

Transformative innovation for better Climate Change Adaptation – Case study: Northern Netherlands

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Abstract

The aim of this report is to investigate the potential for harnessing key features of Transformative Innovation to improve the design and the implementation of Climate Change Adaptation (CCA) strategies, based on empirical analyses. The study draws on the conceptual framework on this question previously defined for the JRC (European Commission, 2024), and the methodology for case studies, also articulated in the same report. The case study research covered several territories from across the EU and beyond, representing a diversity of approaches to CCA and transformative innovation¹.

The framework takes the form of an analytical grid, structured into seven sections, each of them representing a key feature of the ‘transformative innovation’ approach – features understood as essential conditions for the design and implementation of CCA strategies with this high level of ambition. Each section sets out the main question(s) to be addressed in relation to its respective transformative innovation feature.

This Report provides the findings for Northern Netherlands, as at October 2023, and is the result of a collaboration between the Joint Research Centre (JRC), DG CLIMA and DG RTD.

¹ A full list of the case studies is provided in Annex 3

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Executive summary

Policy context

Adapting to climate change has become an increasingly urgent priority for the European Union (EU). Given this urgency, and the systemic nature of climate resilience, new ways to accelerate adaptation are considered. Transformative innovation (TI) is the focus of this report, particularly how it can help support and accelerate adaptation to climate change. This report draws lessons for North Netherlands on how a TI approach is already helping the territory in increasing climate resilience, and what can be done in addition, to further accelerate adaptation. The analysis is based on a theoretical framework along seven dimensions designed to compare TI and Climate Change Adaptation. It is one out of a series of 14 case studies covering several territories from across the EU and associated countries.

Key conclusions

Starting from the water challenge that has prevailed throughout Dutch history, the Netherlands is progressively incorporating a more systemic view across a range of transformations needed for effective climate change adaptation (CCA). Beyond the water challenges, a wider range of climate change risks is now integrated in scenarios for deep transformation of the society. The greatest advances have been in relation to water. The broadening of the CCA across all relevant sectors under the NAS is still incomplete, although concerted partnership work on all of the NAS focus areas is gaining momentum. National guidelines lead developments at regional and local level, tailored to specific territorial needs, built through genuine consensus between stakeholders and strengthened by and learning from experiments in the field. Few tensions, if any, are evident in this multi-level governance perspective. It is a blend of visionary capacity and pragmatism, which works, despite the complexity to the external observer of different configurations involving Provinces, Municipalities, Working Regions and Water Districts, together with national authorities. The Northern Netherlands 'regional' level has little role, as the main CCA actors below the national Government are the Provinces, Municipalities and Water Boards.

The 'traditional' water focus of Dutch national CCA policy has itself become transformative. Under the Delta Programme, the 'Water and Soil Leading' principle guides this seismic shift away from fighting against nature towards working together with nature. The fear of water scarcity now adds to the trauma of flooding. The old imperative of mastering and restricting river flows has given way to the new 'room for the river' approach. The Netherlands' transformational CCA agenda is strengthening, thanks to closer coordination between the Delta Programme and the National Climate Adaptation Strategy (NAS) and complementary support from the Mission-Driven Top Sectors and Innovation Policy. The new NAS starting in 2024 represents an important opportunity to deepen and accelerate the deployment of frontrunner and transformative CCA strategy in the Netherlands. The main conclusions arising from the seven transformative innovation (TI) features are summarized below, and some recommendations are also spelled out in the report.

1/ Directionality

At national level, the Delta Programme, in force since 2010 with substantial dedicated domestic budgetary resources, with its main focus on water, soil and spatial planning, is more advanced than the National Adaptation Strategy (NAS), which deals with a wide range of other sectors and value chains not directly covered by the Delta Programme. Oversight of the two strategies by the same Ministry supports coherence of goals. Both demonstrate directionalities increasingly in favour of

societal transformation. The main innovation strategies relevant to the territory – the national Mission-Driven Top Sector and Innovation Policy, and the 2021-2027 Smart Specialisation Strategy (S3) for Northern Netherlands – are tightly interlinked and display strong directionality with regard to societal challenges. Neither, however, features CCA as a mission in its own right. CCA is instead suffused throughout their mission-driven priorities. Governance arrangements for both CCA and innovation strategies have a strong cross sectoral and multi-dimensional flavour, supporting interaction between them.

2/ Articulating instrument portfolios

There is generous domestic public financing available for CCA in the Netherlands. Spatial planning offers the most comprehensive framework of instruments for CCA relevant investment. R&I relevant for CCA can be supported through the Mission-Driven Top Sectors and Innovation Policy. EU Cohesion Policy supports CCA-relevant R&I through the territory's S3 and Interreg programmes. The ERDF does not co-finance mainstream CCA investment in the region – this is addressed almost exclusively by domestic funds. Local authorities and universities are active participants in CCA related projects under EU-level programmes.

3/ Ensuring cross domain synergies

Cross-domain synergies for CCA in Northern Netherlands, as for the country as a whole, are actively pursued through the NAS and the different inter-institutional governance structures in place for its six priority objectives. The assessment of the territory's efforts so far to maximise cross domain synergies for CCA is strongly positive. However, there remains a view that more could be done in dimensions less focused on economic interests and more in relation to climate change effects on people, culture and nature.

4/ Increasing stakeholder involvement

Northern Netherlands presents an exemplar case of stakeholder involvement in CCA activity. It has a strong tradition of local cooperation based on the 'polder model', with its roots in the struggle against water. As in the Netherlands generally, a multiplicity of structures and actions to involve broad populations of stakeholders, characterise decision making on CCA strategy and its implementation in the territory. In the R&I field, the increasingly continuous Entrepreneurial Discovery Process (EDP) of the S3 builds on the same tradition and is particularly well developed. For CCA, NGOs in the 'nature' sector make a strong contribution to the dialogues in different areas.

5/ Setting up effective multi-level governance models

There is good articulation between the NAS and Delta Programme and regional/local strategies in terms of strategic principles. Comprehensive national level guidance covering different aspects of CCA supports implementation of the Delta Programme at the local level. This includes an obligation for local 'stress tests' for heat, flooding and drought to be carried out every six years in both urban and rural areas. Strong mechanisms are in place for multi-level dialogue on CCA strategy preparation and implementation, which involve all relevant government bodies and encourage collaboration with other stakeholders.

6/ Making room for experimentation

There is considerable experimentation on CCA solutions underway in the region. The challenge now will be mainstreaming of such approaches given the deep implications this is likely to have for land use and spatial planning.

7/ Policy intelligence, learning and strategic capacity

Awareness of climate risks and CCA is high across a wide range of public and non-governmental bodies in the Netherlands as a whole. The region boasts particularly good connections between research and practice in the field of CCA. Monitoring the implementation of CCA measures at different geographical levels is thorough.

1 Introduction

This report has been prepared at the request of the European Commission's Joint Research Centre (JRC), Innovation Policies and Economic Impact Unit, in collaboration with DG CLIMA. The aim of this report is to investigate the potential for harnessing key features of Transformative Innovation to improve the design and the implementation of Climate Change Adaptation (CCA) strategies, based on empirical analyses of territorial cases across Europe. The study draws on the conceptual framework on this question previously defined in another JRC report (European Commission, 2024). The case study research covered several territories from across the EU and beyond, representing a diversity of approaches to CCA and transformative innovation². The methodology for the case studies relies on the following main sources:

- Qualitative interviews carried out with key actors in the two main policy fields: R&I and climate/environment.
- Other policy fields chosen for their particular relevance for each territory: e.g. regional development, spatial planning, energy, water, agriculture, forestry, food, fisheries, health, etc.
- Interviewees included decision-makers, officials in implementing bodies, researchers, NGOs and experts active in the field.
- Documentary and website analyses on strategies, policies and projects. A first round was carried out prior to the interviews on publicly available material, followed by a second round, with documents (public or grey) obtained from interviewees.

This Report provides the findings for Northern Netherlands, as at October 2023.

² A full list of the case studies is provided in Annex 3

2 Presentation of the case study territory

2.1 Profile of the territory

Northern Netherlands – the territory of this case study – comprises the Provinces of Drenthe, Groningen and Friesland – three out of the Netherlands 12 Provinces. It is not an official administrative region, but rather an alliance of Provinces founded in 1992 and used for the definition and implementation of EU Cohesion Policy Programmes since 2000. The Provinces themselves and the municipalities are the institutional levels of authority in the Netherlands. In addition, under the country’s Water Management policy, the territory is divided into 45 functional ‘working regions’, which cross over municipalities and Provinces.

Figure 1: Northern Netherlands – the Provinces of Groningen, Friesland and Drenthe (circled in red) in broader Netherlands context



Source: Wikipedia.org

Northern Netherlands hosts a population of 1.7 million - 10% of the Netherlands’ total, within 27% of its land area. The main cities in the region are Groningen (238.000 inhabitants) and Leeuwarden (123.000 inhabitants). The region has a rural character, as distinct from the urbanised core of the Netherlands, the ‘Randstad’ – with the four major cities of Rotterdam, Den Haag, Utrecht and Amsterdam - located further south. Friesland in particular has its own distinct culture and official

language. It also features the unique UNESCO world heritage area of the islands of the Wadden sea, the largest tidal flat ecosystem in the world, which extends to Germany and Denmark. The Netherlands is the second-most densely populated country in the EU³ and there is huge pressure generally on land use, given the challenging spatial demands of housing, agriculture, industry, communications, infrastructure and nature. Although Northern Netherlands is less densely populated than the national average, it still suffers the same pressures, with agriculture exerting high demands on land use.

The three provinces of Northern Netherlands are ‘Innovation Leaders’, according to the European Regional Innovation Scoreboard 2023⁴, with Groningen standing out as an ‘Innovation Leader+’. Northern Netherlands is home to one scientific university, Groningen, three universities of applied sciences, Hanze, NHL-Stenden and Van Hall-Larenstein, as well as several other research institutes. The territory has a strong knowledge infrastructure⁵ in the fields of: agrifood, energy transition, data science/artificial intelligence, health, circular economy and water technology. With its specialist research institute Wetsus and related ecosystem for knowledge diffusion and adjoining WaterCampus, Leeuwarden prides itself on being the European capital of Water Technology.

Table 1. Northern Netherlands - Key characteristics

Area	11.389km ² - 27% of Dutch territory.
Population	1.729.505 inhabitants (1 January 2020) – 10% of Dutch population. Decrease of 6% forecasted over 2030-2050 (at national level: increase of 11.5%). Population density of 209 inhabitants/km ² (EU average 106), still less than half the national level (517).
Economy	GDP per capita €37.200 (national figure €48.800) in 2021 (Eurostat). Provinces of Friesland and Drenthe have the lowest GDP/capita of the Netherlands (national value €48.800), yet still higher than the EU average (€32.400). Share of employment in primary sectors (agriculture and mining/gas extraction), at between 2.9% and 4.1% significantly higher than the national average (2.2%).
Geography	Rural character in a densely populated and urbanised country. Degree of urbanisation lower than EU average of 75.8% - Drenthe (68.5%) and Friesland (48.4%), or similar - Groningen (77.4%) - but much lower than national average (90.4%). Territory includes islands of the UNESCO World Heritage Site of the Wadden Sea.
Green transition	Gas extraction in Province of Groningen - a historically major contributor to the economy of the territory - is now in strong decline. Groningen is working towards becoming the first green ‘Hydrogen Valley’ in Europe, whilst Leeuwarden strengthens its position as a major European centre for Water Technology. Both cities work actively on wide-ranging low carbon and circular economy initiatives.
Main climate change features	More extreme precipitation and sea level rise resulting in flooding and coastal erosion, with possibly devastating impacts in a region with areas lying below sea level. More frequent, longer and intense droughts impacting on soil health, agriculture, drinking water availability and water quality. High CO ₂ emissions from peat oxidation, coupled with soil subsidence in many areas. Rising temperatures impacting on health, infrastructure and socio-economic activities. Combined climate change effects leading to salinisation of ground water and shortages of drinking water.

³ after Malta

⁴ European Commission (2023a)

⁵ SNN (2020)

The territory faces exceptional challenges in relation to energy transition. Groningen is traditionally one of Europe's largest natural gas producing regions and houses many industries highly dependent on fossil fuels. Yet in 2019, the Netherlands Ministry of Economic Affairs and Climate Policy took the bold decision on environmental grounds, to shut down production from the Groningen gas field completely by 2026. The area is now acknowledged by the EU Clean Hydrogen Partnership as the first green 'Hydrogen Valley' in Europe, with Groningen itself planning to be CO₂ neutral in 2035 and a 100% zero-waste city by 2030. Mobility of the future is tested in Groningen, with the building of the European Hyperloop Centre⁶, a test facility and knowledge centre in hyperloop technologies: a public-private partnership consisting of more than 20 private partners, with financial backing from the European Commission, the Dutch Government, and the Province of Groningen among others.

Box 1. The floods of 1953 and the creation of the world-famous Dutch expertise in water management



Photo source: www.rijkswaterstaat.nl

The history of Dutch expertise in water management starts with the catastrophic floods occurring in 1953. During the night of January 31st 1953 a huge storm had been formed over the North Sea and prevented the low tide to occur during the night. Only few people were informed about the storm and nobody realised the intensity of the danger. The storm raged on, with exceptional force 10 and 11 winds (Beaufort Scale) and huge waves crashed against the coastal lines and the dykes. In the middle of the night, the first dykes, which were not well maintained, started to break in the region of Zeeland, in the South-Western part of the country. Other areas, in Noord-Brabant and Zuid-Holland, started to be flooded as well. Walls of water came into land, taking the population by surprise in their sleep, many not managing to rush to higher places in their homes or villages. Dykes continued to break, houses were washed away and entire villages destroyed.

Villages, cities, farmlands and polders ended up covered by raging water in a record time. As the warning systems and rescue services were slow to react and ineffective, and the water rose again even higher on the second night, people were barely rescued or evacuated in time and many drowned.

The 1953 disastrous floodings broke kilometres of sea dykes, claimed the lives of 1,836 people, caused the loss of thousands of cattle, the destruction of 43,000 houses and 150,000 hectares of farmland were ruined by the salt water. Damages are estimated worth the equivalent of €5.4 billion¹. The whole event leaves a deep imprint in Dutch minds, determined since then to 'fight against the water'.

This tragedy was the starting point for a vast national investment programme in flood protection, which is an essential goal in a country with so much land under sea level and at risk of flooding. The Delta Programme launched later, in 2020, aimed to better protect the population and land against flooding and improve the dyke and water management system with surge barriers, sluices and pumping stations networks based on world-class technologies largely developed in the country.

Source: <https://www.zeeuwsarchief.nl/en/zeeland-stories/de-ramp-van-1953/>



Established water management infrastructure, Friesland, Northern Netherlands
Source: <https://www.fryslan.fr/fryslan-klimatebestendig-2050>

2.1.1 Main climate change risks and vulnerabilities

The main climate change risks for the Netherlands as a whole were updated in October 2023 in a new publication by the Royal Netherlands Meteorological Institute (Box 2).

Based on latest scenarios from the Intergovernmental Panel on Climate Change (IPCC) in 2021, and Royal Netherlands Meteorological Institute [KNMI], 2023), the main risks are: acceleration of sea level rise; more precipitation in winter and increase in extreme precipitations in summer; increase in average temperature and heat waves, with more ‘tropical’ days and less freezing days; and more frequent and more intense drought periods.

“Wet is getting wetter, dry is getting drier, hot is getting hotter, extreme is getting extremer. The low-lying Netherlands is vulnerable to climate change.” (1)

“In the low-emissions scenario, the sea level will rise already strongly in 2100 (26-73 cm); in the high-emissions scenario even more (59-124 cm)” (2)

Sources: (Ministry of Infrastructure and Water Management et al. 2023) (1); (KNMI, 2023) (2).

Box 2. New climate scenarios for the Netherlands from the Dutch Royal Meteorological Institute - October 2023

Temperature - Around 2050 and 2100, warming will be greatest in summer and smallest in winter. More summer days and tropical nights and less icy and frosty days are expected. Heat waves will become more common and even hotter. Cities will be the most affected by the warming trend.

Precipitation - In a warmer climate, it will rain more in winter and extreme showers will be more common in summer. Winters will become even wetter and summers drier. If it rains in summer, it will rain harder.

Droughts - In summer it will rain less overall, allowing more moisture to evaporate from the soil. This will cause more frequent periods of prolonged drought.

Solar radiation - As the air in the Netherlands will become cleaner and there will be fewer and fewer clouds. This means there will be more sun, contributing to further warming.

Wind and storm - The probability of a storm surge (caused by storm high water) remains unchanged. Yet because sea levels are generally rising, higher values for storm surges will need to be taken into account.

Visibility and fog - Climate change has no effect on fog. But because the air is becoming cleaner, there will be less probability of fog.

Sea level rise - In the last 100 years, the world average sea level rose increasingly faster. This will continue in the coming century, because the ice caps at the North Pole and the South Pole will melt further. Total sea level rise, will ultimately depend on how much CO₂ we continue to emit and how much ice remains to melt at the South Pole, where it most of the ice is located.

Source: (KNMI, 2023), own translation

The risks applying specifically to the territory of the Northern Netherlands vary according to the soil composition and location of different areas concerned (coastal or inland zones, soil of sandy, clay or peat-based composition, presence of a major river etc.). These mainly include:

- Drought and water shortages in sandy areas. Water shortages are a particular threat for the Wadden islands, which have limited water retention capacity, no incoming rivers from higher regions and which already have to import fresh water from the mainland.
- Soil subsidence and high CO₂ emissions in peat areas due to oxidation, caused by drying, leading to damage to infrastructure and housing, with remediation costs estimated around €2bn up to 2050⁷.
- Salinisation of groundwater due to sea level rise in coastal areas, which affects some 14% of the Dutch territory⁸. The combination of salinisation with periods of drought and reduced river flows, in addition to soil subsidence, will make it increasingly difficult to fight against saltwater infiltration into groundwater through the current method of using fresh water to push saltwater further underground.
- Risks of flooding and erosion of coastal areas and islands. Sea level rise puts pressure on the polders system, which relies on continuous draining and pumping of water.

⁷ Ministry of Infrastructure and Water Management (2022b)

⁸ Id.

- Loss of biodiversity in areas where natural habitats are affected by rise of temperature and changing precipitation patterns (e.g. higher mortality of shellfish affecting bird population on the Wadden sea).

"If all climate adaptation plans were given the space they necessitate, we would need 1.8x Friesland. That space is simply not available."

Source: (Province Friesland and Water Management Company Friesland, 2023).

These climate risks occur in a territory where space is already limited, compared to most regions in Europe, due to the density of population. There is great competition for land use in Northern Netherlands, within which Climate Change Adaptation (CCA) must find its place.

2.1.2 State-of-play of CCA and innovation strategies

CCA at national level is covered by two strategies:

1. **The Delta Programme**⁹ has a long history, with its roots dating back from the disastrous floods in 1953. Soon after this event, the Delta Commission was established to improve the Netherlands' system of flood defences by means of a vast programme of construction and land management, the so-called Delta Works. Still today, the continuous monitoring, maintenance and upgrading of existing flood protection, as well as the management of freshwater supply, is managed through the Delta Programme. This coordinated action by the central government, together with provincial and municipal authorities, is overseen by a special government appointee, the Delta Commissioner. The programme concentrates on three key issues: water safety (flood risk management), availability of fresh water, and spatial adaptation. Each of these issues is subject to a sub-programme encompassing broad guidelines and concrete Delta Plans with investment measures and implementation schedules.
2. The **National Climate Adaptation Strategy (NAS)** 2016¹⁰ is the Netherlands' response to the European Commission (EC) requirement for CCA strategies at the national level in the EU Member States. It is deliberately focused on sectors, supply chains, themes and climate risks that are not directly addressed by the Delta Programme and its associated Delta Plans. These include:
 - nature, agriculture, horticulture and fisheries
 - health and welfare, recreation and tourism
 - infrastructure (road, rail, water and aviation)
 - energy
 - IT and telecommunications
 - public safety and security.

⁹ <https://english.deltaprogramma.nl/delta-programme>

¹⁰ Ministry of Infrastructure and the Environment (2016)
https://klimaatadaptatienederland.nl/publish/pages/125102/2016_12_02_nas_netherlands_4_5.pdf

The strategy was first translated into operational measures in its Implementation Plan 2018-2019¹¹ – corresponding to the EC required National Adaptation Plan (NAP). An evaluation of the NAS carried out in 2022¹² concluded that relevant action plans have been developed for each of the NAS focus areas. The evaluators highlight the need to accelerate implementation and specifically to mainstream CCA in building regulations. The national government is preparing its new NAS for 2024-2027 in the light of these recommendations and based on new climate scenarios (October 2023) by the Dutch Royal Meteorological Institute <https://climate-adapt.eea.europa.eu/en/countries-regions/countries/netherlands>.

At sub-national level, the obligation to draw up land planning, water planning and other environmental policy documents, as well as to conduct climate change stress tests under the Delta Programme, promotes the development of CCA strategies and the implementation of related measures. In this context Provinces, 'Working Regions' and Municipalities in Northern Netherlands have developed their own CCA strategies. These translate the goals of the Delta Programme to the needs and conditions of each local area. Local CCA strategies developed in the last three years include:

- Climate Adaptation Strategy for the Province of Friesland¹³ 2023;
- Climate Adaptation Strategy for the Working Region Groningen and Noord-Drenthe 2022¹⁴;
- Climate Adaptation Strategy for the Groningen Municipality 2020¹⁵.

CCA strategy clearly enjoys a high profile and considerable institutional 'thickness' in the Northern Netherlands. Friesland Province, Drenthe Province and the Groningen and North Drenthe 'Working Region' are all signatories of the charter for the EU Mission on Climate Change Adaptation. As regards innovation, the Dutch national-level 'Mission-Driven Top Sector and Innovation Policy' has been in place since 2011. This was rated by the OECD in 2020 as a 'fully-fledged mission-oriented innovation policy'¹⁶. The approach translates concretely into 'Knowledge and Innovation Agendas' (KIAs) developed by public-private partnerships in the 'top sectors', directing funding from different channels to the most promising directions and actions for innovation.

Specifically in the Northern Netherlands 'region', the Smart Specialisation Strategy 'RIS3'¹⁷ plays the main determining role, directing EU Cohesion Policy Funds and related domestic instruments in the field of research and innovation. The RIS3 adopts the 'mission-oriented' approach of the Top Sector Innovation Policy. It aims to create a more dynamic, inclusive and effective innovation ecosystem, able to contribute to four main transitions:

- from a linear to a circular economy;

¹¹ Ministry of Infrastructure and Water Management (2018) https://klimaataadaptatienederland.nl/publish/pages/125102/nas_implementation_programme_1.pdf

¹² Ministry of Infrastructure and Water Management (2022b) <https://www.rijksoverheid.nl/documenten/rapporten/2022/12/16/bijlage-evaluatie-nas-hoofdrapport>

¹³ Province Friesland and Water Management Company Friesland (2023) <https://www.fryslan.fr/fryslan-klimaatbestendig-2050>

¹⁴ Working region Groningen and Noord-Drenthe (2022) https://www.provinciegroningen.nl/fileadmin/user_upload/Documenten/Dossiers/Klimaat/Regionale-Klimaatadaptatie-Strategie-Groningen-Noord-Drenthe-januari-2022.pdf

¹⁵ Groningen Municipality (2021) <https://gemeente.groningen.nl/groningen-klimaatbestendig>

¹⁶ <https://stip.oecd.org/moip/case-studies/3>

¹⁷ SNN – North Netherlands Alliance - (2020) [RIS3: Strategie voor het Noorden | SNN](https://www.snn.nl/Strategie-voor-het-Noorden)

- from fossil to renewable energy;
- from care to (positive) health;
- from analogue to digital.

RIS3 is deployed in line with the KIAs in the relevant top sectors 'Agriculture, water and food', 'Energy transition & Sustainability' and 'Health and care'. The RIS3 does not target CCA specifically, however it opens room to CCA-relevant actions and projects, especially under KIA 'Agriculture, water and food'.

Northern Netherlands strategic 'Vision of the future 2050'

"Smart dykes with smart technology protect the northern blue delta against the water. Where dykes are not a solution, we build homes, buildings and infrastructure on the water that can rise with the sea level. (...) We are good at circular and earthquake-climate-proof lifecycle construction".

Extract from RIS3 Northern Netherlands 2021-2027

Source: [RIS3: Strategie voor het Noorden | SNN](#)

3 Analysis against conceptual framework: Transformative Innovation for better Climate Change Adaptation

The “mapping-based framework” report (European Commission, 2024), which serves as the conceptual reference framing this case study, defines an analytical framework identifying seven key features of ‘Transformative Innovation’ as essential conditions for the design and implementation of CCA strategies with high ambition level. These features can be summarised as follows:

1. **Directionality:** defining goals and scope of strategic action, as well as articulating impacts, in a way which reflects societal challenges with wide appeal, formalised through endorsement at highest political level to secure engagement of all relevant authorities and stakeholders.
2. **Articulating instrument portfolios and defining synergies between funding sources:** establishing all-encompassing instrument portfolios addressing the whole innovation cycle and the various aspects of CCA, paired with adequate funding resources.
3. **Ensuring cross domain synergies:** favouring whole-of-government approaches to ensure greater horizontal coherence between various thematic policy areas (R&I, agriculture, environment, mobility, health etc.), resulting in coordinated mixes of instruments of different types.
4. **Increasing breadth and depth of stakeholder involvement:** working towards social acceptance of new solutions and shaping of innovative developments, as well as improving public trust, opening up public debates, managing diverse and sometimes conflicting views over alternative pathways.
5. **Setting up effective multi-level governance models:** maximising potential of vertical synergies, recognising complementary roles for various governance levels - local, regional, national and EU;
6. **Making room for experimentation:** providing adequate spaces for risk-taking and creativity - ensuring a risk-tolerant environment to facilitate development of new and/or radical solutions.
7. **Securing high levels of policy intelligence, learning and strategic capacity:** building strong evidence-based policy learning capacities, based on a solid knowledge base and special skills to manage transitions, as necessary companions to the transformative innovation approach.

The analysis below follows this framework. The key characteristics of the territory’s approach to CCA strategy development and implementation and their linkages with innovation policies and strategies, as revealed by the case study research, are explored in turn, in relation to the above seven features. Each feature constitutes a core section of the Report.

3.1 Directionality: defining goals and expected impacts for society

CCA strategy at national level in the Netherlands presents something of a two-speed picture. The Delta Programme, in force since 2010 with substantial dedicated domestic budgetary resources, with its main focus on water, soil and spatial planning, is more advanced than the National Adaptation Strategy (NAS), which deals with a wide range of other sectors and value chains not directly covered by the Delta Programme. Oversight of the two strategies by the same Ministry supports coherence of goals. Both demonstrate directionalities increasingly in favour of societal transformation. For the Delta Programme, the move away from the water engineering miracles deployed in the past, towards

'Water and Soil Leading' and 'Room for the River' principles represents a deep change in paradigm. This radical shift is also reflected in related strategies and initiatives at the level of the Provinces, 'Working Regions' and Municipalities in Northern Netherlands. Under the NAS, first adopted in 2016, transformative CCA in the other dimensions vulnerable to climate change - such as built environment, human health and public safety, tourism, infrastructure, energy, telecommunications and security - is at a much earlier stage of maturity. However, the necessary strategic elements are in place to speed up CCA also across this wider front.

The main innovation strategies relevant to the territory – the national Mission-Driven Top Sector and Innovation Policy, recently renewed for 2024-2027, and the 2021-2027 'RIS3' Smart Specialisation Strategy for Northern Netherlands – are tightly interlinked and display strong directionality with regard to societal challenges. Neither, however, features CCA as a mission in its own right. CCA is instead suffused throughout their mission-driven priorities. Governance arrangements for both CCA and innovation strategies have a strong cross sectoral and multi-dimensional flavour, supporting interaction between them.

3.1.1 Goal definition

The process behind the creation of the first Delta Programme began in 2007 with the establishment of an inter-ministerial Steering Committee, tasked by Government to answer a crucial question: ***'in view of the likely future effects of climate change, can we - the Dutch - remain living in this country?'*** From the Committee's subsequent investigations, the answer that came back was, ***'Yes – provided we take a proactive approach'***¹⁸. That proactivity has driven the growth of a genuinely transformative strategic orientation in recent years – moving away from the Government's earlier emphasis on dominating nature and water, towards one of starting from nature and letting nature lead the way.

Strategic imperatives for the Northern Netherlands stem from the recognition that the use of the land is reaching limits – even in this less densely populated part of the country. A series of recent extreme flooding and drought events has brought serious and visible consequences. Low water levels in major rivers have affected shipping. Irrigation bans for agriculture have heightened awareness and engendered extra urgency. Forward-looking climate forecasts predict not only sea-level rise, but also drought and water shortages. There will also be slower onset events like soil erosion, salinisation of ground water and loss of biodiversity in natural areas (KNMI, 2023).

Of the two national level CCA strategic documents, the Delta Programme¹⁹, in place since 2010, demonstrates the strongest directionality – with substantial dedicated funding. Its goal is based on the long-term vision that the Netherlands should become climate resilient by 2050 – in relation to water excess and shortage, drought and generally increasing temperatures. In face of the predicted impacts of drought and resulting aridification – likely to happen sooner than massive sea level rise - the Delta Programme takes the opposite direction to the traditional imperative of rapid stormwater

¹⁸ (interview with Delta Commissioner, 2023)

¹⁹ Ministry of Infrastructure and Water Management et al., 2023 [Delta Programme 2024 \(English\) | Publication | Delta Programme \(deltaprogramma.nl\)](#)

evacuation, towards one of water retention for as long as possible – particularly in areas with sandy soils. Today the principles of ‘Water and Soil Leading’ (WaBoS)²⁰ and ‘Room for the River’ mark a radical change of perspective for the Netherlands, with pervasive impacts on strategies, policies and actions (Box 3).

BOX 3. Radical changes in approach FOR CCA: ‘Water and Soil Leading’ and ‘Room for the River’ principles

<u>‘Water and Soil Leading’ principle (WaBoS)</u>	
“Water and soil leading’ consists of the principles listed below, associated with 33 structuring choices with associated measures:	
<ol style="list-style-type: none"> 1. Not passing the burden (on future generations, other areas or functions, from private to public). 2. Taking extremes more into account. 3. Dealing with flooding, drought and the soil in a coherent manner (the Netherlands must turn from a colander into a sponge again). 4. Multi-layer safety. Broader approach to the spatial design behind dykes and barriers (the first layer), for example, in stream valleys (second layer) and crisis management (third layer). This is to ensure a rapid and climate-robust recovery from damage (as layer 4), with water awareness as an integral part. 5. Less covering, less digging, no contamination. 6. Integrated approach in the living environment: goals for climate adaptation, water quality and soil cannot be seen separately from urbanization, housing construction, agriculture and energy supply. 7. Comply or explain: Provinces are required to make a weighted assessment for the different areas, in line with specific regional characteristics. 	<p style="text-align: center;">‘Room for the River’ principle</p> <p><i>“Giving our rivers more room means that we can store and discharge more river water and adapt to the consequences of climate change at the same time.</i></p> <p><i>Each river needs its own solution. We are taking various steps in the vicinity of the river, such as relocation of the dykes, ‘de-poldering’ and digging side channels. More room for rivers also means a change in the land use around rivers. This not only delivers greater water safety, but also new natural and recreational areas. In other words, an attractive environment for both people and animals.</i></p> <p><i>But sometimes a price must be paid. De-poldering or the relocation of dykes, can mean that people and businesses may be forced to move, to give more room to the river.”</i></p> <p>Source: https://www.rijkswaterstaat.nl/en/water/water-safety/room-for-the-rivers</p>
Sources: (Ministry of Infrastructure and Water Management, 2022a) (1) (2)	

The Delta Programme recognises that technical optimisation alone will not be enough and that broader societal policies will be needed in relation to levels of demand for water and land use. The

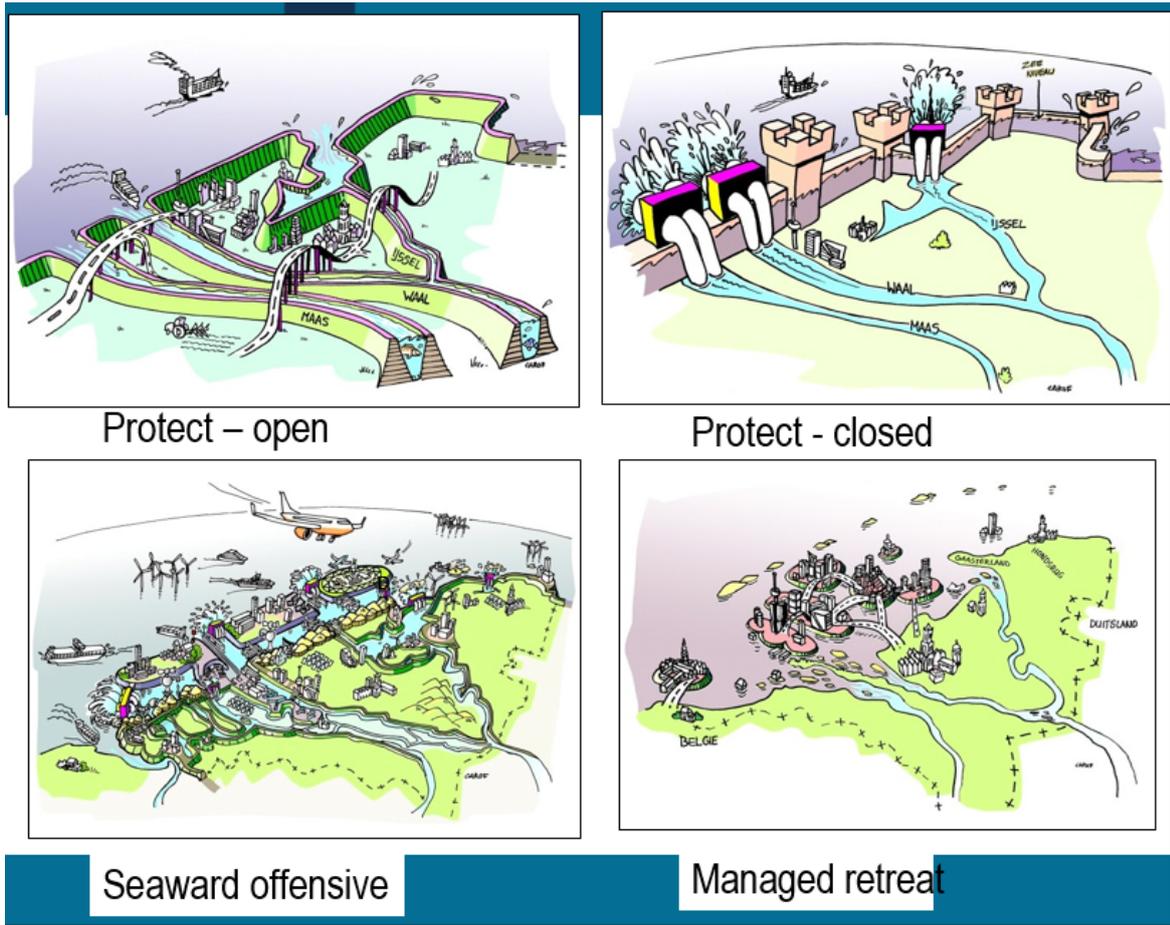
²⁰ ‘Water en Bodem sturend’, Ministry of Infrastructure and Water Management (2022a) <https://open.overheid.nl/documenten/ronl-c35e65eba0903d738ae26dab222462337b0d8de7/pdf>

'Sea Level Rise Knowledge Programme', financed through the Delta Programme, is funding research based on four radical forward-looking scenarios for the Netherlands:

- Protect open – letting the sea come in.
- Protect closed – keeping the sea out (for as long as possible).
- Seaward offensive – building out into the sea.
- Managed retreat!

Each scenario would involve major transformations, with deep societal impacts.

Figure 2: Forward-looking climate change adaptation scenarios for the Netherlands



Source: 'Sea Level Rise Knowledge Programme' financed under the Delta Programme

The NAS purpose is more about integrating CCA into a range of existing national policies, which are not otherwise covered by the Delta Programme. Its Implementation Plan (NAP), adopted in 2016, targets six priorities:

- Heat and health
- Infrastructure
- Agriculture
- Nature
- Built environment
- Collaboration with Provincial and regional strategies.

'*Bollenschema*' - the engaging CCA 'circle diagrams' in the NAS (Annex 2) has become an effective communication tool since the NAS first appeared in 2016. The circles show predicted climate change effects across a wide range of sectors, in relation to different climatic trends. For instance, the 'node' ball '*warmer summers and more continuous warm periods*' shows a wide range of effects, some of which are largely positive (e.g. '*possible increase in crop yields*' and '*increased use of nature areas, public green spaces and urban recreation areas*'), as well as more negative effects (e.g. '*greater risk of foodborne infections*', '*increased exposure to UV radiation – skin cancer cataracts*' and '*increased energy use*') – all with indications of the main sectors implicated and a rough approximation of onset timescale. Overall, the tool supports the formulation of strategic priorities for CCA in sectors less familiar with the field. The content has been upgraded and new sectors added over time since 2016, based on new scientific insights and feedback from users. It has been turned into an interactive tool, publicly available for any actor to use.

Unlike in the water sector, CCA-related policymaking is still at a relatively early stage for most of the NAS target sectors and groups. The NAP is therefore focused more on raising awareness and on involving parties that are not yet sufficiently engaged. Where possible, implementation will be linked to ongoing programmes through action-oriented CCA dialogues leading the development of necessary measures.²¹

As regards innovation strategy, the Government has decided to strengthen the directionality of its national Mission-Driven Top Sector Policy by recalibrating the focus of the 25 missions defined for the 2020-2023 period onto five key Mission Areas for 2024-2027²²:

- Energy transition
- Circular economy
- Health and care
- Agriculture, water and food
- Security.

Each Mission Area breaks down into specific missions which form the basis for Knowledge and Innovation Agendas (KIA), with outputs, outcomes and impacts defined. The broad goals of the KIA are translated into Multi-year Mission-driven Innovation Programmes (MMIP). There is no dedicated Mission Area for CCA in the Top Sector Policy, but CCA is seen as relevant across all five – particularly Agriculture, water and food, for which the concrete MMIPs include:

- MMIP C1 Climate-proof rural area: prevention of flooding and water shortages;
- MMIP C2 Climate-adaptive agricultural and horticultural production systems;
- MMIP C3 Water-robust and climate-proof urban area;
- MMIP C4 Improve water quality.

The strategic directionality of the Northern Netherlands RIS3 reflects that of the national Top Sector Policy – so although CCA is not a headline focus for innovation effort in the territory, it is present in the different strategic priorities addressed.

²¹ (Ministry of Infrastructure and Water Management, 2018)

²² <https://www.topsectoren.nl/actueel/nieuws/2023/mei/26/herijkte-missies-en-scherpere-keuzes-missiegedreven-innovatiebeleid>

3.1.2 Strategic governance

At national level, the Ministry of Infrastructure and Water Management is responsible for both the Delta Programme and the NAS. This helps to avoid fragmentation between the two strategies and fosters synergies between them. The creation of the position of Delta Commissioner, directly responsible to the Cabinet, reflects the crucial national importance of the subject matter of the Delta Programme. In addition, the Delta Commissioner reports annually to the Parliament on the implementation of the Programme to facilitate continuous learning and regular updating of its strategy. Special steering groups monitor the course and progress of inter-ministerial agreements on actions under the Delta Programme, NAP and Top Sector Innovation Policy, securing active engagement of the relevant national authorities at the highest level.

At the Northern Netherlands regional level, the Northern Netherlands Alliance (SNN) <https://www.snn.nl/en> is a partnership of the three Northern Provinces (Drenthe, Friesland, Groningen) and the four largest cities (Assen, Emmen, Groningen, Leeuwarden). SNN itself has little role in CCA activity beyond managing EU Cohesion Policy Funds. The Provinces and cities provide the main strategic oversight for CCA related investments by Municipalities and by Water Boards (publicly elected in the Netherlands) corresponding to the boundaries of the 'Working Regions'.

3.2 Articulating instrument portfolios and defining synergies between funding sources

There is generous domestic public financing available for CCA in the Netherlands. The Delta Programme has its own dedicated Delta Fund with a budget of €21bn for 2023-2036, with a further €20bn foreseen provisionally up to 2050. Although the NAS does not have its own budget in the same way, the CCA related investments it should stimulate can be financed through the wide array of public policies it embraces. Spatial planning offers the most comprehensive framework of instruments for CCA relevant investment. The national Government has CCA agreements with Provinces, district Water Boards, and Municipalities in the Northern Netherlands for the joint financing of CCA measures in the context of spatial planning. There is also the WaddenFonds, established by the Dutch government in 2007 for a period of 20 years, based on revenues from gas extraction and targeting exclusively the three Provinces of Noord-Holland, Friesland and Groningen, which can finance CCA investment.

R&I relevant for CCA can be supported through the Mission-Driven Top Sectors and Innovation Policy. Its budget for 2024-2027 is over €5bn – including substantial resources from the private sector. For large projects there is the Growth Fund with a budget of €20bn for 2021-2025. There are also the various funding channels of the Research Funding Agency. Out of the global figures mentioned, the overall amount going specifically to the CCA theme, across domestic R&I programmes, is not easily identifiable.

EU Cohesion Policy in the Northern Netherlands supports CCA-relevant R&I through the territory's Smart Specialisation Strategy 'RIS3' and Interreg programmes. The ERDF does not co-finance mainstream CCA investment in the region – this is addressed almost exclusively by domestic funds. Local authorities and universities in the Northern Netherlands are active participants in CCA related projects under EU-level programmes. This includes the University of Groningen's participation in the Horizon Europe project RISKADAPT and the Province of Friesland's in the project NBRACER: 'Nature Based Solutions for Atlantic Regional Climate Resilience', under the EU Mission on Climate Change

Adaptation. Also, under the LIFE-IP project Climate Adaptation NL-NASCCELERATE, over 20 Dutch organizations work in partnership to accelerate CCA at local level.

3.2.1 Domestic instruments relevant for CCA

Through the Delta Fund, the national government finances the measures in the Delta Programme together with contributions from other partners. The Delta Fund has some €21bn available for the period 2023-2036, with expenditure reaching approximately €1.5bn annually. The main investments are in water safety (i.e. flood, drought protection), large water surfaces and the water network, including repair and maintenance. There are also significant investments in freshwater supply and water quality, as well as funds for experimentation and the Sea Level Rise Knowledge Programme²³. A further €20bn is provisionally foreseen for the Delta Fund, for the period 2037-2050²⁴.

The NAS does not have a dedicated fund in the same way. Instead, CCA actions are to be financed through the wide range of policies which it influences. In this context, spatial planning is a key policy area in a country with such extreme population density as the Netherlands, when it comes to financing CCA actions. Several principles are of importance: the place-based dimension; acknowledging diversity in the various parts of the country; partnership between the State and sub-national entities, themselves cooperating with district Water Boards, businesses and local stakeholders; the ‘water and soil leading’ principle and the nature-inclusive re-orientation of land. These principles become mutually reinforcing in the framework of Dutch spatial planning policy through integrated approaches combining multiple functions in specific territories. The main relevant instruments (Table 2) are as follows:

- NOVI, the National Strategy on Spatial Planning and the Environment (2019), is the long-term vision of the Dutch government on the future of the living environment. It spells out four priorities: space for CCA and energy transition; sustainable circular economic growth potential; strong and healthy cities and regions and the futureproof development of rural areas.
- The National Rural Area Programme (NPLG) adopts an area-oriented approach, through which the government combines nitrogen reduction measures with interventions to improve nature, soil and water quality and to achieve climate targets.
- MOOI Nederland aims to ensure that the renovation of the Netherlands also works well aesthetically and qualitatively. It conducts forward-looking research and provides stimuli for enhancing development investments in terms of amenity value (beautiful), user value (functional) and future value (robust and sustainable).

Table 2: National framing of main spatial planning instruments of relevance for CCA

Instrument framework	Key characteristics
NOVI: National Strategy on Spatial Planning and the Environment (2019)	NOVI is the umbrella for 25 specific programmes on water and soil, nature, agriculture, rural development (see NPLG below), energy, circular economy, cities and environment. NOVEX, its implementation plan, includes guidelines

²³ (Ministry of Infrastructure and Water Management et al. 2023)

²⁴ (interview with Delta Commissioner, 2023)

Instrument framework	Key characteristics
and NOVEX , its implementation plan (2022) ²⁵	for cooperation between the State and two sub-national levels - Provinces and 16 'NOVEX-areas' with special urbanisation challenges. Spatial agreements are concluded on this basis for each area, including joint funding mechanisms.
NPLG National Rural Area Programme and PPLGs Provincial Programmes for Rural Areas ²⁶	NPLG and PPLGs combine both national and area-specific measures, based on the goals of emissions reduction, nature restoration water and climate resilience. CCA is an integral part of the approach.
MOOI Nederland (2022) ²⁷	MOOI Nederland combines different goals such as preserving biodiversity, agriculture transition, climate adaptation, energy transition, together with economic growth, through local partnership approaches. These investments feed into spatial planning programmes at national, provincial and local levels.

Underlying these frameworks, the government is currently developing a 'National Yardstick for a green climate-adaptive built environment'²⁸, which sets out a framework for climate-resilient design and construction²⁹.

In 2018, the government reached CCA agreements with Provinces, district Water Boards, and Municipalities for the joint co-financing of CCA. With effect from 2021, national funding of €300m is available, to be matched by another €300m from the local and regional authorities. Out of the total amount, the national government is setting aside €200m for the Climate Adaptation Incentive Scheme³⁰. This scheme qualifies Municipalities, Provinces, and district Water Boards for national government grants to boost their expenditure by 1/3 on existing CCA measures or implementation of new ones under their own strategies in fields related to water. Two key conditions for the national funding are: 1) having regional/local CCA strategy in place with detailed implementation agenda and 2) local co-funding of the investments at a rate of 30%. For innovative measures, the national subsidy level can rise to 100%.

Other domestic subsidy schemes for local and regional authorities include:

- Impact Projects - revolving around spatial adaptation, which can inspire other authorities and from which they can learn.
- Living Labs - accommodating research and innovation concurrently, according to the principles of co-creation and participatory design between public and private parties.
- Financial incentives – through which local governments can encourage private citizens to take measures, such as CCA gardens/pathways.

²⁵ Ministry of the Interior and Kingdom Relations (2019 and 2022b) <https://open.overheid.nl/documenten/ronl-d58c7b3d-57b8-42b9-9a1d-bba2a54d4992/pdf> and <https://www.denationaleomgevingsvisie.nl/novex/default.aspx>

²⁶ Ministry of Agriculture, Nature and Food quality (2022) <https://open.overheid.nl/documenten/ronl-69397aa7ef89ba80b3d521510b1581ac1033add1/pdf>

²⁷ Ministry of the Interior and Kingdom Relations (2022a) <https://www.denationaleomgevingsvisie.nl/publicaties/novi-stukken+publicaties/handlerdownloadfiles.ashx?idnv=2263028>

²⁸ National Yardstick for a green climate-adaptive built environment [Delta Commissioner Peter Glas: Yardstick provides good direction for climate-resilient construction | News item | Delta Programme \(deltaprogramma.nl\)](https://www.deltaprogramma.nl/nieuws/national-yardstick-provides-good-direction-for-climate-resilient-construction)

²⁹ Id.

³⁰ <https://klimaatadaptatienederland.nl/overheden/sra/impulsregeling-klimaatadaptatie/>

More specifically focused on the Northern Netherlands, the WaddenFonds³¹ targeting exclusively the three Provinces of Noord-Holland, Friesland and Groningen, was established by the Dutch government in 2012 for period of 20 years, based on revenues from gas extraction. The Waddenfonds is used to provide eco-compensation for emissions through projects improving the environment. Water Board companies in the territory also collect funds for investments in water safety. A small proportion of these funds supports innovation in water safety solutions, including flood defences.

“Numerous challenges come together in the Wadden Sea. Tackling them one by one makes no sense. We will have to deal with them in an integrated way.” (1)

“In order to heighten the ambitions of the many upcoming projects in Harlingen and to diminish possible negative external effects of each project, an overarching and integrated vision is needed. Taking all challenges and ambitions into account, this plan formulates a future vision and forms a framework for the many stakeholders to work together beyond the current sectoral approach of each initiative” (2)

Source: Chair of the Wadden Sea Board (2018 – 2022) (1);

Pilot case of Harlingen in project ‘water as leverage’ (2)

3.2.2 Domestic R&I instruments

The main component of the Dutch R&I funding system relevant for innovation in CCA reside in the Mission-Driven Top Sectors Innovation Policy. In the framework of the KIA under each Mission Area taken together, government bodies, knowledge institutions and more than 2,200 companies pledge to jointly invest over €5bn annually during 2024-2027, in economic opportunities arising from social challenges and development of key technologies (example in Box 4). What proportion of this amount will be relevant for CCA is not known at present³². In addition, the Growth Fund³³ makes €20bn available (2021-2025) for R&I in large projects with the highest potential of contributing to sustainable economic growth, including projects under the Water Technology Growth Plan. Flagship projects related to CCA can be supported through this funding channel, although again it is not known how much of Growth Fund support will be CCA relevant.

Box 4. Mission-oriented Top Sector cooperative research and innovation on climate adaptation in agriculture

In the context of the mission-driven initiatives under the Top Sector ‘AgriFood and Horticulture and Propagation Materials’, the Ministry of Agriculture, Nature and Food Quality started a multi-year public-private partnership (PPP), in 2019, with Wageningen University and Research, the representative organisation of farmers and horticulturists (LTO) and local authorities [Climate-smart agriculture - Wageningen Climate Solutions \(EN\)](#). The aim is to set up practice-oriented networks for agricultural CCA.

This PPP focuses on innovation in the farm, through knowledge exchange and diffusion to and by farmers and local authorities, to promote strengthening and acceleration of climate-resilient agriculture.

The first step is an inventory of current projects in terms of areas, crops and networks with farmers, water boards and other land and water users. Integral approaches to water and soil management, such as retention of water, introducing robust varieties and cultivation systems and soil cultivation generally are of central importance. Effects on other themes, such as green crop protection, CO₂ storage and emission, loss of minerals must also be taken into account.

³¹ <https://waddenfonds.nl/>

³² <https://www.topsectoren.nl/actueel/nieuws/2023/mei/26/herijkte-missies-en-scherpere-keuzes-missiegedreven-innovatiebeleid>

³³ <https://www.nationaalgroeifonds.nl/english>

There are opportunities for funding R&I for CCA through the Dutch Research Council (NWO³⁴), which has an annual budget of almost €1bn to fund curiosity-driven research, research infrastructure and research related to societal challenges. These include lower-TRL research topics listed under the Top Sectors' KICs (Knowledge and Innovation Covenants³⁵), with an annual budget of around €100m for cooperative research. Another relevant funding line under NWO is the Dutch Research Agenda (NWA), established through an innovative co-creation process with the input of citizens and scientists. NWA focuses on bringing science closer to society and encouraging interdisciplinarity, funding “*knowledge-chain-wide research into complex issues in which close collaboration with societal organisations is necessary*”³⁶.

A noteworthy example of maximising synergies between funding sources for R&I is displayed by Wetsus, which has recently secured a ‘framework’ commitment of €5m over 10 years for its applied water technology research, combining funds from the national Ministry of Education, Culture and Science, Ministry of Economic Affairs and Climate Policy and Ministry of Infrastructure and Water Management; as well as funding from the Province of Friesland and the Municipality of Leeuwarden.

3.2.3 European Cohesion Policy

EU funding allocations to the Northern Netherlands under Cohesion Policy are modest compared to the funds available from domestic sources for investment in CCA. The mainstream Northern Netherlands Programme for 2021-2027 (ERDF contribution just over €100m) does not support CCA interventions. Instead, it maximises the value of its resources by focusing on the challenges and opportunities of key transitions through close alignment with the territory’s Smart Specialisation Strategy RIS3, through which it provides EU co-financing mainly for R&I activities³⁷. Around 30% of these relate to climate action, although the large majority relate to climate change mitigation rather than to CCA³⁸. Under Interreg, the Province of Drenthe and several Water Boards are involved in the Interreg North Sea Blue Transition project [Blue Transition progress in the North Netherlands | Interreg North Sea](#), which has set up two living labs involving farmers and aims investigate new solutions to ensure quality and quantity of freshwater while revitalizing natural habitats and reducing CO₂ emissions.

3.2.4 Other EU instruments

Some examples of CCA-relevant projects under other EU instruments, involving participants from Northern Netherlands, include:

Horizon Europe - Mission on Climate Change Adaptation

- The University of Groningen participates in RISKADAPT- Asset Level Modelling of RISks in the Face of Climate Induced Extreme Events and ADAPtation’ [HOME - Riskadapt](#).

³⁴ <https://www.nwo.nl/en/about-nwo>

³⁵ <https://www.nwo.nl/en/researchprogrammes/knowledge-and-innovation-covenant>

³⁶ https://www.nwo.nl/sites/nwo/files/media-files/NWA%20-%20all%20factsheets_EN.pdf

³⁷ (EC, 2021)

³⁸ (SNN, 2023)

- The province of Friesland participates in the project (coordinated by Deltares) NBRACER: ‘Nature Based Solutions for Atlantic Regional Climate Resilience’ [Nature Based Solutions for Atlantic Regional Climate Resilience - NBRACER](#).

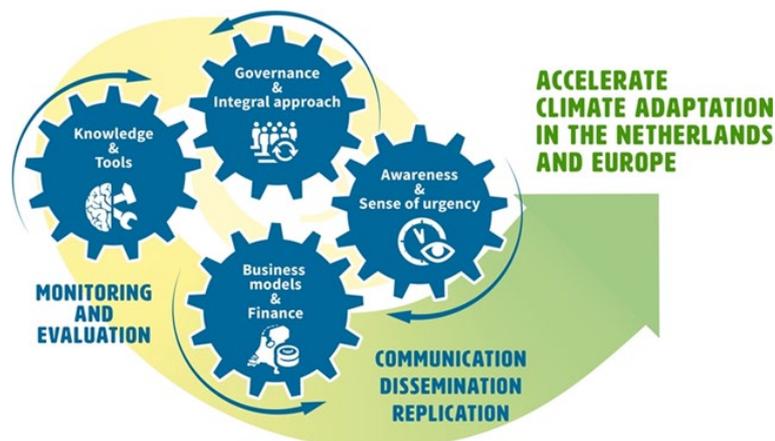
Horizon 2020

- The Province of Groningen, together with other Dutch partners, is involved in the Horizon2020 project REST-COAST: ‘Large scale RESToration of COASTal ecosystems through rivers to sea connectivity’, under which one of the pilots is the Wadden sea [REST-COAST](#).

LIFE Programme:

- The Municipalities of Groningen and Southwest Friesland participate in a consortium of more than 20 Dutch organizations in the LIFE-IP project Climate Adaptation NL-NASCELERATE [LIFE-IP Climate Adaptation NL](#), which aims to accelerate local level implementation of the NAS and the Delta Plan for Spatial Adaptation. In the diagram (Figure 3), the programme’s goals are depicted in four interrelated gears. Each cog wheel represents a number of projects, spread across the country. There are also acceleration actions focusing on communication, networking and dissemination of results that support the programme and ensure that CCA takes place faster overall.

Figure 3. LIFE-IP NASCELERATE



Source: <https://klimaataadaptatienederland.nl/overheden/life-ip-klimaataadaptatie/>

- The Province of Groningen and Hanze University of Applied Science participate in the LIFE project COOL SQUARE on urban greening [LIFE 3.0 - COOL SQUARE NL](#).

Local authorities and universities in the territory are highly active participants in EU level programmes and this list is far from exhaustive.

3.3 Ensuring cross-domain synergies

Cross-domain synergies for CCA in Northern Netherlands, as for the country as a whole, are actively pursued through the NAS and the different inter-institutional governance structures in place for its six priority objectives. The approach is further strengthened through coordination between the implementation of the NAP and the Delta Programme, including interprovincial consultation in the wide variety of domains influenced by the 'Water and Soil Leading' principle. The Delta Programme is also strengthening linkages with the insurance and financial sector and with the health sector.

Work has been underway since 2019 to promote CCA integration into wide range of standards, through cooperation between different disciplines and sectors, in the framework the Climate Adaptation Standards Consultation, OSKA. Interdisciplinary and transdisciplinary approaches are increasingly evident in the CCA-relevant missions under the Mission-Oriented Top Sector and Innovation Policy, notably in the Mission Area Agriculture, Water and Food. The assessment of the territory's efforts so far to maximise cross domain synergies for CCA is strongly positive.

However, there remains a view that more could be done in dimensions less focused on economic interests and more in relation to climate change effects on people, culture and nature. Moreover, there is no mechanism in place to ensure accountability of government authorities for the successful, or unsuccessful, implementation of CCA actions.

Promoting cross domain synergies is the *raison d'être* of the NAS. Mainstreaming CCA across different policy areas - '*Embed climate adaptation within policy and regulation*' - is one of its six key objectives (Figure 4). Governance structures have been established in the framework of the NAS to ensure the necessary inter-sectoral collaboration³⁹. At design stage, the preparation of the Implementation Plan for the NAS (the 'NAP'), was coordinated by the Ministry of Infrastructure and Water Management and also involved:

- Ministry of Economic Affairs and Climate Policy
- Ministry of Justice and Security
- Ministry of Foreign Affairs
- Ministry of Education, Culture and Science
- ProRail – responsible for the rail network in the Netherlands
- Royal Netherlands Standardization Institute (NEN)
- Various knowledge institutions, such as the Netherlands Environmental Assessment Agency (PBL), the National Institute for Public Health and the Environment (RIVM), the Royal Netherlands Meteorological Institute (KNMI), the Netherlands Organization for Applied Scientific Research (TNO), and Wageningen University & Research (WUR).

Figure 4. NAS objectives

³⁹ (Ministry of Infrastructure and Water Management, 2018)



Source: Ministry of Infrastructure and Water Management (2018)

Implementation in the various sectors targeted by the NAS involves different configurations of Ministries as coordinator or participants. For example, ‘Heat stress’ is coordinated by the Ministry of Infrastructure and Water Management, in collaboration with the Ministry of Health, Welfare and Sport, whilst ‘Nature’ is coordinated by the Association of Provinces of the Netherlands, Provincial authorities and the Ministry of Agriculture, Nature and Food Quality in collaboration with the Ministry of Infrastructure and Water.

There is also structured coordination between the NAP and the Delta Programme, including interprovincial consultations, supported by umbrella organizations like the Association of Dutch Municipalities (VNG), and Union of Water Boards (UWV)⁴⁰. The ‘Water and Soil Leading’ principle is comprehensive and influences many policy fields and sectors at different levels. In housing, for example, CCA has been introduced as an important boundary condition in the 35 regional housing deals agreed between central Government, Provinces, Municipalities and other stakeholders about the number of homes to be built in each region, the design of public spaces, the construction of roads etc. In this regard, the Government has recently published a ‘spatial assessment framework for a climate-adaptive built environment’, which indicates where it is best to build given the site-specific risks linked to the water and soil system⁴¹.

The Climate Adaptation Standards Consultation (OSKA)⁴², was born from the coordination between the NAP and the Delta Programme. Originated in 2019, OSKA brings together government bodies, business, knowledge institutions and five different sectoral standards organisations to promote CCA integration into new and existing standards and encourage their subsequent scale-up through cooperation between different disciplines and sectors. Among the subject areas addressed by OSKA so far are standards for infrastructure on weak soil, rainwater shelter, drainage and infiltration, biodiversity in urban areas and nature inclusive building.

Other examples of cross domain approaches can be seen in recent work under the Delta Programme on insurance and how the financial sector generally interfaces with CCA. In addition, the LIFE-IP Climate Adaptation project mentioned earlier [LIFE-IP Climate Adaptation NL](#), fosters synergies between the Delta Programme and the health sector, under the joint coordination of the Ministries of Health and of Infrastructure and Water Management. Since the beginning of 2021, CCA ‘nature action

⁴⁰ <https://www.pbl.nl/sites/default/files/downloads/pbl-2021-navigeren-naar-een-klimaatbestendig-nederland-4619.pdf>

⁴¹ Ministry of Infrastructure and Water Management et al. (2023). Page 10.

⁴² <https://www.nen.nl/en/oska-overleg-standaarden-klimaatadaptatie>

lines' have been developed by the Ministry of Agriculture, Nature and Food Quality, through interprovincial consultation, in collaboration with the Association of Dutch Municipalities, the Union of Water Boards and the Ministry of Infrastructure and Water Management to place CCA actions in current nature programmes.

Interdisciplinary and transdisciplinary approaches are increasingly evident in the CCA-relevant missions under the Mission-Oriented Top Sector Innovation Policy, notably in the Mission Area Agriculture, Water and Food. It is also taking place at the level of individual research organisations. For example, at Wetsus social scientists interact with different technological specialists to study 'responsible innovation roads' towards different water technology solutions⁴³.

"The ambitions in this mission partly require technological, mono- and multi-disciplinary (beta) knowledge, but we are increasingly confronted with a different type of knowledge question. To realise transitions, a new type of research is required that combines knowledge from different scientific disciplines (interdisciplinary) and has a strong connection with practice (transdisciplinary). In addition to technological innovation, a lot of attention is paid to a wide range of other innovations: economic, legal, cultural (...) This has consequences for how we organize the programming of research and innovation."

Source: Topsectors (2024), mission document agriculture, water, food

Yet, although cross-domain consciousness on CCA is at a high level in Northern Netherlands, as in the country as a whole, concerted action does not currently cover all policy areas. CCA is still mainly focused on economic interests and it is felt that more attention could be paid to climate change effects on people, culture and nature under the NAS⁴⁴. According to the recent evaluation of NAS, the coordination between the NAP and the Delta Programme should be further enhanced⁴⁵. Despite widely evident goodwill between the different governmental and non-governmental bodies involved in the various governance structures in operation covering different aspects of CCA, there is no mechanism in place to ensure that authorities at all levels of government are accountable for the successful implementation of CCA actions⁴⁶.

3.4 Increasing breadth and depth of stakeholder involvement

Northern Netherlands presents an exemplar case of stakeholder involvement in CCA activity. It has a strong tradition of local cooperation based on the 'polder model', with its roots in the struggle against water. As in the Netherlands generally, a multiplicity of structures and actions to involve broad populations of stakeholders, characterise decision making on CCA strategy and its implementation in the territory. The most prominent of these are the 'Action-Oriented Climate Adaptation Dialogues' used under the NAS and Delta Programmes. These dialogues promote transparency and collaboration between Government, business, nature and environmental

⁴³ <https://www.wetsus.nl/research-themes/water-innovations-uptake/>

⁴⁴ (Ministry of Infrastructure and Water Management, 2022b).

⁴⁵ (Ministry of Infrastructure and Water Management, 2022b)

⁴⁶ (FMI, 2023)

organisations, Water Boards, agriculture and civil society. They are carried out with understanding of the time and effort needed to reach consensus and achieve genuine co-creation in different situations.

In the R&I field, the increasingly continuous Entrepreneurial Discovery Process (EDP) of the Northern Netherlands Smart Specialisation Strategy RIS3 builds on the same tradition and is particularly well developed. For CCA, NGOs in the 'nature' sector make a strong contribution to the dialogues in different areas, including through the involvement of farmers in delicate discussions over the future of agriculture.

Two new imperatives feature in the 2024 Delta Programme, namely 'Generation Testing' to incorporate the views of young people, as well as greater direct involvement of citizens in CCA. Both remain challenging, but are actively pursued by bodies working on CCA in the territory.

The famous 'Polder model' typical of the Netherlands represents traditionally fertile ground for wider dialogue in Dutch society generally. At local level in the Northern Netherlands, the practice of open dialogue and a sense of community is well developed and has even a specific name in the Frisian language 'Mienskip'.

Mienskip in Friesland dialect literally means 'community', but the real meaning is considerably deeper. It is the mutual connection between people needed to protect their community – traditionally in the fight against the water. People had to join forces to be able to build mounds and dykes in the isolated villages. In Frisian today, *Mienskip* equates to the self-reliance of a small village, the dependence and the connection of the people in this village.

Source: <https://www.immaterieelerfgoed.nl/nl/friesemienskip>

Stakeholder involvement in CCA receives prominent attention in both the NAS and Delta Programme, with multiple methods deployed. A key mechanism is Action-Oriented Climate Adaptation Dialogues⁴⁷ (Box 5). These dialogues aim to develop action plans and agree upon their implementation arrangements. At the start of NAS implementation in 2017⁴⁸, such dialogues took place over the priority areas of 'Heat and Health', 'Insurability of (non-critical) risks', 'Nature and Climate Change', 'Agriculture, Water Management and Insurance' – the latter with co-leadership of the Delta Plan for Spatial Adaptation. Municipalities are free to adopt their own methods for CCA strategies and plans. This was the case for the City of Groningen, which prepared its CCA Action Plan in strong dialogue with a long list of stakeholders⁴⁹ first to identify relevant issues and carry out stress tests. This was followed by dialogues with a restricted set of 'most important strategic partners' such as the Provinces, water management companies and 'security regions' to define priorities and possible ways forward.

Box 5. Action-Oriented Climate Adaptation Dialogues for co-creating action plans for CCA in the Netherlands

Action-Oriented Climate Adaptation Dialogues – requiring the involvement and engagement of both public and private parties – are regarded as a core activity for all action lines identified in NAS, where possible and appropriate.

⁴⁷ <https://klimaatadaptatienederland.nl/overheden/nas/dialogen/>

⁴⁸ (Ministry of Infrastructure and Water Management, 2018)

⁴⁹ (Groningen municipality, 2020)

During such dialogues, the participants prioritise one or more climate risks. They jointly investigate how the effects can be managed and then draw up an outline plan and action programme that may also include amendments to laws and regulations if required.

An Action-Oriented Climate Adaptation Dialogue can be set up if a (potential) urgent climate risk exists for which measures have not yet been identified and/or implemented. The dialogue may focus on a specific sector, theme or supply chain. Engaging in this kind of dialogue raises awareness among the parties involved of the adaptation problem(s) in question. During the dialogue, the parties involved provide access to and utilize available knowledge appropriate to their core activities. They may also encounter knowledge gaps and establish how these gaps can best be addressed. In addition, the parties involved make arrangements on how best practices can be shared and applied, as well as on how the progress of the action programme is to be monitored and managed.

An Action-Oriented Climate Adaptation Dialogue is an ongoing process that may take several years.

Source: Ministry of Infrastructure and Water Management (2018)

Risk dialogue roadmaps reflect one of the seven ambitions from the Delta Plan Spatial Adaptation⁵⁰. They represent the step between climate stress testing and the development of a local CCA strategy. During a risk dialogue, the target area's vulnerabilities to flooding, heat stress, drought and flood risks are discussed between a wide range of parties. The process leads to balanced choices for the definition of specific measures for the CCA strategy and its implementation plan.

"Tackling the latest water management challenges together with farmers is a new approach" (1)

"We moderated a series of open discussions to grasp the farmers' perspective on salinisation and saline farming. Through their daily work farmers acquire unique expertise. This 'tacit knowledge' is highly valuable and supplements the knowledge acquired through the SalFar project. Following the international farmers' café, we summarized the open discussions into guidelines for research on saline farming."(2)

Source: Interreg North Sea projects: (1) Blue Transition and (2) Salfar

Nature NGOs are well organised in the Northern Netherlands and are active and constructive partners in CCA strategies. They participate in strategy and action plan developments a structured manner, representing the 'voice of nature' among the variety of (often conflicting) claims on land use, in particular arable land versus natural areas.

- The NGO Groninger Landschap⁵¹ promotes an approach to CCA based on nature, involving restoration of natural river flows and new approaches to sea level rise through pilot experiments on dykes allowing for natural sedimentation processes. They advocate strong cooperation with farmers, often traditional adversaries, to ensure the acceptability of solutions. The local partnership 'Ecology and Economy in Balance'⁵² in the Eems Delta, is an example of good practice in this

⁵⁰ <https://klimaatadaptatienederland.nl/risicodialoog/routekaart-risicodialoog/>

⁵¹ <https://www.groningerlandschap.nl/>

⁵² <https://eeneinbalans.nl/>

regard. The partnership brings together companies, nature and environmental organizations, agriculture, water boards, the national Government, the Province of Groningen and three Municipalities to address key ecological issues facing the area, prominently including climate change.

- Foundation Natuurbelang De Onlanden⁵³ is a fully independent NGO based on crowdfunding, promoting nature-based approaches in new land planning developments. They promote experimentation with climate buffers in flood-prone areas, involving farmers in complex discussions on transition of agriculture, as well as partnering with researchers, professors and students in living labs to create a vision for the area. The Onlanden itself, at 3.000 Ha, is the largest of five inter-linked wetland buffer areas covering a total of 12.000 Ha protecting Groningen and its surroundings from flooding, storing water, providing natural habitats and recreation opportunities for the population.

Many other initiatives involve stakeholders in CCA-relevant activity in the territory, of which only a few examples are summarised here. These include the Northern Netherlands Climate initiative⁵⁴ - a quadruple helix cooperation between 44 partners: Provinces, Municipalities, water management companies, businesses and business associations, research and technology organisations, utilities, nature conservation associations and intermediaries. The preparation of Vision Friesland was coordinated by the Province of Friesland, with extensive input from a wide variety of stakeholders⁵⁵. ClimateCafe⁵⁶ developed in partnership with by Groningen University of Applied Sciences oversees the collection of factual and objective data in short periods of time (1-2 weeks) through cost-effective methods, supplemented with storytelling, that enables quick yet accurate assessments to be made of the level of resilience of specific areas.

As regards innovation policy in the territory, the Northern Netherlands RIS3 places high emphasis on the quality of stakeholder involvement in its Entrepreneurial Discovery Process (EDP), which has become a continuous process for the 2021-2027 period. The Northern Netherlands Innovation Monitor, introduced in 2015, is also seen as a success story⁵⁷. It is based on active collaboration between universities, local authorities in the region and ten strategic partners, including employers' federation and SME association.

Two noteworthy new approaches to stakeholder involvement are apparent in the recommendations of the 2024 Delta Programme. These reflect the imperative of incorporating young peoples' views through 'Generation Testing', in addition to that of involving citizens generally in the development of CCA-relevant measures⁵⁸. Groningen has some experience of both. The Municipality used a resident panel and special survey to gauge the opinion of residents on measures proposed during the development of its current CCA

"The most important thing is that residents, entrepreneurs and stakeholders take climate adaptive measures. We want them to do something. In addition, we want the target groups to find the environmental environment important. We also want them to know what climate -proof means and what the municipality is already doing to achieve the goals."

Source: (Groningen Municipality, 2020)

⁵³ www.deonlanden.nl

⁵⁴ <https://climateinitiativenoordnederland.nl/en/partners/>

⁵⁵ https://cuatro.sim-cdn.nl/fryslan/uploads/reactienota_fryslan_klimaatbestendig_2050_definitief_1.pdf?cb=gkutSle3

⁵⁶ <https://climatecafe.nl/how-we-work/>

⁵⁷ <https://www.interregeurope.eu/good-practices/northern-netherlands-innovation-monitor>

⁵⁸ <https://www.deltaprogramma.nl/documenten/publicaties/2023/09/13/advies-jongeren-over-dp2024>

strategy⁵⁹. Game Day⁶⁰ encourages Groningen students to engage with CCA through role play in different game scenarios, as part of a broader CCA awareness raising for young people. Citizen involvement, beyond specific local mobilisation actions, nevertheless remains difficult to achieve. As a step in this direction, the national independent Physical Living Environment Consultation Body (OFL)⁶¹ fosters connection and cooperation between the central Government and companies, social organisations and citizens for the development of its annual advisory report on the Delta Programme itself.

3.5 Setting up effective multi-level governance models

There is good articulation between the NAS and Delta Programme and regional/local strategies in terms of strategic principles. Comprehensive national level guidance covering different aspects of CCA supports implementation of the Delta Programme at the local level. This includes an obligation for local 'stress tests' for heat, flooding and drought to be carried out every six years in both urban and rural areas. Place-based specificities are taken into account in the CCA strategies required for each 'Working Region' and prepared voluntarily at other sub-national levels, mainly Province and Municipality in the case of Northern Netherlands. There is a degree of overlap between the boundaries of the 'Working Regions' and these other sub-national levels, particularly in relation to water issues. This is based on an established domestic framework and does not appear to pose a problem for local actors. Strong mechanisms are in place for multi-level dialogue on CCA strategy preparation and implementation, which involve all relevant government bodies and encourage collaboration with other stakeholders.

Both the NAS and the Delta Programme give a clear mandate to Provinces, 'Working Regions' and Municipalities to embed CCA in their development plans and strategies for land planning, environment and economic development. Under the Delta Plan for Spatial Adaptation⁶², Municipalities and local Water Boards in each 'Working Region', in collaboration with stakeholders, have conducted stress tests for heat, flooding and drought, to be repeated every six years, as well as related risk dialogues.

These stress tests must cover urban as well as rural areas. Supra-regional stress tests are planned from 2024 onwards. After having completed the stress tests and risk dialogues, most 'Working Regions' are now focusing on the implementation agenda. Administrative coordination of the NAS is organised through the Association of Netherlands Municipalities (VNG), Dutch Water Authorities (UvW), and the Association of Provinces of the Netherlands (IPO)⁶³. The NAS has adopted the same regional division as that used in the Delta Plan for Spatial Adaptation, as well as the same tools for stress testing and heat maps.

⁵⁹ (Groningen municipality, 2020)

⁶⁰ <https://klimaatadaptatienederland.nl/@223566/game-day/>

⁶¹ <https://www.overlegorgaanfysiekeleefomgeving.nl/english/default.aspx>

⁶² <https://english.deltaprogramma.nl/three-topics/spatial-adaptation/delta-plan>

⁶³ (Ministry of Infrastructure and Water Management, 2018).

The Delta Plan for Spatial Adaptation stipulates that 'Working Regions' must come to a joint strategy between the different sub-national authorities in each one. These generally have shorter term implementation plans updatable according to the results of new subsequent stress tests. The Delta Plan for Spatial Adaptation contains all measures designed to ensure that the Netherlands is designed water-robust and climate-proof by 2050. Municipalities, Water Boards, Provinces and the government work together to speed up and intensify this process. The 'Working Regions' for water-related activity do not have the same boundaries as functional regions defined for other issues, although this is well embedded in Dutch administrative culture and, from the findings of the interview research, is not regarded as a problem.

The Provinces in Northern Netherlands have also developed specific CCA strategies. These follow the national guiding principle of 'Water and Soil Leading'. In addition, they generally translate other national guidance to the local situation, such as the 'spatial assessment framework for a climate-adaptive built environment' and guidance on the development of spatial heat plans. There is customisation, for example the Friesland CCA strategy (Box 6) defines sub-areas (peat soils, clay soils, sandy soils, Wadden Islands and built-up areas), each with its own challenges and possible solutions.

Box 6. Place-specific translation of national guidelines for CCA: Climate-Resilient Friesland 2050+

'Climate Resilient Friesland 2050+' translates the 'Water and Soil Leading' principle into the specific spatial planning contexts of the Province, in addition to guidance elements from other national strategic frameworks, such as the 'National Strategy on Spatial Planning and the Environment Extra' (NOVEX) and National Rural Area Programme (NPLG). This approach culminates in the following eight strategic guidelines:

1. A resilient water and soil system

Forming the basis for a sustainable freshwater balance. Providing the switch between draining of water towards water retention and greater resilience to extreme circumstances.

2. Availability of more local freshwater

Applies to both groundwater and surface water. Reducing dependence on the IJsselmeer which is becoming a less reliable source.

3. Don't pass on

Don't pass on responsibility to future generations, to other areas, or from private to public interest. Take account of future climate change in all investments.

4. Soil vitally improves

Aim for conservation and improvement of the chemical and biological quality of soil – improving its capacity for water storage and biodiversity.

5. Water quality improves

This is essential for restoration of ecological values and biodiversity, for agriculture and for recreation. Enhancing fish migration is part of this.

6. Multi-layered safety

Provide for water safety through three layers:
Prevention (i.e. coastal defence) - Consequence limiting measures - Dealing with risks.

7. Circular & energy transition

Strong commitment to energy transition – limiting emissions and favouring the capture of greenhouse gases and the (re)use of materials.

8. Partnership

Start dialogue with other stakeholders early and build partnership with them on the design of solutions.

[Source:](#) Province Friesland and Water Management Company Friesland (2023)

3.6 Making room for experimentation

There is considerable experimentation on CCA solutions underway in Northern Netherlands. This generally takes place within established strategic frameworks, from which the necessary financing is readily available. On-going experimentation covers the main CCA challenges for the territory, including innovative solutions for coastal defence, freshwater retention, enhancing biodiversity combatting soil erosion and reducing urban heat effects. Live testing of more people-focused CCA aspects, including related new business models, is carried out largely through public-private sector collaboration in the framework of the Mission-Driven Top Sector Innovation Policy. To demonstrate new nature-based solutions, living labs requiring vast spaces have been established for several years already. Some of the nature-based coastal defence experiments, such as double-dyke innovations, have proved their effectiveness. The challenge now will be mainstreaming of such approaches given the deep implications this is likely to have for land use and spatial planning.

Experimentation in relation to CCA in Northern Netherlands is financed in the framework of pilot actions under national programmes and local CCA strategies. Much of this experimentation relates to sea defences and their relationship with nature.

The Rich Dyke experiment between the Eemshaven and Delfzijl, for example, shows how originally 'hard' dykes can be made more attractive for wildlife and at the same time more effective. The project included the placement of a forest of poles and tidal pools, as well as the elevation of breakwaters in the sea. Some of the poles are connected with ropes to allow mussels to attach to and grow, whilst the tidal pools create an ideal living environment for crustaceans, shellfish, molluscs, and algae, and the elevated breakwaters provide resting places for birds during high tide. Together, these measures contribute to the dyke's resilience to higher water levels and offer opportunities for the development of the local ecosystem. Another experiment on the Wadden Sea coast, the Double Dyke (Box 7), allows seawater to enter the outer defences with multiple benefits for nature and potentially agriculture, coupled with increased defensive capacity. Creation of the Double Dyke required a deviation from existing rules in the sense that it required the use of a small strip of land in a Natura 2000 area. This was not done lightly, but it was made possible through strong research-based arguments stemming from other pilot projects in the territory.

Box 7. Experimentation with Double Dyke concept in Northern Netherlands

"The sea level is rising quickly, which requires us to think of different ways for designing our coastal zones. The Double Dyke is one of those innovative pilot projects that attempts to do just that. It could be developed everywhere along the coast if proven successful.

The idea of the Double Dyke is to place a tall dyke next to the coastline and to build a smaller dyke further inland. This creates a unique wet area in between the dykes, which will be regulated by a so-called 'tide diver', and which can be used in many different ways. In this project, a part of this area is used for the development of a wet natural zone where clay-rich silt from the Eems-Dollard estuary can be caught and used for reinforcing the dykes. Another part of the area will be used to develop experiments on saline agriculture and the cultivation of crustaceans and shellfish. The project shows that by looking beyond coastal safety, you can create an area with room for innovations, which is valuable for nature, recreation, research and economy."

Sources : <https://climatescan.org/projects/5134/detail> <https://climatescan.org/projects/5135/detail>

Under the LIFE-IP NAS project⁶⁴, some 20 experimental CCA actions are being carried out throughout the Netherlands. Monitoring and evaluation of these actions will enable lessons to be drawn about solutions that work and what needs to be improved. These lessons are shared and actively brought to the attention of Dutch local and national authorities, as well as at EU level. One of the LIFE-IP NAS actions in the Northern Netherlands, 'Dialogue in sinking peat' (Box 8), relates to soil.

Box 8. New business models for transformation of agricultural regions: 'Dialogue in sinking peat'

This project 'Dialogue in sinking peat' focuses on the climate challenge for agriculture in Dutch peat areas, where the soil is sinking.

New business models are being sought for agriculture in peat meadow areas. A link is also made with the Delta Plan for Agricultural Water Management. The project focuses on two types of areas:

- 1) those with sufficient peat cover: in these areas, agriculture is feasible through technical and economic transitions, such as underwater drainage;
- 2) those with a thick peat layer and little agricultural perspective in the longer term. Major change is required in these areas – either a transformation of land function, or possibly an alternative business model.

Actors involved in this project aim to discover combinations of conditions which make farmers choose sustainable change. New business models are also being investigated with entrepreneurs who are open to future change. To achieve the maximum effect for the area of new business models, their potential for successful exchange and scale-up is identified. This is done based on a land development analysis, which seeks to answer the question: what is the effect of the right business model in the right place, taking environmental factors into account?

Source⁶⁵: LIFE-IP Project NL-NASCELERATE, own translation

In addition, under the Mission-Driven Top Sectors Innovation Policy, the Knowledge and Innovation Consortium for Deltatechnology⁶⁶ is establishing living labs to encourage public-private sector collaboration in the testing of innovative elements in flood defences, such as dyke sensors and 'smart polders' using natural ecosystems as testing grounds. In these field labs, entrepreneurs are given the space to experiment with possible new product elements, together with scientists investigating their effects and students carrying out practical educational assignments linked to the innovations concerned. There is also a field lab for urban CCA solutions, although this is in Eindhoven outside of the Northern Netherlands. Within the territory, experimental solutions to the urban heat island effect are tested with citizens under the initiative Climate-resistant Paddepoel in the Municipality of Groningen⁶⁷. The results will be rolled out to other urban areas in the Municipality in the coming years and presented to other Municipalities as examples to possibly follow.

The above examples represent just a handful of the experimental activities with CCA solutions being carried out in the Northern Netherlands. Those connected with sea defences are among the oldest – some of which have been in operation for 10 years or more and have already proved their effectiveness. For these, the crucial issue is now one of mainstreaming and upscaling. Yet, creating

⁶⁴ <https://klimaataadaptatienederland.nl/overheden/life-ip-klimaataadaptatie/>

⁶⁵ <https://klimaataadaptatienederland.nl/overheden/life-ip-klimaataadaptatie/projecten/businessmodellen-financiering/dialogo-dalend-veen/>

⁶⁶ <https://tkideltatechnologie.nl/>

⁶⁷ (Groningen, 2020)

double-dyke sea defences, for example, along the entire Dutch (even North Netherlands) coast would indeed be a major undertaking, requiring significant land area currently used for other purposes, not to mention the cost. This is a major challenge now facing the territory – experimentation is easy by comparison.

3.7 Securing high levels of policy intelligence, learning and strategic capacity

Awareness of climate risks and CCA is high across a wide range of public and non-governmental bodies in the Netherlands as a whole. It is also relatively high among citizens, even though more work could be done in this area – particularly on risks other than sea level rise. Strong communication efforts on CCA are underway – the ‘circle diagrams’ from the NAS, revealing the multiple inter-related consequences of different climate change effects, have evolved into a valuable interactive medium to support strategy building.

The Northern Netherlands boasts particularly good connections between research and practice in the field of CCA. This is visible in the strengths of the territory’s R&I ecosystem generally, as well as in the growing international CCA reputation of its key research institutions. Strategic capacities for CCA in the territory are also impressive, supported by comprehensive guidance available through the national CCA platform and relevant capacity building initiatives, in addition to less formal networking between CCA practitioners. Monitoring the implementation of CCA measures at different geographical levels is thorough and evaluation of the Delta Programme – originally foreseen every six years – is beginning to take place more frequently due to rapid developments and new scientific insights on climate change.

3.7.1 Awareness and understanding of CCA

Given the Netherlands’ long history of struggle against the sea, the 1953 flood tragedy and more recent flooding events, awareness in the territory is strong in relation to water challenges associated with climate change. The public figure of the Delta Commissioner plays a prominent role in maintaining the high profile of water related CCA issues. General awareness of other CCA dimensions is lower, but this is being comprehensively addressed through the NAS. The first of the six objectives of the NAS is to *‘increase awareness of the necessity of CCA across a wide range of parties, and to encourage them to take climate-adaptive action’*⁶⁸. The highly engaging interactive CCA ‘circle diagrams’ in the NAS (see example in Annex 2) have become an effective communication tool since the NAS first appeared in 2016, serving as a basis for Action-Oriented Climate Adaptation Dialogues. The circles provide a visual summary of current scientific knowledge about the direct effects and indirect consequences of different climate change effects, such as increasing heat, precipitation, drought and sea level rise. The content is interactive – the user can zoom in and zoom out on different consequential circles, click on them for further explanation and even create customised circle

⁶⁸ (Ministry of Infrastructure and Water Management, 2018)

diagrams for different situations and audiences⁶⁹. The circle diagram tool is complemented by the Climate Dashboard⁷⁰ of the Netherlands Meteorological Institute also provides graphic visual representations of key climate evolutions in different geographical areas.

At local level in the territory, residents are informed about the results of the stress tests. For example, in Groningen⁷¹ a dedicated platform has been set up for this purpose, which also provides details on all related municipal activities and information about what residents can do for CCA. In addition, the Municipality conducted a residents' survey on CCA in collaboration with the University of Groningen Environmental Psychology department in 2019 and organised CCA awareness raising events attended by around 3,500 inhabitants. The province of Drenthe has developed the 'Drenthe Adaptation Picture'⁷², an awareness and planning tool providing maps of climate risks for various sectors: agriculture, nature, built environment, infrastructure, recreation and tourism. The tool relies on Netherlands Meteorological Institute scenarios and the adapted 'circle diagrams' from the NAS.

Despite this positive assessment, the level of citizen awareness on CCA in the Netherlands generally could still be improved. In its response to the 2024 Delta Programme proposal, the Cabinet emphasised that change is only possible if there is awareness, stating: *'the recommendations of the Pluvial and River Flooding Policy Platform show that local residents are not yet well informed about what can happen and what they themselves can do to prevent problems with excess water and high water'*⁷³.

3.7.2 Knowledge base for CCA

'Develop and exploit the knowledge base' is the second of the six objectives of the NAS. At national level, the CCA Portal for the Netherlands offers a wide range of user-oriented information including a climate atlas and map natural climate buffers⁷⁴, as well as knowledge dossiers on climate risks and on each of the sectors covered by the NAS. Every year, the Delta Programme Signal Group advises the Delta Commissioner about relevant scientific and social insights, and trends that the Delta Programme should be focusing on. The National Knowledge and Innovation Programme on Water and Climate (NKWK)⁷⁵, a partnership of government bodies, knowledge institutions and companies chaired by the Delta Commissioner, develops pilot projects designed to build knowledge on strategic issues mentioned in the Delta Programme. NKWK has organised an annual tour, since 2016, of CCA projects completed and underway, where practitioners and knowledge providers meet and exchange practical experience. The Knowledge Programme on Sea Level Rise under the Delta Programme, supports research based on the long-term scenarios mentioned earlier. Deltares is a leading knowledge institute providing expertise on nine different themes, of which eight – drought, floods, sea level rise, subsidence, water supply, future-proof infrastructure, water-soil-health and resilient cities – are directly relevant for CCA. Wageningen University & Research (WUR) explores impacts of future climate change on society and ecosystems, developing evidence-based, integrated solutions:

⁶⁹ <https://klimaataadaptatienederland.nl/overheden/nas/adaptatietool/>

⁷⁰ <https://www.knmi.nl/klimaatdashboard>

⁷¹ (Groningen, 2020)

⁷² <https://kaartportaal.drenthe.nl/portal/apps/storymaps/collections/00ea1916da454be98aef94fad319d4d1>

⁷³ Ministry of Infrastructure and Water Management et al. (2023).

⁷⁴ <https://www.klimaateffectatlas.nl/en/opportunity-map-natural-climate-buffers>

⁷⁵ <https://www.waterenklimaat.nl/>

the Wageningen Climate Solutions.⁷⁶ Water Management companies also compile large volumes of relevant data. Friesland's Blue Vision for Spatial Planning (BOVI), for example, which underlies the strategy 'Climate Resilient Friesland by 2050+', relies heavily on such data.⁷⁷

In Northern Netherlands, there is a particularly good connection between the research, economic and governmental actors.⁷⁸ Higher education institutions are actively involved in three main areas. They have strong bilateral collaborations with companies around specific R&I projects, they are key participants in regional cluster activities, such as the Northern Netherlands Energy Valley and living labs, as well as members of innovation ecosystem governance structures like the Innovation Board and the Economic Board for the Northern Netherlands, as well as the EDP for the Smart Specialisation Strategy RIS3. Of the international water technology research centre Wetsus in Leuwarden, a recent independent scientific audit states that, *'the Wetsus model clearly offers an effective pathway from leading research work to practical applications with significant economic and societal impact, that is one of the most effective academic-industry collaboration environments that the peer review committee has seen'*.⁷⁹ International perspectives are also strong in Groningen, which hosts a knowledge hub of the Global Centre on Adaptation (GCA)⁸⁰. Groningen University's multidisciplinary Coastal Resilience Research Group (CRRG) focuses on reinforcing and preserving sustainable, resilient communities in areas around the world with special vulnerability to climate change. Hanze University of Applied Sciences in Groningen coordinates 'Climate Scan', an international knowledge exchange on CCA projects involving over 1,000 active participants worldwide.

3.7.3 Strategic capacity

Strategic capacities for CCA in the Netherlands are high, demonstrating ability to define new pathways in uncertain situations, to be proactive rather than reactive and think outside-of-the-box. An array of no less than 122 tools is available on the Dutch CCA Knowledge Portal⁸¹, developed by central and local government bodies, higher education establishments, NGOs and some by private providers, to help persons at all levels in the system. These include guidelines for carrying out stress tests, risk dialogue roadmaps, tools for regulating and embedding CCA in different policy areas, for capitalising on linkage opportunities between instruments, as well as for promotion and visibility. There are even games to facilitate partnership approaches. Practitioners can also access support provided by the 'Climate-proof Together' platform, a network of professionals working in the CCA field focused on water management, heat, drought, and urban flooding. The platform fosters the sharing of experience and practical knowledge to help avoid actors repeatedly having to reinvent the wheel.⁸²

'Monitor the progress and effectiveness of adaptation policy' is the sixth amongst six objectives of the NAS. The Delta Plan for Spatial Adaptation has developed monitoring indicators which form the basis for compilation of its annual progress reports. Additional indicators are under development for the NAP, in coordination with the Delta Plan. The Netherlands Environmental Assessment Agency

⁷⁶ <https://www.wur.nl/en/themes/climate-change.htm>

⁷⁷ Province Friesland and Water Management Company Friesland (2023)

⁷⁸ (Benneworth and Arregui-Pabollet, 2021)

⁷⁹ <https://www.wetsus.nl/scientific-audit-self-assessment-2023/>

⁸⁰ <https://gca.org>

⁸¹ <https://klimaataadaptatienederland.nl/en/policy-programmes/delta-plan-sa/>

⁸² <https://klimaataadaptatienederland.nl/en/climate-proof/together/>

(PBL) launched a research programme in 2021 to monitor the short- and longer-term implementation of CCA measures⁸³. Planning Office for the Living Environment is also implementing a monitoring programme for CCA⁸⁴. At its launch in 2015, the Delta Programme was originally supposed to be evaluated every six years. The first evaluation was carried in 2021, but the second evaluation has started sooner, in 2023, due to rapid developments and new scientific insights on climate change which have recently become available.

⁸³ <https://www.pbl.nl/sites/default/files/downloads/pbl-2021-navigeren-naar-een-klimaatbestendig-nederland-4619.pdf>

⁸⁴ (Ministry of Infrastructure and Water Management, 2022b)

4 Conclusions

Northern Netherlands belongs to a country that is a pioneer in addressing challenges of climate change in a coherent, strategic and forward-looking way. There is strong understanding that planetary boundaries have been crossed in this spatially limited territory and that it is no longer sustainable to transgress them. In the Dutch struggle for land, CCA has found a place. A remarkable change in paradigm is taking place - from the reliance on nature-dominating technology, towards the realisation that 'nature poverty' is a real threat. Starting from the water challenge that has prevailed throughout Dutch history, the Netherlands is progressively incorporating a more systemic view across a range of transformations needed for effective CCA. Beyond the water challenges, a wider range of climate change risks – including droughts, rather new for a 'wet' country - is now integrated in scenarios for deep transformation of the society, in a long-term perspective.

The greatest advances by far have been in relation to water, more recently water together with soil, under the Delta Programme. The broadening of the CCA across all relevant sectors under the NAS is still incomplete, although concerted partnership work on all of the NAS focus areas is gaining momentum. Under both strategic frameworks, national guidelines lead developments at regional and local level, tailored to specific territorial needs, built through genuine consensus between stakeholders and strengthened by and learning from experiments in the field. Few tensions, if any, are evident in this multi-level governance perspective. It is an impressive blend of visionary capacity and pragmatism, which works, despite the complexity to the external observer of different configurations involving Provinces, Municipalities, Working Regions and Water Districts, together with national authorities.

It should be understood that the Northern Netherlands 'regional' level – although the subject of this Case Study - has little role here. The main CCA actors below the national Government are the Provinces, Municipalities and Water Boards.

Of special note, in the context of this study, is that the 'traditional' water focus of Dutch national CCA policy has itself become transformative. Under the Delta Programme, the 'Water and Soil Leading' principle guides this seismic shift away from fighting against nature towards working together with nature. The fear of water scarcity now adds to the trauma of flooding. The previous water management instinct of immediate water rejection from the land into the sea, is

"The speed of climate change requires an exploration of a possible shift from adaptive delta management to a transformative approach".
 Source: Ministry of Infrastructure and Water Management et al. (2023).

being complemented by the complete opposite orientation of retaining and saving water on the land for as long as possible. The old imperative of mastering and restricting river flows has given way to the new 'room for the river' approach – including a move from the continuous creation of artificial waterways, towards re-naturing and re-meandering of existing water courses (Table 3).

Table 3: Change of paradigms in CCA strategies in the Netherlands – Delta Programme and NAS

	Traditional strategic approach	New approach
High-level paradigmatic changes	Fighting against nature	Working together with nature: the 'Water and Soil Leading' principle
	Addressing water challenges	Addressing multiple Climate challenges in an integrated way

	Managing activities in urban, agricultural or natural areas under different frames	Managing land use in an integrated perspective
Translation of paradigmatic changes into strategies, policies and actions	Traditional water management oriented towards rejecting water into the sea	New water management oriented towards retaining and saving water (from strainer to sponge)
	Mastering and restricting river flows	'Room for the river' approach
	Artificial waterways	Re-naturing waterways (e.g. re-meandering and greening river banks)
	Traditional farming practices	New farming practices, e.g. saline farming
	Grey solutions (e.g. concrete dykes)	Blue-green solutions (e.g. nature-based solutions for river banks)
	One-function spaces	Multi-functional spaces

Source: Authors, based on interviews and documentary analysis

The Netherlands' transformational CCA agenda is visibly strengthening, thanks to closer coordination between the Delta Programme and the NAS and complementary support from the Mission-Driven Top Sectors and Innovation Policy. The new NAS starting in 2024 represents an important opportunity to deepen and accelerate the deployment of frontrunner and transformative CCA strategy in the Netherlands, across a broadening range of sectors and interests. The Dutch tradition of partnership and co-creation will be vital to success. Place-based sensitivity, with smooth interplay between the national vision and local specificities, leaves room for spatial differences.

The main conclusions arising from each of the seven key Transformative Innovation features of the analytical framework are re-stated below. Under each of these features, possible ways forward are suggested, which could help North Netherlands deepen its Transformative Innovation approach to CCA.

1 - Directionality

CCA strategy at national level in the Netherlands presents something of a two-speed picture. The Delta Programme, in force since 2010 with substantial dedicated domestic budgetary resources, with its main focus on water, soil and spatial planning, is more advanced than the National Adaptation Strategy (NAS), which deals with a wide range of other sectors and value chains not directly covered by the Delta Programme. Oversight of the two strategies by the same Ministry supports coherence of goals. Both demonstrate directionalities increasingly in favour of societal transformation. For the Delta Programme, the move away from the water engineering miracles deployed in the past, towards 'Water and Soil Leading' and 'Room for the River' principles represents a deep change in paradigm. This radical shift is also reflected in related strategies and initiatives at the level of the Provinces, 'Working Regions' and Municipalities in Northern Netherlands. Under the NAS, first adopted in 2016, transformative CCA in the other dimensions vulnerable to climate change - such as built environment, human health and public safety, tourism, infrastructure, energy, telecommunications and security - is at a much earlier stage of maturity. However, the necessary strategic elements are in place to speed up CCA also across this wider front.

The main innovation strategies relevant to the territory – the national Mission-Driven Top Sector and Innovation Policy, recently renewed for 2024-2027, and the 2021-2027 'RIS3' Smart Specialisation Strategy for Northern Netherlands – are tightly interlinked and display strong directionality with

regard to societal challenges. Neither, however, features CCA as a mission in its own right. CCA is instead suffused throughout their mission-driven priorities. Governance arrangements for both CCA and innovation strategies have a strong cross sectoral and multi-dimensional flavour, supporting interaction between them.

Possible ways forward:

- Given the specific historical and geographical context of the Netherlands, a convincing strategic framework for CCA with strong directionality has evolved. There is little advice which can be offered to the territory at this stage, other than simply to continue and strengthen the work already underway on this promising path - further defining quantitative strategic goals along the way.
- Under the NAS, detailed investigation will be needed to better understand and exploit the paradigmatic shift points for transformative CCA across the many sectors it covers.
- In line with the findings of the recent NAS evaluation, further work is needed generally to reinforce coordination between the NAS and the Delta Programme. Full use should be made in this regard of EU support, for example, under the LIFE IP project NL-NASCCELERATE (2022-2027), which focuses on the bridge between the two programmes.

2 - Articulating instrument portfolios and defining synergies between funding sources

There is generous domestic public financing available for CCA in the Netherlands. The Delta Programme has its own dedicated Delta Fund with a budget of €21bn for 2023-2036, with a further €20bn foreseen provisionally up to 2050. Although the NAS does not have its own budget in the same way, the CCA related investments it should stimulate can be financed through the wide array of public policies it embraces. Spatial planning offers the most comprehensive framework of instruments for CCA relevant investment. The national Government has CCA agreements with Provinces, district Water Boards, and Municipalities in the Northern Netherlands for the joint financing of CCA measures in the context of spatial planning. There is also the WaddenFonds, established by the Dutch government in 2007 for a period of 20 years, based on revenues from gas extraction and targeting exclusively the three Provinces of Noord-Holland, Friesland and Groningen, which can finance CCA investment.

R&I relevant for CCA can be supported through the Mission-Driven Top Sectors and Innovation Policy. Its budget for 2024-2027 is over €5bn – including substantial resources from the private sector. For large projects there is the Growth Fund with a budget of €20bn for 2021-2025. There are also the various funding channels of the Research Funding Agency. Out of the global figures mentioned, the overall amount going specifically to the CCA theme, across domestic R&I programmes, is not easily identifiable.

EU Cohesion Policy in the Northern Netherlands supports CCA-relevant R&I through the territory's Smart Specialisation Strategy 'RIS3' and Interreg programmes. The ERDF does not co-finance mainstream CCA investment in the region – this is addressed almost exclusively by domestic funds. Local authorities and universities in the Northern Netherlands are active participants in CCA related projects under EU-level programmes. This includes the University of Groningen's participation in the Horizon Europe project RISKADAPT and the Province of Friesland's in the project NBRACER: 'Nature Based Solutions for Atlantic Regional Climate Resilience', under the EU Mission on Climate Change Adaptation. Also, under the LIFE-IP project Climate Adaptation NL-NASCCELERATE, over 20 Dutch organizations work in partnership to accelerate CCA at local level.

Possible ways forward:

- Carry on promoting R&I in innovative CCA solutions and engage an ever-wider variety of sectors.
- Consider a more visible tracking of CCA-specific expenditure across all domestic R&I programmes and RIS3 to gain better understanding of how this compares with the R&I effort in other policy fields.

3 - Ensuring cross-domain synergies

Cross-domain synergies for CCA in Northern Netherlands, as for the country as a whole, are actively pursued through the NAS and the different inter-institutional governance structures in place for its six priority objectives. The approach is further strengthened through coordination between the implementation of the NAP and the Delta Programme, including interprovincial consultation in the wide variety of domains influenced by the 'Water and Soil Leading' principle. The Delta Programme is also strengthening linkages with the insurance and financial sector and with the health sector.

Work has been underway since 2019 to promote CCA integration into wide range of standards, through cooperation between different disciplines and sectors, in the framework the Climate Adaptation Standards Consultation, OSKA. Interdisciplinary and transdisciplinary approaches are increasingly evident in the CCA-relevant missions under the Mission-Oriented Top Sector and Innovation Policy, notably in the Mission Area Agriculture, Water and Food. The assessment of the territory's efforts so far to maximise cross domain synergies for CCA is strongly positive.

However, there remains a view that more could be done in dimensions less focused on economic interests and more in relation to climate change effects on people, culture and nature. Moreover, there is no mechanism in place to ensure accountability of government authorities for correct implementation of CCA actions.

Possible ways forward:

- Continue to intensify the building of operational bridges between Delta Plan, NAS and other relevant CCA strategies.
- Broaden the focus of action more into the people, culture and nature dimensions of CCA, in addition to the currently dominant economic interests.
- Move forward from optional guidelines towards compulsory regulations for integrating CCA in building. Embed National Yardstick and the spatial assessment framework into legal framework, as advised in Delta Plan 2024.
- Consider establishing a mechanism to ensure accountability of government authorities for the successful, or unsuccessful, implementation of CCA actions.

4 - Increasing breadth and depth of stakeholder involvement

Northern Netherlands presents an exemplar case of stakeholder involvement in CCA activity. It has a strong tradition of local cooperation based on the 'polder model', with its roots in the struggle against water. As in the Netherlands generally, a multiplicity of structures and actions to involve broad populations of stakeholders, characterise decision making on CCA strategy and its implementation in the territory. The most prominent of these are the 'Action-Oriented Climate Adaptation Dialogues' used under the NAS and Delta Programmes. These dialogues promote

transparency and collaboration between Government, business, nature and environmental organisations, Water Boards, agriculture and civil society. They are carried out with understanding of the time and effort needed to reach consensus and achieve genuine co-creation in different situations.

In the R&I field, the increasingly continuous Entrepreneurial Discovery Process (EDP) of the Northern Netherlands Smart Specialisation Strategy RIS3 builds on the same tradition and is particularly well developed. For CCA, NGOs in the 'nature' sector make a strong contribution to the dialogues in different areas, including through the involvement of farmers in delicate discussions over the future of agriculture.

Two new imperatives feature in the 2024 Delta Programme, namely 'Generation Testing' to incorporate the views of young people, as well as greater direct involvement of citizens in CCA. Both remain challenging, but they are actively pursued by bodies working on CCA in the territory.

Possible ways forward:

- Incorporate knowledge from behavioural, sociological and political sciences to broaden co-creation processes with citizens and reinforce the role of authorities as facilitators.
- Broaden the inclusiveness of stakeholder involvement in Delta Programme, paying more consideration to less represented groups: young people, less educated part of the population, people with low revenue (a recommendation from the Delta Signal group)⁸⁵.
- Continue to deepen involvement of the younger generation.
- Work out new modes of participation of citizens.

5 - Setting up effective multi-level governance models

There is good articulation between the NAS and Delta Programme and regional/local strategies in terms of strategic principles. Comprehensive national level guidance covering different aspects of CCA supports implementation of the Delta Programme at the local level. This includes an obligation for local 'stress tests' for heat, flooding and drought to be carried out every six years in both urban and rural areas. Place-based specificities are taken into account in the CCA strategies required for each 'Working Region' and prepared voluntarily at other sub-national levels, mainly Province and Municipality in the case of Northern Netherlands. There is a degree of overlap between the boundaries of the 'Working Regions' and these other sub-national levels, particularly in relation to water issues. This is based on an established domestic framework and does not appear to pose a problem for local actors. Strong mechanisms are in place for multi-level dialogue on CCA strategy preparation and implementation, which involve all relevant government bodies and encourage collaboration with other stakeholders.

Possible ways forward:

- The Netherlands operates a successful multi-level governance system for CCA strategy making and investment under the Delta Programme. It will be important to ensure the continued effectiveness of governance as CCA spreads across more sectors in the framework of the NAS.

⁸⁵ <https://www.deltaprogramma.nl/documenten/publicaties/2023/09/13/samenvatting-adviezen-signaalgroep-dp-2023-en-reactie-dc>

- Mechanisms for joint investments between Provinces, Working Regions and Municipalities in the other NAS sectors should become a part of enhanced governance arrangements.

6 - Making room for experimentation

There is considerable experimentation on CCA solutions underway in Northern Netherlands. This generally takes place within established strategic frameworks, from which the necessary financing is readily available. On-going experimentation covers the main CCA challenges for the territory, including innovative solutions for coastal defence, freshwater retention, enhancing biodiversity combatting soil erosion and reducing urban heat effects. Live testing of more people-focused CCA aspects, including related new business models, is carried out largely through public-private sector collaboration in the framework of the Mission-Driven Top Sector Innovation Policy. To demonstrate new nature-based solutions, living labs requiring vast spaces have been established for several years already. Some of the nature-based coastal defence experiments, such as double-dyke innovations, have proved their effectiveness. The challenge now will be mainstreaming of such approaches given the deep implications this is likely to have for land use and spatial planning.

Possible ways forward:

- Make the most of the ecosystem built up under the Smart Specialisation Strategy RIS3 to promote experimental approaches to CCA in more sectors in the framework of the NAS.
- Highlight the need at political level to move towards mainstreaming successful innovations in CCA – especially where there are likely to be land-use sensitivities.

7 - Securing high levels of policy intelligence, learning and strategic capacity

Awareness of climate risks and CCA is high across a wide range of public and non-governmental bodies in the Netherlands as a whole. It is also relatively high among citizens, even though more work could be done in this area – particularly on risks other than sea level rise. Strong communication efforts on CCA are underway – the ‘circle diagrams’ from the NAS, revealing the multiple inter-related consequences of different climate change effects, have evolved into a valuable interactive medium to support strategy building.

The Northern Netherlands boasts particularly good connections between research and practice in the field of CCA. This is visible in the strengths of the territory’s R&I ecosystem generally, as well as in the growing international CCA reputation of its key research institutions. Strategic capacities for CCA in the territory are also impressive, supported by comprehensive guidance available through the national CCA platform and relevant capacity building initiatives, in addition to less formal networking between CCA practitioners. Monitoring the implementation of CCA measures at different geographical levels is thorough and evaluation of the Delta Programme – originally foreseen every six years – is beginning to take place more frequently due to rapid developments and new scientific insights on climate change.

Possible ways forward:

- Intensify knowledge development on transnational issues, such as river management to understand cross-border impacts e.g. of fluctuating Rhine and Meuse flows originating from neighbouring countries – as suggested in Delta Plan 2024.
- Work on standardisation of data compiled by waterboards and aggregation of these at higher level (Provinces)

- Incorporate increasingly specialised staff working on CCA at local and Provincial levels.

Transformative CAA innovation is well underway in the Netherlands as a whole. Examples of good practice are abundant in the Northern Netherlands – its Provinces, Municipalities and ‘Working Regions’. They derive from the territory’s long history with water and are fuelled by the strong collective working spirit of the Dutch people. The main advice this study could give would be, *‘carry on like this!’* It is hoped that the possible ways forward suggested here can be useful to the Dutch authorities in their journey through Transformative Innovation approaches to more effective CCA.



Photo: Coastal defence on Wadden Sea and Lauwersmeer, Northern Netherlands (© Authors).

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Interreg North Sea Building with Nature

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Interreg North Sea Salfar – Saline Farming

<https://northsearegion.eu/salfar/about/>

LIFE COOL SQUARE

<https://webgate.ec.europa.eu/life/publicWebsite/project/details/5528>

LIFE IP Climate Adaptation

<https://klimaatadaptatienederland.nl/overheden/life-ip-klimaatadaptatie/>

NBRACER project under EU Mission CCA (Horizon Europe)

<https://cordis.europa.eu/project/id/101112836>

RISKADAPT project under EU Mission CCA (Horizon Europe)

<http://riskadapt.eu/>

REST-COAST Horizon 2020 project

<https://rest-coast.eu>

Water as leverage for Climate Adaptation Wadden Sea

<https://www.worldwateratlas.org/news/setting-the-scene-report-for-water-as-leverage-wadden-sea-region-ready-saywad/>

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<https://klimaatadaptatienederland.nl/>

ClimateADAPT page on climate adaptation activities in Netherlands
<https://climate-adapt.eea.europa.eu/en/countries-regions/countries/netherlands>

Climatecafé
<https://climatecafe.nl/how-we-work/>

Climate effect atlas
<https://www.klimaateffectatlas.nl/en/>

Climate Initiative Northern Netherlands
<https://climateinitiativenoordnederland.nl/en>

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<https://climatescan.org/>

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<https://www.deltares.nl/en>

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<https://dp2024.deltaprogramma.nl/core-message/in-five-minutes/>

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<https://www.groningerlandschap.nl>

Foundation Natuurbelang De Onlanden
<https://www.deonlanden.nl>

Global Centre on Adaptation
<https://gca.org>

Groningen Climate initiative
<https://climateinitiativenoordnederland.nl/en>

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<https://www.hanze.nl>

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<https://nas-adaptatietool.nl/>

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<https://klimaatadaptatienederland.nl/en/policy-programmes/nas>

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<https://www.waterenklimaat.nl/>

Nature and Environment Federation Groningen
<https://nmfgroningen.nl>

Netherlands Enterprise Agency- Rijksdienst voor Ondernemend Nederland - RVO
<https://www.rvo.nl>

Netherlands Environmental Assessment Agency – PBL

<https://www.pbl.nl/en/>

SNN-Northern Netherlands Alliance

<https://www.snn.nl/en>

Spatial planning policy

<https://www.denationaleomgevingsvisie.nl/home/default.aspx>

Valuta voor veen – Value for Peat

<https://valutavoorveen.nl/>

Wetsus - European centre of excellence for sustainable water technology

<https://www.wetsus.nl/>

List of abbreviations

CCA	Climate Change Adaptation
EIA	Environmental Impact Assessment
GHC	Green House Gas
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Center
KIA	Knowledge and Innovation Agendas
KNMI	Royal Netherlands Meteorological Institute
MMIP	Multi-year Mission-driven Innovation Programmes
NAP	National Adaptation Plan
NAS	National Climate Adaptation Strategy
NOVI	National Strategy on Spatial Planning and the Environment
NPLG	National Rural Area Programme
NRRP	National Recovery and Resilience Plan
PPS	Purchasing power standard
R&D	Research and development
R&I	Research and innovation
TCR	Transboundary climate risks
TI	Transformative Innovation
TTO	Technology Transfer Office
IPCC	Intergovernmental Panel on Climate Change
WaBoS	“Water and Soil Leading” principle

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Date	Interviewee	Position
09.10.23	Wetsus - European centre of excellence for sustainable water technology	
	Pieter de Jong	Liaison officer (Brussels)
	Roel Meulepas	Research management team, director Europe
	Jan Post	Research management team, program director
10.10.23	Cees Buisman	Chief Executive Officer (online)
	Foundation Groninger Landschap	
	Marco Glastra	Director
	Oscar Borsen	Collaborator
	Global Center on Adaptation - GCA	
	Floris Boogaard	Professor Spatial Transformation - senior consultant at Deltares Lecturer Hanze University of Applied Science
	Hanze University of Applied Science	
	Piet Zijlstra	Project leader - Climate Testing Ground
	Northern Netherlands Alliance - SNN	
	Luc Hulsman	RIS3 manager
	Dana Khudaybergenova	Advisor Programme management
	Foundation Natuurbelang De Onlanden	
	Lieselot Smilde	Leader
	Province Groningen	
	Gert Noordhoff	Senior Project Leader – Region Deal nature-inclusive agriculture North Netherlands
	Eric Lanooy	Programme manager Climate Adaptation Coordinator working region Groningen/ North Drenthe
Province Drenthe		
Cipke Uri	Process Director Climate Adaptation	
11.10.23	Jennifer Brecheteau	Team Water, Soil and Environment
	Province Friesland	
	Egbertha Schuiling	Project Leader regional Water programme and Friesland Climate Resilient 2050+
	Water Company (Waterschap) Friesland	
	Karel Veeneman	Programme manager Climate Adaptation (online)
	Working region South-West Friesland	
	Tineke Pijnacker	Programme manager Climate Adaptation and Water Ambassador for municipalities Friesland
	Nature and Environment Federation Groningen	
	Bas Hollander	Policy officer – Land Planning and Climate Adaptation
Martijn van der Glas	Project leader Climate and Energy	

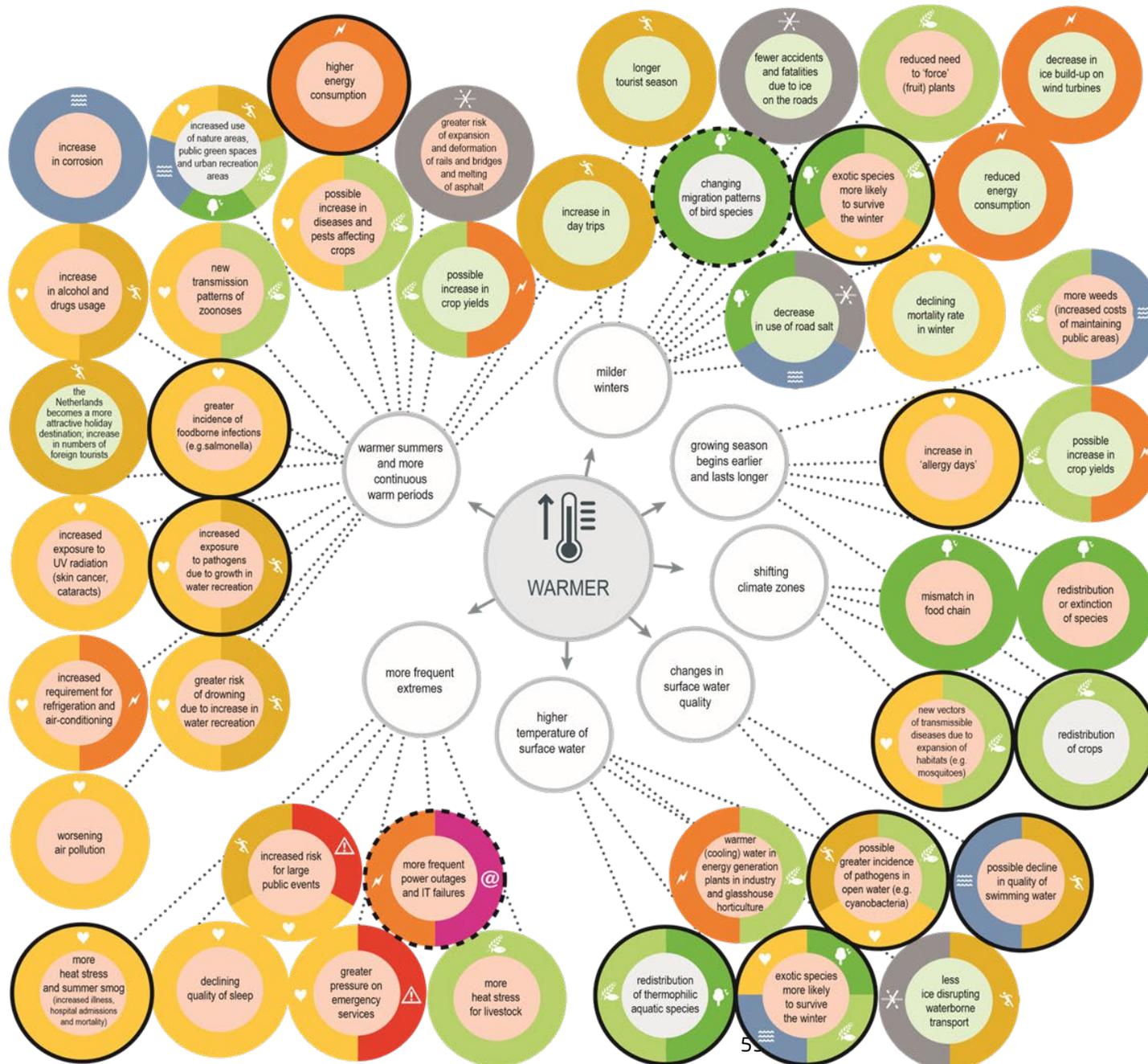
Date	Interviewee	Position
12.10.23	Delta Commissioner	
	Peter Glas	Delta Commissioner (online)
	Martijn Looijer	Deputy to Delta Commissioner (online)
	Netherlands Enterprise Agency- Rijksdienst voor Ondernemend Nederland (RVO)	
	Sandra Schoof	Programme Manager Water as Leverage - Department for International Development (online)

Annex 2. Climate Adaptation tool from the Dutch National Adaptation Strategy

In the frame of the Dutch NAS, CCA ‘Circle diagrams’ (‘bollenschemas’ in Dutch) have been prepared in 2016 and turned into an effective communication tool. The circle diagrams provide a visual summary of the latest scientific knowledge on effects of four climate change – heat, rain, droughts and sea level rise – on 10 sectors potentially affected by these changes: water availability; nature; agriculture, horticulture and fisheries; health; recreation and tourism; infrastructure; energy; ICT/telecoms; security; built environment and land planning. Distinction is made, on the one hand, between direct and indirect effects, and on the other hand, between positive and negative effects. Short-term versus long-term effects are also shown. The first static version has been turned into an interactive version, in which the user can select specific climate impacts or sectors, or only positive or negative impacts, etc. and prepare tailor-made visualisations according to their needs.

Reference : NAS adaptation tool (<https://nas-adaptatietool.nl/>)

National Climate Adaptation Strategy (NAS)
Climate trends, climate impacts and consequences for sectors



Sectors

- Water and spatial management
- Nature
- Agriculture, horticulture and fisheries
- Health
- Recreation and tourism
- Infrastructure (air, road, rail, water)
- Energy
- IT and telecommunications
- Safety and security

Impact

- Medium to marked effect: this decade
- Marked effect: this century

Nature of effect

- Effect is an opportunity
- Effect is a threat
- Unclear whether effect is an opportunity or a threat

source: - PBL. Aanpassen met beleid klimaatverandering (Adapting to climate change), 2013
- PBL. Aanpassen aan klimaatverandering/klimaatverandering (Adapting to climate change), 2015
- NAS workshop sessions, 7 June, 1 September and 12 October 2016

Disclaimer: These diagrams offer a simplified and incomplete representation of the actual situation. In the interests of clarity, not all components of the known causal relationships are shown.
P.M. Scientific check on this version

Annex 3. List of case studies

Case studies have been carried out to analyse to what extent and how enabling factors towards ‘Transformative Climate Change Adaptation’ strategies, as identified in the conceptual report (European Commission, 2024), are at play in reality, and what can be done to overcome barriers in various territorial contexts. The methodological framework described in the conceptual report essentially acts as a practical guide for undertaking cases studies on CCA strategies in different territories, in a uniform way. These case studies are listed below:

“Transformative innovation for better climate change adaptation” – Case studies

Country	Territory	URL (*)	DOI	JRC number
Belgium	Leuven	https://publications.jrc.ec.europa.eu/repository/handle/JRC137313	10.2760/58125	JRC137313
Finland	Espoo	https://publications.jrc.ec.europa.eu/repository/handle/JRC137316	10.2760/177322	JRC137316
Finland	Turku - Southwest Finland	https://publications.jrc.ec.europa.eu/repository/handle/JRC137315	10.2760/211155	JRC137315
France	Provence-Alpes-Côte d'Azur	https://publications.jrc.ec.europa.eu/repository/handle/JRC137314	10.2760/46893	JRC137314
Greece	Attica and North Aegean regions	https://publications.jrc.ec.europa.eu/repository/handle/JRC137322	10.2760/493562	JRC137322
Iceland		https://publications.jrc.ec.europa.eu/repository/handle/JRC137291	10.2760/305796	JRC137291
Italia	Emilia-Romagna	https://publications.jrc.ec.europa.eu/repository/handle/JRC137319	10.2760/790200	JRC137319
Netherlands	Northern Netherlands	https://publications.jrc.ec.europa.eu/repository/handle/JRC137312	10.2760/10862	JRC137312
Poland	Mazovia - Stare Babice	https://publications.jrc.ec.europa.eu/repository/handle/JRC137323	10.2760/58125	JRC137323
Portugal	Norte	https://publications.jrc.ec.europa.eu/repository/handle/JRC137321	10.2760/399394	JRC137321
Romania	Nord Vest - Cluj	https://publications.jrc.ec.europa.eu/repository/handle/JRC137317	10.2760/923916	JRC137317
Slovenia	Gorenjska	https://publications.jrc.ec.europa.eu/repository/handle/JRC137320	10.2760/502482	JRC137320
Spain	Andalucia - Granada	https://publications.jrc.ec.europa.eu/repository/handle/JRC137324	10.2760/104672	JRC137324.
Sweden	Blekinge and Värmland	https://publications.jrc.ec.europa.eu/repository/handle/JRC137318	10.2760/249067	JRC137318

(*) Links may give error message for those studies still under publication

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