. These other farmers mentioned that the project team's overlap of members with the earlier mentioned organisations (through the coordinator and environmental consultant) did not provide the means strong enough to effectively steer the system level resources to become available to individual farmers. Also with regard to the fit it was mentioned that not enough resources were made available. For example, farmer 11 did not deem such resources to be available. Because of both the inaccuracies in Overseer, as well as the uncertainties around research-trials of the project he found to not be supplied with a strong enough legislative fit in order for him to implement such

practices. He mentioned: 'Because of the inaccuracy that the council is working with in Overseer, which is plus or minus 30 percent on a good day there is so much uncertainty around the science that it's hard to know what we should or shouldn't be doing.' The farmers 15 and 16 also mentioned to not be provided with relevant system level resources with regard to a fit with regulation. An overview of the coordination of resources is provided in Table 18.

Farmer	11	12	13	14	15	16
Interests (0/123)	0	1	123	13	12	1
Interest congruence (0/100%)	0%/0%/0%	80%/0%0%	80%/20%/20%	80%/0%/20%	80%/20%/0%	80%/0%0%
Participatory approach (0/9)	1	1	6	4	4	3
Goal alignment (0/123)	0	1	13	13	13	1
Individual resources (0/12)	0	2	12	12	12	12
resource dependency (0/23)	0	0	23	23	0	2
Resource coordination (0/23)	0	0	23	23	2	2

Table 18

Relations between concepts:

When looking at the conditions for the farmers with regard to the coordination of relevant resources it showed that a high individual resource availability is positively related to resource coordination for most farmers. For farmer 15 and 16, who had high resource availability, this was merely regarding knowledge stemming from the network level. This is therefore found to be little in line with hypothesis 3a. Also resource dependency was positively related to resources coordination for the farmers 11, 12, 13 and 14, and to a lower degree for 16. No positive relation was found in this regard for farmer 15. This is highly in line with the hypotheses 3b.

When looking at relations between other elements of collaboration and resource coordination it was found that goal alignment also played a role in the relevant resource coordination in the project. Farmer 13 and 14, who were aligned with its goals, also were provided with relevant network and system level resources from the project. The farmers that were not aligned with its goals were characterised with a lower relevant resource coordination. The farmer 16, however, was in to a low degree in line with the goals and did not find the resources to be of relevance.

Furthermore, the low engagement of actors in a participatory approach was also positively related to the relevant resources coordination. Farmer 11 and 12, who were not engaged in a participatory approach, also did not deem the resources to be relevant. The farmers 13, 14 and 15, who were involved to higher degrees, did find those resources relevant. This is in line with the hypothesis 4d. It is therefore found that hypotheses 4c and 4d both are partially in line with the findings.

Implementation of the innovation:

Since the Nitrogen losses were a key-component of the project the reductions therein for individual farms again effectively depict the relevance of innovations at the system level. Data is derived from documentation of the individual farmers and the intermediary parties DairyNZ and knowledge provider AgResearch. Important in this context is that Rotorua is a high rainfall area, meaning that

leaching figures are naturally relatively high in comparison to other locations. Furthermore it should be noted that farmer 16 identified his farm as highly unrepresentative for the catchment as it had a very low production in the first place. Therefore, the farmer placed less value on the N application level, and with that on leaching reductions.

The results of the innovation differed strongly. Farmer 13, 14 and 16 implemented the innovation highly successfully. The other farmers reduced their leaching less. An overview of the reductions is found in Table 19.

Farmer	11	12	13	14	15	16
Interests (0/123)	0	1	123	13	12	1
Interest congruence (0/100%)	0%/0%/0%	80%/0%0%	80%/20%/20%	80%/0%/20%	80%/20%/0%	80%/0%0%
Participatory approach (0/9)	1	1	6	4	4	3
Goal alignment (0/123)	0	1	13	13	13	1
Individual resources (0/12)	0	2	12	12	12	12
resource dependency (0/23)	0	0	23	23	0	2
Resource coordination (0/23)	0	0	23	23	2	2
N loss reduction	0	2	16	32	5	10

Table 19

Relations between concepts:

Now when looking at the effects of the elements of collaboration within CSB on the implementation of the innovation weak relations were found. It is found that the farmers 13 and 14, who had a high goal alignment with the system level, were highly successful at implementing the practices. The farmers 11 and 12, characterised by a low goal alignment, were largely unsuccessful at implementing the innovation. For farmers 15 and 16 this positive relation was, however, not found. This was therefore partially in line with hypothesis 5a.

When looking at the role of resources coordination, farmers 11 and 12, who were characterized by a low resource coordination also implemented the innovation largely unsuccessfully. On the other hand, the farmers 14 to 17, who were provided with relevant resources through the coordination, did implement the innovation to a medium or highly successful degree. This shows how both goal alignment and resources coordination played an important role in the success of innovations. This is therefore in line with the hypothesis 5b.

Summary

Similar to Rerewhakaaitu, the concepts leading up to goal alignment were characterised by strong positive relations. The farmers were generally characterised by a low individual interest and interest congruence. This was reflected in a low engagement in a participatory approach, which was again reflected in a low goal alignment of farmers with the system level. This provided empirical proof for the hypotheses 1a, 1b, 2a, 2b and 2c

When looking at the relations leading up to the relevant coordination of resources, stronger relations were found than for Rerewhakaaitu. The lack of engagement in a participatory approach and goal alignment was also reflected in the low coordination of resources to become relevant to the involved farmers. Furthermore, individual resource availability and resource dependency were also largely

related to the relevant coordination of resources. Resource dependency was highly positively related, whereas for individual resource availability a partial positive relation was found. In sum, this provided strong empirical proof for the hypotheses 4c and 4d, and average proof for the hypotheses 3a and 3b.

With regard to the relations between goal alignment and relevant resource coordination a strong link was found. The participatory approach and goal alignment were both highly related to relevant resources coordiation.

When looking at the relations leading up to the implementation of the innovation, both the alignment of goals and relevant resources coordination were reflected in the degree of successful implementation of the innovation for the farmers. Partial empirical evidence was therefore found for the hypothesis 5a and strong empirical evidence was found for 5b.

When looking at the innovating actors more specifically in terms of what concepts proved to be decisive, it was found that the actors with a high individual interest, availability of individual resources and a large resource dependency were able to acquire relevant resources. It also shows that when not aligned with the goals, but more engaged in a participatory appoach and provided with relevant coordinated resources, farmer 16 is still able to implement the innovation largely successfully. It should, however, be mentioned that the farm's leaching figures were not representative for an average normal productive dairy farm. And if so, leaching reductions were most likely to be lower. Decisive factors for actors to implement the innovation were therefore found to be the coordination of resources together with individual resource availability, resource dependency and individual interest.

4.3 Case study 3: Sustainable Milk Plans Upper-Waikato

Introduction and background:

The Sustainable Milk Plan (SMP) project was a collective voluntary project initiated by DairyNZ that aimed at stimulating farmers to adopt more sustainable farm management practices. The Upper Waikato Sustainable Milk Project (2021 - 2024) was the largest project of its kind. Sustainable Milk Plans (SMPs) were formulated by farmers and consultants for 700 dairy farms located within the Upper Waikato catchment. Collectively, farmers agreed to voluntarily implement almost 6,000 actions to reduce their environmental impact.

The aim was to accelerate the adoption of good farm management practices through delivery and implementation of a Sustainable Milk Plan on every farm. The results of which were to support on-farm changes towards nutrient reductions (mainly concerning Nitrogen) that will improve water quality and ecosystem health in the Waikato River and demonstrate to policy-makers and the wider community the collective commitment of farmers to sustainable dairying in the catchment.

Furthermore, the project was characterised by a steering group ran by DairyNZ, which comprised a variety of industry players and legislative actors including milk suppliers, fertilizer companies, dairy consultants, farmers and Council representatives. 2 Farmers with politically active roles as well as a farmer representative group were present within the steering group. The project's funding was provided by the Waikato River Authority and DairyNZ (sourced from levy and Primary Growth Partnership programmes), through which mainly the consultants' rates and consultant-trainings were paid. Both of these groups were also represented in the steering board.

Case context:

The Upper Waikato is the largest catchment of the North Island, consisting of roughly 700 farmers. With regard to the external policy environment there were, at the time being, no regulations set in place. The Waikato-catchment was, however, characterised by upcoming legislation in the years to come. The future regulations consisted of a waterbodies leaching reduction policy called 'Healthy Rivers', which was presumably including a gradual reduction of N leaching for all darying in the catchment. In that context the SMP project was focused on showing the potential of farmer-lead sustainability plans, that is bringing about positive environmental change without intervention from policy.

The innovation:

The SMP itself can be seen as a concise (three-page) plan that holds the key characteristics of the farm's distinct practices or changes in practices towards more sustainable farm management and the reductions that were achieved in terms of N losses. While the plan aimed for broader more sustainable production practices the nutrient management side was a distinct feature of the plan. The practices and practice changes were modelled by the sub-contracted consultants and presented over the three-year time frame of the project for the individual farms as well as for the catchment as a whole.

The interviewees:

The interviewees represent actors at different levels in the project. That is the farmers, including Farmer 24, who was involved in the stakeholder discussions leading up to the future Healthy Rivers policy. Furthermore, the interviewees 25 to 28 were involved in the steering board. Interviewee 27, a stakeholder relationship manager, was representing the council and AgResearch as an intermediary between the council and the knowledge provider. Furthermore the consultants 26 and 28 and 27 were representing DairyNZ, being the main network actors in the SMP case.

20	Farmer
21	Farmer
22	Farmer
23	Farmer
24	Farmer & member Healthy Rivers Stakeholder group
25	Farmer
26	Environmental consultant (DairyNZ)
27	stakeholder relationship manager (Council & AgResearch)
28	Environmental consultant (DairyNZ)

Table 20

Individual interest:

The interests in the innovation were found to be relatively high. The interests in the economic dimension were found for all actors, apart from farmer 25. That is, by being part of the project this would enable farmers to find economically workable solutions for reducing their N losses. As mentioned by farmer 23: 'It is important for me to know what to be able to do in a way that I could sustain my farm.' This was also identified by the involved stakeholder relations manager for example mentioned: 'There was a big drive to check what costs and measures would be possible for farmers to adhere to.'

With regard to social sustainability low interests were found. This was also mentioned by the coordinators. Farmer 25 did, however, mentioned to have social sustainability interests: 'Yes, I would like to sustain my family, home and community, as a part of rural sustainability.' Farmer 25, however, did not mention to have an environmental interest in the project. His individual interest is indicated to be average (2).

A strong interest in the whole of the case was that the industry needs to do better with regard to water quality and therefore the individual contributions were enabling and proving the industry's progress and all together show this progress to legislative authorities. For example, with regard to the interest in the project farmer 20 mentioned: 'I presumed the whole project was led in such a way that it was letting farmers show to the industry how to do things better, and to not get aboard in that would be crazy because we have to move with the time. So it is a no brainer to move aboard.' With regard to the environmental interests, farmers often indicated the upcoming legislation to be of interest. As mentioned by farmer 22: I suppose that is part of it. Being ahead of the game, not having to be told. Being ahead of what is going to happen in the future. So we've made that change already.' Farmer 23 had an interest in the environmental dimension in that regard as well: 'I think part of being in the program was because we were close to the lake. It was about finding out where we stood in the nutrient side of things and making some goals to move forward, and knowing because we were close to the Waikato river, we were probably going to have to reduce in the future.' On the other hand, farmer 25 mentioned to have no need to adhere to the legislation, since he already largely adhered to it himself. He also did not mention any interest in setting an example for the industry. Overall, this resulted in high interests for the farmers involved, as depicted in Table 21.

Nr	20	21	22	23	24	25
Interests	123	123	13	13	13	2

(0/123)						

Table 21

Interest congruence:

The farmers in the case were characterised by a high interest congruene. The economic interests were strongly congruent in the case as these interests were shared by 5 farmers. The social sustianability interests were shared by farmer 20 and 21 and therefore also found to be averagely congruent between those farmers. The farmers, apart from farmer 25, were characterised by a high interest congruence with regard tot the sustainability implications of the innovation. An overview of the interest congruences of farmers is found in Table 22.

Nr	20	21	22	23	24	25
Interests (0/123)	123	123	13	13	13	2
Interest congruence (0/100%)	80%/80%/80%	80%/80%/80%	80%/0%/80%	80%/80%/0%	80%/80%/0%	0%/0%/0%

Table 22

Engagement in participatory approach:

With regard to this engagement, the farmers could discuss the practices with consultants and steering group-engaged farmers. Farmer 24 indicated that the farmers were involved in a participatory approach of setting up the SMP together with the consultant. The farmer were involved in the SMP process through feedback-conversations. While the consultant put together the final plan, this provided farmers the possibility to shape the plan. This was done through individual feedback moments. Six of these feedback-moments were held throughout the project.

The question whether actors were engaged in the participatory approach through direct involvement or not was found to be very diverse. Whether this provided the possibility to make decisions about the development of the plan according to a farmer's own interests or not was found to be very diverse within the case. Farmer 20 mentioned to be able to steer the innovation towards his own goals. Yes, we were completely in charge of addressing our own plan, we did that on farm level and with the DairyNZ consultants coming over on the farm. Farmer 21 did, however, not have a say in that: 'No I probably didn't. I never saw the plan and had no say in what was in it whatsoever.' The same was found for farmer 25. The other farmers were, similarly to farmer 20, able to have a direct say in the set-up of the SMP.

With regard to the individual appearance at the feedback moments with the consultants no documentation is available. This was therefore mainly derived from farmers' own recall. All farmers were present at the consultant feedback-conversations (3), apart from farmer 23 and 25. They were only present at one of the talks (1). Multiplied by their intensity of engagement the Table 23 depicts the engagement of the different farmers in a participatory approach.

Nr	20	21	22	23	24	25
Interests (0/123)	123	123	13	13	13	2
Interest congruence (0/100%)	80%/80%/80%	80%/80%/80%	80%/0%/80%	80%/80%/0%	80%/80%/0%	0%/0%/0%

Participatory approach (0/9)	9	3	9	1	9	1

Table 23

Relations between the concepts:

The relatively high interests of farmers in the innovation was not shown in their engagement in a participatory approach. The interests of farmers was therefore poorly related to the participatory approach. The farmers 20, 21 and 23 had a high interest and were characterised by a relatively higher participatory approach. Whereas farmer 25 had an average interest, he was characterised by a low engagement. Farmer 23 had a high interest, yet, was characterised by a low engagement in the participatory approach.

The engagement in a participatory approach was also not found to be starkly related to interest congruence. For farmers 20, 22 and 24 a positive, yet, low relation was found. Farmer 25 who had no interest congruence with other farmers was, however, characterised by a low engagement in the participatory approach. This is therefore not in line with the hypothesis 1a and 1b.

Goal alignment:

The goals in the project were set around economic and environmental sustainability. However, again, no concrete goals were set around the social sustainability within the project. The consultants were specifically adviced/tasked to identify the farmers goal and then work towards this. This was mentioned by Bramly: 'The question would be that for some people the motivation to change was more about farm efficiency and farm production rather than environmental. Giving an environmental benefit was moreover the second driver. So, you can easier get someone across the line if they can increase their milk production. This works better to get them to reduce something.' This was identified by farmer 26: 'Often I found myself as a consultant looking for the production benefit and health benefit knowing that there was a secondary environmental benefit. So it was about engaging them in the economic sustainability, but then trying to get the farmers see the environmental benefits they could achieve.' For this reason it is discerned that the project aimed at environmental and economic sustainability goals when needed. Farmers having economic (1) and environmental (3) sustainability goals were therefore identified as highly aligned.

When looking at the goals of farmers the combination of economic and environmental goals was found as well. Farmer 20 mentioned: 'We have goals of improving the capacity on-farm on things such as effluent use, reducing risk of run-off, N losses.' However, he also mentioned: 'The biggest goal is in the end of the day that we need to make a profit.' With regard to the economic sustainability goals other farmers had goals as well. For example farmer 21 mentions: 'The goal there is to make a profit, it's not sustainable if you make losses, so make a profit on a 4 dollar pay-out too. So keeping the cost structure low has always been a goal.' Together with an environmental goal towards the reduction of his N losses this is reflected for farmer 21 in a high goal alignment (22).

Farmer 23 mentioned: 'Minimise environmental impact, starkly reduce our N use and comply with all regulatory requirements at all times.' At the same time he mentioned to have an economic goal as well.' The overlap of goals also showed in the goals of farmer 24: 'My goals were to try and get down nitrogen and phosphorous loss as low as practically possible with as little loss in profit as possible.' Farmer 23 and farmer 24 were therefore mentioned to have economic and environmental goals, thereby being highly aligned (22).

Furthermore, farmer 25 mentioned solely an economic goal: 'Maintain a profitable farm while adhering to regulations.' Since the adherance to legislation is merely a requirement for legal

production this was not identified as a goal and therefore his environmental sustainability goal alignment with the system level was deemed to be low (1). Overall, the farmers were characterised with a high goal alignment with the system level. This is depicted in Table 24.

Nr	20	21	22	23	24	25
Interests (0/123)	123	123	13	13	13	2
Interest congruence (0/100%)	80%/80%/80%	80%/80%/80%	80%/0%/80%	80%/80%/0%	80%/80%/0%	0%/0%/0%
Participatory approach (0/9)	9	3	9	1	9	1
Goal alignment (0/123)	13	13	13	13	13	1

Table 24

Relations between the concepts:

The high interests of farmers 20 to 24 was reflected in a high alignment of their goals with goals at the system level. Farmer 25, who had an average interest, was aligned to a lower degree. With regard to the interest congruence the same relation held ground. When farmer's interests were largely congruent with the interests of other farmers their goals were aligned with those at the system level to a higher degree. This is in line with hypotheses 2a and 2b.

The engagement in a participatory approach was positively related to goal alignment for the farmers 20, 22, 24 and 25. This was therefore found to be partially in line with hypothesis 2c.

Individual resource availability:

The resources needed for implementing the innovation stemming from the individual level were mainly financial resources and knowledge. With regard to financial resources varying amounts were required. Whereas some reductions costed money others actually saved on expenses. With regard to knowledge, an understanding about nutrient management practices, nutrient losses and Overseer was needed.

Farmer 20 had both finances and knowledge available on-farm. He had a good understanding of nutrient reductions, as he mentioned: 'I am trained in sustainable nutrient management. So I am fully familiar with Overseer and nutrient management plans in general.' 21 had enough finances since he claimed: 'A lot of the stuff we were doing didn't cost anything. We just cut back on the input.' He, however, mentioned to not have enough knowledge to implement the practices. Farmer 22 also had sufficient finances, as he mentioned: 'Yes, we had enough financial resources to put the changes in place already.' Regarding knowledge he also mentioned to be sufficiently equipped. Farmer 23 as well as 25 did, however, not have enough financial resources: 'Money was a limitation. Knowledge I think there was enough, also my own knowledge was quite sufficient to understand the changes' (interview 23). An overview of all farmers' individual availability of resources is provided in Table 25.

Nr	20	21	22	23	24	25
Interests (0/123)	123	123	13	13	13	2

Interest congruence (0/100%)	80%/80%/80%	80%/80%/80%	80%/0%/80%	80%/80%/0%	80%/80%/0%	0%/0%/0%
Participatory approach (0/9)	9	3	9	1	9	1
Goal alignment (0/123)	13	13	13	13	13	1
Individual resources (0/12)	12	1	12	2	12	2

Table 25

Resource dependency:

The case was characterised by a low resource dependency. It is mentioned that often resources are available. Consultants indicated a large variety of resources stemming from fertilizer companies, research-hosted group activities and consultancy agencies. It was mentioned how the resources were often out there. The general conception shared by all actors was: 'The resources are out there, it is up to the individual farmers to find them and use them.' (Interview 23).

When looking at individual farmers a low dependency on knowledge was found. Farmer 20 mentioned to have enough knowledge available in his network. Also farmer 21 mentioned to be sufficiently supplied in terms of knowledge: 'I like to use the DairyNZ website, they have a lot of resources on their website. Also from the Fonterra website I get resources. Furthermore, we have a fertilizer consultant. And we go to dairyNZ farm discussion group, 4 times a year.' Farmer 23 also mentioned to have access to enough knowledge: 'I had resources from my personal network enough. I talked to a guy who plants native vegetation. And my feed and fertilizer company helped a lot.' Others mentioned similar availability of network level resources/knowledge stemming from their own networks.

With regard to system level resources there was a larger dependency stemming from the farmers. Farmer 20 mentioned that the legislative fit was not sufficiently available outside of the project to lead to the effective implementation of the innovation: 'For instance there is the next plan of the Waikato river, which is going to identify our progress on leaching reductions to the waterways. Now we don't have a way to present those figures yet, and I think how is the regional council ever going to correctly measure that. Because they haven't showed the capability of monitoring plans. That is a real constraint. I think it has to be industry led. I think we don't have enough capability to do in that regard. The main thing is that we cannot be having different sectors' players doing the same thing over and over again for one farm. If a dairy company does it one way, the regional council does it another way, and every person has a different idea of it, nothing is going to be achieved. That would be a waste of resource. It needs to be clear and deliberate. Because if you have one plan, including all legislative and industry standards, all of this extra work can be skipped.' He therefore was dependent on system level resources for providing a legislative fit with the implementation of his innovation (3). Farmer 22 also mentioned the need for system level resources for identifying his fit with legislation. Also farmer 24 mentioned: 'We needed to see where we were relative to the rules, as to whether we needed to improve on the N side of the system and make some goals to move forward.' The farmers 21, 23 and 25 did not mention the need for obtaining such a legislative fit. An overview of the dependencies of farmers is provided in Table 26.

Nr	20	21	22	23	24	25
Interests (0/123)	123	123	13	13	13	2
Interest congruence (0/100%)	80%/80%/80%	80%/80%/80%	80%/0%/80%	80%/80%/0%	80%/80%/0%	0%/0%/0%
Participatory approach (0/9)	9	3	9	1	9	1
Goal alignment (0/123)	13	13	13	13	13	1
Individual resources (0/12)	12	1	12	2	12	2
resource dependency (0/23)	3	0	3	0	3	2

Table 26

Relations between the concepts:
No strong relationships were found between the dependency on resources on the one hand and goal alignment and engagement in a participatory approach on the other. Farmers 21, 23 and 25 were, however, identified with both a low participatory approach and a low resource dependency. The findings are therefore not in line with hypothesis 3c and partially in line with hypothesis 3d.

Coordination of relevant resources to enable innovation:
The project was characterised by an extensive coordination of resources. As mentioned by farmer 27: 'So I think of it as being quite well resourced. There were good agency connections, whether it is the fertilizer industry advising on nutrients or the regional council advising on low nutrient land-use management. There was a good connection between agencies in order to do that.' This was confirmed by a DairyNZ consultant (interviewee 26): 'There were resources stemming from the council I didn't even knew that were there.' In general it was identified that necessary resources were widely available in the project.

On the other hand, when looking at the knowledge that was being discerned from the project (network-level) by the consultants and whether this became sufficiently available to farmers was found to be very diverse. As mentioned by farmer 22: 'I think my biggest concern about the whole thing were the consultants. In terms of who is doing the nutrient calculations [including N modelling], and where they are getting their information from. Since there were large differences in their capabilities. Some consultants from Fonterra didn't have the whole picture about nutrient management so that can inflate the actual impact of the result.'

These differences in consultants' capabilities were reflected in the relevance of coordinated resources as became available to farmers. Farmer 20 was supplied with sufficient resources: 'So initially the resources to do the plans was provided by DairyNZ, and that was more than adequate.' Also farmer 22 mentioned that the consultant provided highly relevant resources that fitted his needs for implementing the practices as proposed in his SMP. He mentioned: 'If we needed information they would get it out to us.' On the other hand, farmers 21, 23 and 25 mentioned to be supplied insufficiently in terms of knowledge. Farmer 23 for example mentioned: 'Probably the guy didn't gave me as much as I needed. Because he was a fertilizer representative for a small company,

so he wasn't actually DairyNZ personnel. So we probably didn't get as much resources that they could throw at us. We could have done much more.' Also farmer 25 mentioned the consultant did not have sufficient knowledge. Farmer 25: 'It wasn't that good. It didn't give me the depth of knowledge about Overseer I required. No offense but the consultant, I can't remember who he was, but you wouldn't use those numbers.' The relevant resource coordination to individual farmers is depicted in Table 23.

Also at the system level resources were provided through the coordination. The system level was again characterised by high resource availability. The project had important key individuals involved that were able to influence the debate on the new rules, including policy members and a farmer who was active in the debate around the upcoming water quality regulation. The project had a concrete focus on developing resources that provided/instigated the reputation of the practices to result into acceptance by regulatory parties. As explained by farmer and the Healthy Rivers stakeholders group-member (farmer 24): 'This is probably because of doing all the work with SMP on seeing what actually happens with nutrient reductions and analysing what has been done. So all that stuff fed into the healthy rivers discussion and debate, that now is coming up with the regulation.' This indirectly lead to the formal acceptance of the SMP scheme in legislative standards. This was again verified by farmer 26: 'The environmental plans are in there because we showed it could be done. We could show to the larger community that this could be done on such a large scale.'

When looking at the availability of such resources as discerned by individual farmers, again, large differences appeared. As mentioned by farmer 20: 'I think to some degree they did that. Regarding requirements of the regional council in terms of water management and effluent management. And then how are you going to implement your changes in line with those requirements. So that sits sideways. For me I put that in my SMP, for example, that these are our minimal legislative farm requirements around effluent or water. So then we build our effluent system that is set to the standards of the regional council. That is the way forward. So I think we had guidance in that regard.' farmer 20 was therefore provided with relevant system level resources (2).

Farmer 23, on the other hand, mentioned that the plan did not provide him with enough resources as it only provided the minimal requirements of the regional council. He, however, only saw relevance in having a larger fit with regard to environmental plans in general. He mentions: 'It should be one plan that covers all the system that need to be covered around the farm, within the farm gate, and I suppose outside the farm gate. If you got a clear environmental plan that is covering all the industry level standards, you have a hope to achieve it.' He found the legislative fit not satisfactory in that regard, aiming solely at the minimum requirements and not at the targets as potentially brought in through future legislation. Farmer 25 also mentioned the system level resources to not be satisfactory in that regard. An overview of the relevant resource coordination to farmers is provided in Table 27.

Nr	20	21	22	23	24	25
Interests (0/123)	123	123	13	13	13	2
Interest congruence (0/100%)	80%/80%/80%	80%/80%/80%	80%/0%/80%	80%/80%/0%	80%/80%/0%	0%/0%/0%
Participatory approach (0/9)	9	3	9	1	9	1
Goal alignment	13	13	13	13	13	1

(0/123)						
Individual resources (0/12)	12	1	12	2	12	2
resource dependency (0/23)	3	0	3	0	3	2
Resource coordination (0/23)	23	0	23	0	23	0

Table 27

Relations between the concepts:

The coordination of resources was strongly related to the individual resource availability. Farmers 20, 22 and 24, who were sufficiently equipped with resources were provided with highly relevant coordinated resources. The farmers with a lower resource availability were provided with low or no relevant resources through the coordination in the project. The resource dependency was also related with relevant resource coordination, however, to a lesser degree. The farmers 20, 22 and 24, who needed system level resources, were provided with relevant network and system level resources. The farmers 21 and 23, who were not dependent on the project's resources, were not provided with relevant resources. Farmer 25, who was dependent on system level resources, was not provided with relevant resources. This is highly in line with the hypotheses 3a and 3b.

When looking at the elements of collaboration representing CSB, a little positive relation between goal alignment and resource coordination was found. Farmers 20, 22, and 24, who were aligned with the system level goals were provided with relevant coordinated resources. Farmer 25, who was characterised by a low goal alignment was, however, not provided with relevant coordinated resources. For the other farmers this positive relation was, however, not found. This is therefore partially in line with hypothesis 4b.

Furthermore, the engagement in a participatory approach was stronger positively related with relevant resource coordination. Farmers 20, 22 and 24 were more engaged in a participatory approach. This was reflected in the high availability of resources as provided through the project. For farmers 21, 23 and 25 their low engagement was also reflected in a low availability of coordinated resources. This is highly in line with hypothesis 4a.

Implementation of the innovation:

The success of the implementation of the innovation relevant at the system level was again depicted by the reductions in N leaching. Since the N losses were a key-component of the project the reductions therein for individual farms effectively present the relevance of innovations at the system level. The data was derived from the SMP plans as provided by DairyNZ. There were large differences found with regard to the success of the innovation, as depicted in table 28.

Nr	20	21	22	23	24	25
Interests (0/123)	123	123	13	13	13	2
Interest congruence (0/100%)	80%/80%/80%	80%/80%/80%	80%/0%/80%	80%/80%/0%	80%/80%/0%	0%/0%/0%

Participatory approach (0/9)	9	3	9	1	9	1
Goal alignment (0/123)	13	13	13	13	13	1
Individual resources (0/12)	12	1	12	2	12	2
resource dependency (0/23)	3	0	3	0	3	2
Resource coordination (0/23)	23	0	23	0	23	0
N loss reduction	6	2	25	2	8	-1

Table 28

When looking at the relations leading up to the implementation of the innovation it was not found to be highly related to goal alignment for most farmers. It was, however, related to the relevant coordination of resources. Whereas farmers 20, 22 and 24, who were provided with relevant resources, implemented the innovation highly or moderately successfully, the farmers 21, 23 and 25 characterised by no relevant resource coordination did not. The findings are therefore partially in line with hypothesis 5a and highly in line with hypothesis 5b.

Summary:

The positive relations between the different concepts as leading up to goal alignment were less strongly presented in this case. It showed that the case was characterised by high interests together with interest congruence between the farmers, both having a strong relation with goal alignment. The high interest congruence and interest in the case were, however, not strongly reflected in the engagement in a participatory approach. Also the relation between the engagement in a participatory approach and goal alignment was found to be low. This provides empirical evidence for the hypothesis 2a, 2b and partial evidence for hypothesis 2c in the case.

When looking at the relations between the concepts leading up to relevant resources coordination stronger relations were found. While the participatory approach in SMP did not lead to goal alignment, it did relate strongly with the relevant resources coordination. That is, when actors were not involved in a participatory approach, they also found resources stemming from the project to be coordinated insufficiently. The high goal alignment was little related to the relevant coordination of resources. However, this positive relationship could have also been camouflaged by the lack of individual resources for two farmers or the lack of their engagement in a participatory approach that were both represented to a low degree for those farmers.

The results of the case study identified how the availability of individual resources plays a decisive role for the relevant resource coordination and with that the uptake of an innovation. The resource dependency was also largely related to the relevant coordination of resources. The case therefore provided empirical evidence for the hypotheses 3a, 3b, 4a, and partial evidence for hypothesis 4b.

When looking at the relations leading up to the implementation of the innovation strong positive relations were found. Whereas coordination of resources was directly positively related, goal

alignment was only related when resources were relevantly coordinated. This provided partial evidence for hypothesis 5a and evidence for hypothesis 5b.

In sum, the results show that the relevant resources coordination plays a decisive role. The relevant coordination of resources was also strongly related to the engagement of farmers in a participatory approach. Also the individual resourcing was an important element related to the relevant coordination of resources, and therefore played an important role for farmers taking up the innovation relevant at the system level. When looking more specifically at the farmers, it was found that those with a high congruence and interest, as well as individual resources and a certain amount of resource dependency implemented the innovation to a highly or medium successful degree.

4.4 Cross-case analysis

The Table 29 below presents the degrees to which evidence was found for the positive relations within the different cases.

Case	1	2	3
H1a Individual interest with participatory approach	hp	hp	np
H1b Interest congruence with participatory approach	hp	hp	np
H2a Individual interest with goal alignment	hp	lp	hp
H2b Interest congruence with goal alignment	hp	hp	hp
H2c Participatory approach with goal alignment	hp	lp	lp
H3a Individual resources with resources coordination	hp	lp	hp
H3b Resource dependency with resources coordination	lp	hp	hp
H3c Resource dependency with participatory approach	hp	lp	lp
H3d Resource dependency with goal alignment	hp	lp	lp
H4a Coordination of resources with participatory approach	hp	lp	hp
H4b Coordination of resources with goal alignment	hp	lp	lp
H5a Goal alignment with implementation of the innovation	lp	lp	lp
H5b Resources coordination with implementation of the innovation	lp	hp	hp

*highly positive (hp): 5-6 farmers; little positive (lp): 3-4 farmers; not positive (np): <3 farmers

Table 29

Overall the relations between the different concepts as leading up to goal alignment were found to be highly or little positive in all cases. All cases showed highly positive relations of both the appearance and congruence of individual interests with goal alignment. Case 1 and 2 showed positive relations stemming from both the individual actors' interest and the congruence between those individual actors' interests with the engagement in a participatory approach. In case 3 the interest and interest congruence between the farmers was however not found to be related with their engagement in a participatory approach. Divergent, yet, overall positive relations are found between the engagement in a participatory approach and goal alignment. In cases 2 and 3 it proved to be little related to goal alignment, however, this relation was stronger for case 1.

When looking at the relations between the concepts leading up to relevant resources coordination overall positive relations were found. With regard to the role of both dependencies and availability of individual resources on the coordination of those resources, divergently positive relations were found. Case 3 showed highly positive relations for the availability and dependency of resourcing leading up to the relevant coordination of resources, whereas case 1 and 2 showed both highly and little positive relations between these concepts.

When looking at the other elements of collaboration towards CSB (participatory approach and goal alignment) in relation to resources coordination, overall positive relations were found. The coordination of resources is highly positively related to the participatory approach in cases 1 and 3. Goal alignment and the relevant resources coordination were more little than highly related in the cases.

When looking at the relations leading up to the successful implementation of the innovation the coordination of resources is characterised by overall highly positive relations. Goal alignment is related to a lesser degree throughout the cases. While the cases provided no strong empirical evidence for its relation with the successful implementation of the innovation, this could have been camouflaged by the decisive role of the relevant coordination of resources.

The decisive factors:

Regarding the decisive factors for instigating the innovation relevant at the system level, defined as those with highly positive relations for two or three out of three cases, it was found that interest and interest congruence played a large role in the alignment of goals. For the largest part of the cases interest congruence was related to the engagement in a participatory approach. Because there was no evidence found for the relation in case 3 this makes it less of a decisive factor. The engagement in a participatory approach did, however, play a decisive role in the coordination or resources. The same was found for individual resources and the relevant resources coordination. Finally, the coordination of resources was found to be a decisive factor for the implementation of the innovation.

In sum, the individual interests, individual resources, interest congruence, engagement in a participatory approach and resources coordination play a decisive role in the collective implementation of innovations relevant at a system level. The goal alignment of individual innovating actors with those at a system level was proven to be less distinctively related.

5. Conclusions

In order to identify the stimulating and hampering factors for individual actors to develop or implement a sustainability innovation relevant at a system level, an individual stakeholder approach is developed in this study. This approach provided insights in the factors that play a role in the collective implementation of sustainability innovations at an individual level, based on the individual interests, goals and resources held by individual actors whilst moving towards the successful implementation of a sustainability innovation. In relation to these individual concepts three elements of collaboration towards collective system-building were identified to stimulate individual actors to implement innovations relevant at the system level. These elements were: The engagement of actors in a participatory approach, the goal alignment of individual innovating actors with the goals at a system level and the coordination of resources to become of relevance to those actors.

Now in order to identify the stimulating or hampering factors, the relations between these concepts, as leading up to the implementation of a successful innovation, were identified and hypothesised upon. That is, whether their appearance or non-appearance led to implications for the other concepts and eventually the implementation of a sustainability innovation relevant at the

system level. Since such hypothesised relations are positively related, this consequently meant that the positive appearance of a concept would lead to a stimulating factor, wheras the negative appearance would lead to a hampering factor.

The hypothesised relations were tested in 3 case studies related to more sustainable nutrient management practices in New Zealand. The cases showed quite some empirical evidence for the largest share of the hypothesised relations. The positive relations between the different concepts as hypothesised leading individual actors to develop successful innovations at the system level, enabled to identify the following factors stemming from an individual level.

When looking at the interests of individual actors, for all cases strong empirical evidence was found for the presence and congruence of individual interests of the innovators in the innovation as a factor for moving towards a successful innovation. Individual interest and interest congruence played a large role, either through the participatory approach or directly through the alignment of actor's goals with the goals set at the innovation system level. Whilst the engagement in a participatory approach was to differing degrees related to the appearance of interests and interest congruence of individual actors within the empirical data, the largest part of the empirical data showed it to be highly related to individual interests and interest congruence. It did prove to be related to goal alignment and highly related to relevant coordination of resources that on their turn are related to the implementation of successful innovations for those instances. This confirms the hypothesised role of engagement of individual actors in a participatory approach and the factors (individual interest and interest congruence) as important factors for developing innovations relevant at a system level.

When looking at the configurations of resources as identified on the three different levels, strong evidence was found in the cases for the hypothesised relations. First and foremost, the availability of individual resources, being finances and knowledge, proved to be highly important in order for individual farmers to be able to be provided with relevant coordinated resources that allowed them to to take up the innovation. It is often stated that without such individual resources farmers were not able to apply (financially) or understand (knowledge-wise) the coordinated resources. Secondly, also resource dependency was found to be related to the coordination of relevant resources.

Finally, when looking at the elements leading up to the successful implementation of an innovation, overall evidence was found for the relations of resource coordination and goal alignment with the implementation of resources. The relevant coordination of resources was found to be a decisive factor for the implementation of innovations. The goal alignment was, however, found to be little related to the successful implementation of an innovation relevant at the system level for individual actors. While the relation was found to be little an overall higher reduction of leaching was found for the farmers that were highly in line with the goals. Discrepancies in measurements of the successful implementation of innovations, however, created a lack of distinct evidence for approval or disproval of this relation.

In sum, the presence and congruence of individual interests, the availability of individual resources, the relevant resources coordination and the involvement of individual actors in a participatory approach are factors at an individual level that were identified to play a decisive role in the implementation of innovations relevant at the system level throughout the empirical data collection. Almost all of the other hypothesised relations between concepts and elements found empirical evidence in the cases, yet, to differing degrees between cases.

More research would be needed to provide evidence for such relations as well as to identify other relations that could play a role in the factors leading up to sustainability innovations relevant at the system level and were not hypothesised upon.

6. Discussion

This research provided an initial understanding of the individual factors influencing the successful implementation of sustainability innovations relevant at the system level. It arrived from the conception that the focus of CSB is thus far mainly based on the collaborative efforts needed, while not taking in account the individual positions of innovating actors. taking for granted the participation and dedication of (innovating) actors at an individual level to work towards a system level goal. By applying an individual actor perspective it enabled to identify the position of individual innovating actors in collective system building and the factors that enabled them to contribute to it by implementing an innovation relevant at the system level. Whereas previous research identified the importance of addressing collective system building from a micro perspective such an analysis was not yet provided on an empirical basis.

Previous research indicated both the coordination of (individual) actor's resources in order to become of relevance to system-building and the alignment of individual company goals with system-building goals to be important factors for setting system level changes into motion. Such research was, however, still mainly approached from a system-level of explanatory factors. This research, however, identified these concepts specifically from an individual actor perspective that played a role in the alignment of goals and coordination of resources, with the final aim of identifying its effects on the successful development and implementation of sustainability innovations relevant at the system level. It provides an initial understanding of the importance of the concepts and relations between those at the individual level as applied to the field of on-farm more sustainable nutrient management.

While being mainly explorative in terms of identifying such relations, the research predominantly showed how such individual factors play a role in the development and implementation of sustainability innovations relevant at the systemic level. This concretises the statement made earlier that processes of collective system-building are to be engaged from an individual actor perspective in order to provide results in terms of the development and application of innovations relevant at an individual level.

In terms of future research a further aim could also be on extending the identification of such individual factors to other system building activities as identified by Planko et al. (2016), e.g. market formation and system orchestration. An identification of the individual factors in those activities could further substantiate evidence and understanding of the relevance of applying individual level of analysis to the (collective) development and implementation of innovations relevant at the system level.

However, the study did have its limits with regard to providing evidence. First and foremostly, in terms of external validity, the empirical data gathering of only three case studies limited its generalisability within its field of application, being more sustainable N leaching management. Therefore more cases would be required in order to increase external validity.

With regard to internal validity the hypotheses provide a clear way of identifying the relations between concepts, however, inconsistencies in measuring the different concepts were found. Firstly, the results of the implementation of the innovations as measured in N leaching (high, medium, or low implementation) were characterised by relatively large uncertainties caused by differences in rainfall, soil types and slope of the locations. The correctness of the results can therefore be affected. This can be resolved by taking in account the relative differences in such outside factors in modelling and focussing more on gradual differences instead of on the specific starting and ending years of projects.

Secondly, the conceptualisations of individual interests could be improved. The measurements are mainly revolving around farmers' own perceptions of their interests, goals and

resources. Whereas the incentives for entrepreneurial actors to engage in a CSB activity and take up the innovation relevant at a system level are mainly dependent on a farmer's own perception, the measurement based on this perception did provide internally valid evidence for their engagement. However, since memory decay, biases and social acceptability can play a role, the measurement of those concepts can differ between actors within and between case studies. This limited the external validity of the research. Therefore, apart from validating the measurements through verification by engaged actors, a more structured approach should be developed in future, e.g. consensus based, cross-validated with the involved actors, to identify this fit and improve external validity.

The same issue was found for the conceptualization of the engagement of individual actors in a participatory approach. As this, again, was based on the farmer's own perception this could have resulted in biases towards the preconceptions or intentions of individual actors. Furthermore, differences in ways of individual engagement in the participatory approach, e.g. one-on-one conversations versus grouptalks and field days, did not allow for an effective comparison. Both of these issues lead to a reduced external validity.

Furthermore, the conceptualization of goal alignment could have been made more specific. Often actors involved in a project aimed at the development or diffusion of an innovation have goals with regard to the implications in the three dimensions of sustainability but also have a distinct emphasis on specific dimensions. This can occur for practices aimed at the reduction of Nitrogen leaching as individual actors can have different emphases on different dimensions with regard to the implementation of the innovation, that are not taken in account effectively using merely a comparative three dimensional conceptualisation. The possibility to indicate different emphases on dimensions could therefore provide a more useful approach to identify the differences or similarities between goals of actors in future research.

In sum, differences in cases in terms of conceptual fit reduced the external validity of the research. A more consistent conceptualisation within and between cases would have lead to more detailed and coherent comparisons. A more externally valid conceptualisation of the concepts altogether with the inclusion of more cases to verify these results is needed in future studies in order to effectively and correctly identify the factors for collective system building at an individual level.

7. Policy advice

In order to effectively guide a process of collectively developing and/or diffusing innovations relevant at the system level, the results of this study show the importance of paying attention to the individual interests, goals and resources available to individual farmers. Hence, advice can be specified in concrete terms based on these same concepts and the relations between those and the elements of collaboration within CSB as found in the cases. This advice is mainly aimed at coordinating actors working on either a network or system level or both.

Interests: Different innovations provide different levels of interests of individual (supposedly) innovating actors. This could mean that, in cases of low interests, a preliminary aim should be at involving the farmers and actors that have an initial high interest in the innovation, in order to thereafter show other actors how this fits with their goals. This approach could work more effectively as opposed to involving all actors and by doing so decrease the interest congruence and overall relative interest of the farmers involved. Another possible strategy might be to more specifically target the interests of potentially involved actors, e.g. when a farmer is largely in line with the goals on a system level, yet, wants to implement the innovation in a way that is more fitting with his/her needs, socially, economically or environmentally. Possible strategies for identifying such interests or congruence of interests can be a stakeholder analysis or conversations. While this might occur as a repetitive task, it does create a good overview of identifying (possibilities for) such an interest congruence.

Goals: When looking at goals, again, a specific focus on individual actors is found to required. It showed from the results that interests and interest congruence between individual actors is highly related to the alignment of actors' goals with system level goals. Henceforth, it can also be stated that in order for farmers to adopt system level goals this means that it is important to take their interests or goals into account in the development or stimulation of the implementation of innovations. In order to achieve system level goals with regard to the implementation of innovations a participatory approach is useful, that is to involve actors in the process of developing and implementing the innovation. By doing so, interests of individual actors can be taken in account more effectively and, simultanouesly, the importance of system level goals can be brought to the attention of individual innovating actors. Since goals are often related in nature, or as earlier mentioned 'nested', this does provide an important role for coordinating actors in terms of identifying this fit between goals and interests of different (potentially) involved actors and conveying this to both system and individual level oriented actors.

Resources: Also when looking at resources, as provided through coordination in a project, specific attention is to be paid to the individual farmers and the availability of their individual resources (knowledge and finances). The results of the cases showed that the lack of individual resourcing can hamper the innovating actors to absorb the provided network and system level resources and with that hamper the innovation to be taken up. Often the demands for complementing such knowledge are found to be highly specific for different actors. Therefore attention can be paid by network or system level actors on providing knowledge and institutional support as seen a specific need for by individual actors. This can increase the effectiveness of providing relevant resources to individual innovating actors. Furthermore, this research showed that engaging individual (supposedly) innovating actors in a participatory approach is related to the coordination of resources to become of higher relevance to those actors. Hence, the direct involvement of innovating actors in such activities and specifically aiming such activities on providing relevant resources to individual actors might be

important to provide the success of collectively developing innovations with relevance at the system level.

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Appendix A. Interview questions related to conceptual framework

Conceptual framework/Concepts	Indicators [meetschaal]	Hypotheses + interview questions
General introduction		What is your profession? What is/was your role (or roles) in the (name of specific program)*?
1. *Implementation of innovation relevant at system level*	1. Part of the proposed innovation implemented [percentage of all features/the whole package] 2. Effect of nutrient management practices [Reduced N leaching/kg of Milk solid]	What features of the innovation(s) did you implement? (Name the list of goals of the innovation) What was your exact result in reduction of Nutrient leaching?
1. *Individual interest of specific stakeholders*		II
	3. Individual actors 4. Specific interest [1= economic 2= social 3= environmental] ;[Quant.] 5. Actors with specific interest involved [yes/no]; [Quant.]	Which persons were involved in the development of the innovation? (Perhaps skip for farmers, transform: What were key persons in the project according to you, that played a vital role in letting the collaboration and the project in general succeed?) What was your specific interest in the innovation? Were all the stakeholders with a specific interest that needed to be taken in account involved?
2. *Interest congruence between individual actors*		IC
	6. Presence of interest congruence [yes/no] ;[Quant.] 7. Conflicting interest 8. Specific interest identification [Yes/no]	Farmers: Did you and other individuals in the project have a mutual interest in the project? Did you and other individuals in the project have a conflicting interest in the project? What was your interest in the (Name

		of the project)? Coordinator: Did the people/organisations that were involved in implementing the innovation have (any) mutual interests in implementing the innovation? If so, what was this interest/were these interests? Were there people that had interests that did not fit with the others' interests? If so, what was this interest/were these interests? Did you specifically make clear what were each other's interests prior to the collaboration?
		PA
	9. Participatory approach [1 = indirectly via a spokesperson or coordinator that talks with all actors; 2 = directly engaging actors/stakeholders by including them in the conversation; 3 = Directly including actors allowing decisions about the direction of the activities.] 10. Direct say in direction of the innovation process [Yes/no] 11. Turn up [High/low] [amount relative to all meetings; relative to catchment total]	Farmers: Were you involved in collaborative activities with coordinators that concerned a back-and-forth discussion, individual feedback, or any form of group decisions, with regard to developing the innovation? Were you involved in making decisions about the direction of the innovation through back-and-forth-discussion or any participative activity? Were you present at the project meetings? How many times (relate to amount of meetings)? Coordinator: Idem; What was the turn up at these events in comparison to the amount of farmers in the catchment?
3. Alignment of individual actors' goals with system goal		GA

		12. Goal(s) [Qual.] 13. Social sustainability goals [Yes/no]; [Qual.] 14. Economic sustainability goals [Yes/no]; [Qual.] 15. Environmental sustainability goals [Yes/no]; [Qual.] 16. Goal alignment [1= economic 2= social 3= environmental] ;[Quant.] 17. Coming towards each other's goals [Yes/no]; [Qual]	Farmers: What were your goals regarding the implementation of the innovation? Did you have any specific goals with regard to the social implications of the innovation? Which ones? Did you have any specific goals with regard to the economic implications of the innovation? Which ones? Did you have any specific goals with regard to the environmental implications of the innovation? Which ones? Was this in line with the goals the coordinator had on sustainability? Did you try to come towards the coordinator(s) regarding your goals? Did the coordinator(s) try to come towards you in regard of your goals? Coordinator: Was this in line with the goals the growers had on sustainability? If not. What were differences with regard to the goals? Were there actors not in line with the goals as proposed throughout the project?
4. Multiple level resource coordination			*IR RC*
		18. Individual resources availability [Yes/no] and [Quant.] 19. Resource dependency 0 = no 1 = yes 20. Network resources availability [Yes/no] and [Quant.] 21. Network resources coordinated [Yes/no] and [Quant.] 22. System resources [Yes/no] and [Quant.]	Farmers: Did you have enough knowledge; finances to proceed with your innovation at the start? a) Did you have enough resources in your own network to implement the innovation? b) If not, did the collaborative efforts provide you with such resources? Did the network provide you with enough relevant resources? So resources that the people inside the network/project could profit from. So that is having other people in it with skills etc., or enough connections with necessary science deliverers. With the network is meant those people that are

	23. System resources coordinated [Yes/no] and [Quant.] scenario: high/low resource dependency scenario	involved in the project. Did the (name of project) provide you with enough relevant resources that were of use for the whole of the newly developed innovation, such as reputation of the technology, collective expectations in order to be implemented for the whole of the sector/industry or legislative changes? So that is resources that were relevant for making the innovation a success from an industry level. Coordinator and other actors: Did innovating growers have enough resources to proceed with your innovation at the start? So that is knowledge; finances. Did the network itself have enough necessary resources to enable the innovation to be implemented? So that is having other people in it with skills etc, or enough connections with necessary science deliverers. These are resources that the people inside the network or project could profit from but also resources developed inside the project that made sure that the goals of the project could be achieved. Did you manage these in a way that they became relevant to individual individual farmers? Did the (name of project) provide resources that were of use for the whole of the newly developed innovation, such as reputation of the technology, collective expectations or legislative changes? So that is resources that were relevant for making the innovation a success from an industry level. Did you manage these in a way that they became relevant to individual farmers?
5. *Collective strategies on resources and policy*		*H9:* Forming collective strategies in order to collaborate, regarding incentivizing legislative and regulatory changes as well as effectively distributing resources, is relevant for developing and

		implementing innovations that are of relevance at the system level.
	24. Collective strategy based on resources [Yes/no] and [Quant.] 25. Collective strategy based on legislation/regulation [Yes/no] and [Quant.] Coordination of resources.	Did you apply any form of collective strategy to manage, distribute and coordinate the resources that were available or needed in the collaboration? (Management of resources at different levels already asked in 18, 20, 22) Did you apply any form of collective strategy to incentivize legislative or regulatory changes favouring your innovation?
Closing off		Thank you for this interview Noting ways to follow up

*With '(name of project)' is meant the collaborative activity or CSB activity in question