TOWARDS A SYSTEMIC VISION OF WATER

H2050 TRANSITION ARENA WATER

DISCLAIMER

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(De Weerdt, Y. & Halet, D. (Red.), 2021)

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Introduction: a new way of looking at things

Things were fine for a long time

Water is a primary necessity of life, so it is makes sense that we organised ourselves to make it accessible for a range of human and social needs. The basis is the natural water cycle: water from the sea enters the rivers through evaporation and precipitation, and then flows back to the sea. Over the years, man has grafted his own cycle onto this. We extract water from the ground or from watercourses, collect rainwater, discharge used water either subsurface or to watercourses, and build

comprehensive infrastructure to manage and control all these processes (water treatment plants, drinking water pipes, sewers, canals, etc.).

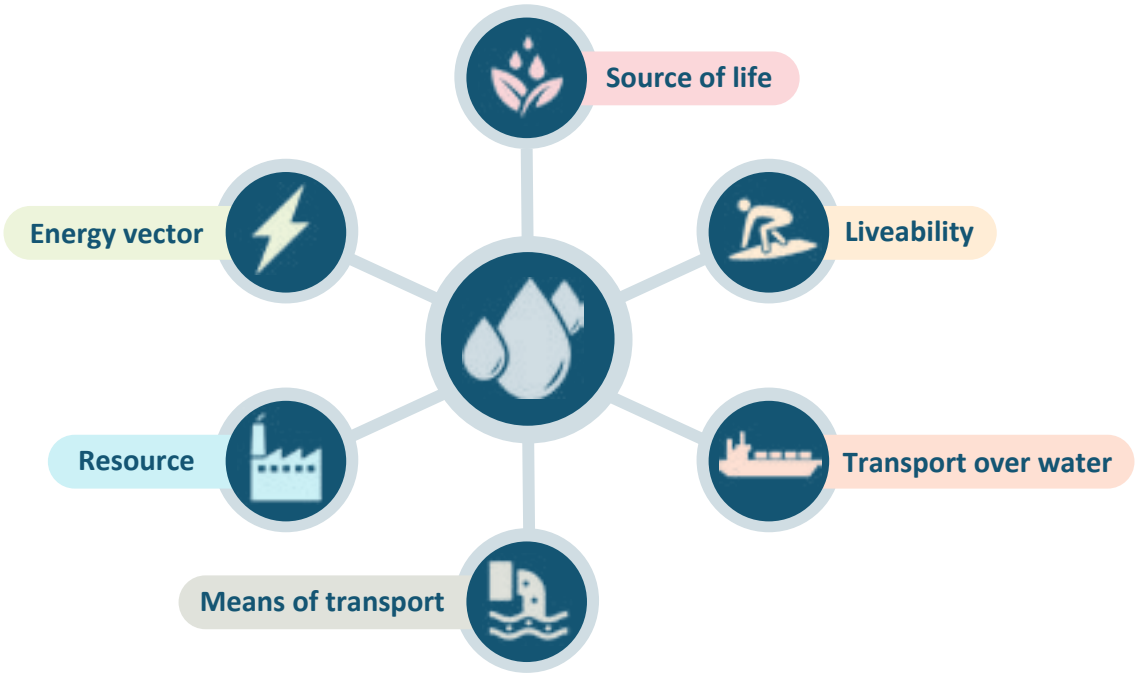
Some of the human interventions in the water system have undeniably led to substantial welfare gains, also in Flanders, and, through health gains, clearly also contributed to well-being. That was precisely the reason for building all these things. They stimulated the vigorous development of agriculture, port activities, industry, trade and employment, among other things.

Today, Flanders has 6.6 million predominantly affluent inhabitants, an industrial sector where 500,000 employees create more than €50 billion of gross added value, 23,000 agricultural companies together farming almost 50% of the total Flemish land area, i.e. 600,000 hectares, a land take of 6 ha/day by operations that pave over at least some of this land, and more than 1,000 km of waterways (of which 650 km are man-made) used for professional shipping. All of this results in growing tension between the needs of society and how we organise ourselves on the one hand, and the natural resilience of our water system on the other. This tension is already manifesting itself in problems of water scarcity, flooding and water quality. These burden us with ever-increasing social costs (e.g. insurance costs, health costs, additional investment and operational costs in water infrastructure).

The predicted demographic changes, the associated impact on raw materials and space, climate change, increasing road traffic congestion, growing urbanisation and social trends towards self-organisation only seem to heighten this tension.

The organisation of our water system and water chain had long proven to be highly efficient. Flanders has an impressive network of waterways, an excellent drinking water network that supplies high quality drinking water to almost every household, almost without restriction and at a low price, and it has an extensive sewage network to drain waste water. However, the underlying rationale of the system is highly linear and focused on management. Drinking water is generally extracted from ground and surface water. Once it is used by families and companies, the waste water is flushed away and treated, and discharged to the surface water. Rainwater generally follows the same path. For example, despite low water availability in Flanders, much water is extracted from natural resources and is then discharged to the sea. Nevertheless, these resources are not being replenished at the same rate: their rate of depletion is actually accelerating and the rate at which they can be replenished risks slowing down. Moreover, various forms of pollution threaten the quality of both ground and surface water.

Water is a question



As a society, we expect a lot from water: Water as an ENERGY VECTOR (Fire fighting - hydropower - water jet cutting - fuel - cooling - air conditioning), TRANSPORT over water (Recreation - passenger transport - goods transport), Water as a MEANS OF TRANSPORT (Raw materials - waste - solvent); Water as LIVEABILITY (Religion - identity - culture - art - war - urban canyoning - tourism - wellness - urban fishing - water sports), water as a SOURCE OF LIFE (Photosynthesis - health - reproduction - habitat - drinking water - vegetation) and water as RESOURCE (Hydrogen - drink - food).

Up until now, it has been possible to accommodate all these uses, but competition for water continues to steadily grow, for example by the continuing link between a growing population and an increasing demand for water, increasing prosperity which also results in an increasing demand for water, etc. There are also transitions that are starting to interact with each other. Among other things, energy, food and water systems are in transition, but health and mobility are too. All these systems are connected. This is taking shape, for example, in what has come to be called the Energy-Food-Water-nexus. The growing focus on interdependence has emerged from a growing awareness that water capital is eroding and there is strong sectoral approach without an understanding of connections. As a result, there is too little capital to meet the growing needs. The instincts for solutions fall back on competition mechanisms or making distribution mechanisms more focused. However, these risk creating new problems, e.g. regardering legitimacy and trust, or of shifting problems, e.g. from supply to water quality.

Nonetheless, the expected competition for the water system, as a result of growing water demand in various sectors of society, is an issue that is difficult to delineate, and is interwoven with various actors and factors, and therefore with interests and social struggles. An important question is therefore how this competition will be handled. You could work with a strict prioritisation or ranking of access or actors. However, these reflexes have a number of underlying assumptions, which we will examine in more detail here. To what extent is a ranking of different parties compatible with the

mutual intertwining of the various water claims? To what extent does such an approach presuppose that the pre-conditions can be verified? What happens, for example, if supply is suddenly cut off at the border, or the water flow is reversed? To what extent does a disconnection plan presuppose compliant actors who are fully aware of the agreements?

Waterpreneurs choose a different vision. By definition, they take into account unverifiable environmental factors. Their business plan is resistant to shocks. They focus on growing the water capital together. As such, they avoid the looming vicious circle of increasing scarcity, which is solved with more competition, which leads to even more scarcity, and so on.

Towards a systemic vision

So there is not one central question regarding the future of the water system. Not one vision that can provide a conclusive solution. Rather, it is a series of questions. Many questions have already been asked, in different places by different people. Do we really need drinking-quality water for everything we use drinking water for? Are public drinking water companies the only ones capable of producing potable water and supplying it to homes? Is the paradigm in which people take the lead over nature in handling water still viable? How can we continue to guarantee equitable access to water in times of scarcity? Is the rate at which we are reducing the buffer capacity due to solidification faster or slower than the rate at which we are planning to build buffers? To what extent will the water system be affected by (expected) changes in the energy, mobility and food system? Is our governance model up to scratch in light of the water challenges of today? Do we have the right knowledge to answer these kinds of questions?

In addition, there are also new types of issues that require ever more focus. There is the question of the vulnerability of our water system, especially in relation to terrorism, for example the deliberate contamination of the water system as an extreme but not inconceivable scenario. But the possible rise in sea levels also frames a number of issues. This illustrates the growing complexity of these challenges, which are increasingly difficult to view as separate issues.

It clearly appears that various conventional paradigms and lenses are no longer entirely suited to the challenges they have to address. In the coming chapters, we will therefore explore various other ways of looking at water, which recognise water as a system from the outset, and we will therefore explore the solutions to the systemic issues that the water system increasingly poses to our society.

The leading ideas of today

"We forget that our world was created by an accidental chain of events, and that history shaped not only our technology, politics and society, but also our thoughts, fears and dreams. The cold hand of the past emerges from the grave of our ancestors, grips us by the neck and directs our gaze towards a single future. We have felt that grip from the moment we were born, so we assume that it is a natural and inescapable part of who we are. Therefore we seldom try to shake ourselves free, and envision alternative futures".

(Yuval Noah Harari - Homo Deus)

This is especially true today when we are faced with complex, global challenges such as climate change, care, access to water, energy, mobility, and so on. In our search for possible solutions to these challenges, we often start from existing worldviews, paradigms, beliefs and ideas (leading ideas). But this also means that we continue to push the familiar solutions forward, keep applying them over and over again, and real transformative innovations never see the light of day.

If we want a system (such as a water system) to change course, we need to look at the underlying beliefs and ideas. We need to be aware that they exist and have an impact, to formulate them as clearly as possible, and also dare to question them.

From status lawn to convenient grass

Yuval Harari nicely illustrates this in his book with an example of where our love for a beautiful lawn comes from:

"Well-kept lawns demanded land and a lot of work, particularly in the days before lawnmowers and automatic water sprinklers. In exchange, they produce nothing of value. You can't even graze animals on them, because they would eat and trample the grass. Poor peasants could not afford wasting precious land or time on lawns. The neat turf at the entrance to chateaux was accordingly a status symbol nobody could fake. It boldly proclaimed to every passerby: "I am so rich and powerful, and I have so many acres and serfs, that I can afford this green extravaganza. 'The bigger and neater the lawn, the more powerful the dynasty. If you came to visit a duke and saw that his lawn was in bad shape, you knew he was in trouble. People all over the globe associate lawns with power, money and prestige. No wonder that in the nineteenth century, the rising bourgeoisie enthusiastically adopted the lawn. The lawn has therefore spread far and wide, and is now set to conquer even the heart of the Muslim world. Qatar's newly built Museum of Islamic Art is flanked by magnificent lawns. [..] Their more than 100,000 square meters of grass - in the midst of the Arabian desert - require a stupendous amount of fresh water each day to stay green. [..] But you are also free to shake off the cultural cargo bequeathed to you by European dukes, capitalist moguls and the Simpsons - and imagine for yourself a Japanese rock garden, or some altogether new creation. This is the best reason to learn history: not in order to predict the future, but to free yourself from the past and imagine alternative destinies. Of course this is not total freedom - we cannot avoid being shaped by the past. But some freedom is better than none".

Many system characteristics find their origin in how a given system came about. This history also helps us better understand a range of choices in the organisation, infrastructure and management. There are often rationales that are no longer equally relevant, but still help to determine a system's capacity for change. The following rationales/thinking patterns have so far been identified about how the water system is managed today.

Fighting against or working with water

For example, there is the mental model that **"dikes can prevent flooding"**. This model hasn't always been around. We started building dikes 1000 years ago, and for about 400-500 years, there was the mental model that dikes could overflow in winter and burst every 10 years. Nobody expected dikes to provide protection. What you often see in history, however, is that there is a shift of decision-making power from locals to outsiders (e.g. a government that will centralise things more, with the rationale of protecting the population and appropriating more resources and power to this end - thereby taking it out of the hands of others - Flanders experienced such centralisation in the 17th-18th century). Specifically as regards the story of the dikes, this implied that maintenance and construction were no longer carried out by the residents but by experts/officials/engineers who were in the capital (local knowledge became secondary). There was a lot of local knowledge, but if this knowledge is no longer used (everything is organised centrally) it fades away (try speaking fluent German if you haven't spoken it in 10 years, let alone write it). "The result: If you can't do anything with your knowledge anymore, it fades." We are now seeing a movement whereby people want to give responsibility back to local actors, as this is seen as the key to the solution (relying on the knowledge on the ground and using it for the specific design and maintenance). From the insight into the history behind the mental model, we can already identify two critical success factors, without which it will be difficult to strengthen local decentralised water management again:

> (1) First and foremost, this trend must be underpinned by the relevant authority and decision-making power, but also by the regeneration of local water knowledge, the restoration of water as a commons for local communities.
>
> (2) In addition, sufficient attention must be paid to social inclusion. History has already shown on multiple occasions that models of shared management are unsustainable when inequality in society increases (see also below).

In summary, we have undergone an evolution (both in the management of surface water and in the distribution of drinking water) in which users/residents themselves bore the consequences but also the benefits of a gradual scaling back this management to more centralisation. This is a process that was started 400 years ago, but is still not completed. Polders and water rings still perform their intended function, some households still have their own drinking water well.

Who pays the piper calls the tune?

The history of drinking water is a history of waters. In the 1800s, there were different types of water, and people started to use them for specific purposes (in André Guillerme's book: the Age of Water, the situation in the North of France is described in great detail, with a list of the different professions and what type of water they specifically used in their business operations). Antwerp had the following types of water, for example: rainwater, various neighbourhood wells (that used groundwater), a water pump shared by several homeowners, water sellers (e.g. water from the brewery, open surface water). The general reasoning was to drink this water as little as possible. These water supplies were maintained by the neighbourhood, with the guiding principle being

'interest-payment-control'. A principle that was also applied in the Water boards in the Netherlands, but which was abandoned in 2006. According to the **interest-payment-control** principle, a category that has a proportionately greater interest in the duties of the water board also pays a larger amount to the water board (a farmer has more interest in good water level management than someone who rents a house in this area). This higher payment in turn leads to greater control in managing the water board. So the larger the interest, the larger the payment and also the larger the control.

One effect of this is that part of the population is always marginalised (20-25% of the population). Sometimes the people were also deliberately excluded from paying, to avoid them having any control, and the cost they had to pay was not so high that it could be borne by others (a social inclusion challenge - see above).

Over time, and going back to a period when water was crucial for public health, the government has increasingly taken care of drinking water production. This has meant that a mental model has become engrained on the government side that it is the 'guardian' of **drinking water quality** at the service of public health, and there is a strong conviction that this role can **only be played by the government** (the drinking water sector also sees itself as guardian of drinking water quality these days). This mental model is highly characteristic of the water system, especially as regards drinking water supply.

There is enough for everyone, what shall we drink?

This central drinking water supply has always worked so well that people no longer know where their drinking water comes from and where their waste water goes. Drinking water only becomes water in the eyes of the public when it comes out of the tap, and stops being water when it goes down the drain. The consumer's mental model is: drinking water is abundantly available in every house, at any time (at a low price) and can be used for everything (laundry, toilets, washing the car, spraying the garden, cooking, showering and bathing, and even drinking). Within the drinking water system, there is also the rule that **supply always equals demand**. As with energy, the system fails if it is unable to match supply with demand at any point. Demand is seemingly placed outside the system, and is only indirectly brought into the system, via weak control such as awareness raising.

In addition, there is also a significant **linear way of thinking about water**, which does not integrate availability and limitation of water as such, or turn it into a problem, and will therefore mainly intervene at the end of the chain to guarantee the efficiency of the system. We also believe that by treating the water quality again at the end of the chain before draining it away (or transporting it to treatment plants), we will be able to keep the water resource sufficiently available for all the social functions we have listed in this process. This mental model is also reflected in the emphasis in the water system on liability after consumption, and much less on ownership of the resource, and the responsibility that this entails. This linear thinking can also be found in the fact that the speed at which groundwater layers are replenished was not an important part of the control system. Such replenishment delays are incorporated in system models, because of the reinforcing feedback that is often associated with them. As such, if the control is primarily based on avoiding shortages, you risk losing sight that shortages are avoided ever more narrowly, and seemingly all of a sudden water stock meters start flashing red everywhere.

Get the water out

Another historical mental model that plays a role both within cities and in rural areas is the following. Historically, the function of 'water as a means of transport' prevailed in cities. The key issue was how to get **water out of the city as quickly as possible**: indeed, pollution was flushed out of the cities, waste water had to be discharged from the city as quickly as possible for health reasons and often also because of the stench. Waste collection did not yet exist, nor did plastic; waste was primarily organic and was therefore flushed away. You can also recognise this same mental model within the national context. Dry meadows and fields were essential for efficient agriculture. Water had to be drained away as quickly as possible (ducting of canals, construction of drainage systems, etc.).

The popular saying **'The Flemish are born with a brick in their stomach'** is derived from the Flemish people's passion for building, hardened in Flemish clay, and finds its origin in the typical **Flemish Peasant Model**. There were large farms in the Polders and Haspengouw, but in the rest of Flanders there were primarily small farms (3-4 ha) that generated their income from various activities (including many wet farming activities):

Proto-industrial (=working from home): basket weaving (from self-packed willow twigs), home weaving

Para-agrarian: fishing, peat cutting, maintenance of waterways/roads/locks, timber production, pollarding willow

These proto-industrial and para-agricultural activities were highly labour-intensive and yet cheap, and are also referred to as the Flemish Peasant Model. As a result of the industrial revolution, many of these activities were at risk of becoming obsolete and the farmers in question had to look for other sources of income, whereby people started to travel to the city to work as maidservants, to work in industry, seasonal workers, and so on. This commuting (rather than a migration of the rural population to the city) was also maintained by the church and politicians by, among other things, constructing a high-performance network of neighbourhood railways and later road infrastructure for cars. In general, income security was an important priority. Access to land and preferably as an owner was also very important in this respect. The mental model of owning the land, as an important investment for social security, is very much alive in Flanders. And this access had to be guaranteed for posterity as well. As such, the inheritance system stipulated (for a long time) that all children had to inherit an equal amount. This resulted in considerable parcelling and fragmentation, in which farmland was converted into building land and ultimately resulted in fragmented spatial planning and ribbon development. The fact that the income was derived from different activities also allowed this fragmentation to persist - if your core activity only comprises crop yields, you can no longer get by if the plots get smaller generation by generation (the Flemish peasant model was actually aimed at deriving income from different activities).

This fragmentation therefore played less of a role on the large farms (e.g. Polders), where the farm was bequeathed to one successor and the other children were bought out - the polder farm was not split up - and the wet farming activities were also abandoned much more quickly by the larger farms (30 ha of land) because they had no time to pollard willows and braid baskets, if they also had to work a large patch of land. Over the years, wet farming activities disappeared, even on smaller farms. The fact that we still have river meadows and water meadows today is because these areas were used by agriculture. This is sometimes forgotten. At a certain point in history, a strong separation was introduced between lands for agriculture and lands for nature (compartmentalisation).

Freedom of choice in agriculture

Our agricultural past conceals yet another mental model. The **farmer** has always considered himself to be the person with most freedom (the choice of crop is sacred). The older generation of farmers also remember the time when anything was possible. If they didn't have water, they would just go and get it. If we now impose rules preventing, for instance water capture and their harvest fails as a result, it will come across as "They have taken this away from me". Now they are bombarded with lots of rules they didn't have to comply with in the past.

In general, the people of Flanders are greatly attached to their freedom - if **rules** are imposed, then it seems necessary that they are also enforced (just think of enforcing bans in the context of water use/water capture). This mental model is also historical. After the fall of Antwerp in 1585, Belgium, or rather its precursor, had various rulers. Think of the Spaniards, the French, the Austrians and last but not least the Dutch. The Catholic church also played an important role in oppressing Flanders. As such, Belgians or Flemings, are not so fond of laws and regulations that have been devised by their overlords. Whether it be the church or some foreign ruler who thinks he can call the shots. After all, the overlords represented a state that was not for the citizens of Flanders, but which was an enemy and therefore needed to be resisted. Any loop hole that could be found to attack the perfidious government was welcome. Undoubtedly a recognizable feature of Flemish culture.

Informing about facts = convincing?

On the other hand, there is a mental model in e.g. the government that pursues policy via prohibitions, assuming far too quickly that these are self-evident, and that objective, **scientific argumentation** can convince. Convincing communication in the jargon. As a government or experts, we simply have to replace the (wrong) story in the citizen's head with our own (correct) story. The emphasis in this regard is on conscious, individual changes in behaviour. The underlying assumption is that people are resistant to change, but that they can be convinced, and their behaviour will change as long as their information deficit is remedied. There is extensive scientific evidence that the opposite is true, and that behavioural change leads to changed intentions and convictions, and not the other way around. The fact that this evidence has existed for decades, and yet is not being applied, could be proof in itself that convincing communication as a mental model does not work.

Fragmentation or non-updated specialisations?

The reason why humans as a species have become so successful and dominant, finds its origin +- 70,000 years ago, during the cognitive revolution of humans, when our ability to speak greatly expanded. With this language, we also developed the ability to invent common stories, with which we were able to live and work together in large groups. These stories were about honour, justice and clearly not always about scientifically robust subjects (such as faith in gods, or life after death). Science is a language of understanding. Stories/myths are a language of collaboration. Science is an important tool for understanding the sustainability crisis. A crisis that would have been difficult to understand without science. It is what we do with the science that we should be aware of (a scientifically based story is no guarantee for inspiring and mobilising people).

In recent centuries, this development of scientific knowledge has primarily focused on specialisation. By dividing major problems into minor problems that can be tackled quickly, our natural need for quick feedback and results is fulfilled. This may have led to the creation of silos, with their division of disciplines and competences, among other things.

However, addressing the sustainability crisis requires developing sustainability competences, which are not only technical in nature, but also include aspects such as systems thinking, long-term thinking, being able to solve complex problems, and co-creation. Tackling the sustainability crisis requires a different way of thinking in growth and **thinking in time horizons**, especially given the fact that value chains are global.

"I used to think the top environmental problems were biodiversity loss, ecosystem collapse and climate change. I thought that with 30 years of good science we could address these problems. But I was wrong. The top environmental problems are selfishness, greed and apathy, and to deal with those we need a spiritual and cultural transformation, and we scientists don't know how to do that. (Gus Speth)"

To shrink is to decline

The mental model today is that we need economic growth for our prosperity. There is a morbid fear of scaling down, which is almost synonymous with decline (**"to shrink is to decline"**). Within this model, nature is seen as a supply of resources that need to be transformed. This is in stark contrast to Native Indians who see nature as a living deity to love, worship and live in harmony with. Native Indians also work from the perspective of 7 generations, i.e. about 500 years. This is highly relevant in the context of the global challenges we face, and the impact that people have on them. It is in stark contrast with our Western decision-making horizon. Most policy decisions, investment decisions and business cases have a duration of 2 to 4 years.

Moreover, this economic model is also very much geared towards **competition**. A mental model that is clearly visible in the breakdown of the various social functions of water, from which we expect added value. These functions are often not viewed as synergies, but rather in competition with each other. Industry needs to compete with the public for groundwater, agriculture is in competition with shipping for the water in watercourses.

Everything under control?

Another mental model starts from **management and control** within the water system. This model is visible in different places, and has different consequences. First of all, this mental model is visible in the virtual lack of any natural watercourses in Flanders. Practically all watercourses have been modified, so the water flows could be controlled. This 'infrastructure', a function of the desired control of water, increasingly clashes with the revival and growing importance attached to ecosystems, which do not take into account the limits set by man in the system. The model of management and control is also visible in the high-end centralised organisation of drinking water production, drinking water supply and waste water treatment. As a result, consumers are 'disconnected' from the consequences of their water consumption. There is no longer a direct connection between how people use water and what this means for the water supply on the one hand, and the (costs of) waste water treatment on the other. The latter aspect is reinforced by the fact that pricing is based entirely on drinking water consumption, which also finances waste water treatment, and not on household waste water production. In system terms, there are therefore a number of feedback mechanisms missing from the water system.

And then some.

Some other leading ideas and mental models identified in the interviews:

- There is **no incentive** to tackle problems if **no culprit** can be identified. Without a culprit, responsibility automatically lies with the government and therefore usually with a cost to society.
- Tackling problems is postponed until all knowledge is available. **Procrastination** is not only the result of being able to identify the culprit, but also of wanting to have all knowledge we need before taking action, an approach that is generally known as evidence-based policy: only when we know for sure what the effects of a given policy measure or policy approach are, can responsible decisions be taken.
- **Risk aversion**: Now that we are faced with drought, a manual is being drafted for what we need to do if there is not enough water. That is the current mentality in the government: "we don't want to take risks and we want to be covered", "look, we're just following the manual".
- Need for **ownership** in order to generate added value. If there is no ownership, there is little incentive to generate added value.
- **A blind spot for ethical issues**. Scarcity and distribution issues are closely related. Water is no exception in this regard. And yet, the ethical aspect of water is not yet fully taken on board in Flanders. The professorship of Dutch Prof. Dr. Ir. Neelke Doorn on 'Ethics of Water Engineering' at Delft University of Technology, shows that it is possible. Not including the ethical dimension in the reflections is also a mental model.
- **The inability to draw added value for the future to the present**. We find delays difficult to handle. It is not straightforward for us to draw added value in the future to the present. This inability to handle delays also manifests itself in terms of the type of measures we take. If a decision is made to take action, preference is given to measures in which we can see the results immediately - these are often measures at the end of the chain. For example, the proposed interventions are focused to a large extent on removing pollution. Not on avoiding the contamination in the first place. We prefer to focus on measures that cure rather than prevent (however, the increasing share of medicine residues compromises the health of our environment).
- Deferring interventions until a **disaster** occurs. There is a mental model that we first need a disaster / catastrophic / impactful event to take steps towards our goal.

  "Give us this day our daily bread, and the occasional flood" (Dutch proverb)

- **Symptom control:** We take action where the problems manifest themselves, not where their root cause is. If water pollution is identified, the responsible government will try to reverse the pollution. The culprit will be sought, but generally not to find the root cause with the culprit, but usually in order to pass on the clean-up bill. The polluter pays, then we consider it harmonious from a societal point of view. But what if the pollution is the result of a system error much earlier in the chain, or of policy in another domain. Are we equipped to find answers to that?

The leading ideas for tomorrow?

Too much water is not the same as too little water

'In abundance prepare for scarcity' - ***Mencius***

Introduction

At the root of both too much and too little water, and the extremity with which they increasingly occur, lies an irregularity that is exacerbated by climate change, among other things.

Too much water generally has a strong local character. Only very exceptionally, for example the flood in the Netherlands in 1953 and the flood in Flanders in 1976, has there been too much water at supralocal or even regional level. A water shortage, on the other hand, tends to shift relatively quickly towards a regional, more collective problem. Moreover, a different kind of involvement is required depending on the problem. When flooding occurs, we are physically confronted with too much water, which we want to get rid of. Engineering solutions are often put forward, and designers and landscape architects have also recently come into the picture (e.g. for the construction of water squares). For water scarcity, there is a much stronger focus on behaviour (e.g. spraying, capture bans, frugal water use, etc.). A shortage of water therefore requires a new kind of thinking and knowledge. There are usually a number of 'gaps' that need to be bridged, filled in, and new connections that need to be made. Interestingly, despite their different characteristics as a challenge, it is difficult to see them in isolation from each other, in the sense that whoever can provide a solution for a shortage of water is possible already well-equipped to deal with too much of it.

Policy driven by extremes and translated into averages

Floods often provided momentum to garner social support, in order to take action. As a result, the policy is often a response (with a few years delay) to disasters from the past, i.e. primarily floods. However, the dry summers of recent years have shown that solving situations of excess water does not guarantee the avoidance of occasional or structural water shortages. There is a need for an integrated and area-oriented spatial approach.

The approach to flooding has resulted in the three-stage strategy of capturing, buffering, and draining. In practice, we see that there is a rather strong focus on drainage. While the great added value lies at the level of water capture. The problem that arises is that the parties responsible for the proper implementation of the three-stage strategy do not have the tools to optimise water capture (this is at the level of the policy areas of spatial planning, agriculture - see below on the challenge of bringing these strands together).

Moreover, we see that, in the past, solutions were rolled out generically based on averages. For large infrastructure works, the necessary refinements have been made (via sensitivity analyses). At building level, however, averages are still used today. To this day, new construction projects are designed on the premise that they need to meet the average water demand of a family (see also below under 'water separation') or whatever the average size of a cistern needs to be under the Rainwater ordinance. Working with averages has clearly contributed to the fact that in Flanders, we have started to be smarter in handling rainwater. However, we can now see that we are working with different rationales (whether or not working with averages) at different levels that are nonetheless connected to each other.

Now for later

A shortage of water requires a different approach compared to too much water, as we mentioned earlier. If only because of the delay effect it conceals: you have to restrict things now (being frugal with water) to avoid problems in the future (too much water generally occurring). Even if citizens are advised not to wash their car or spray the grass with tap water, or there is a ban, they still get water from the tap. But the delay effect also plays a role in the extraction of groundwater layers. If too much is extracted in the summer, it takes a lot of time and rainfall to replenish them for the next summer. That never used to be a problem, but it became clear in the summer of 2019 that there are no guarantees anymore, if we carry on this way.

Occasional shortages can therefore become structural shortages, causing competition to shift to surface water, for example. It comes as no surprise that the claim to surface water from agriculture has only become increasingly visible in recent years. Another indication of the interconnectedness of the various water claims on the part of society.

Technology

Technological innovations also respond to filling the 'gaps' on the one hand and, on the other hand, to the interwovenness between avoiding water shortages and the energy transition, for example. Under the name riothermia, you will then find innovations such as underfloor heating that is powered by heat from the dishwasher. Heat extraction from sewage water is also possible in this regard. But with water recycling showers with heat recovery, it goes one step further. Because these showers, through the combination of significantly reducing water consumption and efficient heat recovery, may facilitate phasing out fossil fuels from domestic heating.

Water separation

For the residential sector, reflecting on how to prevent shortages reveals a number of important mental models in housing construction. For example, water is collected at height (via the roof), then diverted and stored in a buffer under the ground, after which it has to be pumped up again to be used on the different floors.

Up until now, new construction projects have generally been designed from the premise that they need to meet the average water demand of a family, and that water demand, whether for cooking or spraying plants, is translated into litres of high quality tap water or drinking water. As a result, this level of tap water consumption is constantly copied and has been structurally embedded in our housing stock (and thus in the water system) for the coming decades, despite all evolutions in the construction of water cisterns in new-build homes. Moreover, the significant economic aspect of the policy still leads to control at the level of individual behaviour or households, always resulting in sub-optimal micro-optimisation. Many collective solutions, which could also be underpinned by new social practices, remain very much out of the picture in this kind of policy approach.

Let the knowledge flow

Because too much water (and sometimes also water shortages) are generally local in nature, finding solutions requires local hard and soft knowledge. Also because each area (geographically or in terms of process) has a different structure and a different field of actors that requires or makes other solutions possible and/or desirable. Nevertheless, local knowledge of water has been increasingly pushed to the background by increasing central management of the water system and the expectation on the part of citizens that the government will tackle problems for them efficiently. In practice, this efficient approach is dominated by considerable 'buffer thinking' (holding a number of cubic metres).

Rebuilding water intelligence

Nonetheless, we recognise the need for local knowledge. The report 'Vlaanderen Wijs met Water' states that everyone should know 'when water comes, how and when to collect it, and how and when to discharge it'. To achieve this, it is necessary to restore or rebuild a form of collective 'water intelligence'. This requires different mental models and starting points than the ones we use today for knowledge building among experts. Intelligence can only be built up by making it visible.

On the waves of climate

In order to achieve the medium- and long-term climate goals, the Flemish Coalition Agreement (2019-2024) also makes a strong commitment to renovating home ownership, thereby making it energy-neutral or energy-efficient. In the context of the proposed recovery plan (2020), a label bonus and an interest-free renovation credit (where the interest burden is borne by advance payments from the Energy Fund and the Climate Fund) will be used to entice as many new owners as possible to comprehensively renovate their homes in the area of energy. More and more parties are asking this question (among others the social partners) to seize this renovation wave, to take an important step forward not only in the area of energy but also in the area of water. Indeed, frugal water use often goes hand in hand with lower energy consumption. In 2018, the residential sector was responsible for 7% of the gross inland energy consumption in Flanders, and 34% of total water consumption (excluding cooling water) in Flanders, and accounted for 62% of total tap water consumption. Households play a key role in the energy transition today, but they also play a key role in the water transition.

Only using drinking water for drinking, and devising and implementing alternative solutions for all other water uses, would represent a major change in the way water supply is organised in homes. And it would mean reducing the pressure on the drinking water system.

By linking the use of, and knowledge about, water to other challenges (e.g. energy, climate and biodiversity issues), surprising opportunities and synergy benefits might emerge. It is with good reason that water has a very high (dis)solving capacity.

Between farmer and frog

Man living in harmony with nature is like clear water.
He stands close to the source and does not renounce the earth. - ***Lao-Tzu***

Introduction

One farmer told us during a meeting that he once wanted to irrigate his crops to grow, or even just survive. However, the water level in the watercourse where he wanted to draw water was so low that the frogs were at risk of dying. The government then imposed a ban on water capture, to protect the frogs. The farmer felt trapped, as although he didn't want to kill the frogs, he had to put food on the table. The government acted as guardian of the frogs, the farmer felt ignored in his interests as guardian of his income. The person sitting next to the farmer in that same meeting turned out to be the person who imposed the ban on water capture, who had never thought about how the ban would resonate with those on the receiving end. Perspectives were exchanged, face to face, and mutual understanding emerged. How come no dialogue is organised at times like these? After all, we don't know if it was essential to save the frogs. Or whether there was another way to save the frogs or help the farmer, as there was no discussion. The precautionary principle was applied, so no-one needed to know. Although there was a water shortage, the manageable water between farmer and frog was still too deep. By managing via bans, there was no leeway for identifying a shared interest, from which a shared solution could emerge.

Farmer of the future

We see farmers and horticulturists primarily as the producers of food and crops. This translates into a business model that focuses on productivity. For a large part of our solutions to the water challenge, we look at agricultural areas (buffer basins, management agreements, etc.), without really having a vision for the future and a clear idea of where we actually want to take agriculture in the longer term.

But imagine we gave farmers a much broader role in society. For example as a soil manager, water manager or manager and entrepreneur behind the 'green pharmacy'. With the latter, cultivated healthy crops can be seen as the medicine for a healthy life. This would be the first step in switching from caring for the sick to caring for health. This approach would relieve the pressure on the food-oriented model, and would open up new possibilities. As examples of how this could be imagined, the 'health farmer' and the 'water farmer' emerged in the transition space. For the commons, the health farmer and the water farmer manage our wealth, the water capital and healthy land.

In contact with each other, a new economy emerges

The new farmers blur the dividing line between health policy and agricultural policy and put the farmer back in a more direct relationship with his customers. This doesn't need to have a negative effect on revenues. Given that there will rarely be an oversupply in this philosophy, prices will not drop (drastically) and the health farmer will also earn his living. And perhaps we can incorporate external environmental and health costs or benefits in the pricing, for example. The costs currently incurred by the authorities for maintaining and managing the areas that belong to the commons can also contribute to the new earning model of the farmer. The health farmer or water farmer opens up new paradigms.

A first manifestation of a new business model is, for example, the cooperative in which ARDO combines the strength of 362 farmers for organic agriculture ("together we are strong"). From the perspective of a Regional Metabolism (an idea we explore elsewhere), the experiences and results of this collaboration can be visualised. We can then examine whether such an initiative can also be used in other areas, and whether insight can be gained as to how this contributes to the Water capital.

Governance

In order to give these new farmers, or 'management farmers', a robust framework for their actions (and non-actions), it is important that there are sound agreements with regard to governance. As a guideline, for example, we can look at the basic principles expressed by Elinor Ostrom in her book 'Governing the commons'. She has documented how communities in many places around the world are devising ways to govern the commons, so that they can survive for their needs and future generations.

The basic principles are:

- Define clear group boundaries: what are the resources and who are the users.
- Match rules governing use of common goods to local needs and conditions.
- Ensure that those affected by the rules can participate in modifying the rules.
- Make sure the rule-making rights of community members are respected by outside authorities
- Develop a system, carried out by community members, for monitoring members' behavior
- Use graduated sanctions for rule violators.
- Provide accessible, low-cost means for dispute resolution.
- Build responsibility for governing the common resource in nested tiers from the lowest level up to the entire interconnected system.
- These basic principles can also be 'tested' in the Regional metabolism.

Water as Capital

If we think of life on Earth as a vast series of trades and transactions, water is the currency in which these exchanges are made ***- Jha, (2015)***

Introduction

Water is the most precious thing on earth. All life is derived from the existence of water. So it's no coincidence that the water on Mars gets so much attention. Water can therefore be seen as the earth's capital, and therefore our society's capital. It is part of the so-called commons, which gives us as humans the responsibility to manage this capital responsibly and with humility for the benefit of the greater good.

If we look at the monetary system, two things already stand out in our relationship with capital:

- We never throw it away. If someone else does, you pick it up and, depending on your character, you put it in your wallet, take it to the poor or run after the thrower and alert him to his mistake - but either way, no one lets money go to waste.
- It multiplies as it flows. Monetary capital is used to invest, whereby added value is created and the capital grows. So we strive to make it bigger, or at least maintain it, and not to end up at the last penny or even get into debt.

How would the water system be managed if the principles/structures of the monetary system were applied to it: what is the role of the central bank, can you increase your capital by bringing in reserves, can you improve water quality by allowing water to be used (it multiplies when it flows), etc.?

Different forms of capital

As the French sociologist Pierre Bourdieu points out, there are various forms of capital in our society: economic capital, cultural capital, social capital, symbolic capital, linguistic capital, ecological capital... A transposition to the water system, by analogy with this classification, could give the following interpretation to these different forms of capital in the water system:

- Economic water capital: the money (e.g. from income from drinking water bills, corporate taxes) and real estate (water infrastructure, etc.) that we have at our disposal to relieve the tension between what we expect from the water system and what the water system can provide.
- Cultural water capital = the body of knowledge and training among the various social players that allows us to jointly manage our water resources. It is the degree to which citizens (water users) are aware of the water challenges, they have knowledge of and insight into the water system, and (as a result) also take their responsibility in managing the water system (and their connection with water also becomes much wider than it is today. Today, the main connection with personal water use is the water bill).

- Social water capital: relates to networks and relationships and bringing together specialist knowledge to tackle new water issues, water families, water communities, and so on.
- Symbolic capital: by analogy with "Made in Germany" or "Belgian Chocolates". This is a symbol of quality. Simply because it appears on a product means the product is considered high quality, and this is taken as a given. In terms of water, we could think of the image of water. The mental model in Flanders is that "water from the tap is always potable" (which is certainly not the case in other parts of the world). If, due to malicious acts (e.g. terrorism), this cannot be guaranteed at a certain point in time, this is mentally a heavy blow for society. Symbolic water capital could also refer to the image of a water drinker: fit, healthy, active, conscious, pure.
- Linguistic water capital: These days, a lot of value is attached to information or data. By building up more knowledge about water and water systems, combined with collating existing information and converting it into actionable data, value is also created. This water data can be used by various parties to optimise water management, but also to research and develop new applications.
- Ecological water capital: the value provided to society via water. This is already partly contained in the concept of ecosystem services. The more of these services we can allow water to provide, the greater the 'capital' will be.

Like all other types of capital, we want to increase the value of water capital in its broadest form, this will require the use of alternative control mechanisms, which today are based more on pricing, standards and permits.

Water metabolism as a lens

A fractal is a way to see infinity - ***Benoit Mandelbrot***

Introduction

Your metabolism converts the food you eat into energy. In a normal diet, your body uses up to about 85% of your daily calorie intake to maintain all your physical processes. For example, the digestion process and keeping your body warm, blood circulation, healing wounds, growing hair and the general recovery of your body. It plays a crucial, major role in the health of an organism.

We use water metabolism here as a metaphor for a living system/environment, taking water as our starting point. Indeed, the water system is essential for the health and vitality of natural systems and societies.

Because it is a metabolism, and everything in it is connected to each other, you could see this set-up towards the future as a 'fractal setup'. What does that mean exactly?

INSPIRATION:

In order to examine the water system from a metabolism point of view, it is good to first know the broader (philosophical) context. Looking at the major challenges in the world, we see 5 major crises: water, food, energy, finance and climate. These are all interconnected. Among other things, they are connected by Maslow's hierarchy of needs/conditions for life. Water is the essential condition for life: food stands for growth, energy for creativity and dynamism, finance for structures and climate for systems.

If there is a crisis on all these levels, which is in fact a moment of transition, Maslow asserts that a change of consciousness/self-actualisation is necessary to be able to grow to a higher level. In fact, you could say that this requires a shift in consciousness as regards water.

In other words, it is not logical to look for the solution at the current levels, and actually fall back to where we came from. From the 'leap of consciousness', we look again at the basis, the water system, and from that new/other view and knowledge we examine the other connected systems and work out the next steps. These connected systems are then not only the 5 large ones we cover here, but also the underlying systems such as biodiversity, care, education, etc. But all from water as a centre/basis.

Seeing all actors as a whole

By looking at water as part of a regional metabolism, many actors are naturally related to water management in the broad sense.

The way in which these actors and their activities relate to and respond to water is interlinked via this metabolism and thus also has an impact on the other actors. As such, the metabolism functions as an invitation to cooperation.

Organisation

To this end, thematic groups can be used around the water functions (Energy vector, Transport, Means of Transport, Liveability, Source of Life and Raw material) or on the water/food/energy nexus. The aim is researching, gathering knowledge, setting up, supporting and mapping initiatives. Given the interaction between the different parts, the driving forces of these thematic groups together form a steering group for the Regional metabolism project. Each theme group can look for cooperation with private and public parties, on the basis of what is necessary. There is no clear form in this regard, but customisation per theme and initiative. Nonetheless, integrality must be monitored from within the steering committee, so that the same parties are not approached for every initiative. Moreover, the exchange of knowledge, ideas and contacts can then take place. A practical example is the organisation of the Transitiecoalitie voedsel (Food Transition Coalition) in the Netherlands, the Kennisactieprogramma Water (Water Knowledge Action Programme) or the Water-Land-Schap programma onder het Open Ruimte Platform (Water-Landscape programme under the Open Space Platform).

Value models

An improved understanding of the societal added values that can be created makes it possible to draw up 'theories of change' using simple business models, multiple business models (measuring not only hard euros, but also indirect benefits in euros and the impact on other areas).

So here is a clear link with **'Water as Capital'**. The knowledge, experiences, data, projects, etc. can serve as input for the research in the project. Conversely, insights from **"Water as Capital"** can be tested in practice or investigated in the water metabolism.

Compliance

These days, economic systems are primarily set up and developed at the global level. Fair competition, in which the consumer is protected, is often the starting point. Anti-trust and competition authorities are set up to supervise this. If we think in terms of the commons, and production and logistics processes can also be incorporated, a cooperation authority (instead of a competition authority) could be helpful and useful. Agreements could then be made whereby the interests of all stakeholders were taken into account in the distribution of income and expenditure, whereby the common good was central. Nevertheless, from an integral/holistic perspective, it must also be taken into account that its benefits outweigh the effects on the benefits of free (international) trade.

The way in which innovations, adaptations and applications of (new) systems and structures are paid for or financed (via water purification bills, water consumption, indirect factors such as medicines, etc.) must also be carefully considered.

Integrality

The analogy with the metabolism is based on an integral/holistic vision (encompassing and transcending). The water system is part of a broader metabolism... It can therefore be seen as a fractal in the bigger picture. In a metabolism, syntheses are made of the stimuli from different subsystems, which together then lead to an action - which does not necessarily benefit each subsystem in the short term.

A metabolism functions because there is interaction between the components and it is controlled by the exchange of information. The theoretical interactions and information flows are almost infinite - so it seems to be a matter of first mapping out the most important interactions and rigging up the most important information flows. The idea of the water/food/energy nexus may be useful here - they already seem to be three essential systems for our social metabolism.

Innovation and technology

Innovation lies in new technologies on the one hand, and in new ways of dealing with current technology on the other. But also a combination of both. Innovation can also lie in the way we design the environment and/or the water system. And finally, and perhaps the most important thing is that by bringing water (problems) to the fore, we can change people's mindset, and other behavioral patterns can arise. That is also worth investigating.

New technology can also be developed and researched in elements relating to the deeper properties of water. In addition to the physical, biological and chemical properties, we also look at the intrinsic properties of water (see: Different water requires different wisdom).

Different water requires different wisdom

"The saddest aspect of life right now is that science gathers knowledge faster than society gathers wisdom." - ***Isaac Asimov***

Water has its own wisdom. It flows where it wants to go. It is not always easy to control or manage. Water therefore flows and manifests itself on many different levels, in different areas and different forms of use.

Water also has many different properties, physical (e.g. conduction, temperature, colour), chemical (e.g. by substances dissolved or present in it) and biological (e.g. bacteria, algae, etc.). In addition, there is a fourth group of intrinsic properties, such as its ability to form hydrogen bonds, which underlies a range of unique properties, but also the fact that water is not only a molecule but also a sensation. If there is water nearby, you are attracted to it, whether it is the ocean or just a small stream. That kind of experience cannot be captured in atoms or formulas.

It is clear that the different areas where water manifests itself, in combination with the myriad special properties of water, brings with it great complexity. This means that knowledge of water alone is not always sufficient. Interacting with and living with water also demands wisdom.

Fragmentation as a swear word for specialisms

When we refer to the fragmentation of water policy, it often expresses a certain sentiment of immobility, a sense of inertia, too much complexity (bureaucratic or otherwise). It is a good idea to find out how these sentiments came into being. After all, much of what happens in the 'fragments' has never been problematic, possibly even praised, for a long time. However, many of these specialisms in their original form are no longer suitable for tackling the new issues affecting water.

The evolution towards a more hybrid water network requires the incorporation of new knowledge. Experiments and ideas are developing on all kinds of spatial scales, and are increasingly crossing the boundaries of policy and disciplines. The rapid pace of new developments (cyber-attacks, terrorism, Covid-19, biotechnology, AI) also prompts new knowledge questions, in which we will have to integrate philosophical issues more quickly into the solutions we develop.

In the organisation of water, we see a movement away from centralistic to a hybrid form, with much more movement and dynamics decentralised. This requires (re)new(ed) knowledge to be added to the system. This applies not only to knowledge about policy, but also about the knowledge of water itself.

'Where is the wisdom we have lost in knowledge?
Where is the knowledge we have lost in information?
Where is the information we have lost in fragmentation?'

-T.S. Eliot

New reality and new perspective bring new knowledge

The world we live in seems to be changing faster and faster. There is often talk of a 'revolutionary evolution'. This was already the case before the corona outbreak, and is only becoming more relevant in these times. Before corona, terrorism was the most obvious example of how the vulnerability of the water system to evil intentions added a new dimension to water management. In a larger perspective, we could even argue that the five major global crises (climate, finance, energy, food and water itself) can all be linked to water in their origin and solution.

There is also the fundamental question of ownership of water, which in turn can take on a strong ethical dimension. This therefore opens up exciting new spaces in which knowledge and practical synergies can emerge to support the transition to a future-proof water system. The Earth carries the water, but the water also carries the Earth.

The puzzle relaid

In light of the above, the fragments or specialist knowledge are primarily pieces in a puzzle of a new knowledge landscape. Teams who, on the basis of their expertise, were involved in both water purification and the absorption of medicines in water, see powerful links between the two in the systemic view of water in the light of new social issues. As such, soil improvement also starts with healthy and vital water, and a well-functioning water system is again largely dependent on what grows on that soil.

A major challenge is to bring all these pieces of knowledge from the specialism back to the whole. It is not a sum of knowledge, but an evolutionary path. Two identical atoms have the same properties. However, as soon as they bond to a molecule, new properties emerge. It is a process of encompassing and transcending. This process takes place at all levels, and is one of the sources of integrated knowledge and wisdom.

Dream big, start small, scale wisely

Conceiving and searching for the new or renewed knowledge which is necessary for a systemic vision of water can probably best be driven from practice on a (smaller) scale. A local or regional water metabolism could be a very fertile starting point in this regard.

By making visible on that scale how different needs and activities are interconnected throughout the entire water system, formulating relevant questions becomes much easier, and because of the link with practice also more powerful. And it provides more insight into how specific water challenges can best be solved at the level of action. As a result, less and less will have to be solved by the government. The government will increasingly become an orchestrator and facilitator. Government will still be necessary for certain matters. In such an approach, the role of the government is focused by the actors themselves. And it will then be easier for the government to get things done.

We can call it a 'water garden', in which a new social interaction for the change in the water system can be investigated and built up.

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