Transition analysis

Drought in Twente

towards a knowledge-in-action agenda for the transition to a more resilient water system

By: Joanne Vinke-de Kruijf, Tom Coenen and Beau Warbroek

With: Caroline van Bers, Cheryl de Boer, Stefan Nijwening, Derk Loorbach

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KIN Dutch Climate Research Initiative

Accelerating transitions together

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Foreword

Drought and water scarcity in Twente have motivated a transition analysis and the development of a knowledge agenda. This analysis and agenda are the result of a small-scale 'knowledge-in-action' project. The aim of this project was to achieve more transition-oriented cooperation between researchers and regional partners (see UT news item,2025). For this project, the research team at the University of Twente (UT) received financial and substantive support from Klimaat Initiatief Nederland (KIN). It also made use of a discussion guide and analysis carried out by HAS green academy and KIN for the East Brabant region. As in East Brabant, the analysis and agenda lay the foundation for an innovative, co-creative Crutzen workshop and an accompanying research programme.

This report outlines the foundation for transition-oriented collaboration. It shows how parties in the region describe drought as a transition challenge. This portrayal is based on a series of interviews with parties from the region and the experiences of the researchers involved. A draft of this report was shared and discussed with the parties interviewed. They agreed with the picture outlined. Specific comments and suggestions from a number of parties were used to paint a more complete and nuanced picture.

This report is structured as follows. First, an introduction to the issue is presented and the method is explained. We then discuss the Twente water system and the organisation of water management, the current situation and the solutions that parties see. We then discuss the situation on the basis of seven themes that appear to be decisive for the pace and direction of the transition to a resilient water system. For each of these themes, several transition questions have been formulated; these are knowledge gaps that need to be addressed with a view to the desired transition to a resilient water system. We end with a brief conclusion and outlook.

1. Introduction

The Netherlands has traditionally been a water-rich country where people are accustomed to draining water as quickly as possible to prevent flooding of agricultural land, homes and businesses. As a result, water scarcity, drought and desiccation are recurring problems. Desiccation in particular – a structural shortage of water in the soil and a decline in groundwater levels – has been regarded as an ecological problem for decades. Partly due to climate change, we are now increasingly faced with too little or too much water.

The Delta Commission's first advisory report (2008) explicitly mentioned freshwater supply – in addition to flood protection. However, initially, the focus was mainly on freshwater supply in the central and western parts of the Netherlands, this despite the fact that the effects of long dry periods have been felt for much longer on the high, dry sandy soils in the eastern Netherlands. Whereas in other parts of the Netherlands, water supply via pumps and pumping stations is almost always possible due to abundant inflow, a large part of Twente depends on rainwater. This means that up to 90% of the streams in north-east Twente can dry up in the summer. As a result, drought in Twente has been causing recurring problems for nature and agriculture for decades. For this reason, regioanl water authority Vechtstromen took the initiative in 2013 for a North-Western European project on the governance of drought adaptation (the DROP project, see Bressers et al, 2016).

In 2018, there was a broader social awareness of the consequences of drought. That year was extremely dry, with major consequences: even the drinking water supply came under pressure. It is estimated that this drought had an economic impact of 0.5 to 2 billion euros, mainly due to its impact on agriculture and shipping. In addition, the drought caused cracks in buildings, foundation problems and was harmful to water quality and natural ecosystems (Ecorys, 2019). In Twente, shipping on the Twente Canal was only possible to a limited extent. Ultimately, there were no immediate shortages in the supply of drinking water. The subsequent years (2019, 2020, 2022 and the first half of 2023) were also characterised by prolonged drought. Drinking water is no longer taken for granted. In 2024, a National Action Plan for Drinking Water Conservation was published, which focuses not only on supply but also on demand for drinking water. For example, it states that drinking water consumption must be reduced from 128 to 100 litres per person per day by 2025 (Min I&W, 2024).

Due to climate change, the whole of the Netherlands will experience more frequent periods of above- or below-average rainfall. Combined with high evaporation and rapid water drainage, this increases the risk of drought, water scarcity, water shortages and flooding (KNMI, 2023). In this report, we focus primarily on situations in which the demand for water exceeds its availability. We are aware of the different types of drought, but do not distinguish between them in this document.

Although climate change is a reason to discuss drought and water shortages, experts agree that it is not the primary cause. Climate change merely exacerbates existing problems: 1) the storage capacity of the soil has been drastically reduced by the exploitation of peat and marshlands, monoculture in agriculture and the breakdown of organic matter; 2) historical changes to the landscape have reduced the ability to retain water; and 3) socio-economic and demographic developments have increased the demand for water. Whereas around 1850 it took a drop of rainwater 16.5 days to travel from east Twente to west Overijssel, today it takes only 9 hours; no less than 50 times faster (Alles stroomt op Het Lankheet - Het Oversticht, 2025). In a proverbial sense, the water system (here referring to the interconnected surface water and groundwater systems, including infrastructure, soil and landscape) has changed from a sponge to a colander. Although infrastructure and landscape developments have brought many benefits to the region for people and the economy, they have also put pressure on the availability of fresh water.

In addition to drought, climate change has also led to more frequent extreme rainfall in the Netherlands. The consequences of this were recently painfully evident in Enschede. An extreme downpour on 21 July 2024 caused so much damage that residents of 62 houses had to leave their homes for good (Tubantia, 2025). Because drought and water shortages are an urgent and under-exposed problem, this issue is the starting point for this analysis and agenda. More generally, it can

be said that existing systems (including soil, infrastructure, landscape and governance) lack sufficient resilience to provide safety and security, even in the event of extreme fluctuations in rainfall. Hence, the subtitle of this report is: towards a more resilient water system. Values such as legitimacy (is the transition lawful, legitimate and socially acceptable) and fairness (does the transition recognise differences and interests, allow for participation in decision-making and ensure a fair distribution of costs and benefits) are not explicitly mentioned in this subtitle, but are important to monitor, both when considering the process and the outcome of this transition.

2. Method

To arrive at this transition analysis and agenda, the research team conducted 11 semi-structured interviews with 13 individuals from 10 different organisations that influence or are affected by drought in various ways (see Table 1). In selecting the individuals to be interviewed, the UT research team was supported by the Vechtstromen and the Eastern Netherlands network organisation Pioneering. Draft versions of this report were discussed with interviewees in two validation sessions. In addition, insights were drawn from our many years of involvement with this theme and from conversations in the 'corridors' during recent network and project meetings. Relevant to mention are an international symposium on drought (June 2025), a session on drought and water scarcity during the UT Climate Event (November 2025), the annual event of the Twentse Golf (November 2025) and research and meetings of the DIWA projects (a cross-border project on drought), SpongeWorks (a European project aimed at increasing the sponge effect of water, soil and landscape) and JCAR-ATRACE (a research programme to reduce cross-border risks of drought and flooding in the Benelux and Germany).

Table 1: Overview of organisations interviewed

Public parties	Province, water authority, municipality / Twents Waternet, regional sponge strategy (secondment from water authority)
Private parties	Water-dependent company, construction company, architectural firm
Other parties	Port of Twente, drinking water company, agricultural organisation, nature organisation

In the interviews, respondents were asked about the current situation of the water system, perspectives on the drought problem, characteristics of the problem and (promising) solutions. We specifically asked about the need for a transition, i.e. a fundamental change in culture, structures and practices. We then explored the way forward in more detail. What might this look like? What and who is needed to achieve it? The recorded and transcribed interviews were then analysed individually and processed into analyses of the current situation, bottlenecks and possible solutions, and the identification of key themes that emerged from the interviews.

3. The Twente water system

The Twente water system is characterised by high sandy soils that drain water via various moraines through stream valleys to lower-lying areas further west. The subsoil is varied and sometimes complex (boulder clay moraine). With a view to agricultural production and limiting flooding, many winding streams have been straightened and deepened over the past decades and centuries, so that they function as narrow, efficient water drainage systems. Drainage and dewatering works were also constructed to regulate groundwater levels and to quickly drain peak precipitation via streams, rivers and canals.

The Twente Canal, constructed in the 1930s, served both as a water drainage route and for the transport of raw materials and products from the Twente (textile) industry. The canal still has an important transport function and also serves to supply water from the main water system. Over time, many marshy and wet areas have been reclaimed for agriculture (see Figure 1), with intensive land use and monocultures reducing the organic matter content in the soil. All this has led to a water

system that can effectively drain water but has poor retention capacity. Due to the limited natural inflow of water, the sandy subsoil and increasing periods of drought, the risk of water scarcity is increasing – not only for nature and agriculture, but also for industry and the inhabitants of Twente.

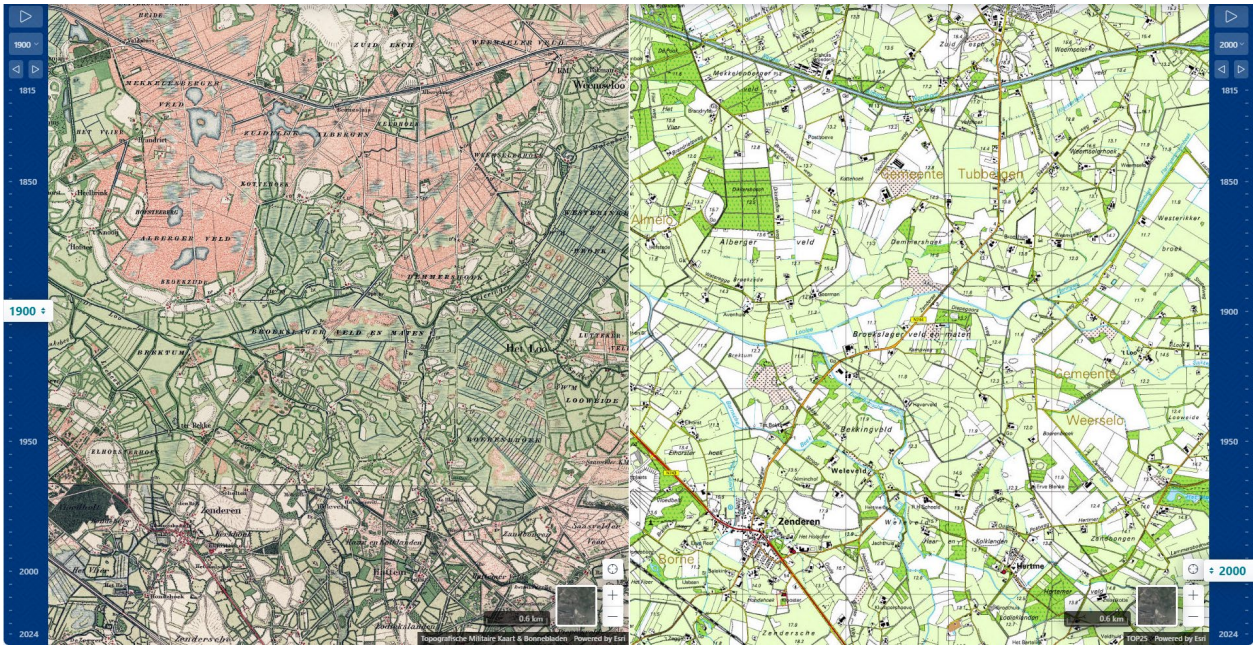

Figure 1: Map of Twente, comparison between the years 1900 and 2000. Source: https://www.topotijdreis.nl/vergelijk/kaart/1900/kaart/2000/@247716,484432,9

Although desiccation and drought have been causing problems for decades, especially for nature, drought has only recently been recognised as a broad social and administrative issue. The acute pressure on the system is evident from the fact that new businesses with high water demands (such as chip manufacturers) and houses cannot be connected to the drinking water network. To address these acute problems, drinking water company Vitens wants to lay dozens of kilometres of new water pipes from west to east Overijssel (Vitens website). At the same time, demand for water is expected to increase further. For example, the railway zone of Enschede and Hengelo has been designated by the national government as a location for the construction of 10,000 homes (Tubantia 2025).

To provide a clearer picture of the problem, Twentse Golf (a public-private network initiative for a future-proof water system) commissioned the Twente Water Balance in 2023 (see Figure 2): an estimate of the amount of water that enters Twente, is used and leaves the system. The amount of water is expressed in Olympic swimming pools. This balance shows that the incoming water (99% precipitation and 1% import) is almost entirely used up by evaporation (68%) and drainage (24%). The remaining 8% is consumed by the agricultural sector (5%), consumers (2%) and industry (0.6%). This balance provides insight into the average amount of water in the whole of Twente on an annual basis. However, this only gives a limited picture. In winter, too much water regularly causes high groundwater levels and flooding. In summer, there is often a structural shortage. Moreover, relatively 'small' items in the water balance can be of great local importance, such as the extraction of water for irrigation next to a vulnerable nature reserve.

Figure 2: Estimate of water supply, use and drainage in Twente. Source: De Twentse Golf | De Twentse Waterbalans

The governance of the Twente water system involves a broad group of (semi-)public organisations, each with their own powers over parts of the water chain. The province of Overijssel is responsible for groundwater quality, water extraction areas, spatial planning and licensing for large groundwater extractions. Water occupies a prominent place in the province's latest coalition agreement (2023-2027). In addition to a regional water programme – a policy framework for soil, drinking water, water quality and climate adaptation – an Overijssel water approach was also launched in 2025. In this approach, the province is fully committed to cooperation, innovation and awareness.

The Vechtstromen Water Authority is responsible for area-specific implementation: water level management, regulating withdrawals from regional surface waters, managing streams, ditches and regional flood defences, and wastewater treatment. Vechtstromen has been working on projects and programmes to tackle the challenges of drought and water shortages for a long time. An important partnership is Zoetwatervoorziening Oost- Nederland (ZON, Freshwater Supply East-North-North-West Netherlands). Since 2016, organisations in this partnership have been working on projects and pilot schemes to investigate and solve drought problems. Vechtstromen is also the initiator of DIWA (cross-border drought approach), a partner in the European SpongeWorks project and was a partner in the Lumbricus knowledge programme (website Vechtstromen).

When the water comes from the Twente canals, Rijkswaterstaat (the Dutch Department of Waterways and Public Works) becomes involved, as these main waterways are managed by the government. Vitens also manages the production and distribution of drinking water, which in Twente is almost entirely extracted from groundwater. Vechtstromen and Vitens, together with Grolsch, are the initiators of De Twentse Golf, a network that has been working since November 2023 to create a future-proof water system in Twente.

Finally, the fourteen municipalities in Twente each have their own responsibilities for water management in the built environment, particularly with regard to sewerage, rainwater and spatial development. Together with the Province of Overijssel, water authority Vechtstromen and drinking water company Vitens, these municipalities form a partnership for rainwater and wastewater: Twents Waternet (Home - Twents waternet).

Knowledge institutions such as the University of Twente and Saxion University of Applied Sciences also contribute to innovation and knowledge development through various projects and initiatives. To strengthen this collaboration, a Water Resilience Initiative was launched in November 2025. With this initiative, the Province of Overijssel, Vechtstromen, the municipality of Enschede, KIN and the UT Climate Centre have committed themselves to strengthening their programmatic collaboration.

4. Current situation, possible solutions and bottlenecks

Due to the significant interdependencies within the water system, decision-makers are increasingly aware that no single party can solve the water problem on its own. Despite parties seeking each other out, the current situation is characterised by fragmentation of responsibilities and risk-averse behaviour. Decision-making is slow, partly due to the tendency to seek complete certainty before taking action. In addition, unlike flooding, drought often does not seem acute, which dampens administrative and social urgency. While national policy and frameworks are slow in coming, water demand that exceeds local water supply at certain times of the year puts pressure on other policy programmes in the region, such as the urbanisation strategy, housing ambitions and the associated economic ambitions.

The interviews reveal a wide range of possible solutions, ranging from small-scale, short-term measures to long-term system adjustments. Technical solutions such as the construction of transport pipelines from west Overijssel, expansion of pumping capacity for the Twente Canal and reuse of effluent water are mentioned as necessary steps to alleviate acute bottlenecks. Water conservation through building regulations and awareness campaigns are also an important avenue, although the low price of drinking water does not provide an incentive to make a difference. 'True pricing' of water could offer a solution, although this also raises new ethical issues surrounding the availability of drinking water for low-income groups.

At the same time, the interviews revealed that experts agree that the current water system has reached its limits. Isolated measures are not enough. Many experts see the need to move from treating the symptoms to a fundamental redesign of the landscape and water system that not only drains water during the peak discharges but also retains water for drier periods. Structural solutions mentioned include raising groundwater levels, creating space for water in stream valleys and widely applying measures to increase the sponge effect of the soil.

In the long term, these measures require a shift in the paradigm from 'controlling' to 'moving with' water. The idea behind water and soil management policy is widely shared, but it faces practical and administrative objections and is therefore not yet part of everyday practice. Although there is consensus on short-term solutions, discussions about the long-term direction of the region, and therefore what is and is not possible (function follows level), are more difficult to conduct. These discussions are important because the short term (capacity expansion) can be at odds with the long-term transition (structural redesign of the water system aimed at retaining water).
Small-scale solutions are already being tested extensively and often successfully, but this rarely leads to wider implementation. For example, there have already been several pilot projects using grey water for industrial or sanitary applications. Investment costs, strict legislation (especially when used in the food industry) and limited financing options are major barriers to this. A recurring theme here is that there is no business case for water and fewer subsidies are available for it (compared to other areas such as energy).

The interviews revealed the following overarching transition question: *How can the water transition in Twente be designed in such a way that – given increasing drought, historical choices and other*

societal transitions – a resilient and equitable water system is created? From the interviews, we distilled seven themes that determine the pace and direction of this transition. The themes are not ranked in order of priority, but each forms an important part of the transition to a resilient water system.

The first theme we will elaborate on is (1) urgency and perception, or people's perception of the current situation. We will then discuss three themes related to governance: (2) roles and responsibilities, (3) vision, cooperation and guidance, and (4) policy instruments. The last three themes have a substantive focus and concern, respectively, (5) balancing a local approach with systemic interventions, (6) interactions with other transitions, and (7) the relationship with spatial planning.

We have formulated transition questions for each of the themes. These transition questions link to knowledge gaps that need to be addressed in order to stimulate the transition to a resilient Twente water system. Rather than improving and optimising what we already do, the transition questions explicitly address how we need to fundamentally change the way we organise, manage and act in order to achieve the desired future water system. In doing so, we recognise the complexity, uncertainty and political decision-making inherent in such systemic changes.

1. Urgency and perception of drought issues

The interviews reveal a clear picture of water scarcity as an urgent problem. The interviewees find it problematic that the sense of urgency surrounding drought and water shortages in Twente fluctuates greatly and is closely linked to current weather conditions. During dry periods, there is visible attention to tackling drought, but as soon as it rains, attention shifts to other issues such as flooding. This cyclical awareness hinders structural behavioural change and stands in the way of long-term measures. Outside the region, the urgency is even less, which means that drought in Twente is not given high national priority.

According to those interviewed, what does not help is that citizens and businesses have little incentive to save water: "the water will come out of the tap anyway". The low price of drinking water and the lack of more coercive instruments such as standards for drought are concrete examples of this. Companies such as Grolsch are trying to raise awareness, but are hampered by legislation and regulations on, for example, the reuse of effluent water and a culture of ignorance or low priority regarding water conservation. Stress tests can play a role in increasing knowledge about drought. At the same time, there is a risk in strongly quantifying drought: this can lead to a sense of technical feasibility, which underestimates system complexity.

Moreover, the perception of drought is not always in line with actual hydrological conditions. In 2022, for example, skippers thought they would not be able to navigate the Twente Canal, even though this was possible. Such misperceptions influence behaviour, policy choices and the legitimacy of measures. The interviews therefore emphasise that structural system change is only possible when awareness increases broadly and over a longer time horizon, among citizens, businesses and administrative actors. What is striking here is the emphasis on water scarcity, while, as the water balance shows, a lot of rainwater is drained away. This is partly unavoidable due to the variation in precipitation throughout the year. However, insufficient use is still being made of the opportunities to utilise and retain water in the region.

Transition questions:

- How is water viewed and valued by the various actors? To what extent does this valuation depend on place and time? How does water demand relate to the social value of water in Twente?
- How must perceptions and valuation of water change in order to enable a resilient and equitable water system? Which perceptions must be abandoned?
- Which influential actors do not yet see drought as urgent, and how can the sense of urgency be increased? To what extent does a sense of urgency play a role in achieving a resilient water system?

- How do differences between perceptions and hydrological reality influence the possibilities for collective steering towards sustainable water use in Twente?
- What image do actors have of uncertainties? How do they deal with uncertainties and what are the implications for the transition?

2. Roles and responsibilities

Although waterways, groundwater and surface water, and piping systems together form a single physical water system, administrative responsibilities and powers are highly fragmented. Parties feel that roles and responsibilities within the Twente water system are diffuse and insufficiently coordinated. The organisation of water management is characterised by compartmentalised powers and responsibilities. In addition, as with other social issues, the relatively short time frame of administrators plays a role.

The national government develops national frameworks and standards but does so slowly and offers little guidance for a regional approach to drought. The Province plays a crucial role in spatial planning and groundwater monitoring. According to interviewees, it has so far acted mainly reactively in this regard. Water authorities, which are formally responsible for the regional water system, feel that their scope for action is limited by political pressure, limited resources and the lack of clear strategic and spatial frameworks from central government and the province. Municipalities are responsible for water management in the built environment, but their options are partly determined by choices made at higher levels of government.

In the opinion of those interviewed, a clearly defined structure of responsibilities and powers is lacking. Interviewees gave different answers to the question of which actor should take the lead in addressing drought in Twente. Some mentioned the Province, others the water authority or the region of Twente. This demonstrates that there is still no shared view on this issue. Policy challenges such as drought, water quality and flooding are intertwined but organisationally separate. There is a great deal of cooperation on interventions and programmes, which is also a requirement under the Environment Act and the Water Framework Directive (WFD). However, parties lack an even more strategic approach to drought at the system level. Actors also continue to operate from their own institutional logic. This is experienced within the water chain, but also in all areas affected by water scarcity (e.g. housing, agriculture, industry). According to the interviewees, cooperation often depends on individuals and informal networks (such as De Twentse Golf) and is not yet sufficiently embedded in formal governance structures. The result is an administrative vacuum in which joint decision-making and willingness to invest are under pressure.

Transition questions:
- To what extent does the current governance system support or hinder the transition to a resilient water system?
- How can actors work together to shape the governance of a resilient water system (and the transition to it)? What are the key considerations when shaping this governance?
- What redistribution of roles and responsibilities is needed to enable system change in the Twente water system? What tensions does this entail, both in the process and in the outcome (e.g. learning approach versus reliability, innovative collaboration versus administrative responsibilities)?
- What factors determine administrative legitimacy and support for a fundamental redesign of the Twente water system, and how do these develop over time?
- How are the interests of different actors, including those with limited influence, represented and (re)weighted in decision-making around the water transition?
- What new roles and responsibilities are necessary for a resilient water system? Which existing roles will come under pressure as a result? What distributional effects (winners and losers) will this create?

3. Vision, cooperation and guidance

Although there is broad consensus on the need for water and soil management policies, interviewees say that implementation is lagging. Reasons cited include fragmentation, administrative reluctance, and a lack of a clear direction for change. Instead of a shared vision for 2050 or 2100, the emphasis is on achieving WFD targets for 2027. This encourages a short-term approach and a tick-box mentality, in which structural choices about future water availability, spatial planning and climate adaptation are insufficiently addressed. Various bodies are working implicitly or explicitly on the ingredients for a vision, such as the Freshwater Supply Programme for the Eastern Netherlands, the Regional Administrative Consultation Rijn-Oost (RBO), the Overijssel Water Approach, the Regional Water Programme, and the Regional Sponge Strategy. However, there is a lack of coherence and agreement. What does not help in this regard is the absence of an articulated, overarching vision of where the region should be heading in the long term. Many regional parties see the water authority as the ideal party to take a leading role in the water transition. The water authority indicates that it needs a clear landscape vision from the Province. The Province puts the ball in the court of lower authorities.

The above demonstrates that an actor with a clear mandate, support and time horizon to steer the system change are lacking. Water authorities are often seen as the logical driving force because of their responsibility for the water system and their implementation power. However, water authorities are not responsible for the domain in which a key role is reserved: spatial planning. The Province has an important role to play in this but has not yet succeeded in creating a broadly shared long-term vision. The national government is necessary for guiding frameworks, legislation and financial scope, but in the eyes of regional parties it operates cautiously and slowly. Given that freshwater problems vary greatly from region to region, it is not obvious that the national government will focus strongly on local issues and solutions.

Current initiatives and cooperation are therefore dependent on individuals: committed administrators, motivated civil servants and leaders from the business community. This dependency makes the transition vulnerable and difficult to scale up. Companies such as Grolsch and organisations such as Natuur en Milieu Overijssel sometimes take a leading role in networks such as De Twentse Golf, but lack structural support and resources . The collective need for a shared goal on the horizon is recognisable, but fails to get off the ground due to a lack of administrative mandate and political consistency.

Transition questions:

- Which actors play a key role in steering the water transition in Twente at different times and levels? Who determines when which tensions and interests are given priority? And how do these roles shift over time?
- What structural differences exist between the current Twente water system and a proposed resilient water system? And what changes are necessary to achieve this? What conflicts and considerations play a role in this?
- How can actors work together to develop a shared and guiding long-term vision for the water system? And how can they ensure that this vision is fair, widely supported and sustainable?
- What images do actors have of a resilient water system? To what extent do these images conflict? What needs to change in terms of perceptions, structures and practices in order to arrive at a shared vision?
- What dependencies (physical, institutional) characterise a resilient water system and what are the implications for governance?

4. Policy instruments (communication, economic, legal)

Current policy instruments are insufficiently focused on 'smart' water management. They mainly focus on flooding. For example, there are no standards for water shortages. As a result, drought mitigation remains dependent on voluntary initiatives and ad hoc measures. National frameworks for water conservation, circular water use or the promotion of efficient water use in agriculture,

industry and households are largely lacking. Mandatory instruments such as land exchange and the Water Act are rarely used due to a lack of administrative support.

Economic instruments reinforce this imbalance: the low price of water offers no incentive to save, subsidies for water innovations are limited and fragmented, and 'true pricing' is not applied, which means that the social costs of water use are not taken into account. In times of abundant water, it is drained as quickly as possible to prevent damage. In times of low water levels, investments are made in pumping capacity or damage is inflicted. The cost price of water is low regardless of the circumstances. This hinders investments in circular water chains, soil improvement and extensification. Legal barriers, such as ownership issues in collective water storage and strict rules on the reuse of purified water, slow down area-specific initiatives. Without a targeted package of legal, economic and communication tools, the transition will remain dependent on individual projects.

Transition questions:
- Which elements of existing policy and legislation hinder or limit the transition to a resilient water system in Twente? Through which mechanisms do they do so?
- Which policy instruments are decisive for the actual realisation of the Twente water transition? Where do bottlenecks arise between transition ambitions and implementation practice?
- Under what conditions and through what paths of change can legislation and regulations evolve from stabilising to facilitating a resilient water system?
- How can time- and place-specific values of water guide the management of the Twente water system in a transition to resilience? And how can these values be institutionally embedded?

5. Local approach and system dependencies

The drought challenge requires an area-specific approach in which problems relating to drought and flooding, and sectors such as housing, agriculture and industry are considered in conjunction with each other. Local measures such as infiltration, wadis and small-scale storage increase resilience, but are insufficient to solve structural drought or water shortages. It is crucial that local spatial choices are aligned with the hydrological capacity of the regional system. In concrete terms, this may mean that high-grade agriculture, a new neighbourhood or a new business with high water demand are not permitted in certain areas or are only permitted under certain conditions.

Without coordination between local and regional spatial choices, new lock-ins will arise on top of existing ones: housing construction in vulnerable areas, agricultural structures or industries that require large amounts of water, or infrastructure that limits future flexibility. Spatial choices should therefore be assessed in terms of how well they fit within a future-proof water system.

In addition, there are tensions between regional choices and national water distribution. Regional water storage or agricultural transitions can have consequences for other areas and therefore require supra-regional coordination. Current policy offers little guidance for adaptive strategies and area-specific standards, making it difficult to implement integrated choices.

Cross-border system dependencies also play a role in Twente. A large part of the Vecht river basin is located in Germany. In addition to agreements on national water distribution, the amount of water in the Twente Canal ultimately depends on water supply from Germany. Water is currently still imported from Germany for production purposes. This may no longer be possible in the future, as Germany is also facing water shortages.

Transition questions:
- Given system dependencies, what decisions need to be taken at what level? Which decisions in Twente have an impact on other regions and vice versa? What are the key considerations for solidarity and fairness?
- How is the water transition intertwined with hydrological and administrative developments in surrounding areas, and what vulnerabilities and dependencies does this entail for the region?

- How can area-specific initiatives be structurally linked to regional and supra-regional goals for the water system without undermining local capacity for action?
- How can lessons learned from local initiatives be translated, adapted and scaled up to other areas, within and outside the region, without losing their area-specific effectiveness?
- Which mechanisms in local drought measures in Twente could lead to long-term lock-ins? And how can adaptation pathways be designed in such a way that future options remain open?
- How can a balance be found in the water transition between adaptive space for area-specific drought approaches and the institutional safeguards needed for system change?

6. Interactions with other transitions

The drought challenge touches on several societal transitions that run parallel and influence each other. Technological solutions such as effluent reuse, infiltration measures and sponge landscapes can only be effective when linked to changes in spatial planning, agricultural practices, economic structures and governance.

Conversely, drought poses a direct constraint on the energy transition, for example when low water levels hinder the *modal shift* to freight transport by water. The agricultural transition is accelerated by drought: water availability requires different crops, soil improvement and alternative revenue models such as carbon capture. In spatial planning, the combination of housing construction challenges and limited water availability conflicts with the need for water and soil-inclusive planning. The circular economy offers opportunities for the reuse of water flows, but legal restrictions and food safety standards are currently hindering upscaling. The potential cultivation of crops for circular building materials is also under pressure due to water scarcity.

The governance transition under the Environment Act – working as 'one government' – runs parallel to all these changes and is a prerequisite for making integrated choices. Finally, climate adaptation requires that drought, flooding and heat stress be tackled jointly, with adaptation pathways that are also sustainable in 2050 and 2100.

Transition questions:

- What mutual dependencies and feedback loops exist between the water system and other natural and physical systems (such as soil, nature and the built environment) in Twente? What significance do these have for the water transition?
- Under what conditions can the water transition in Twente contribute to strengthening other urgent transitions such as agriculture, circularity, biodiversity loss, energy and urbanisation? And where do tensions or conflicts arise between these challenges?
- How is the water transition intertwined with transitions in other sectors, both within and outside the region? What vulnerabilities and dependencies does this entail for the water transition? And how can integrity be guaranteed?
- How can coordination between the water transition and other transitions be achieved, both practically and administratively? How can actors deal with side effects, mutual dependencies and tensions?

7. Spatial planning

Drought is also a spatial planning issue. Historical landscape choices such as land reclamation, desiccation through drainage and the design of rapid drainage systems have led to a landscape that loses water quickly and is therefore susceptible to drought. At the same time, social challenges such as housing, agriculture, industry and nature are confronted with the physical limits of water availability.

Without a spatial vision in which water and soil are guiding principles, measures will remain fragmented and reactive. Standards currently focus primarily on flooding; drought standards are already being considered. Governance frameworks for dealing with water shortages are virtually

non-existent. As a result, activities such as intensive ,drinking drinking water extraction or housing construction in areas with low hydrological capacity remain dominant.

In the opinion of many interviewees, a transition to a resilient system (water, soil and landscape) requires fundamental choices: space for water in low-lying areas and stream valleys, concentration of buildings on higher sandy soils, flexible water levels instead of rigid summer and winter levels, and acceptance of periodic flooding in certain places. Practical measures such as building without basements, integrating green-blue structures and using moraines as water buffers support this transition, but spatial planning will also have to be fundamentally reconsidered. Achieving this spatial transformation requires national and provincial long-term visions that guide the choices being made now, but will mainly have an effect by 2050 or even 2100.

Transition questions:

- How do spatial planning and the water system in Twente influence each other? And what implications does this have for the water transition in a context of increasing drought?
- What role does water availability currently play in decision-making for spatial development in Twente? And how can it guide long-term choices under drought-sensitive conditions?
- What redistribution or reformulation of roles and responsibilities between administrative bodies is needed to ensure that water availability is structurally taken into account in spatial planning in Twente?
- How do hydrological system characteristics relate to various social and economic functions in Twente? And what considerations and choices are needed to connect these in the water transition?

5. Conclusions

The interviews paint a picture of water scarcity as an urgent and complex issue in Twente. To tackle the most pressing bottlenecks, significant investments are being made in solutions. At the same time, interviewees acknowledge that these measures may stand in the way of fundamental systemic change. According to some, the region runs the risk of continuing to invest in a 'sick' system with high social costs in the long term. There is still too little discussion about the long term, probably because this is when lock-ins and conflicting interests come to the fore. How we think and talk about water plays a role. What if we stopped thinking in terms of water scarcity and fundamentally reconsider our view of and approach to water?

The European Water Resilience Strategy takes the first steps in this direction. It calls for attention to be paid to restoring and protecting the water cycle, to smarter water management and to green infrastructure for water retention. In the literature, this is also referred to as regenerative water management: a holistic approach aimed at restoring and improving the water cycle and ecosystems. We are seeing all kinds of efforts in this direction, both from individual organisations and from organisations as a collective. For example, Grolsch wants to purify its own water and thus contribute to a circular water cycle, but is encountering obstructive regulations.

Various (semi-)public parties are considering the long term (until 2100), but there is still a lack of shared vision and guidance. Regional transition agendas are also often insufficiently coordinated, raising the question of whether the approach to housing construction is compatible with a future-proof water system. Studies such as Twente op aterbasis' (Twente on a water basis), in which a robust water system forms the basis for integrated area development, and initiatives such as the Regional Sponge Strategy attempt to provide an answer to this question.

From a transition perspective, we see that there is plenty of experimentation and knowledge development taking place. However, there is a lack of a shared vision and direction. This analysis and the resulting research programme aim to contribute to this by approaching the challenge from a transition perspective. Central to this is recognising the need for fundamental change. It requires a different, smarter and more resilient approach to water – in dry and wet times. This also requires

dismanteling existing culture, patterns and structures; not all interests can be served at all times and in all places. Such a transition is urgently needed to address not only today's bottlenecks but also tomorrow's challenges. Transitions are fraught by complexity, uncertainty and disagreement. In such situations, it can be helpful to explore conflicts and tensions in experiments. Learning from these can help to create a new water system. This analysis and agenda lay the foundation for transition-oriented cooperation in Twente. For achieving a more resilient and equitable water system in Twente and the rest of the Netherlands.