FRESH4Cs

A roadmap for implementing alternative water sources in coastal regions

Interreg
EUROPEAN UNION
2 Seas Mers Zeeën
FRESH4Cs
European Regional Development Fund

Colophon

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1 Towards an integral perspective

The Interreg 2 Seas project FRESH4Cs focuses on sustainable growth through demonstration projects and testing around alternative sustainable freshwater sources in coastal areas. Traditional water sources as we know them are coming under increasing pressure. There are several reasons for decreased water availability, such as climate change and population growth (Liu et al., 2017). This is even more problematic in coastal areas due to salinization of surface waters. Current solutions are predominantly designed to combat flooding leading to a mismatch between water supply and water needs.

Discussions about water issues are often centred on water quantity. However, the quality of water is something which cannot be ignored because the users of the water system are increasingly faced with water quality issues. Moreover, effective freshwater management is a complex process. It poses both technical challenges and substantial socio-economic challenges. This is due to the many stakeholders that are involved in the water system, their interdependencies and potential conflicts of interests. Addressing these complex challenges in the water system requires a paradigm shift from cost to value of water.

The integral value perspective is gaining traction in ecosystem research. Early actor involvement and a clear area-based approach are crucial in realising integral value (Kuitert & van Buuren, 2022). These aspects are central to this roadmap. It describes the water system, actor involvement and the values they were aiming for, and what barriers were encountered in the cooperation. Based on this, lessons for the future are drawn and implications for future policy are discussed.

This roadmap came about through triangulation of different research methodologies. Desk research was conducted on scientific literature and reports from research agencies and governments. In addition, interviews were conducted with actors involved in the water system of the Netherlands, Belgium and the United Kingdom. These actors were mainly users, managers, authorities and NGOs. Farmers in East Suffolk (UK) and the Oudlandpolder (BE) were asked for their views on water issues through a survey.

2 The water system and its stakeholders

There are differences in the ways in which countries' water systems are organised, despite the fact that the Water Framework Directive was introduced in 2000 (European Commission, n.d.). Looking at the countries involved in the FRESH4Cs project it becomes clear that systems across these countries also vary considerably. The light blue colour in Figure 1 depicts where substantial differences in terms of actors between the regions were noted. While the use of water runs across similar lines, especially the public bodies involved are highly heterogenous. The different actors responsible for policy making, regulatory frameworks, managing drainage and safeguarding quality result in highly fragmented policies and governance that are difficult to connect when facing cross-border issues. In this chapter the differences between the water system in the United Kingdom, Belgium and the Netherlands will be reviewed through the following themes: fragmentation or centralisation, licences for abstraction and prioritisation, monitoring bodies, nature protection and research and knowledge institutions.

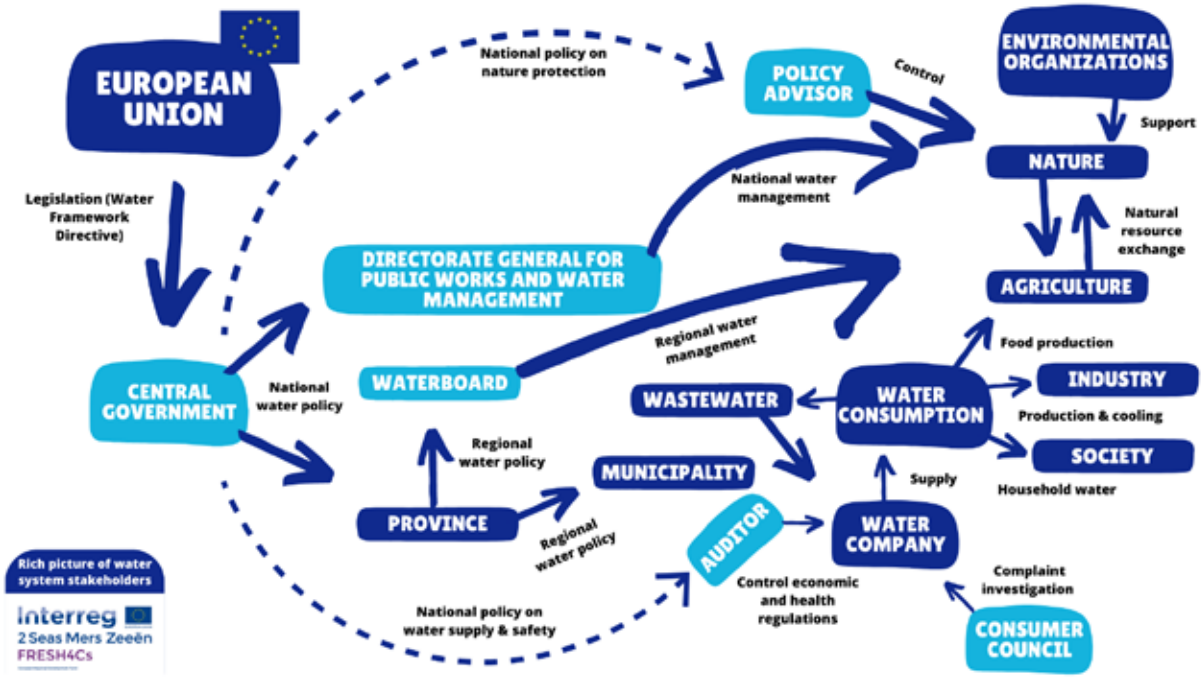


Figure 1 **Actor relationships in the water system**

Fragmentation or centralisation

In the Netherlands, Belgium and the United Kingdom there are many actors involved in the regulation, production and use of water and all these actors depend on each other and may have conflicts of interest. Some actors are partly governed by members who are politically elected, which is known to be a complicating factor for innovation and system change (Mazzucato, 2018). At the national level, water policy is based on the Water Framework Directive. This then ends up at the regional level. The water system is managed by governments at both national and regional levels. In Belgium, this playing field was hugely fragmented in the past. Since the introduction of the Coördinatiecommissie Integraal Waterbeleid (Coordinating Committee on Integrated Water Policy), this has improved, but there are still issues that indicate fragmentation. For example, the management of unnavigable watercourses which, depending on the category, is managed by the Vlaamse Milieumaatschappij, province, municipality or polder.

Centralisation of water management does not seem to guarantee success. In the Netherlands and the United Kingdom, there are fewer actors involved in water management, but actors lack a clear understanding of roles and responsibilities. Users' needs have changed over the years. Users are not just looking for sufficient water, but for sufficient freshwater. This has implications for the design of the water system and therefore frictions arise between different actors. This will be discussed further in Chapter 3 in which networks for stakeholder collaboration and the role of the government are discussed.

Licences for abstraction and prioritisation

In all countries, the permit application for water extraction is handled by the government. In Belgium, this is done through the municipality or province, with support from the Vlaamse Milieumaatschappij. In the Netherlands, Rijkswaterstaat is responsible and in the United Kingdom it is the Environment Agency. The focus on permits is strong in the United Kingdom. This is partly because licences were issued for an unlimited time in the past. The licensing system is rigid and the Environment Agency relies heavily on evidence before any adjustments are made to the water system in a region. From the user's perspective, the licencing process can be experienced as unclear. Stakeholder involvement is gaining importance in this process everywhere in recent years and especially in the United Kingdom.

During periods of drought, all countries broadly follow the same plan in prioritisation. The highest priority is assigned to safety, for instance the protection of dykes, and vulnerable nature. This is followed by utilities for drinking water and energy. Next are the sectors that can make a big impact with little water, and all other sectors are last in line. Users being part of the groups that are lowest on the priority list are motivated to look for solutions. More on this in Chapter 3 about stakeholder collaboration.

Monitoring bodies

In the United Kingdom, there is an independent organisation for water users, the Consumer Council for Water (CCW). They represent consumers' interests and investigate complaints. In the Netherlands and Belgium, things are different. In the Netherlands, there is a complaints contact point that contacts the appropriate water authority. In Belgium, complaints are made through the water company, they investigate the complaint.

There is also a difference in the way auditors carry out their duties. In the United Kingdom, the auditor, OFWAT, in addition to inspecting for water quality, does a check on market operations. They provide a competitive playing field in which water companies perform their functions. In Belgium and the Netherlands, although agreements on quantity and quality are made through the government, there is less focus on the market function.

Nature protection

In the Netherlands, the protection of nature is less secured through governmental bodies than in other countries. Apart from Staatsbosbeheer, there are not many government organisations with a primary focus on nature protection. However, it is secured in the tasks of the large organisations such as Rijkswaterstaat and the waterboard. In Belgium and the United Kingdom, there is more specialisation and there are more advisory bodies. For example, the Environment Agency operating in the United Kingdom alongside Natural England. In Belgium there are also more actors active on nature, for example the Vlaamse Landmaatschappij and the Vlaamse Milieumaatschappij. There is also an important role for environmental organisations. They protect nature and can raise funding for local projects. In doing so, they connect local stakeholders in the region to come up with solutions that are good for both nature and water users in the area. “So the way we do it is we say you’ve got the land asset, you’ve got this wonderful bit of farmland that could be improved with the rivers. And we will we will come do the work. Little charged, little cost to you. And you have to explain how it’s going to improve their land…” (Environmental organisation, personal interview, 2021). Examples include The Rivers Trust, Bond Beter Leefmilieu and Zeeuwse Milieufederatie.

Research and knowledge institutions

Finally, there is a group of independent research institutes and knowledge institutions. They are not part of the water system itself, but help the various actors gather relevant information. This is done both in the technical field by, for example, looking at the water quality of sources, or the technical operation of new methods, and in the economic domain looking at feasibility or mutual cooperation in the system.

Stakeholders in FRESH4Cs

Looking at how system partners are involved in the FRESH4Cs pilots, we see a clear representation of the agricultural sector. Farmers are involved in freshwater projects in various ways. In general, farmers are looking for solutions on a small scale. They often do this with other farmers in the vicinity. Occasionally farmers collaborate with other agricultural users on a bigger scale by setting up a cooperative.

In addition, farmers are involved in large-scale solutions that are initiated by other actors in the water system. This was the case for most of the FRESH4Cs pilots. Collaboration in these pilots involve different combinations of actors representing agriculture, industry, drinking water companies and governments (Table 1). Governments tend to influence the options in the project from their regulatory role, and they are always involved in projects because of this role. Sometimes governments have an even stronger involvement, this especially occurs if nature protection or restoration is a goal in the project. The pilots for which this was the case are marked in green in Table 1.

Table 1 Stakeholder involvement in the FRESH4Cs pilots

	Farmers	Industry	Water company	Government
Felixstowe (UK)	x			x
Felixstowe MAR (UK)	x			**x**
Koksijde (BE)			x	x
Kwetshage (BE)				**x**
Terneuzen (NL)	x	x	x	x
Kruiningen (NL)	x	x	x	x

3 Stakeholder collaboration

Inspired by the framework of Doughnut Economics, the following themes will describe stakeholder involvement in freshwater management. This framework consists of five components: purpose, networks, governance, ownership and finance (Raworth, 2017). The purpose of an organisation will be discussed first, looking at why actors work together and what their mutual goals are. Next, the networks of the actors and the dynamics in these networks are examined. The third component focuses on governance, this includes discourse about how things are organised, and the typical processes, structures and cultures that are required to get things up and running. Fourth is ownership, or how actors establish a sense of ownership and proactiveness amongst all actors. The final component is finance and how alternative systems can become economically viable.

In the following Figure the five dimensions of stakeholder involvement for the Terneuzen pilot are depicted. Examples of the other pilots are available in Appendix A. In the following chapters main cross-case findings for each dimension are discussed.

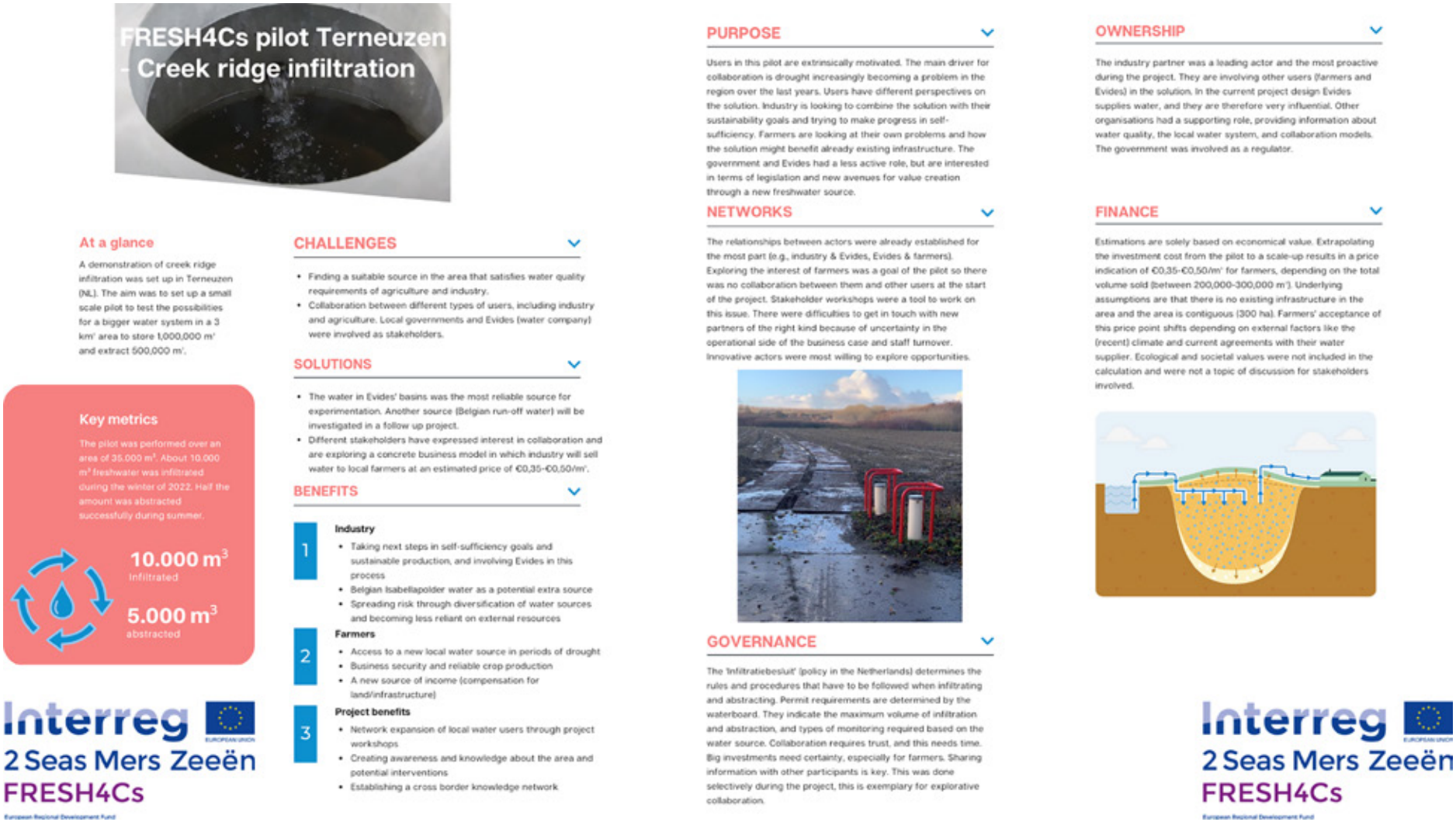


Figure 2 Stakeholder collaboration in the Terneuzen pilot

Purpose

Entrepreneurs who are intrinsically motivated are more effective and also have more staying power (Rovanto & Finne, 2022). In the FRESH4Cs pilots and beyond, it is noteworthy that most actors involved are driven by problems they face in their current freshwater supply. This indicates that these actors are extrinsically motivated. However, there is a difference between large actors like industry and small actors like farmers. Larger industrial actors, but also water companies seem to recognise that while solving foreseen problems in future water supply they can also meet their sustainability goals and bring something good to the communities they reside in. They do this with other local actors that are reliant on water. *"From the outset, we have been committed to water reuse and water conservation. Continuity and reliability are very important in a company that depends on water. You don't want to be dependent on one source, so you spread the risk. That is why we have built a strong relationship with the local water company; they use the same strategy" (Industry, personal interview, 2021).* Also these larger actors recognise that a subsidised project is a good opportunity to learn, to experiment and find out how a completely new system may work to their benefit, as well as to others.

Smaller actors like farmers, on the other hand, keep it closer at home and focus especially on solving their own problems. They seek to improve systems that are already in place, for example increasing basin capacity. For them subsidised projects are a good opportunity to overcome the financial burden of investments to improve current systems and they are happy to collaborate with larger actors to achieve this. *"They are generally happy for something to happen, because the annoying thing with freshwater facilities is that a single farmer can hardly facilitate that because all of them have to be constructed. To keep their own business afloat with that. That investment is generally big and they cannot estimate in advance exactly whether they need it every year" (Industry, personal interview, 2021).*

Not all farmers feel the need or are in a good position to innovate. Sometimes these actors do not view the water problem as theirs to solve. Some already did some investments, or they lack the infrastructure that make them interesting actors to involve in projects like FRESH4Cs. Others do not expect water to become a problem in the near future due to their long-term abstraction licence, or simply sit in an area where freshwater is not a problem at all. This was illustrated by a survey in the Oudlandpolder (Belgium) where over 50% (n=73) of the farmers indicated that they did not expect water problems in the future.

Networks

As mentioned in Chapter 1, freshwater management involves a lot of actors and there are many interdependencies between them. Therefore, effective development and implementation of innovative solutions require involvement of actors that are carefully selected and that are representative for all those who have a stake, either in the short or the long run (Hillebrand et al., 2015). For most actors such innovations go beyond current relationships and require them to find new partnerships and new coalitions.

The FRESH4Cs pilots have shown that it is not easy to get in touch with new partners of the right kind and to carefully select those who need to take part in the project. Sometimes this is due to a soured relationship between different actors because of decisions made in the past. *"... basically then we should just defuse that situation by sitting together and talking it out. Look in the past all that has happened, things have been said, yes okay that's unfortunate and that shouldn't have happened, but let's continue to work constructively and work together in a different relationship" (Water company, personal interview, 2021).* Considerable efforts were put in finding farmers with an interest to participate in the Terneuzen project, for example. Also, it was difficult to get the right governmental bodies at the table, often because they were too busy or could not define a clear role for themselves. Overall the projects included especially those with a clear direct, often economic interest or those already forming part of the network of relations of the project partners. Actors whose interest were less obvious, at least for the short run, think of tourism or nature organisations, were not always involved.

Governance

The governance component of stakeholder collaboration is described by two themes. First, the Kaats & Opheij model (2011) is used to describe the different models for organising stakeholder involvement. This is followed by a second topic focusing on early actor involvement.

Collaboration model

There are different ways to organise a collaboration. Figure 3 describes four different collaboration models as transactional, explorative, entrepreneurial or functional, based on two dimensions:

1. The innovation objectives of the cooperation. Do actors want to improve an existing system or do they seek radically different innovations in their products, services or competences?
2. The way how actors deal with information and learn during the process. Are actors open and transparent and exchange information whenever they can, or are they rather selective in sharing information?

Transactional collaborations involve improving existing systems and exchanging information selectively in function of improvements needed. Functional collaborations, still focus on improving an existing system. Here, however, agreements focus on the process by which a certain result can be achieved, rather than the solution itself. For this, collaborating actors go a step further in exchanging information. Exploratory cooperation focuses on entirely new solutions. However, knowledge is still only shared selectively, whereas in the entrepreneurial way of cooperation, knowledge is fully exchanged to achieve desired goals together (Kaats & Opheij, 2011).

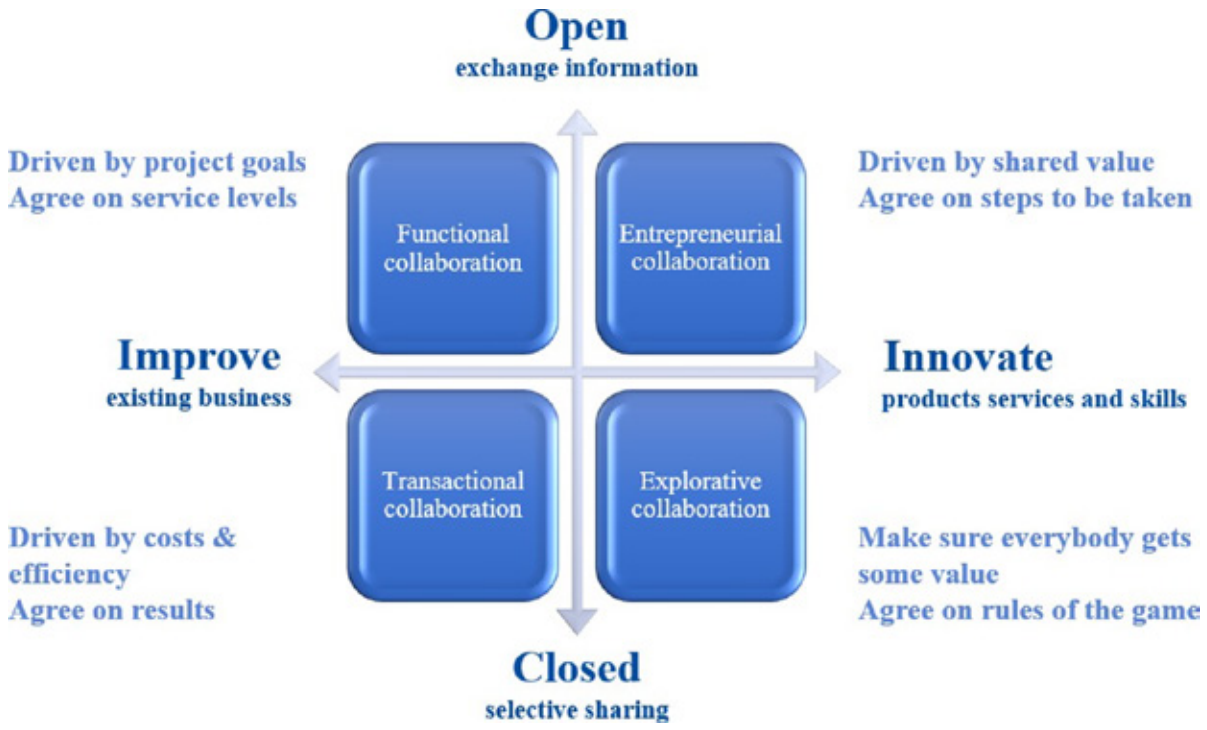


Figure 3 Collaboration models (Adapted from Kaats & Opheij, 2011)

Innovation objectives

As was shown in the section describing the purpose, the main objective of the FRESH4Cs pilots was to develop innovative new systems. Developing entirely new systems is not always on the agenda of all actors. Some actors, e.g. some of the farmers involved, were clearly seeking to improve their current systems and seeking ways to make previous investments in irrigation infrastructure to pay off. As the following quote shows, new innovations are clearly dependent on previous investments i.e. they are path-dependent. *"But farmers can't get out of it now because they can't farm without the irrigation licences from the Environment Agency. They've invested an awful lot of infrastructure in these farms" (Environmental organisation, personal interview, 2021).*

Learning and trust

Zooming in on the dimension of learning reveals some additional interesting findings. Within the FRESH4Cs pilots learning was an important requirement and therefore learnings are formalised and embedded in the project. However, within this project-based context it becomes a challenge to disseminate learnings from one project to a next project. Moreover, interviews show that outside the FRESH4Cs pilots and in smaller scale activities, learning is usually not the main goal when famers collaborate on water issues. *"Sometimes farmers are reluctant to share information. If they find information that is in their own interest, they share it with us, but not with others. They ask us not to share it with others. We try to respect that as much as possible" (Government, personal interview, 2021)*. This finding is consistent with current academic understanding about the limited role of learning in many entrepreneurial firms. Farmers working together to solve immediate problems base their solution on the information that is immediately available with the participating farmers. These collaborations fit with the do it yourself approach that many apply. However, it runs the risk that available information is not up to date and therefore that solutions are not state-of-the-art. The survey in the Oudlandpolder (Belgium) shows 40-60% (n=64) of the farmers are not familiar with innovative solutions, such as creek ridge infiltration or other techniques.

Overall it became clear that sharing of information is a crucial step defining the collaboration. There were situations in which actors were pointing at each other to be the first to expose information for example on estimates of costs and revenues. An interview with a farmer shows the difficulty in sharing information of this type with others. *"That's probably in our farming culture, that we often try to do everything ourselves. Because, when the costs come into the picture, we also must agree on that. And that can't always really be overseen at the front. So, you need a basis of trust and a good form of cooperation" (Farmer, personal interview, 2021)*. It's clear that information about the business case is highly sensitive and therefore that collaborations require to build trust and sometimes even a contractual base.

Explorative collaboration

Figure 4 indicates how the organisation of the FRESH4Cs pilots were largely exploratory and in most instances trying to combine the interest of different actors and exchanging information where needed. For many cost and efficiency were important aspects to safeguard and results were an important guiding principle. A good process outline was sometimes lacking. However, from the innovation and co-creation literature, it appears that a process outline with clear milestones, is important even in the exploratory phase (Cooper & Sommer, 2016; Şimşit et al., 2014). The component of cost and finance will be discussed in more detail at the end of this chapter.

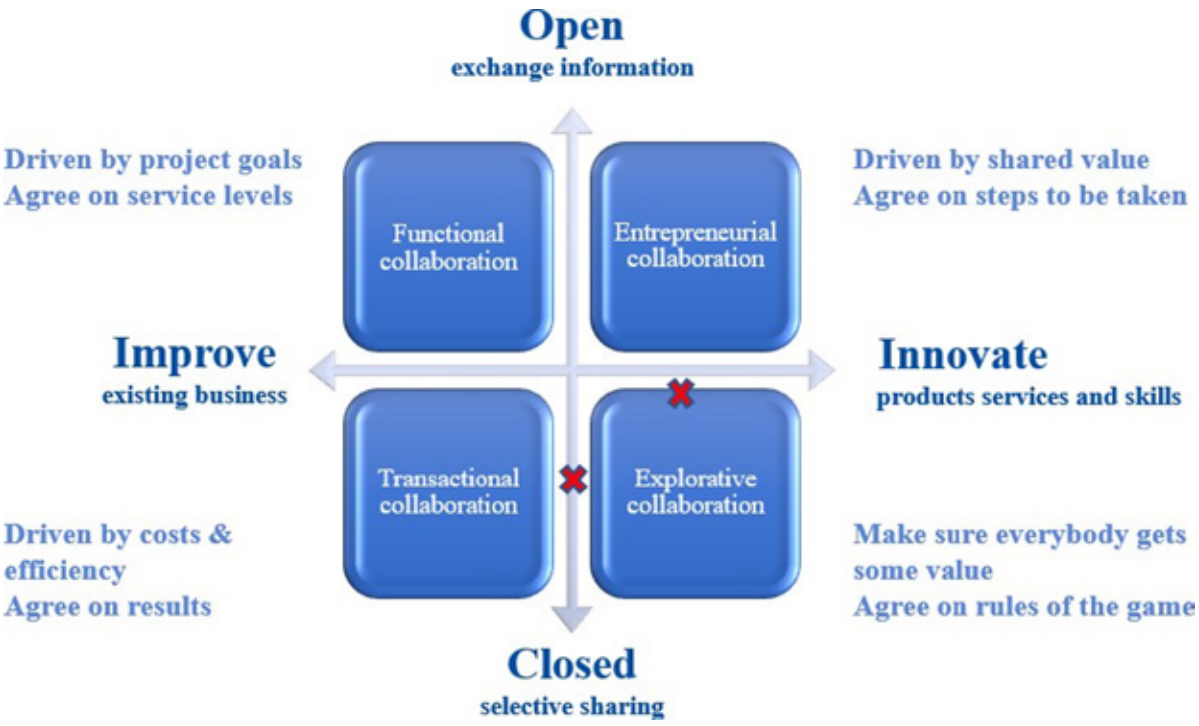


Figure 4 Collaboration models in the FRESH4Cs pilots

Early actor involvement for radical innovation

Dynamic systems needing a system change requires not only the involvement of representative and carefully selected actors but also an early involvement of those actors. Only by such an early involvement, actors can develop a shared vision on the added value and use that to drive action. It then becomes important how value is defined. With opposing interests, projects run a risk to focus on the interest of either one of the actors leading to **single value**. Many projects have already moved beyond this situation of single value and today actors are often trying to **combine** their individual interests.

In these situations there are always winners and losers. A next level are projects in which value is **coordinated** and actors try to reach a minimum level of value. They are trying to optimise and balance value and to get the most for all out of their money. The most ideal situation is where actors strive for **integrated value**. Within this situation the whole becomes greater than the sum of its parts. It requires a long term view on shared goals and then thinking backwards to what is needed today to achieve this (Kuitert & van Buuren, 2022).

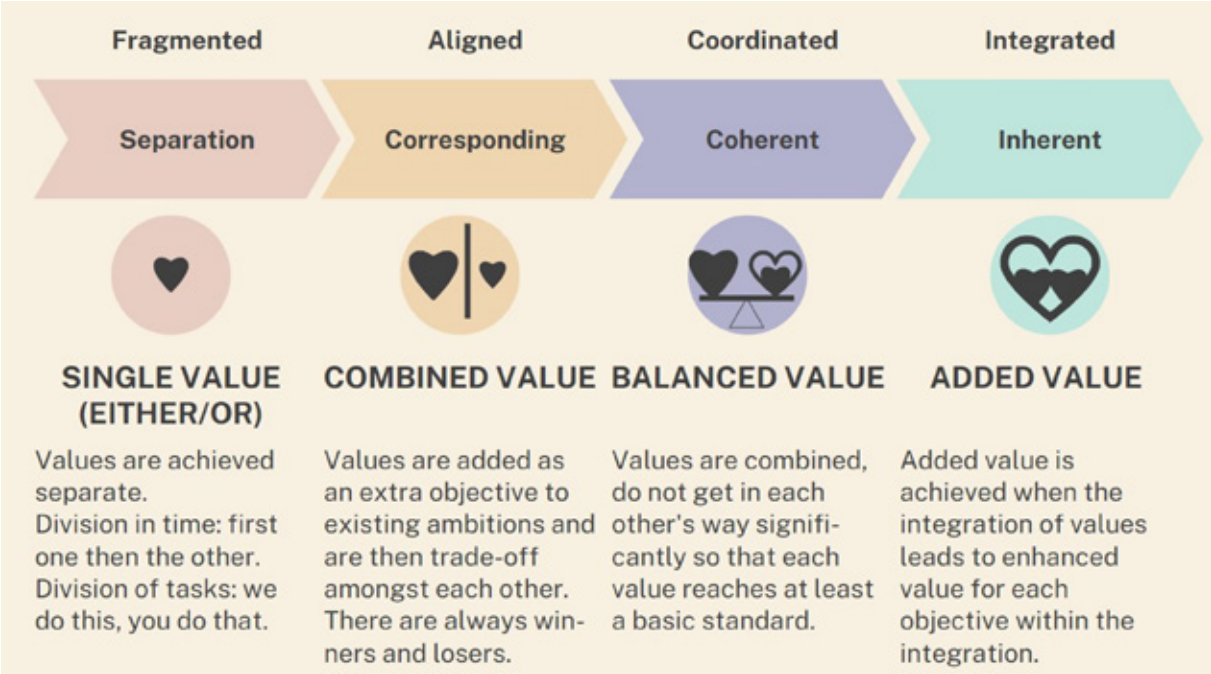


Figure 5 Value and value integration (Adapted from Kuitert & van Buuren, 2022)

In the FRESH4Cs pilots the timing of involvement of the full ecosystem is generally late. The vision on goals and objectives of the pilot projects were developed at the pre-project proposal phase and based on value needs of the key project partners. In this pre-project phase a full exploration of the values of all actors was difficult to achieve and as a consequence the project was not guided by a complete, holistic view on the value of water. This can especially become an issue if multiple projects or actors are working on solutions in a region. *"A lot of very creative solutions are coming up, a lot of initiatives are coming up. That also means that all these initiatives might perhaps work against each other in some areas, whereas they should be able to reinforce each other. So that is a point of attention that I do think is important. That everyone is well aware of each other's projects and checks if we are not snatching each other's water, so to speak" (Water company, personal interview, 2021).*

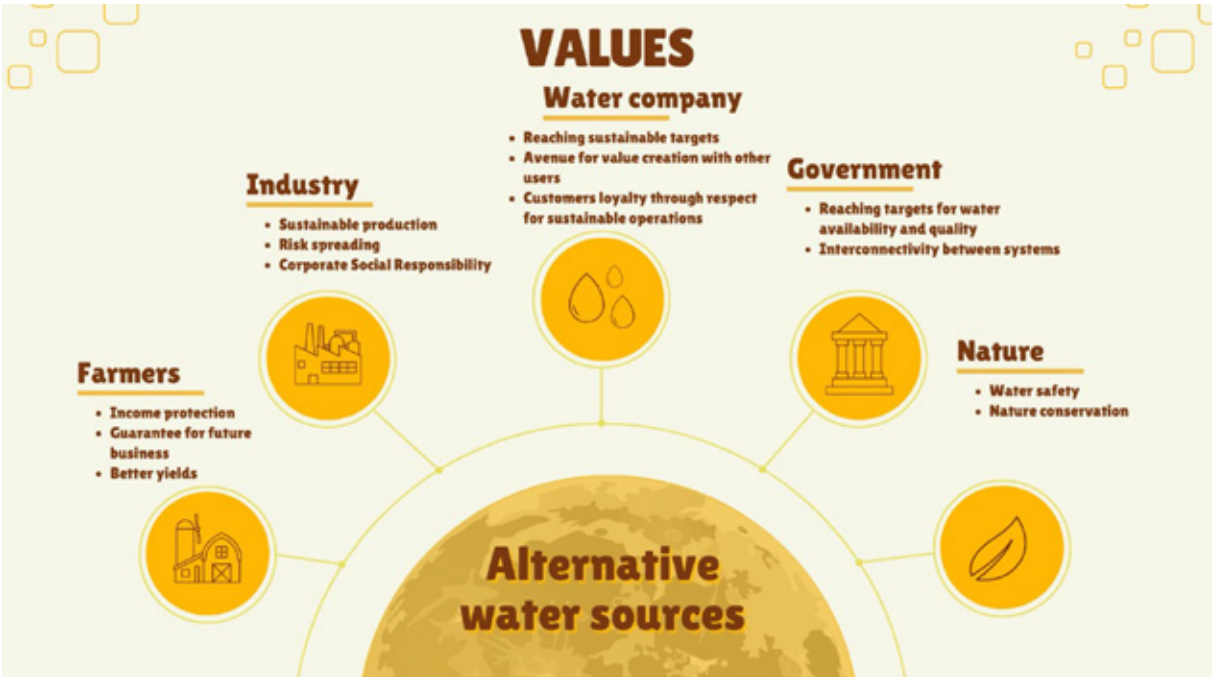


Figure 6 Actor values in the FRESH4Cs pilots

The values that guided actors' motivations to participate in activities are represented in Figure 6. They range from farmers seeking better yields and income protection, to industry partners looking to become less dependent of a single water source, to nature conservation safeguarding biodiversity. Within FRESH4Cs these values were coordinated during the pilots, with actors striving to achieve their value, without harming others. *"... and especially to avoid, of course, that measures we would take might unintentionally have a negative impact on another party. We absolutely have to avoid that" (Water company, personal interview 2021).*

Ownership

The ownership component is the fourth element in stakeholder collaboration being discussed. Main themes in this paragraph include proactiveness of actors; the different roles in collaboration; a changing role of governments; and vertical linkages.

Proactiveness of actors

Ownership is a very important aspect determining a projects' success. In major transitions having a single strong leading actor is often not enough and may even be harmful. The outcomes of projects led by a single actor, often the initiator, are highly determined by the discipline of this actor and run the risk of being too focused on a single perspective (Kuitert & van Buuren, 2022). Therefore project partners need to establish a sense of proactiveness and ownership with all the actors involved. Ownership requires actors being clear on their roles and being able to establish trust amongst the others.

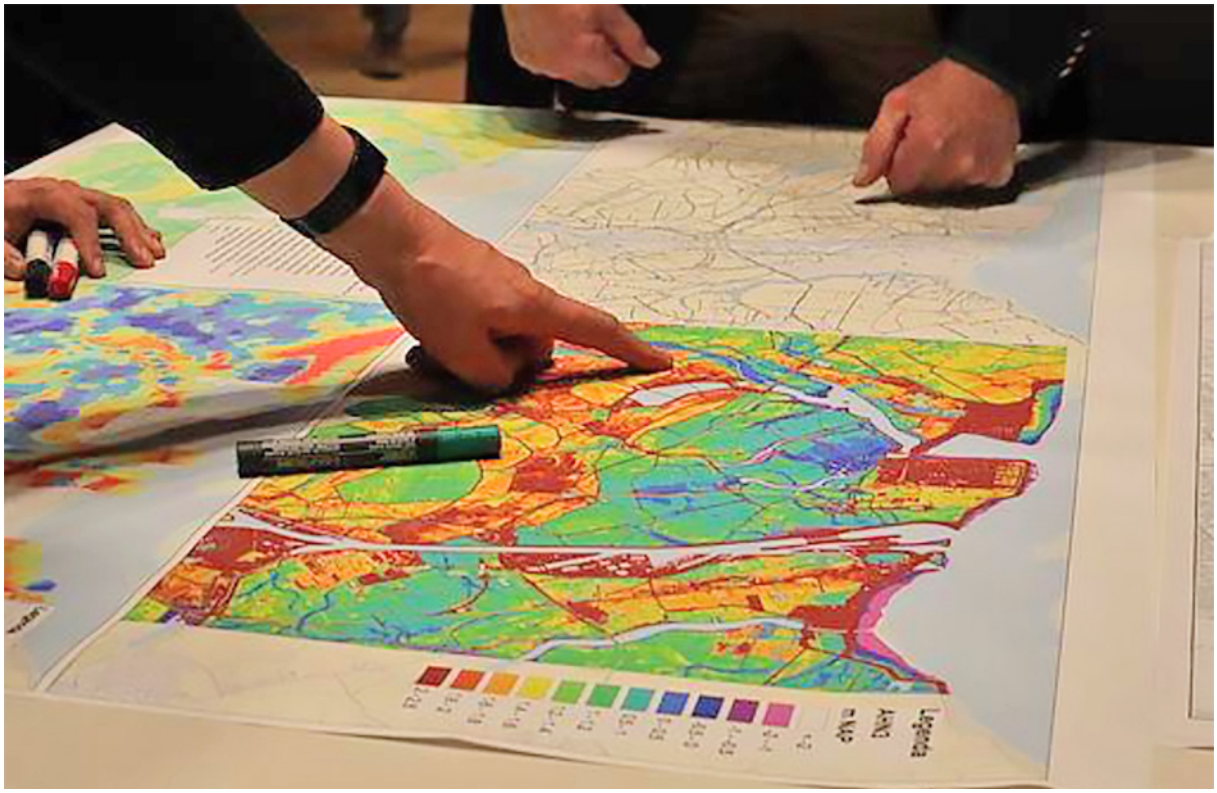
Roles in collaboration

In formal collaborations, the following division of roles are noted:

- **Client**: Projects are often initiated by governments implementing or stating new legislation and frameworks.
- **Project owners and developers**: Project ideas often come from governments, larger organisations, or a collective of farmers. They are oriented to the long term and recognise that solutions must be put

in place today to create long-term freshwater security. They dare to look beyond the boundaries of their own business model to enter into new collaborations and invent new business models. *"And only then you can use it, so with [Industry] we are looking at a lot of things. Can we do that also locally, maybe find or develop other water sources to use for [Industry] because at least then you don't have that whole transportation …" (Water company, personal interview, 2021)*. These actors decide who sits at the table with them and at what time. They also show more organisational power. This affects the balance of power between cooperating actors.

- **Information providers**: Governments with knowledge about laws and regulations, independent research institutes with knowledge about water quality, and knowledge institutions.
- **Regulator**: Governments with authority in the area and over the water source.
- **Finance**: Actors putting money and resources into the project.
- **Users**: These often consist of agriculture, industry, drinking water companies and nature.



For informal collaborations, there is no fixed structure and there are no formal roles. An advantage of this type of collaboration is that there is a lot of flexibility. The basis of this type of collaboration is what one has available oneself in terms of knowledge, infrastructure and networks and therefore does not require an extensive search for new resources. An example of this type of collaboration is informal water trade between neighbouring farmers.

As was noted before, in formal collaborations, small actors oftentimes expect large actors to take the lead, which is a clear sign that pro-activeness is not automatically present with all actors.

A changing role of governments

Various scholars point out that the complex system change that is needed today requires a different role of the government (Stam, 2022; Kuitert & van Buuren, 2022; Mazzucato, 2018).

Traditionally, the role of the government was defined by market failures and within the FRESH4Cs project various arguments were found for governments to intervene due to market failures. For example, sufficient water of the right quality is not always available to all and is highly location based. *"For a company like [Industry], the continuity and reliability of water supply is hugely important. That is not always in sync with water availability. That does pose a big challenge" (Industry, personal interview, 2021)*. Investing in new technologies often is not attractive economically or because of the current regulatory framework. *"As always, legislation often lags behind other developments which can then directly be one of the barriers to implementing new technologies" (Water company, personal interview, 2021)*.

Considering the complexity of today's issues with regard to freshwater, not only market failures deserve attention. System failures should be taken into account, for example the fact that the prices of plots do not take the access of nearby freshwater into account. *"There are plots of land in areas where you really can't find freshwater, which are valued higher because the demand there is simply much higher than plots where you would have that advantage. I think it's a special mechanism that I don't quite understand" (Government, personal interview, 2021)*. Not all actors can benefit from new systems and that value needs to be redistributed between actors. However, users are having trouble to organise this redistributions themselves. *"Then you always end up in talks like, yes, but that costs so much, but how much does it benefit us and we don't see the returns directly, because that's also the difficulty. If you invest in, for example, restoration of natural areas, wetlands and so on, which benefits the water quality very much. It is not like you achieve that and the next day you have good water. That takes some time and that's not easy either" (Water company, personal interview, 2021).*

With increasing complexity today there also are transformation failures stemming from misalignment between actors, for example in coordinating water quality across borders. *"Ultimately, it's a water distribution issue. Especially if you also do business together with [other region]. Because that's where most of the water ultimately comes from. They would also like to have water in the coming years. The demand is getting stronger there" (Industry, personal interview, 2021)*. Inefficient or an inflexible monitoring system is another transformation failure leading to a mismatch between water use and the needed water quality. *"... so they [Industry] had said to [Farmers], we have water, and those [Farmers] eventually said: gosh, it's so much extra work for us to use that water of yours. Even though it's fine, but then we all have to take samples and investigate. We think that's too much hassle and so then that water is not used and so they use drinking water..." (Water company, personal interview, 2021).*

Examples of misalignments resulting in different types of ownership failures are summarized in Figure 7.

Figure 7 Examples of market, system and transformation failures in the water system

Looking at the role of governments in the FRESH4Cs project it becomes clear that this role is not always played as expected. Also it becomes clear that governments itself struggle with their role. It seems as if they are still largely driven by market failures, trying to fix a market imperfections and having difficulty to see themselves as part of the system and as an actor that can create, together with others, an entirely new system. Examples of this were found in governmental bodies struggling with their original focus on either flood or drought prevention. *"You have a large lake in the centre of the Netherlands. And you can pump the water out from there and transfer many, many kilometres through these water ditch systems. No, our only obligation to do that in this country is to protect environment" (Internal Drainage Board, personal interview, 2021)*. Similarly on their focus on either quality or quantity of water. *"Waterboards do not actually have a statutory duty in freshwater supply" (Waterboard, personal interview, 2021).*

They question whether they should take a broader role and go beyond their traditional assignment in regulating and protecting. This struggle leads other actors to passively wait for the action, thus affecting ownership and proactiveness. Governments are starting to recognise this and are participating in projects to adjust policies. *"It remains the case that we as a government are always behind the times. You want to know the effects of measures before you adjust your policies accordingly. That takes time while the measure becomes more popular with users. So, you always stay behind, but we try to participate at the front end in studies such as FRESH4Cs so we know what kind of questions we will get in the future" (Government, personal interview, 2021).*

A more proactive role of governments is also needed considering the increasing amount of users that are exploring integrated solutions. Moreover, there are signs of users who are willing to explore sustainable opportunities. *"So to coordinate that [new opportunities] in a sustainable way where we actually look for added value or value creation by trying to look for the common interests, and to take opportunities from that" (Water company, personal interview, 2021)*. Some governments are already integrating higher demands of user groups in their regional plans. *"Regional plans will identify how best to create resilient water supplies for all users, while protecting and enhancing the environment. They will be developed collaboratively by the water companies, other water-using sectors, environmental groups and regulators who collectively make up the regional water resources planning groups. Groups should also engage with other stakeholders such as local authorities, devolved government and interest groups" (Government, personal interview, 2021).*

Vertical linkages

Now all this is about how actors relate to each other but ownership also requires that the people involved in the project are capable to commit their entire organisation. An interview with an environmental organisation shows that getting commitment from other actors can be hard to achieve. *"There's another thing that myself and my colleagues have noticed recently is that there's not a lot of joined-up thinking in terms of environmental improvement. So you've got all sorts of organizations that don't necessarily effectively work together" (Environmental organisation, personal interview, 2021)*. Absence of such vertical linkages within the project partners was observed in key persons having opposing views or not being fully aware of the projects status and next steps, due to reorganisation.

Finance

The importance to start projects from a shared view on integral value has been mentioned before. Creating this view on value is not an easy thing to do and science is constantly looking for new frameworks that can help define and measure all values, so not only economical value but also social and ecological value. Available frameworks such as the one of Commonland (2021) depicted in Figure 8 take a long term view and work with a metric that is accepted by all. This can then become a powerful to find the right financial instruments, which are also capable of redistributing value to those who invest, but cannot directly benefit from the innovation.

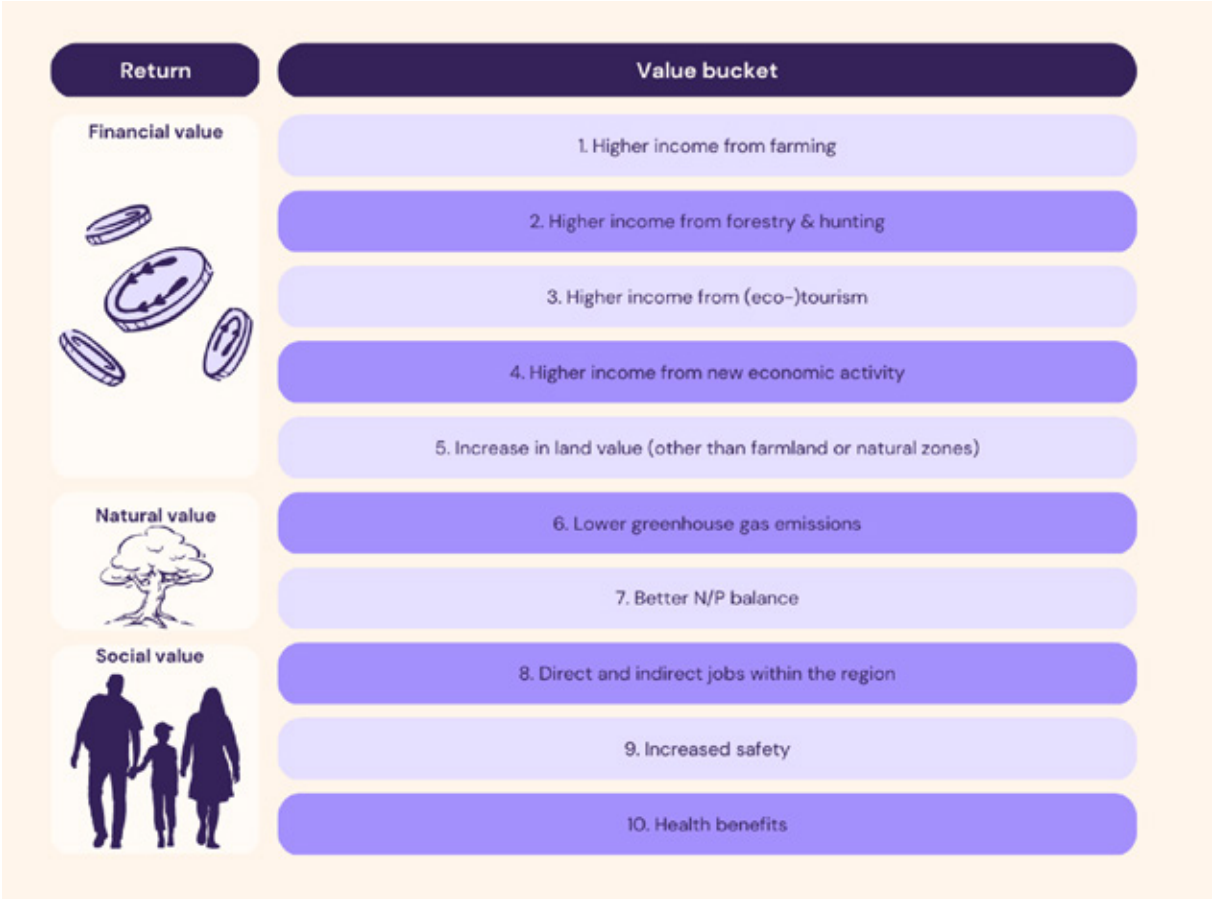


Figure 8 Metrics for integral value (Adapted from Commonland, 2021)

The FRESH4Cs pilots show that there is still a way to go before integral value can be used as a guiding principle. Investments in alternative freshwater systems are often considerable for which returns, both financial and non-financial, only become available on the long term. Despite of this, the focus is especially on the short term financial value, leaving societal and ecological gains undiscussed. Focus is on cost and payback time and at the basis of the calculations are highly stakeholder-specific estimations of the future price of water.

These estimations vary with current prices paid; risk perceptions with regard to not having water; estimations of the cost of not having water; as well at the current cash flows situations. "*So they [farmers] ask: can't you invest? Yes, we can invest, but then you have to, look we are not a charity, then you have to guarantee that you buy that water. Yes, but if it is wet next year then we don't need it, especially in that agricultural sector that is a bit more difficult …" (Water company, personal interview, 2021)*. Similarly, previous research shows that recent exposure to drought is very influential for the drought risk perception of farmers even if they have access to external water (van Duinen et al., 2015). This reveals how experience driven farmers' considerations around water tend to be.

Subjective estimations result in a wide range of acceptable prices, from €0,12 to €3 per m^3 depending on the type of user. Add to this that the current price of water usually does not fully incorporate all social and ecological cost involved in the current production systems. Sometimes projects are funded through environmental organisations to compensate for social or environmental values not being incorporated into projects. *"… but we get the money from the government or from government institutions. It is no good as going to a farmer and saying we're going to improve your river and you've got to pay at least half the costs because he won't do that" (Environmental organisation, personal interview, 2021)*. This narrow focus leads to current prices not reflecting the true cost, but also, to a mismatch between those who pay and those who gain. This was mentioned in an interview with a water company as a complicating factor. *"That is a factor though, you have to look at value more than cost, and it is still sometimes difficult to get that into people's heads" (Water company, personal interview, 2021)*. The location specificity and the entry barrier posed by available infrastructure or capital intensiveness of new infrastructure results in solutions that are not equally available to all. This makes a common metric and finance system with which those who lose are compensated more than needed.

4 Barriers and enablers for collaboration

The observations in FRESH4Cs can be summarised by means of barriers and enablers for the implementation of alternative freshwater systems. These are mainly focused on the collaboration aspect inside and outside the FRESH4Cs pilots. Barriers include themes like awareness of water users, stakeholder participation, and others. Enablers cover exploration, sharing information and clarifying project roles.

Barriers

There is a distinctive growing awareness between water users that things need to change. Not all users feel the need, or have the right information to accomplish this and they are extrinsically motivated to solve water problems. Also, sharing information across projects and actors is not self-evident and requires trust.

- Continuous knowledge dissemination focusing on problem recognition, awareness, willingness to act and new opportunities for users.
- Make sure that trusted actors, those who are objective and view issues from multiple perspectives are involved from the earliest phase in projects.
- Explore problems together.

Not all stakeholders are financially or physically able to participate in innovation projects.

- Make clear who benefits and who doesn't from current solutions. This requires a common metric to divide value more equally.
- Design solutions for those who lack infrastructure, e.g. (environmental) compensation schemes, service models like those of Felixstowe Hydrocycle[1] or INERO[2].

1 One of the FRESH4Cs pilots. A farmer led realisation of a pipeline and water management infrastructure to bring drainage water, currently pumped to sea, inland for irrigation and potentially for public water supply. The Environment Agency, local authorities and Drainage Board are partners. https://www.felixstowehydrocycle.com/

2 Collaboration between Ardo, a producer of frozen vegetables in Ardooie (BE), and 47 local farmers. They constructed a buffer basin with a 150.000 m^3 capacity which is filled with treated effluent. A network of underground pipelines is connected to the farmers that are unified in a co-operative with Ardo and Inagro. https://ardo.com/en/project-in-the-picture- planet

The water system consists of a heterogeneous and fragmented stakeholder field. It is difficult to get in touch with all of the actors, leading to incomplete representation in projects and solutions that are not acceptable for all. A short term project-based approach together with the focus on direct financial costs and revenues runs the risk that a system is created that is fit for purpose only on the short term.

- Continuous mapping of actors, their interactions and value perceptions.
- Ongoing relationship management as a basis for stakeholder selection.
    - Complete representations, including all policy domains, experts, users and contributors and covering all necessary disciplines.
    - Search for actors that are politically independent to build long-term relationships.
    - Make sure that stakeholders are vertically aligned. For example, in one of the FRESH4Cs pilots in the United Kingdom, the full commitment of the Environment Agency allowed for a project implementation otherwise impossible.

A large proportion of the actors in the water system have conflicting perspectives on the value of freshwater. This can be problematic because subsidized projects often start from the assumption that a shared vision on the value of freshwater is available and do not incorporate activities to develop such a shared vision.

- Organize a program of interlinked projects (instead of standalone projects) around a well-accepted shared vision.
- Establish a clear line of communication to correct for errors in the system that do not align with the shared vision on the value of freshwater.

Current projects are led by an initiator, who typically represents a single discipline, focusing on either quantity or quality of water, technical or social aspects, and private or public constructions. This person has a strong influence on the direction and outcome of the project.

- Make sure that lead actors represent all disciplines.
- Set up talking groups for lead actors to increase the possibility of replication in other areas.

Enablers

A small but increasing amount of actors, both small and large, recognise that a focus on integral value is needed and are willing to explore beyond traditional narrowly defined policy domains. The surveyed farmers in the Oudlandpolder (Belgium) and East Suffolk that expect big water issues in the future is nearly double compared to the ones facing water issues now (from a quarter to half of the farmers).

- Utilise the momentum of growing awareness around water issues and large actors recognising problems and make a push for change.
- Establish a clear vision on the value of freshwater with these users in a first project and in co-creation with all actors.
    - Focus on the broader public issue, not on the technical issues. Expand the scope to freshwater, including simple behavioural changes like water reuse.

Similarly, collaborations like the Felixstowe Hydrocycle and Living Lab Schouwen-Duivenland[3] show how actors, including experts, governments and farmers are increasingly willing to cooperate and share information. These collaborations show that creating trust takes time, but is a necessity to arrive at a solution that works for all actors.

- Develop the necessary infrastructures for ongoing information sharing and collaboration, and stimulate users to participate in these collaborations.
- Make sure that education and exchange of scientific evidence forms part of the activities, to ensure that all actors can oversee the consequences of actions and solutions are state-of-the-art.

Actors, including the governments themselves recognise that governments need to participate in a new roles. Explicating these roles and outlining a clear process are key for successful innovation projects.

- Define the roles of government in accordance with the challenge and observed failures in markets, systems or transitions. A growing international support base and a strong role of Europe creates opportunities for a considerable redesign of governance systems.
- Start projects with defining the process, milestones and roles.
- A lot of actors are currently exploring opportunities in new projects. The coordinating role is key to keep an overview of the system.

3 A network organisation centred on innovative solutions for complex local issues in water, food, education and governance. Partners include governments (municipality and province), universities, the waterboard, environmental organisations, farmer unions, and more. https://livinglabschouwen-duiveland.nl/

5 Roadmap

The key lessons from the experiences in this challenging and important project centre on the organisation for integral value. First, availability of freshwater should be considered a mission, a large program of interrelated and consecutive projects, in which governments take an active role co-creating solutions together with science, businesses and the public. It requires long term investments and not only technological innovation but also institutional and bottom-up social innovation. It therefore requires strong strategic involvement from all actors from the earliest phase of the project on, but also a carefully planned social innovation process.

There is a growing awareness and support base for mission-driven innovation. Yet, future activities should be structured towards organising ourselves in such a way that we can allocate sufficient time to establish a shared vision and to define long term goals. This will require more time for definition and alignment in a pre-project phase and a commitment for a series of related projects. This will need a different organisation than we currently have for subsidised projects.

As part of this long-term view it is important to agree on a common metric for measuring all costs and all returns. This is key to design financial instruments and enable a redistribution of value for those who do not directly benefit from the preferred solution. Development of a common framework and metric and the use of this for assessing all stakeholder-specific impacts and dependencies may become a first strategically important project of which the outcomes may be used for development of a programme of follow up projects.

At the same time it is important to take some time to consider the geographical scope of projects, with possibly more attention for cross-border projects. Ultimately, at the project-level lead actors need to have a clear view on their roles and on the instruments and competences with which they can create trust and ownership with all actors.

Figures 9 and 10 summarize the recommended measures at the strategic, program and project level.

Figure 9 Measures on the strategic and program level

Figure 10 Measures on the project level

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Appendix A: Stakeholder involvement in the FRESH4Cs pilots

At a glance

In the coastal Suffolk region, water is currently pumped into the North Sea. In this pilot, a piping network has been established for irrigation purposes. At the same time, Managed Aquifer Recharge (MAR) was evaluated as an alternative to reservoir storage.

Key metrics

The pipeline supplies 9 different reservoirs, up to 14 km inland. Many water quality measurements have been conducted, with a monthly analysis of source water (590 compounds x 13 samples).

11.5 km pipeline
supplying 9 reservoirs

590 compounds
measured

CHALLENGES

- Agricultural irrigators in coastal Suffolk are facing reduced supply of freshwater resources (16% by 2027), due to regulatory reform and competition from Public Water Supply.
- Establishing a farmer cooperative and collaborating with regulatory and environmental stakeholders.
- Meeting water quality standards for infiltration and abstraction.

SOLUTIONS

- Reducing the pumping of high volumes of drainage water into the North Sea by constructing a piping network.
- Six farmers are cooperating through a limited company. Half of the funding came from members, proportional to their usage.
- Monitoring is key, but associated costs have a high impact on commercial viability and replicability.

BENEFITS

1 **Farmers**
- Access to a new local water source in periods of drought
- Accelerated farmers' awareness of the threats in the region
- Prepared for increased restrictions on licences
- Business security and collaboration with peers

2 **Regulator**
- A better understanding of new systems and how to licence them
- Greater awareness of opportunities that may be available on other locations for MAR

3 **Project benefits**
- Reducing the negative impact on valuable salt marshes
- Discovered the importance of working in partnerships (e.g. to overcome permit barriers, and MAR-schemes), leading to a conjunctive perspective on water resources to overcome local water resource pressures
- Clearer lines of communication between stakeholders

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PURPOSE

Users in this pilot are extrinsically motivated. The main drivers for collaboration is twofold. Firstly, climate change will decrease user access to water. Secondly, licences will become more strict in the future. Users have the same perspective on the solution and are making their businesses resilient. The government had an active role, and was mostly concerned with the water quality. They want to study the feasibility of new systems and how legislative frameworks are able to address different needs.

NETWORKS

Interest for farmer cooperation was explored at the beginning of the pilot. Interesting to note is that communication lines between farmers and the regulator have strengthened. Expectations between farmers and the regulator have become clearer, although some issues have yet to be addressed. These are primarily based on how to find balance between economic viability and the monitoring requirements.

GOVERNANCE

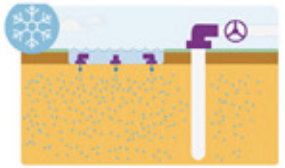
Since 2021, farmers in the UK are facing a reduction in their average uptake because of the trading and variation policy (groundwater). In 2026, time limited licences will be reviewed for the east Suffolk area to achieve a reduction to sustainable levels. Setting up MAR required groundwater investigation consent, discharge consent (water quality) and an abstraction licence (water quantity). Environment Agency is the governmental body responsible for granting these licences. Monitoring requirements were experienced as a big strain from the farmer perspective. However, it is difficult to take risks in decision making from the regulator perspective. As mentioned before, communication lines have been established throughout this project, enabling feedback between farmers and the regulator about further developments.

OWNERSHIP

Six farmers have established a cooperation through a limited company in this pilot. They were the leading actors looking for a solution. Environment Agency was closely involved in the project design, minimizing issues around licences. The Internal Drainage Board have also been heavily involved to achieve the pipelines and pumping.

FINANCE

Half of the costs for the pipeline have been funded by loans from members, proportional to their usage. The other half was funded by the EU grant from FRESH4Cs. The total monitoring and permit cost for MAR was £63,000, excluding labour costs. This has a big impact on the commercial viability and replicability of the pilot and will influence farmer investment decisions in the future. Members pay £0,20/m³ for water delivered to their reservoir through the pipeline. This covers the running cost and also repays their loans in 14 years. Ecological and societal values were not included in the calculation.



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FRESH4Cs pilot Koksijde - A nature-based solution

At a glance

A demonstration of treating concentrate with a willow marsh in Koksijde (BE). The aim was to show the positive effect of the use of willows on the water quality to be discharged. The willow marsh is operational since the beginning of 2022.

Key metrics

A reduction of the nutrient content of the discharged water has been demonstrated in the first year of operation. This is a valuable contribution to the environment and the quality of the canal and in the end the ocean, as the canal discharges into the North Sea in Nieuwpoort.

8.000 m²
willow marsh area

over 40%
nitrogen reduction in the summer

CHALLENGES

- Setting up a full-scale installation, using a natural system based on willows for the treatment of concentrate of the reverse osmosis (RO) process.
- Collaboration between different types of local and regional stakeholders.

SOLUTIONS

- Planting a willow field appears to be an effective measure to treat the concentrate of RO.
- Setting up communication lines with local governments sped up the permitting process.

BENEFITS

1 **Industry**
- Establishing better connections with local and regional stakeholders
- Exploring new treatment possibilities for RO concentrate
- Winner of the 'Blue Innovation Captain' award in 2022

2 **Regulator**
- A better understanding of new systems and how to licence them

3 **Project benefits**
- Positive contribution to the environment by an increase of the water quality of the canal (SDG 14)
- In the future, this technique could be a first step for further treatment to produce alternative freshwater for the region
- This type of treatment can be used to treat waste water of any kind. The advantage is not only the improvement of the water to be discharged but the system offers also a green buffer

PURPOSE

The Intermunicipal Water Company from the Veurne Region (IWVA), now Aquaduin, historically produces drinking water from a freshwater lens under the dunes in Koksijde. They serve about 62,000 people living there permanently. During the summer this amount doubles. This results in a big difference in daily consumption. Aquaduin is extrinsically motivated by limited access to freshwater in the region, albeit with a long term strategy. They have experimented with Managed Aquifer Recharge (MAR) and water reuse since 2002. The government was involved as a regulator.

NETWORKS

At the beginning of the pilot, the goals were discussed with all local and regional stakeholders. This network was already established because of previous projects like DEMOWARE and other experiences with MAR and water reuse at Aquaduin. The project is beneficial to Aquaduin and the local environment. This network might expand in the future because of the positive results in the pilot.

GOVERNANCE

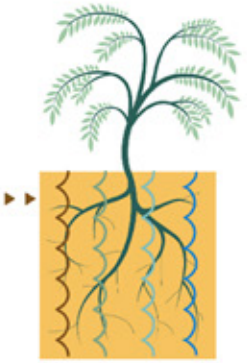
To start the construction and the use of the willow marsh an environmental permit was needed. The permit procedure started in July 2020 and the permit was issued on the 25th of January 2021. When the permit was obtained, the construction of the willow marsh was granted to a contractor based on a public tender. As this pilot did not involve multiple users, collaboration was not an issue, or something to be worked on. Investments were already proved to be feasible during DEMOWARE, leading to support from Aquaduin management.

OWNERSHIP

Aquaduin is a public company and the leading actor during the project. The shareholders are the six communities where drinking water is distributed. As Aquaduin was unable to purchase land next to Torreele, the community of Koksijde agreed to make land available. Aquaduin can use this land for 27 years. The infrastructure is financed and owned by Aquaduin, and subsidized by FRESH4Cs.

FINANCE

The pilot was funded by Interreg. A price calculation has previously been made in the DEMOWARE project. This calculation is based on a 20 year lifetime. The reduced nutrient content of the discharged water in 2022 already resulted in an estimated reduction of discharge tax by €30,000. Investment costs and operational costs are estimated at a total of €25,774. In conclusion, the pilot seems to result in a net gain from an economical and an ecological perspective.



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FRESH4Cs pilot Kwetshage - Water storage & reed marsh

At a glance

In the pilot at Kwetshage (BE), the goal was to implement an above ground water storage for the development of reed marsh. This contributes to the goals of establishing enough nature areas (Natura 2000).

Key metrics

Based on the expected mean flow rate of the wind water mill, mean precipitation and expected infiltration of the stored water a net capacity of 760 m3 per day is expected.

36.000 m^3
net storage capacity

20.000 m^3
infiltration (estimation)

CHALLENGES

- Kwetshage is a flood area. Above ground storage of water inevitably means a reduction of buffer capacity during floods
- Spring and summer tend to have prolonged dry spells in recent years, as a result of climate change. Under the current mode of water management this generates risks of water shortage during summer

SOLUTIONS

- The Kwetshage pilot has looked for an optimal combination of lowering the surface (excavations) and increasing water level, spatially differentiated within the area
- Augmenting water storage capacity and retaining buffer capacity are both important climate related measures, both are addressed in this pilot

BENEFITS

1 **Farmers**

- Although the purpose of the project is nature development, practice and experience in this pilot can serve in implementing measures for sustainable water management in agricultural areas of the Flemish polders (potential benefit)

2 **Project benefits**

- Per year a total volume of water of 56,000 m³ is prevented from being evacuated outside the project area
- The water gathered and stored during winter is used for habitat development

PURPOSE

Vlaamse Landmaatschappij (government) has the goal of retaining as much water as possible during the winter periods in the Kwetshage pilot location. With excess precipitation, water storage seems to be the perfect solution to avoid critical low water levels in future summers. However the practical organisation of this seemingly easy way to tackle problems is less obvious due to climate change. The main driver for collaboration is drought increasingly becoming a problem in the region over the last years.

NETWORKS

No new relationships between actors have been established in this FRESH4Cs pilot. However, insights have been shared across pilots and actors within FRESH4Cs. The solution could potentially benefit farmers, their interest should be explored in the future.

GOVERNANCE

Initially a combination of above ground surface water storage and creek ridge infiltration was aimed at as a means of retaining excess surface water in winter periods. However, due to a delay in obtaining the environmental permit, the creek ridge infiltration part had to be cancelled, as this could not have been performed within the timeframe of FRESH4Cs anymore. For constructing the demo, an environmental permit was obtained. An archaeological survey and an appropriate assessment (Natura 2000) were performed prior to applying for the environmental permit. Additionally an agreement with the railway operator had to be negotiated, as a new water way had to be constructed closely to a major railway. With a peat layer in the underground all precautions had to be taken to avoid soil instability during and after finishing the works.

OWNERSHIP

Vlaamse Landmaatschappij is the leading actor in this pilot. They are planning to explore the willingness of farmers to make use of these types of solutions in the future. The government was involved as a regulator.

FINANCE

The gain of buffer capacity is reached outside the demo site for FRESH4Cs. Nevertheless the investment for FRESH4Cs is crucial for reaching the overall goals in the project area. Investments in the demo area should be considered together with measures taken in other parts of the major project area. As this pilot mainly has environmental goals, a Cost-Benefit Analysis could be insightful to understand the effectiveness of investments. This information is currently missing.

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FRESH4Cs pilot Kruiningen
Treatment for agriculture

At a glance

In the Kruiningen (NL) demo, a feasibility study was conducted for the investments and permits needed to reuse all the process water of Lamb Weston's new production line for own and local agricultural use.

Key metrics

Monitoring of the quality of the effluent water for critical parameters that affect discharge in local ditches and use for irrigating crops for farmers. Insights are gained into the water usability.

45%
of the time within nitrogen parameters

CHALLENGES

- Phosphate values in the current effluent are too high
- Identifying the best way to transport the water to external and internal users, and making sure water is reused in a circular system

SOLUTIONS

- Implementation of a hybrid system to make sure water can be reused the whole year. Potatoes can be washed; mixing water for the right purpose (cascade) is key

BENEFITS

1 **Industry**
- Measurements required to gain insight in the local water quality, and the traces of the past (e.g. PFAS)
- Eliminated options that are less attractive (e.g. creek ridge infiltration)

2 **Farmers**
- Monitoring the quality of the current effluent water on the critical parameters for the local ditches and for the farmers (crops) creates insight
- Access to a new local water source in periods of drought (potential)

3 **Project benefits**
- Network expansion of local water users through project field day visit and workshop
- Creating awareness and knowledge about the area and potential interventions
- Establishing a cross border knowledge network

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PURPOSE

Lamb Weston / Meijer (LWM) operates a factory in Kruiningen to process potatoes. They use about 1,5 million m³ of Biesbosch water delivered by Evides (water company). Water reduction is one of the objectives in their sustainability program. One of their ambitions is to reuse cleaned process water. Farmers are looking at their own problems and how the solution might benefit already existing infrastructure. The government and Evides had a less active role, but are interested in terms of legislation and new avenues for value creation through a new freshwater source.

NETWORKS

LWM has organised external stakeholders sessions. During these sessions they discussed their plans to optimize the local system. They involved local stakeholders during these sessions (farmers, government, knowledge institutes). Interesting to note is that a system similar to the willow marsh pilot in Koksijde (BE) to treat brine and remove N, P and heavy metals could be beneficial for LWM. Relationships for further exploration have been established.

GOVERNANCE

LWM noted that water management that could be beneficial to others is more expensive (e.g. the taxes for discharging on the ditch are more expensive than discharging into sea, because the effluent is seen as waste water). This makes the incentive for companies to contribute to circular local water systems low. Moreover, legislation is not future-proof. For example, current legislation does not take the risk of legionnaire's disease into account for growers. To send the water to the farmers by natural waterways, a permit was required from the waterboard. The parameters are determined based on the water quality in the local ditches.

OWNERSHIP

LWM is the leading partner in this pilot. They are involving other users (farmers and Evides) in the solution. Due to the low level of Chlorine < 200 mg/liter EC, it is not an option to use a creek ridge to store processed water. When designing circular water models, water quality levels should remain high. Pipelines for process water to the ditch of the farmers are considered not essential. This means LWM has to find a more expensive alternative routing, in case a land owner is not willing to provide access. This is different for Evides. It is likely LWM will be the owner of an optimized local system.

FINANCE

The price of water and a business case for water availability is missing and needed. An Evides pipeline for agriculture, with storage and process water of agriculture and industry seems like a serious option for the future. Ecological and societal values were not included in the calculation and were not a topic of discussion for stakeholders involved.

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