Summary

Knowledge and Innovation Agenda Agriculture, Water, Food 2020 - 2023

TOPSECTOR WATER & MARITIEM

Topsector Agri & Food

TOPSECTOR

Rijksoverheid

Introduction

As part of its mission-driven Top Sectors and Innovation Policy, the government has set out its ambitions for a number of major social themes. The following six missions cover the areas of agriculture, water and food:

A Circular agriculture
B. Climate-neutral agriculture and food production
C. Climate-proof rural and urban areas
D. Healthy, safe and appreciated food
E. Sustainable and safe North Sea, oceans and inland waters
F. The best protected and liveable delta in the world.

The top sectors Agri & Food, Horticulture & Propagation Materials and Water & Maritime have drawn up a joint Knowledge and Innovation Agenda for the six missions across the years 2020-2023.

Innovating together

The agenda was drawn up in close consultation with the stakeholders: government ministries, the public sector, the business sector, regional authorities and water boards. This makes the agenda a widely-supported document that will give direction to the Joint Top Sectors and Innovation Policy for the coming years.

Building and strengthening

The agenda builds on the topics of the previous knowledge and innovation agendas of the three top sectors, such as sustainable water use, sustainable and safe food, climate-neutral and circular production, high-quality plant-breeding materials and smart technology. This more-intensive cooperation between the three top sectors and the governments (national and provincial) will ensure a more integrated approach to the topics at stake. New themes are biodiversity, climate adaptation, water quality, sustainable North Sea and other large waters, and the circular use of raw materials.

Netherlands as hotspot

By working together and investing in knowledge development and innovation, a major contribution can be made to solving sociatal issues, both in the Netherlands and abroad. The agenda will also ensure that the Netherlands will remain as the global hotspot for smart solutions to future problems in agriculture, horticulture and the water sector.

** The complete Knowledge and Innovation Agenda can be downloaded from www.kia-landbouwwatervoedsel.nl*

The tasks

Ambitions

The Netherlands faces a number of major challenges in the areas of agriculture, water and food. In this Knowledge and Innovation Agenda, the three top sectors have described how they will tackle the knowledge and innovation tasks associated with the six missions.

Circular agriculture

Although major steps have already been taken, our food production system still emits too many harmful substances into the soil, water and air. It is our ambition to achieve a system of raw material reuse without negative impact on soil, water or air. At the same time, the system must give more space to biodiversity, contribute to the replacement of fossil raw materials by renewables, and to the replacement of animal proteins by alternatives.

Climate-neutral agriculture and food production

The Paris Climate Accord sets out the ambition to strive for maximum warming of 1.5 degrees Celsius. The Dutch government aims to reduce greenhouse gas emissions by 49% by 2030 and by 80-95% by 2050. This makes clear that the agricultural and horticultural sector will, in combination with carbon sequestration in nature, have to produce in a climate-neutral manner.

Climate-proof rural and urban areas

In rural areas, the challenge is to make regional water management, agriculture and nature more climate-proof. In some areas, the challenges are already so large and complex that new business and earning models for agriculture are needed. Many natural areas are suffering from water shortage, which can cause irreversible damage. There are also major problems in urban areas: the large paved surfaces in cities quickly lead to flooding, drought and heat stress in a warming and erratic climate. In both rural and urban areas, good water quality for people and nature remains an important concern.

Appreciating healthy, safe food and the green environment

In recent decades, the gap between food production and consumers has widened. A growing proportion of the population no longer knows how food is produced and so has a lower appreciation of food, the green environment, and those who produce and care for both. Enormous amounts of edible food are wasted and increasing unhealthy consumption patterns are leading to increasing public health challenges.

Best protected and livable delta

The Netherlands is the best protected and habitable delta in the world and it is vital that this continues to be the case after 2100. Climate change is a major challenge. It is uncertain how fast the sea level will rise, extreme weather conditions are becoming more frequent and the discharge of rivers shows large fluctuations. Under these conditions we must protect ourselves against flooding, prevent extreme salinization of rivers and groundwater in the coastal zone and ensure a climate-robust maritime economy in balance with other river/sea functions and uses. This calls for future-proof and integrated solutions. At the same time, we are already faced with the challenge of making water interventions more sustainable and keeping their costs under control.

Sustainable use of the great water sources

More and more economic activities are taking place on and in the water: offshore farming and renewable energy at sea and in large inland waters are growing exponentially. The many existing and planned activities, and by climate change, are putting pressure on the quality and management of both water and resources.

Tough tasks, powerful parties, international reach

The tasks present considerable challenges for the public and private sector and knowledge institutions. In the fields of agriculture and in water and food, the Netherlands is a global leader in the development of smart, efficient solutions. This puts the top sectors Agri & Food, Horticulture & Propagation Materials and Water & Maritime in an excellent position to engage with these challenges and remain world leaders in sustainable solutions for global social issues in agriculture, water and food.

Missions

A Circular agriculture

- Reduce fossil nutrients, water use, and nitrogen deposition
- Healthy, robust soil and cultivation systems
- Reuse of organic side and residual flows
- Protein supply from plant sources
- Biodiversity in circular agriculture

B Climate-neutral agriculture and food production

- Reduction of methane emissions from livestock farming
- Agricultural soils: nitrous oxide emission reduction, carbon sequestration increase
- Reduction of peat-meadow oxidation
- Increased carbon sequestration in forest and nature
- Energy production, -use, and -saving (incl. greenhouses as a source of energy)
- Production and use of biomass

C Climate-proof rural and urban areas

- Climate-proof rural areas: preventing inundation and water shortage
- Climate adaptive agriculture and horticulture systems
- Flood- and climate-proof urban areas
- Improved water quality

D Appreciated, healthy and safe food

- Appreciation of food
- Healthy food as an easy choice
- Safe and sustainable primary production
- Sustainable and safe processing

E Sustainable and safe North Sea, oceans and inland waters

- Sustainable North Sea
- Nature-inclusive agriculture, fisheries and water management in the Caribbean Netherlands
- Rivers, lakes and intertidal areas
- Other oceans and seas: Blue Growth
- Fishing

F The Netherlands is and must remain - past 2100 - the best protected and habitable delta in the world

- Making water management more sustainable at acceptable costs
- Adapting to accelerating sea level rise and increasing weather extremes
- The Netherlands' Digital Water Country
- Sustainable energy from water

Key enabling technologies

- Smart Technologies in Agri-Horti-Water-Food
- Biotechnology and breeding

The six missions and the knowledge and innovation agenda

A Circular agriculture

In 2030, the agricultural and horticultural sectors will be using substantially fewer raw materials and excipients. As much value as possible will be derived from residual flows and end products. The emission of polluting substances into surface water, air and soil will have been reduced to (almost) zero. Agriculture and horticulture will be using robust varieties and cultivation systems. Food production will be based on ecological processes which increase biodiversity and enable agriculture and horticulture to operate more resiliently. There will be greater supply of plant-based protein sources.

Main knowledge and innovation themes

- Reduction of nitrogen deposition on vulnerable nature; better, circular use of nutrients and water
- Development of robust cultivation systems, on healthy soil and substrate, based on agri-ecological principles
- Optimised reuse of side and residual flows
- Development of new plant-protein sources within Europe for food and feedstuffs
- Insight into how biodiversity can be restored and utilised in a circular agriculture system.

EXAMPLE

Plants self-defending against pests and diseases

Plant (disease) resistance is at the core of plant health. Many important horticultural crops are susceptible to insect pests and infections. Some of the plant's 'own' microorganisms that live in and on the plant (the microbiome) could become a part of the plant's natural defences against such attackers.

In the project *Strengthening plant resistance against diseases and pests by adjusting the plant microbiome*, research is being conducted into the effects of the microbiome on plant resistance. The aim is to gather knowledge about the possibilities of adapting the microbiome in such a way that the plant's natural resistance increases to the point where the plant can protect itself against diseases and pests.

EXAMPLE

Valorising residual flows

The pulp that remains after the extraction of sugar from beet contains a number of components with interesting applications. For example, microcrystalline cellulose (MCC) fibres from sugar-beet pulp could be valuable substitutes for wood fibres, which currently dominate the market. Not only because their extraction is cheaper and more environmentally friendly, but also because MCC fibres have much greater application potential than wood fibres. These applications are being developed in the project *Extraction and valorisation of microcellulose fibres from beet pulp*. This will increase the value of sugar beet and limit the use of production methods that harm the environment.

EXAMPLE

Recovering minerals from manure

At present, the use of minerals in agriculture is not a closed cycle. Minerals enter our country via cattle feed and artificial fertiliser and end up as manure. Closing these cycles will be a major step towards making the sector more sustainable while, simultaneously, offering interesting business possibilities.

In the project *Added value manure and minerals*, a technology has been developed that produces 'green' fertiliser using biorefining and other processing techniques. This allows minerals to be recovered and secondary raw materials to be extracted and reused in the biobased economy. The project's technology simultaneously recovers nitrogen and phosphate from animal manure. The first Green Minerals Power Station has now come online, where this concept is applied on an industrial scale.

EXAMPLE

Closing the cycle via animal feed

Circular agriculture is about closing the flow of raw materials, as much as we can, at the lowest possible geographical level. In various projects, the Top Sector Agri & Food is examining the development of animal feeds that make maximum use of residual and side streams from the agrifood sector. This means that as many valuable nutrients as possible remain in the cycle and that the import of raw materials for animal feed can be reduced. Animal feeds are also being developed that contain substantially less protein and phosphorus yet still perform well. All these measures will help reduce the import of raw materials and the excretion of minerals in manure.

B Climate-neutral agriculture and food production

In 2050, the agricultural and horticultural sector will be operating climate neutral. Emission of greenhouse gases (by then significantly-reduced) will be compensated by additional CO_2 capture in the soil and in nature. The sector will no longer use fossil raw materials and will have become a provider of sustainable energy.

Main knowledge and innovation themes

- Reduction of methane emissions in the livestock sector
- Reduction of peatlands oxidation
- Reduction of nitrous oxide emissions from fertilisation of agricultural soils and from outdoor cultivation
- Carbon sequestration in agricultural soils, in outdoor cultivation, in forests and nature
- Reduction of energy consumption in greenhouse horticulture.

EXAMPLE

Nutrient cycle guide

The Recycling Guide is being developed into a business management program that accurately maps the efficiency of nitrogen, phosphate and carbon recycling at every point in the business system and compares it with standard and reference values for an individual dairy farm.

The Recycling Guide supports dairy farmers to make management decisions that positively contribute to the circular use of raw materials and the reduction of nitrogen and greenhouse

EXAMPLE

Towards climate-neutral greenhouse horticulture

By 2030, the horticultural sector's goal is to halve its CO_2 emissions compared to 2019. Essential to success will be the development and implementation of energy savings in greenhouses, the availability of sufficient external CO_2, the implementation of urban heating networks combined with the further development of geothermal heat, and restructuring and newbuild of the horticultural area by at least 300 hectares per year. *The Greenhouse as energy source* programme is focussed on the development of knowledge, concepts and supporting technology. It is also working on maximum real-world implementation of developed techniques following an area-specific approach. A good example of such research is projects in which fossil-free cultivation systems are developed and demonstrated.

EXAMPLE

Seaweed for food and feed

Seaweed is nutritious and versatile; it could become an important source of plant protein. However, large-scale seaweed cultivation is not yet profitable in Western Europe. Innovations expected from the *Seaweed for food and feed* project will address this issue by reducing production costs and increasing economic returns.

This project is developing knowledge and innovation in the Seaweed Sector that will accelerate the growth of new and sustainable raw materials in the Netherlands. Knowledge is needed along the entire seaweed value chain: from breeding and processing to consumer behaviour. The aim of the project is to turn seaweed into a new sustainable source of healthy foods, food additives and animal feed, based on sustainable seaweed cultivation in Dutch waters.

Key top sector numbers

Number of businesses
174,059 (99% sme)
10.8% NL

A&F	T&S	W&M
145.140	23.700	3.375

R&D expenditure
€ 1.6 mld.
17.7% NL

A&F	T&S	W&M
0,7 mld.	0,3 mld.	0,6 mld.

Export value
€ 88.2 mld.
20.4% NL

A&F	T&S	W&M
63,7 mld.	19,1 mld.	5,4 mld.

Employees
1,224,000
13.7% NL

A&F	T&S	W&M
1.041.000	128.000	55.000

Production
€ 174 mld.
12.8% NL

A&F	T&S	W&M
141 mld.	10,3 mld.	14,6 mld.

Added value
€ 64.6 mld.
10.1% NL

A&F	T&S	W&M
49,8 mld.	10,3 mld.	4,6 mld.

Source: CBS Monitor topsectoren 2018

Main knowledge and innovation themes

- Prevention of flooding and water shortage in rural and urban areas
- Development of climate-proof agricultural and horticultural production systems and design of a climate-proof built environment
- Improvement of water quality.

C Climate-proof rural and urban areas

By 2050, the Netherlands will be climate proof and water robust in both rural and urban areas. In rural areas, the management of groundwater and surface water will be such that it makes an important contribution to the climate resilience of agriculture, horticulture and groundwater-dependent industries without irreversibly damaging nature reserves. At the same time, the agricultural and horticultural systems will have been designed to cope with climate change. The built environment is climate proof by optimizing urban water management, greening the city, and climate-proof building. Improving the quality of groundwater and surface water will remain a constant concern.

EXAMPLE

Clean water in horticultural areas

Through the project, *Preventing and combating emissions from greenhouses*, the sector is working on issues relating to emission-free cultivation and the purification of residual flows (closing the water and nutrient cycles).

The aim of this project is to develop a system for optimal management of water flows. One key challenge in the long-term reuse of water is the accumulation of sodium and other undesirable substances. Through this project, new knowledge is being developed about the sodium absorption and sensitivity of greenhouse crops in order to make sodium-generated water discharge redundant.

EXAMPLE

The value of trees and other urban greenery

Residents appreciate and benefit from urban greenery and it has many positive effects on climate, air quality, biodiversity and water management. However, these benefits are difficult to quantify. This project is collating current knowledge about the benefits and complementing it with practical knowledge.

Designers, policymakers and managers of urban green spaces will find it more easy to incorporate the current and potential benefits into plans and decisions that will, ultimately, define the health, user-friendliness and management of our urban outdoor spaces. Tree growers and traders can develop and market products targeted at specific functions of green space.

EXAMPLE

Raw materials from waste water

Water boards, research institutes and industry are working on a variety of methods to recover raw materials from wastewater. The production of kaumera, a gumlike substance, extracted from waste-water sludge was started in 2019. Kaumera can be used as a coating for seeds and fertilizer granules and as a glue and binding agent. This innovation reduces sludge waste by 20-35%, lowers CO_2 emissions and brings energy savings of 30-80%.

EXAMPLE

Climate-proof cities

Cities need to become more sustainable, smarter and more humane if we want to keep them truly liveable. The vision, of sustainable climate-proof cities, offers opportunities to make urban environments more independent and resilient.

The project *Climate Work: a work in progress* examines how the business community and government can contribute in a cost-effective way to designing climate-proof cities. For example, the project is looking at how rainwater can be used/reused locally instead of being drained away via sewer systems, to help cities bridge extended dry periods. It also examines how urban design can help in better coping with heat stress.

D Appreciated, healthy and safe food

By 2030, the sector should be producing healthy, safe and sustainable food. The food production system will be more-robust and 'green' products will be making a valuable contribution to the environment. Consumers will value the sector and be willing to pay fair prices.

Main knowledge and innovation themes

- Increasing the appreciation of, and confidence in, food and greenery and in the way it is produced
- Encouraging the production and consumption of healthy and sustainable food
- Developing safe, sustainable production systems without risk to the environment
- Developing a substantially more sustainable and safer food chain.

EXAMPLE

Tasty vegetable proteins

In terms of nutritional value, vegetable protein is perfectly capable of fulfilling part of the growing demand for high-quality protein. Currently, however, only a small percentage of animal protein is being replaced by vegetable protein. This is largely due to the different structure and taste experience. The project Towards next generation meat analogues is developing a technology that will give the next generation of meat analogues improved taste properties. These improvements will increase consumer acceptance, so creating more possibilities for vegetable protein to make a greater contribution to overall protein requirements.

EXAMPLE

Improving the quality of fruit and vegetable chains

Consumers want high-quality fruit and vegetables that look good and stay fresh after purchase. At the same time, they expect the chain to ensure food safety and sustainability, and they explicitly ask for fewer pesticides and less packaging. How do we achieve this while maintaining product quality?

The aim of the *Fresh on demand* project is to optimally align the fruit and vegetable chains with consumer wishes and requirements, in order to increase fruit and vegetables consumption. This project is developing knowledge about physiological quality, measurement and detection methods, smart and targeted use of (quality) information from various links in the chain, and other tools to address food safety and sustainability requirements.

EXAMPLE

Working on appreciation

Based on the idea that appreciation starts with dialogue, the *top sectors Agri & Food and Horticulture & Propagation Materials* are using a variety of approaches to increase and improve engagement between consumers and food producers. The top sectors are closely involved in Dutch Food Week, a national event where food, food production and innovation are central. During this week organisations from the sector will share their enthusiasm and knowledge with society. The long-running Taste lessons project will provide children with an interactive, playful way of learning all about one or more product groups from the Schijf van Vijf (Food Pyramid). Children learn what a responsible diet is and learn more about taste, sustainable food production and consumption. Every two years, the AgriFoodMonitor project gathers the opinions of citizens into data which form the basis for new policies.

EXAMPLE

Tailor-made nutritional advice

Effective prevention programmes are needed to ensure healthcare is affordable for all. Lifestyle advice through mass media campaigns rarely leads to noticeable improvements in public health. In the *Personalised nutrition* project a method is being developed that measures an individual's eating behaviour, together with a number of health markers, and, almost instantaneously, translates these into personalised advice. It is expected that if consumers receive (almost) immediate feedback on the consequences of their choices, they will be more motivated, and better able, to adopt and maintain healthy behaviours.

EXAMPLE

Reducing food waste

Every year, millions of kilos of food, especially fruit and vegetables, are thrown into the bin. Not only in consumer kitchens, but all along the chain from grower to shopping basket. Wasting food has major economic, ecological and social effects. With every kilo of food thrown away, 1.3 litres of petrol is wasted. A quarter of the annual amount of food thrown away globally, is enough to feed the 800 million people in the world who are undernourished.

In the *CARVE* project, participating partners shared their (practical) experiences, for example by making tools they had developed available to other companies. In a number of pilot-projects, experience was gained in reducing waste in agrifood chains. For example, efforts were made to reduce dairy waste by supplying desserts in smaller serving quantities. Another pilot study examined the extent to which packaging influences the consumer's storage behaviour. The future of 'returned bread' was central to another pilot project which asked the question: Can returned bread be used to make gingerbread, bread porridge and biscuits?

E Sustainable and safe North Sea and other waters

By 2030, the ecological capacity, water safety, water quality and freshwater supply of marine waters in the Netherlands should be in balance with the demand for renewable energy, food, fisheries and other economic activities. In 2050 this will also apply to rivers, lakes and intertidal areas (estuaries and mudflats).

Main knowledge and innovation themes

- Balance between economic activities at sea, such as the generation of renewable energy and the production of food, and the spatial and ecological carrying capacity of the North Sea
- Finding the right balance between fishing, agriculture, tourism, water management and nature in the Dutch Caribbean
- Balanced, optimal and area-based management and use of rivers, lakes and intertidal areas in the Netherlands
- Development of sustainable coastal and marine fisheries in the North Sea.

EXAMPLE

Plastic-free rivers

Plastics are a growing source of pollution in rivers, lakes, seas and oceans. In this project, a technology has been developed that removes plastics from the water before they become part of the plastic soup phenomenon. With the help of air bubbles, about 80% of floating plastic greater than 1 mm in size is captured; this is about half of all floating, river plastic. The technology has been successfully applied in the Netherlands and an installation is planned for Asia.

EXAMPLE

New nature in the North Sea

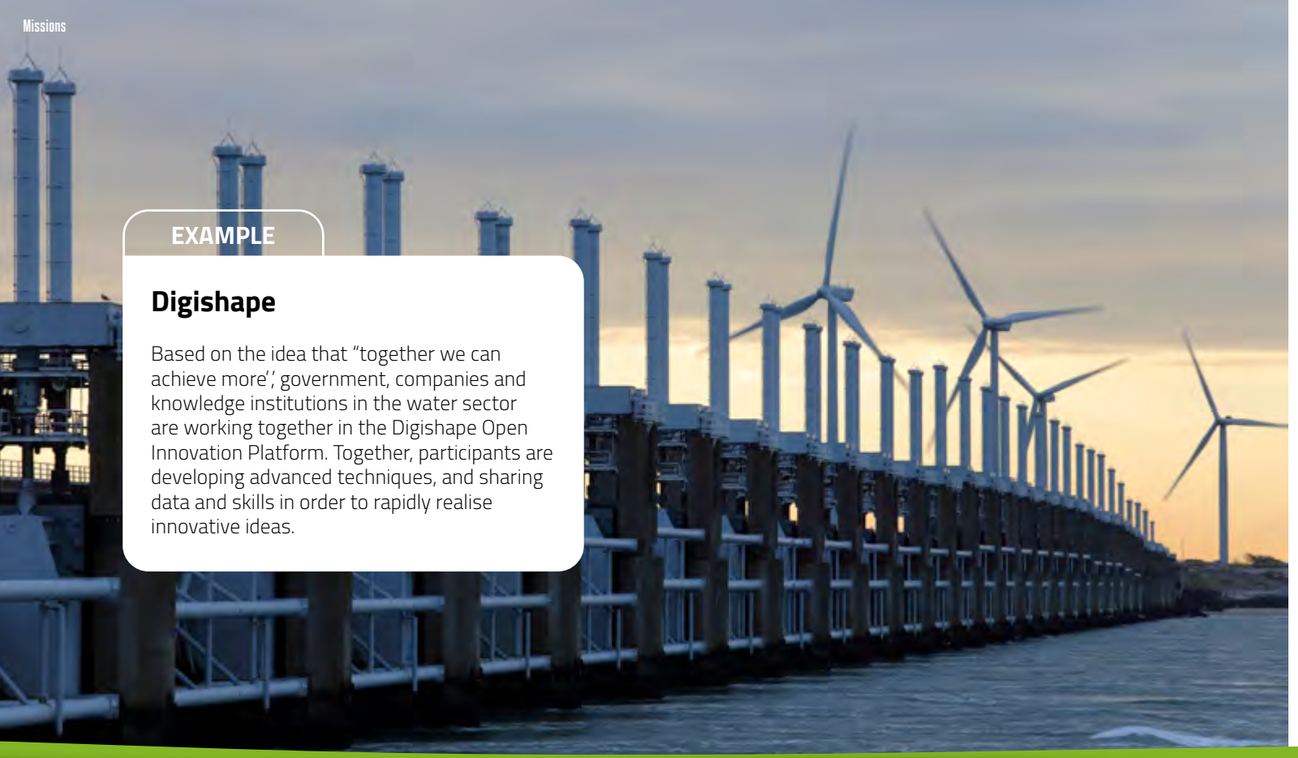
Can offshore wind farms contribute to the recovery of reefs in the North Sea? In this project, artificial reefs and cages with oysters have been placed within the boundaries of a wind farm. In the coming years the development will be monitored to understand what conditions best support healthy development of marine flora and fauna. Oyster reefs and mussel beds filter the seawater cleanly and form a resting and spawning area for fish.

EXAMPLE

Storing renewable energy in water

Balancing supply and demand of energy is increasingly challenging. The supply of green energy is growing, while energy demand is increasingly diverse. In order to ensure a balance between supply and demand, energy sources, storage and provision must be linked logically, economically and practically. In the Power to X project, a concept is being developed in which electricity, hydrogen, heat and mains water will be sustainably produced.

The concept is based on using solar panels that also collect rainwater. This water is stored and purified into demineralised water from which hydrogen is produced. In summer, when solar panel electricity generation is at its highest, some is used to heat water for underground storage. Heat from surface water systems can also be stored. In winter, the stored heat is released to heat local residential areas.



EXAMPLE

Digishape

Based on the idea that "together we can achieve more', government, companies and knowledge institutions in the water sector are working together in the Digishape Open Innovation Platform. Together, participants are developing advanced techniques, and sharing data and skills in order to rapidly realise innovative ideas.

F The Netherlands is, and will remain, the best protected, safest and most habitable delta in the world.

To 2100 and beyond, the Netherlands will continue to be the best protected, safest and most liveable delta in the world. Rising sea levels and strong fluctuations in river discharge will require new approaches.

Main knowledge and innovation themes

- Improving the sustainability and cost control of current water management measures
- Developing innovations to further improve existing measures; developing feasible, alternative, transformative measures to adapt to accelerated sea level rise and more extreme weather conditions
- Digitisation of water management to achieve cost, quality and/or risk reduction improvements in water management
- Use of water in the extraction, storage and transport of energy.

EXAMPLE

The Marker Wadden: hydraulic engineering for nature and recreation

In the Lake Marken, the Dutch government bodies, Natuurmonumenten and Rijkswaterstaat, are constructing the Marker Wadden, an artificial archipelago, and simultaneously addressing many of the practical management problems of the Lake Marken. Sand, clay and silt from the lake are being used to create spawning grounds, islands and natural banks on a massive scale, benefitting endangered animals and plants. The project is creating a robust nature reserve in the heart of the Netherlands, significantly contributing to Dutch nature. The Lake Marken will also become a mecca for water sports enthusiasts.

EXAMPLE

Is the *Sand Motor* exportable?

The *Sand Motor* along the Zuid-Holland coast is a superb example of the globally-leading position of the Dutch hydraulic engineering sector. The sand motor is shaped as an elevated hook, so that wind, waves and currents ensure the continuous supply of sand along the coast, contributing to a safe coast.

One of our projects is investigating whether the sand-motor principle can also be applied abroad. The British have been struggling to combat coastal erosion for centuries. At the moment in Britain, at a critical location, two villages and a gas terminal are threatened by erosion. Inspired by the *Sand Motor*, a sand plate is now being sprayed into place to slow down erosion and, hopefully, provide enough time to design a twin sister of the Dutch *Sand Motor*.

Key Enabling Technologies (KETs)

Ongoing development of a number of Key Enabling Technologies (KETs) is crucial to achieving the Six Missions that guide this knowledge and innovation agenda. Certain of these KETs are important across several Missions. By maintaining cross-mission coordination around technology developments, steps to practical applications will be accelerated and made more concrete.

This concerns the following subjects:

- Artificial Intelligence
- Machine Learning
- Autonomous Robots
- Datafication
- Big Data
- Modelling
- Digital Twinning
- Standards
- Decision Support
- Human-Computer Interaction
- Precise And Non-Destructive Measurement
- Sensors
- Genome Technology
- Bioinformatics
- Genome Prediction
- Gene Editing
- Phenotyping
- Seed Technologies

EXAMPLE

Adaptive horticulture

The global acreage devoted to horticulture is growing by more than 10% year on year across all systems, from manual labour to agrotechnology. This trend is expected to continue. To make horticultural technology a success, in addition to access to knowledge, good, well-organised local suppliers and qualified growers are required. With the help of adaptive horticulture, new technologies will dynamically adjust to changing local climate and market conditions. At the same time, the necessary knowledge and skills, of growers, advisors and suppliers, will be continuously developing and adapting. Experts, based remotely, are already able to manage and supervise systems digitally, providing immediate guidance to local growers and interventions if necessary.

KETs

EXAMPLE

Water-saving potatoes

The potato is rather smart: it efficiently converts water and nutrients into a high-quality food. Potatoes currently play an important role in meeting the growing global demand for food and this is likely to continue. Potato cultivation, however, has to respond to the global problem of increasing drought. Without sufficient hydration, the yield and quality of potatoes declines rapidly.

In the *Water-saving potatoes* project, breeding companies and knowledge institutes are working together to better understand the genetics behind drought tolerance. Growth experiments have mapped out which mechanisms cause reduced yield under dry conditions. The next step is to use modern genetic technologies to develop instruments which support potato breeders to independently select drought-tolerant varieties in their breeding programmes. Via these technologies, new varieties are being developed that will significantly improve future food security.

EXAMPLE

Nanoparticles from the water

Developments in nanotechnology are increasing the use of nanoparticles in many kinds of products. Inevitably, these particles end up in drinking water sources, with uncertain consequences, especially for public health. It is, therefore, crucial that we develop methods for measuring nanoparticles – down to miniscule quantities. The results of such measurements are being used to understand the effects nanoparticles have on waste-water treatment, drinking-water treatment and the environment.

Measurement methods are being developed within a project that can measure the occurrence of these particles even in extremely-low quantities. Already, new knowledge is being gathered, about the behaviour of nanoparticles, which will feed into the design of new membranes for nanoparticle removal.

EXAMPLE

Sharing data for sustainability

The agrifood sector has to deal with many variables (such as soil type, crop type, variety, climate, storage conditions) that influence the quality of the final product. Precision agriculture is ideally suited to integrating knowledge and data from and between the various links in production chains.

In the *Precision agriculture 4.0* project, agricultural companies, supply and processing companies, service providers and inspection authorities are developing a system in which participants share data safely, transparently and accurately in order to enhance these data by smart analysis and manipulation. Optimal sharing of data makes it possible, for example, to make sound, informed decisions around cultivation, processing and marketing, leading, for example, to substantial reductions in the use of fertilisers, crop protection agents and end-product loss and wastage.

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