WAGENINGEN WORLD
MAGAZINE OF WAGENINGEN UNIVERSITY & RESEARCH ABOUT CONTRIBUTING TO THE QUALITY OF LIFE no.2 2020

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Research in the polar night
Finding plankton and fish beneath the arctic ice from the *Polarstern*

Forecasting with digital twins
Continuous real-time information makes for more accurate models

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WAGENINGEN UNIVERSITY & RESEARCH

The mission of Wageningen University and Research is 'To explore the potential of nature to improve the quality of life'. Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 5,000 employees and 12,000 students, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.

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FEATURES

PHOTO JEROEN HOFMAN

Unliveable heat

'Global warming could have far greater consequences for our children's generation that we have imagined up to now. Depending how fast the temperature rises, between one and three billion people could be living in intolerable heat within 50 years. That could lead to the biggest waves of migration in human history.

'We arrived at this scenario by analysing the distribution of the world population over climate zones in collaboration with colleagues from China, the US and Europe. The vast majority of people live in regions with an average annual temperature of around 13 degrees. You might think that's coincidental, but we also found that this temperature preference hasn't changed in 6000 years, in spite of all the technological progress and opportunities for migration. And to our surprise, a completely different study identified the same optimum temperature. This was a study by economists who analysed the differences in economic production from one year to the next in various countries, and saw that people produce less the further the annual temperature ranges from 13 degrees. So it would seem as though something fundamental makes people best able to function at that average temperature. What does that mean for the future? According to our calculations, to keep the same relation between population density and temperature, one billion people would have to migrate per degree of warming.

'To get a better sense of the robustness of that estimate, we also looked at the hottest one per cent of the land on Earth. At present, that mainly means some sparsely populated parts of the Sahara, but with the worst-case global warming scenario, in 50 years' time the temperatures in those places will be found on about one fifth of the global land surface: an area that is home to more than three billion people. So you arrive at a similar estimate with either of these approaches. The message is clear. We can do our children a great service by working hard now on limiting global warming.'

Marten Scheffer,
distinguished professor at Wageningen University & Research

EDUCATION

PHOTO MARTE HOFSTEENGE

Emergency fund for students

University Fund Wageningen (UFW) has raised over 65,000 euros via crowdfunding for students who have got into severe financial difficulties due to the coronavirus crisis.
The pandemic has caused problems for some students, for example because they have lost their part-time jobs or because foreign scholarships are no longer being paid.
UFW initially had a target of 35,000 euros for the emergency fund but it has comfortably exceeded that. UFW itself donated 1000 euros, as did the board of alumni society KLV. Wageningen Ambassadors, the group of influential Wageningen alumni who support the university, has promised 10,000 euros. The campaign will continue until 1 September.

RANKING

Best agricultural university again

For the fourth time in a row, Wageningen University & Research has been ranked first in the QS World University Rankings for the category Agriculture and Forestry. UC Davis in the US is in second place. Wageningen is ranked eighth for Environmental Sciences and 14th for Development Studies.
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GREENHOUSE HORTICULTURE

Demo greenhouse for zero-emission cultivation

The Dutch minister for Agriculture Carola Schouten and her American counterpart Sonny Perdue opened the demo greenhouse KAS2030 at Wageningen Plant Research in Bleiswijk in late January. KAS2030 is a low-emission demonstration greenhouse for vegetables, fruit and flowers. Researchers combine the latest technology and cultivation systems to reduce emissions of CO_2 and the use of pesticides and fertilizer to zero. Diseases and pests are dealt with using biological methods and the energy-efficient greenhouse reuses water and nutrients as much as possible.
'We use the demo greenhouse to try out things that are not possible in a commercial setting. If we can get a better understanding of what is needed for zero-emissions cultivation, we can help the horticulture sector take that step,' says researcher Frank Kempkes. The Dutch horticulture sector has undertaken to be CO_2-neutral by 2040. *Info: frank.kempkes@wur.nl*

PHOTO GERARD-JAN VLEMKE

AQUATIC ECOLOGY

Plastic particles halve aquatic creature numbers

Wageningen ecologists have shown that tiny plastic particles have a negative effect on biodiversity. Their research focuses on tiny creatures such as worms, water fleas and snails in the beds of lakes and ditches. These organisms churn the sediment, filter out substances, eat and are eaten, making them important for amphibians and fish. PhD candidate Paula Redondo-Hasselerharm studied the balance in these small ecosystems in a long-term field experiment. After 15 months of exposure to nanoplastics and microplastics, some species were not faring so well. There were only half the total number of organisms compared with similar sites without plastics. The ecological effects of small plastic particles had previously only been investigated in the lab. The findings were published in January in *Science Advances*.
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PHOTO SHUTTERSTOCK

VIROLOGY

PHOTO ERIC SCHOUTEN

WUR is working on a coronavirus vaccine

The Virology chair group is part of a European consortium developing a coronavirus vaccine. The Wageningen researchers are replicating virus proteins.

The spikes that can be clearly seen in images of the virus and that it uses to penetrate our body cells consist of proteins. The Wageningen researchers will be producing these proteins in insect cells as the basis for a vaccine. 'The body will recognize the protein as exogenous, and will therefore make antibodies and memory cells. If you are then infected by the coronavirus, the body will soon produce antibodies to defeat the virus,' says Wageningen virologist Gorben Pijlman, explaining the underlying theory.

To produce the proteins, the researchers are tracking down the piece of DNA in the virus that encodes for the proteins in question. They are then copying this DNA into a virus that is harmless to humans, infecting cultured insect cells and letting these cells produce the protein on a large scale. Once the researchers have developed functioning proteins, they will be tested extensively. First the researchers will test whether the proteins get our immune system working sufficiently and then they will test whether this is safe.

Other groups in the European consortium are also developing coronavirus proteins. 'The protein that scores best in the tests will end up in the vaccine,' says Pijlman. The European Commission is funding the consortium, which is led by the Danish company Expres^{2}ion Biotechnologies. Wageningen virologists have made proteins for vaccines before. For example, in 2013 they made an effective prototype vaccine for chikungunya.

See page 10 for more on this.

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EDUCATION

Five stars for Wageningen MOOC

The free online course on 'Nutrition, Exercise and Sports' was one of the best MOOCs of 2019, according to participants. On the course platform ClassCentral, 30 new MOOCs including the Wageningen course received the maximum score. More than 2400 were assessed. 'Nutrition, Exercise and Sports' is about the influence of nutrition on sporting performance and health.

Info: www.wur.eu/moocs

WAGENINGEN ACADEMY

Online learning opportunities for professionals

Wageningen Academy offers numerous online courses, such as the Plant Breeding and the Plant Pathology & Entomology modules. These modules can be followed anytime, anywhere, and there is an optional exam. We also offers courses which start on a set date, offering participants a learning experience with group discussions, interaction and networking opportunities. The course Principles of Sensory Science is one example. We are also mixing online and offline education in so-called blended programmes such as the Executive MBA in Food & Agribusiness. These programmes give participants the opportunity to prepare at home and participate in face-to-face meetings. In response to the coronavirus outbreak, Wageningen Academy has created more online opportunities. Wageningen offers online learning opportunities for professionals as well, from MOOCs to MSc programmes.

More information: www.wur.eu/academy

ECONOMICS

The richer you are, the more food you bin

Consumers probably waste much more food than was thought, especially when they have more spending power. Wageningen economists think consumers are responsible for 19 per cent of food waste, over twice the proportion that was previously assumed. That is because previous estimates do not allow for the effects of wealth on consumer behaviour. Food waste starts when consumers have at least 6.70 dollars to spend per person per day, according to a study by Wageningen Economic Research. Waste increases rapidly at first as prosperity rises and then more slowly as affluence increases further.
The researchers related food waste to consumer affluence using data for example from the FAO, the UN's Food and Agriculture Organization. This let them estimate global food waste and wastage per country.
The study was published in February in the scientific journal *PLOS ONE*.
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PHOTO ALAMY

PLANT SCIENCES

PHOTO ALAMY

Heating the soil destroys Japanese knotweed

The fast-spreading weed Japanese knotweed can be combated by heating soil containing stem and root remains of the plant, Wageningen plant scientists have discovered.

Removing Japanese knotweed plants above ground does not help much as the parts of the plant left in the soil continue to sprout. Effective methods for dealing with the invasive exotic are badly needed as it drives out indigenous plants and can damage asphalt and buildings with its powerful roots and stems. So Wageningen University & Research, Probos and Tree-O-Logic tested a heating technique developed by Herik Zuigtechniek and the contractors Van Gelder, the companies who commissioned the study. Soil containing the remains of Japanese knotweed was first sieved to remove the largest roots and then heated in a mobile apparatus. 'We tested the heated soil to see whether the plant grew back. It turned out this method destroyed 99 per cent of the knotweed remains,' says researcher Chris van Dijk. 'To get rid of the plant, it is important to dig out the site where it grows carefully, and excavate up to a metre deep. You also need a follow-up plan just in case a fragment survives the heat treatment.'
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ENVIRONMENT

Satellite spots dirty ships

International shipping is responsible for high emissions of sulphur and nitrogen oxides, often much more than is permitted. But checking whether ships are keeping to the rules for fuel use is time-consuming and therefore rarely carried out.
Now Wageningen Meteorology and Air Quality scientists are collaborating with colleagues at Leiden University on a new detection system. Satellite images show traces of the emissions of nitrogen oxides on shipping routes. The researchers are investigating how they can interpret the images and link emissions to individual ships.
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PHOTO GIOVANNI CARDILLO / SHUTTERSTOCK.COM

CONSUMER BEHAVIOUR

Happier when norms change

Consumption levels and family sizes are largely due to subconsciously experienced social pressure to conform to norms. Research shows that changing those norms can make people happier and boost sustainability.

PHOTO JUAN ALBERTO CASADO / SHUTTERSTOCK.COM

This international study by economists, ecologists and social phycologists, including Wageningen professor Marten Scheffer, shows that people conform to the norms in their society as regards consumption and numbers of children. They compare their material position, for example their house, clothes and car, to that of others. According to research in Bangladesh, women want the number of children that is normal in their community, even if fewer children would make their lives easier.

'Everyone has a right to free choice. Yet it turns out that there is a sustainable solution that would also make the vast majority of people happier,' says Scheffer. Smaller family sizes reduce poverty almost everywhere. Women's education has a big impact on the number of children.

It also transpires that social activities make people in the West happier than accumulating more possessions. The study appeared in March in the scientific journal PNAS.

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MARINE BIOLOGY

Albino seal given transmitter

At the start of the year, the albino seal Snow White returned to the sea from the seal rescue centre. Researcher Sophie Brasseur of Wageningen Marine Research equipped it with a transmitter.

This is the first seal to take part in a study of the behaviour of seals that have recovered during a stay in the rescue centre.

When the young male ended up in the Ecomare seal rescue centre in October 2019, he weighed 16.8 kilos and was suffering from lungworm. The seal made the national news thanks to his rare albinism. By 15 January, after treatment and recovery and now weighing 40.7 kilos, Snow White was ready to go back to the sea. Sophie Brasseur used a special adhesive to attach a transmitter to the seal's neck hairs. The transmitter will fall off when the seal moults, probably between May and August. Until that time, the device will transmit data on the location, the routes the seal takes and whether he is swimming or resting. The study will also give Brasseur more insight into the behaviour of albino seals. Snow White has poorer sight than other seals but is very good at catching fish. When hunting, seals mainly use their whiskers, which let them sense tiny movements in the water.

The transmitter data up to the end of April showed that Snow White has been swimming back and forth between the Wadden Sea and North Sea, goes far out to sea sometimes and dives to depths of 35 metres. He also hunts fish along the Noord-Holland coast. For updates (in Dutch) on Snow White, see www.ecomare.nl/verdiep/volg-zeehond-snow-white.

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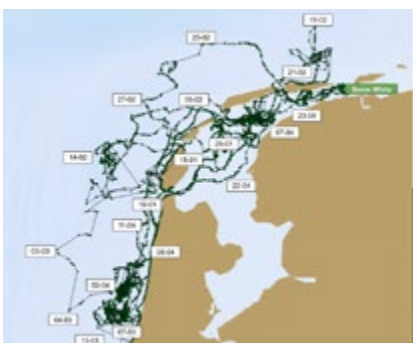

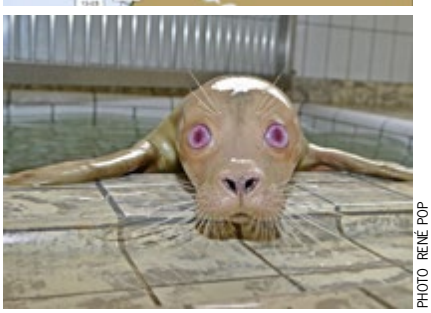

PHOTO RENÉ POP

BIOLOGY

App shows local nature

The app NatureToday shows at a glance the plants and animals you could encounter wherever you happen to be in the Netherlands. There is a short description for each species, plus up-to-date information on the breeding or flowering season. The app incorporates the expertise of biologists from dozens of nature and land management organizations and science institutes. Also the data of tens of thousands of nature lovers is being incorporated. The information is refreshed daily and is constantly being expanded. The Wageningen biologist Arnold van Vliet helped initiate the new nature app and also coordinates the NatureToday.com website.

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PHOTO NATURE TODAY

BIOBASED ECONOMY

Compostable plastics decompose well

Compostable plastics in organic waste decompose sufficiently rapidly, according to research at Wageningen Food & Biobased Research.

In a practical experiment at a Dutch organic waste processing company, compostable plastic products were monitored during the process. The products included rubbish bags for organic waste, plant pots and fruit labels. After about 11 days of composting, the organic remains that had not yet decomposed were sieved. The researchers found that 70 per cent of the unprocessed remains consisted of organic waste that decomposes slowly and is returned to the composting process. There were also the remains of compostable rubbish bags, which break down completely when returned to the process. They also found contaminants such as metal, glass and stones, while 1 per cent consisted of 'ordinary' plastic based on petroleum.

The researchers conclude that the compostable plastics that satisfy the European norm break down fast enough in Dutch organic waste processing systems. Compostable products made from polylactic acid, such as tea bags and plant pots, even decompose faster than paper and orange peel, for instance. A solution is needed, though, for the ordinary plastic found in the organic waste.

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PHOTO ANP

ENVIRONMENT

EU gives 15 million for pesticide study

A major European study is being started on the effects of pesticides on the environment, plants, animals and people. It is the first comprehensive study of the effects of pesticide use in agriculture. Violette Geissen, professor of Soil Physics and Land Management, is coordinating the research, which will involve 28 institutes from 10 EU countries. Researchers will be assessing the use of pesticides in 10 European regions and the consequences for ecosystems, food and people. In the Netherlands, the project will look at 10 conventional farmers and 10 organic farmers growing potatoes or with dairy herds in Groningen.

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FOOD SUPPLY CHAIN

Supermarkets are assessing waste

1.7 per cent of the food offered for sale in Dutch supermarkets is eventually thrown away. Five supermarket chains – Albert Heijn, Aldi, Jumbo, Lidl and PLUS, representing three quarters of the Dutch market – provided data on waste to researchers at Wageningen Food & Biobased Research. The discarded products are mainly fresh products such as bread, meat, fish, vegetables and fruit. Relative waste in terms of weight is highest for bread and cakes, at 7.7 per cent.

Supermarkets want to cut food waste by half by 2030. The insights from this research will enable targeted actions to reduce food waste. The survey was initiated by the Dutch Food Retail Association (CBL) and performed by the Samen tegen Voedselverspilling foundation; it will be repeated annually.

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PHOTO ALAMY

MICROBIOLOGY

PHOTO PIXABAY

Chlamydia discovered in the Arctic seabed

An international research team that includes Wageningen scientists has discovered bacteria related to chlamydia under the Arctic Ocean. They live deep in the seabed without oxygen, at huge pressures and without a host, which is unusual for these bacteria.

Chlamydia is known mainly as the cause of sexually transmitted diseases in humans and animals, but the bacteria can also infect microorganisms such as algae and plankton. That is why it came as a surprise to the scientists to find related bacteria living without a host. They took samples from the seabed during an expedition to hydrothermal sources in the Arctic Ocean between Iceland, Norway and Spitsbergen. When they analysed the samples in the laboratory, they found the DNA of various relatives of the chlamydia bacterium. By comparing the genetic makeup to that of the familiar chlamydia, the researchers gained new insights into how the bacterium developed into a pathogen. For example, it turns out that certain genes that are important for the host-dependent lifestyle are present in this distant relative too.

'We think the bacteria in the Arctic Ocean use nutrients from other microorganisms around them to survive and grow,' says professor of Microbiology Thijs Ettema. Some chlamydia species are so prevalent in the seabed that the researchers think the bacterial group could play a bigger role in marine ecosystems than was assumed to date. They can probably be found elsewhere in the world too. Ettema: 'Every time we explore a new environment, we discover new microorganisms that were unknown to science.' The research was published in March in the scientific journal *Current Biology*.

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NUTRITION AND HEALTH

Fat cells not responsible for chronic inflammation

Overweight can lead to mild chronic inflammation in the body, resulting in diseases of affluence such as diabetes or fatty liver. For years, scientists assumed that such inflammation is due to the immune cells in fatty tissue not functioning properly because of the accumulation of fat. However, research by PhD candidate Xanthe van Dierendonck in Wageningen's Human Nutrition and Health group has shown that these immune cells still promote inflammation in a slimmed-down state. When the researcher removed the protein that appears to promote the accumulation of fat in cells, the fat was broken down and the cells became thin again. But the thin immune cells still caused slight chronic inflammation and insulin resistance. The research results were published in February in the scientific journal *Cell Reports*.

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PLANT DISEASES

Tulip virus X is a survivor

Tulip virus X can survive underground for up to three months, or possibly even eight months. What is more, it can survive in many more different species of weed than previously thought.

These findings come from a study of viruses in the bulbous plants tulips and lilies and in hostas. Wageningen Plant Research is carrying out the study with Zwaagdijk applied research centre and the Flower Bulb Certification Agency in a public-private partnership. They are looking at the sources of the viruses and the options for tackling them.

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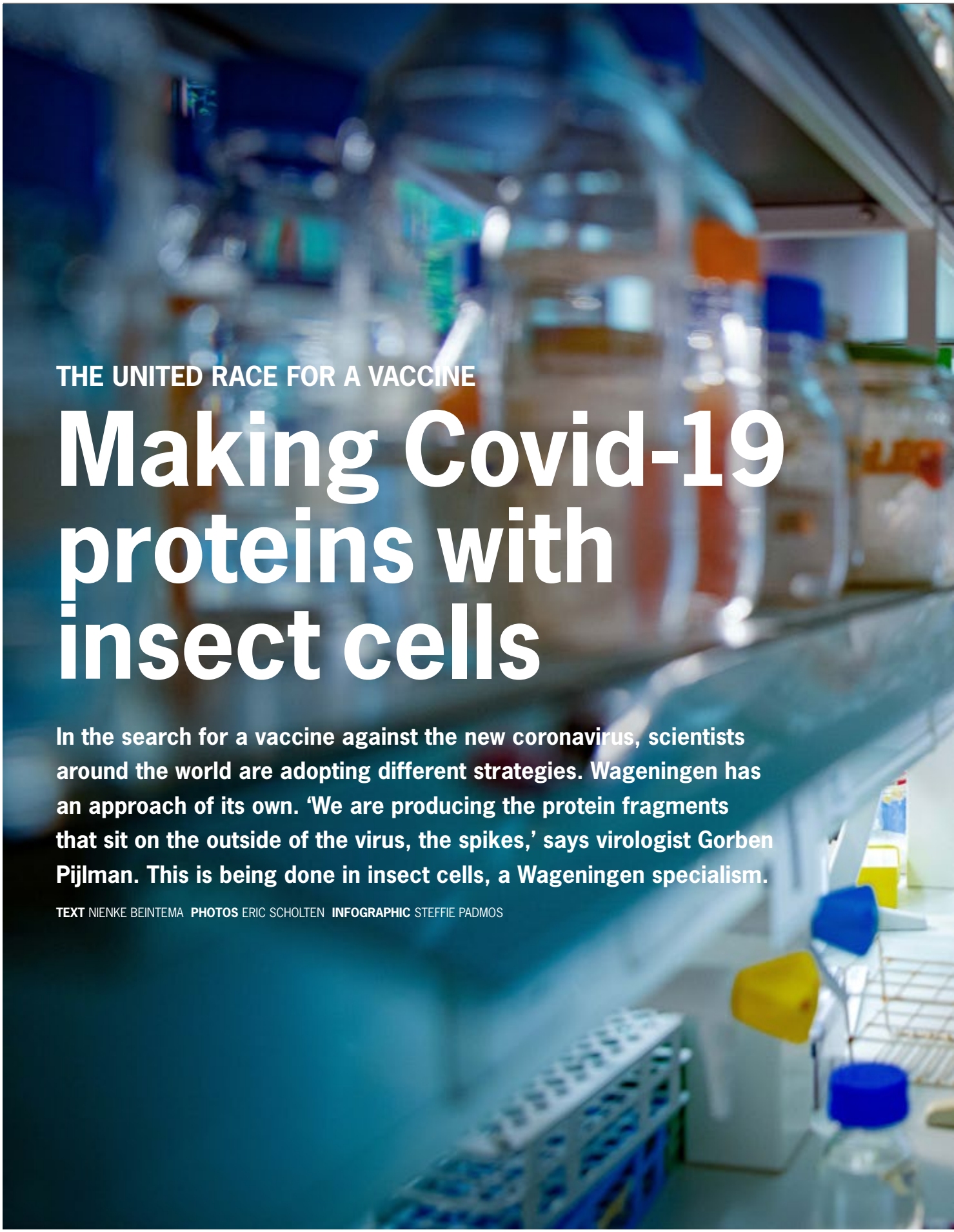
PHOTO SHUTTERSTOCK



THE UNITED RACE FOR A VACCINE

Making Covid-19 proteins with insect cells

In the search for a vaccine against the new coronavirus, scientists around the world are adopting different strategies. Wageningen has an approach of its own. 'We are producing the protein fragments that sit on the outside of the virus, the spikes,' says virologist Gorben Pijlman. This is being done in insect cells, a Wageningen specialism.

TEXT NIENKE BEINTEMA **PHOTOS** ERIC SCHOLTEN **INFOGRAPHIC** STEFFIE PADMOS


VIRO 3

> ‘The point is to get a vaccine fast, not to be the first to make one’

A bizarre summer is ahead of us: without full pavement cafes, without crowded beaches and swimming pools, without festivals, sports camps or foreign holidays. How quickly daily life and the global economy can get back to normal depens on a single crucial factor: the development of a vaccine. Only when there is an effective vaccine can we slowly let go of social distancing. Wageningen scientists are collaborating in the worldwide quest.
‘We are working with several partners on a vaccine against Covid-19,’ says Gorben Pijlman of the Laboratory of Virology. ‘The initiative came from the Danish company ExpreS2ion Biotechnologies, who we’ve been working with for quite a while.’ The collaboration primarily has focused on diagnostic tests and vaccines against chikungunya and Zika, two tropical viral diseases. Pijlman: ‘We now want to apply the same strategies to Covid-19-19.’ The universities of Copenhagen and Tübingen are collaborating on this too, as is Leiden University Medical Centre, which has the expertise for working with live coronavirus. The new collaboration was set up at lightning speed. ‘The European Commission earmarked funding for research on a coronavirus vaccine in February, and put out a call for proposals.’ says Pijlman. ‘In such cases, you always stand a better chance with an international collaboration. The Danes brought a consortium together in no time, based on existing partnerships. So we got a phone call too, and we said “yes” without hesitation.’

STIMULATING IMMUNE SYSTEMS

The key to vaccination is that the immune system is stimulated in a way that is specific to the target pathogen. The immune system then manufactures antibodies against the pathogen, as well as ‘memory cells’. These specialized white blood cells enable the body to go straight into action if it is infected again, and to produce large numbers of antibodies to defend itself against the attack.
Classic vaccines, such as the measles vaccine, consist of a weakened or deactivated version of the virus. People who are immunized with it do not fall ill, but they do develop immunity to the pathogen. Another approach is to give people fragments of the genetic material of the target virus. The very first coronavirus vaccine, for which testing started in the US in April, is of this kind. In this case, small, characteristic fragments of RNA from the virus are introduced into the body. RNA functions as a blueprint for manufacturing proteins. On the basis of the virus RNA, cells in the immunized person’s body start manufacturing pieces of virus protein themselves, after which the immune system produces antibodies against them.

PROTEIN FRAGMENTS

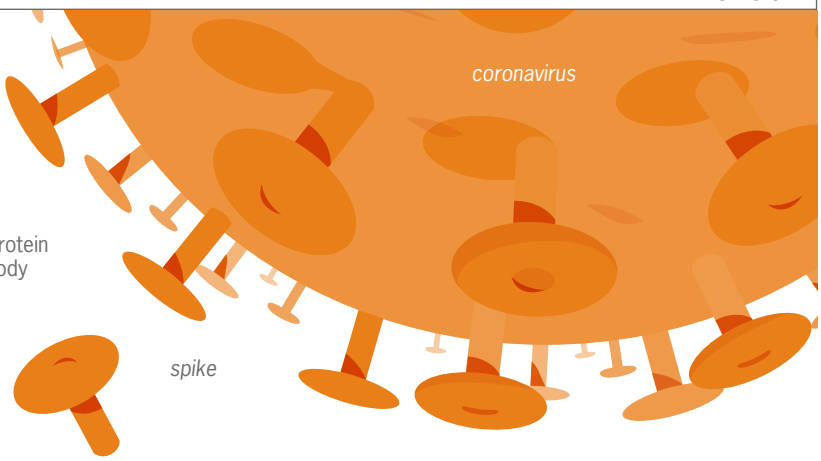
‘We are going for a different approach,’ says Pijlman. ‘In our lab we manufacture protein fragments that are found on the outside surface of the virus. These are the spikes you can see, and we produce the spikes that are specific to the coronavirus.’
The idea is that our immune system recognizes those spikes as foreign and starts producing antibodies against them. If ever the complete virus then enters the body, the spikes on the virus will immediately spark off an immune response. ‘The big advantage is that to make these spikes, we can rely on technology that is already in use in the pharmaceutical industry,’ says Pijlman. ‘RNA vaccines are much newer. Nobody knows yet whether you can easily produce them on a large scale.’
And that is one of the main success factors in the development of vaccines, independently of the question of whether they are safe and effective: are they also fast, reliable, cheap and producible on a large scale? ‘That is the case for our spikes,’ claims Pijlman. That production is now going on in insect cells, a Wageningen specialism.

MOTH CELLS

Many laboratories use mammalian cells for the production of complex proteins, but Pijlman sees a number of clear advantages to using insect cells. They are easier to grow in a bioreactor than mammalian cells. The researchers infect the cells of a moth with a genetically modified baculovirus into which they have introuced the gene for the target protein, in this case the spike protein. After being infected with the baculovirus, the insect cell’s machinery goes into action to produce the target protein. ‘This is done in large concentrations,’ says Pijlman. ‘One cell can produce up to 30 per cent of its own dry weight in protein.’
Established vaccines are already produced by this method, for example the vaccine against the human papillomavirus (HPV), which causes cervical cancer. ‘In this case, the insect cell produces small protein particles that strongly resemble HPV: these are known as virus-like particles,’ explains Pijlman. ‘We use this approach to make more complex vaccines as well, such as those against Zika and chikungunya. And now against the novel coronavirus. Our Danish partners are going to glue our spikes onto virus-like particles, which will create something resembling a real coronavirus.’
Combined approach
The production of the spikes is under way, says Pijlman, but there are still challenges. ‘The spikes themselves are so small >

THE WAGENINGEN ROUTE TO A CORONAVIRUS VACCINE

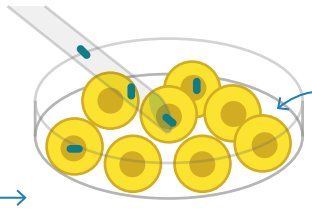
Insect cells are used to replicate the spikes – the protein fragments on the outside of the coronavirus. The body identifies this protein as foreign and manufactures antibodies against it.

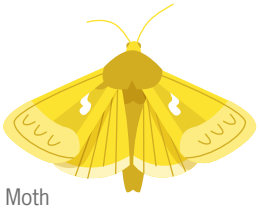


The gene that codes for the spike proteins is put into a baculovirus

Baculoviris

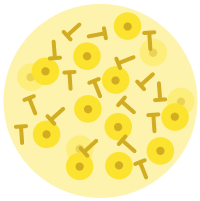
Cells from a moth are infected with the virus

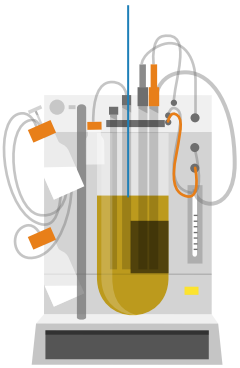




Moth cell

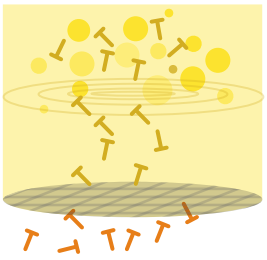
The insect cells produce the spike proteins in large quantities in a bioreactor



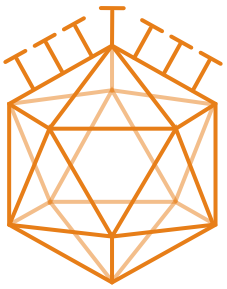


Bioreactor

The spikes are purified



The spike proteins are linked to virus-like particles



Virus-like particle

TESTING FOR COVID-19

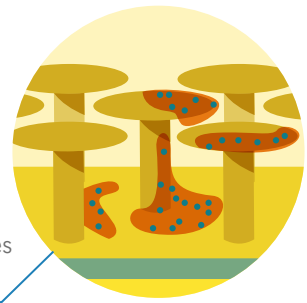
The spike proteins produced by insect cells are used in serological tests which identify antibodies to the coronavirus in the blood. This kind of test can also serve to reveal how well a vaccine works.

1. The spike proteins are fixed to a surface

2. A drop of blood is added

3. Antibodies against the coronavirus attach themselves to the spike proteins

Assay



4. A dye is used to make the antibodies visible

> ‘There is no way around very careful testing’

WEAKENING THE VIRUS FOR LIFELONG IMMUNITY

Jelke Fros of the Laboratory of Virology in Wageningen is working on another vaccine strategy: using weakened, or attenuated viruses. If you vaccinate people with an attenuated virus, they don’t fall ill but their immune systems do produce antibodies.

‘That weakening can be done in a variety of ways,’ says Fros. ‘For example, you can switch off some of the virus’s genes. But if you want to do that effectively, you need a lot of biological knowledge about that virus. Are you sure you are making it inocuous, for example? And might it reverse-mutate? This makes safety a bigger issue.’

Fros and his colleagues are therefore using another special method. In all living organisms the genetic code consists of just four bases, or ‘letters’. ‘Bacteria and some viruses have the bases C and G next to each other more often than do humans and other vertebrates,’ says Fros. A recently discovered component of our immune system makes use of this, he explains. ‘That component is geared to recognizing genetic codes that have C and G next to each other more often. We try to offset this adaptation by introducing extra CG combinations in certain places. The immune system reacts more strongly to this, and therefore cleans up the virus more efficiently.’

Meanwhile, the immune system learns to recognize the virus, so that it can react even faster next time. ‘Because the virus is still functional, and can reproduce a little bit, it activates other parts of our immune system too. That gives you a bigger chance of lifelong immunity.’

The method offers advantages over conventional methods of weakening viruses, says Fros. ‘It means we can play with the number of added CG combinations to optimize the degree of attenuation, the effectiveness and the safety of the vaccine.’

This approach is still in its infancy, says Fros, but it could form an important piece of the overalll puzzle. ‘One good thing might be that in the long term, our approach could reinforce other strategies.’

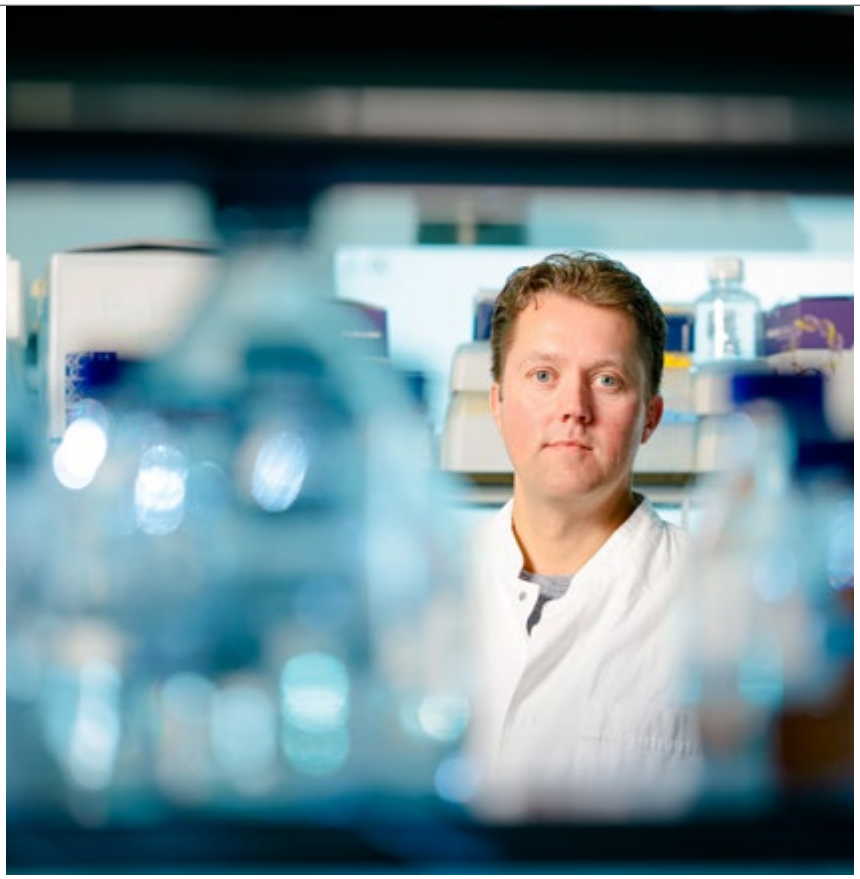
that the immune system does not efficiently recognize them individually,’ he explains. ‘So we are now working on ways of attaching them to those virus-like particles in repeating sequences.’

This is a unique approach worldwide, Pijlman emphasizes. But on more general issues such as practical questions about tests and how best to administer the vaccination, there is plenty of consultation between labs. ‘That is something very special about the current period,’ says Pijlman. ‘There is great community spirit and tremendous openness. The point is to get a vaccine fast, not to be the first to make one.’

So is it sensible for all those labs around the world to work with different strategies? ‘It certainly is,’ responds Pijlman. ‘The road towards an effective approved vaccine is long. During this race, a lot of candidate vaccines will fall by the wayside, either because they don’t work well enough or because of undesirable side effects.’ The point is to end up with at least one vaccine, says Pijlman. And it is possible that all those strategies could produce a combined approach. A combination of two vaccines, perhaps, which work in different ways and complement each other.

DEVELOPMENT STOPPED

One of the challenges is that there is not a single vaccine against other human coronaviruses on the market yet. ‘A prototype was developed for a vaccine against the SARS virus, and that is a coronavirus too,’ says Pijlman. ‘But the development of that vaccine stopped when the virus died out. Such a pity. If that vaccine had been fully developed, it would now only have been a question of “plug and play”: put a new gene in the cells that produce the virus protein, and you’re done.’



Virologist Gorben Pijlman

In spite of the great urgency of finding a vaccine, the researchers cannot cut many corners. They have to follow the fixed procedure, with animal studies followed by human studies. That process normally takes about three to four years. Pijlman: 'Evaluation processes are being fast-tracked in this emergency situation, but there is no way around very careful testing. All in all, we hope that our consortium will have a vaccine within a year and a half. That really would be superfast.'

Wageningen will not be the first to produce a working vaccine, guesses Pijlman. 'I think we shall start testing it on people relatively late in the day, maybe only in November,' he says, 'because we want to do really good animal studies first.' American researchers started testing a new RNA vaccine on people in April. They skipped the animal testing stage. But that won't speed up the process, according to Pijlman. 'In the race for a vaccine, you never know how it will go,' he says. 'It might well be that one after the other, they have to go back to the lab because there is something that is not optimal, either to do with effectiveness or with safety.'

The animal tests that are needed to test potential vaccines are coordinated by the working group on animal models set up by the World Health Organization (WHO). Wim van der Poel, professor of Emerging and Zoonotic Viruses at Wageningen Bioveterinary Research (WBVR), is in this working group. The group discusses questions such as which animals are best suited for testing a Covid-19 vaccine, how best to expose these animals to infection in a research setting, and how you can objectively establish how sick an animal gets or how much virus an animal spreads.

The animal research must be as efficient as possible, stresses Van der Poel. 'Not only because we want to get good results as quickly as possible,' he says, 'but also because we want to minimize the number of animals we use. As far as we can, we always research the effectiveness of a vaccine in artificial systems, such as cell cultures. But there comes a point when you really need to shift to living animals, to be able to research the effectiveness and the safety exhaustively. But you have to do that as efficiently as possible, too. That is what makes WHO coordination so important.' Cross-pollination between human and veterinary vaccine research is very important, says Van der Poel. 'There are some things, such as effective ways of administering vaccines, that you can test quicker and more easily on animals than on humans.'

TESTING FOR IMMUNITY

Meanwhile, the Wageningen research could be applied in another area, says virologist Pijlman. The spikes could be of use in blood tests that indicate whether people have had the virus and therefore have antibodies in their blood. You can for example fix the spikes to a plastic surface, and then add some of the person's blood serum. If this contains antibodies to the coronavirus, they will attach themselves to the spikes. You can then use a dye to make them visible. 'That way you can get an idea of what percentage of the population might already be immune,' says Pijlman. 'A test like that can also help to determine the effectiveness of a vaccine by finding antibodies that can neutralize the virus.'

Pijlman and his colleagues started their vaccination project on 1 April. 'Bioprocess engineers are helping us to develop the right process conditions,' he says. 'A team of colleagues in Biochemistry are on hand to purify the spikes. And the company Applikon is putting large bioreactors at our disposal free of charge. Help is coming from all sides. That is the wonderful thing about this period.' ■

www.wur.eu/coronavirus

Life is good on the Fami

Groups of four sows nurse their young together and the piglets learn to pee into a urinal. In Venhorst in the Dutch province of Brabant, a consortium is doing research on an innovative eco- and animal-friendly shed design called 'The Family Pig'. Everything revolves around the question of what makes pigs happy.

TEXT RENÉ DIDDE

PHOTO: THE FAMILY PIG

It is 'raining' food from a rotating arm hanging from the ceiling of the shed. Sows and piglets jump about and tumble over each other. They rootle for the scattered pellets with their noses. It all looks more playful than the pigs crowding around troughs in conventional pig sheds. And the pigs certainly have space in this shed: over 1000 square metres for the sows and their offspring.

Groups of four sows nurse their young together, each quartet in its own section where they raise about 60 piglets together over five weeks. The 60 piglets, whose curly tails are not docked, forage more freely than piglets in conventional sheds with their slatted floors and slurry pit.

'Pigs are naturally social animals and this makes them happy,' says Tjacko Sijpkens. 'And a happy pig is healthier, stronger and produces tastier meat.' As a business advisor, Sijpkens noticed some years ago that pig farming didn't have a great image. What with animal welfare issues, the problem of excess manure and ammonia emissions, this sector often comes under fire.

So in a newly constructed experimental farm in Venhorst in Brabant, the business advisor from the northern province of Groningen took the initiative in May 2019 to start a 'living lab', where numerous new ideas are tested. This venture is called 'The Family Pig'. Wageningen is contributing to the project with expertise about animal behaviour and wellbeing.

In the 'nurseries', the piglets are fed by their mothers for the first five weeks, but soon start foraging for feed pellets too. The sows leave the nursery after a few weeks and return together to a central space. The piglets live for 24 weeks, a week or two longer than in the conventional system, in which they are separated from their mothers after four weeks rather than five. 'Scientific research has shown that contact between pigs at a young age improves their social skills, so they don't bite each other, for instance,' explains Liesbeth Bolhuis of the Wageningen Adaptation Physiology chair group. The pigs' behaviour is recorded by students and – especially in this coronavirus period – by video cameras.

> **'Pigs are social animals and this makes them happy'**

ly Pig farm

PHOTO: VAN ASSENDELFT FOTOGRAFIE

SUPPORT FOR THE FAMILY PIG

The Family Pig is working in a consortium on a new concept, with support from the European Union, the ministry of Economic Affairs and the province of North Brabant. Working with founder Tjacko Sijpkens and his company Big Developments, and Wageningen University & Research, are ICT company Noldus from Wageningen (producer of a chip with a track & trace system in the pigs' ear tag), Inno+ (energy-saving climate system, mainly cooling), and construction company Dura Vermeer. The budget for five years is 4.3 million euros, 2.5 million euros of which is public funding. Other contributors are Agrifoodcapital and Boekel municipality, with knowledge and a plot of land, respectively.

Elsewhere in the shed is a urinal which the piglets learn to pee into. When they do so, they are rewarded with a drop of syrup out of a pump. For their faeces, they are directed to a different section, dubbed the 'poop-al'. 'The great advantage of separating excreta at source is that no ammonia is formed,' explains Sijpkens. That reduces nitrogen emissions into the environment and the negative impact on local residents and the farmer. But that is not all: 'It is also nicer for the pigs themselves,' says Liesbeth Bolhuis. 'Because a high concentration of ammonia leads to stress and affects their sense of smell. And smell is the most important sense for pigs, for recognizing others of their species.'

RATIONAL BASIS

Bolhuis was involved in developing the shed from the first brainstorming sessions on Sijpkens's question 'what does the pig want?' 'We want our assumptions about a 'happy pig' to have a rational basis. So we are studying the interactions among the pigs, and between the pigs and this new shed system.'

Is the financial and economic model of The Family Pig an attractive prospect for conventional pig farmers? Doesn't it make the pork much more expensive? The costs of building a Family Pig shed are the same as those of a conventional shed, says Sijpkens. 'The separate sanitation costs the same as a slurry pit, for instance.' Extras such as the nurseries and the food scattering system do not add to the expense, and costs incurred for feed are the same. 'We think we save on medical costs and on transport. And our piglets grow faster to the 120 kilos at which they are ready for slaughter. This way we avoid the expensive transport from the breeding farms to the pig farms where they are fattened up, which is also stressful for the pigs.'

The Family Pig is not necessarily bound for a free-range butcher's shop that sells local meat, or for the organic section of the supermarket. 'We want to serve all market segments,' says Tjacko Sijpkens. 'We don't look at the label of the meat, but at our piglets' wagging tales.' ■

www.wur.eu/familypig

PHOTO: VAN ASSENDELFT FOTOGRAFIE

LIESBETH BOLHUIS
Behavioural physiologist at WUR

THE ROAD TO ZERO HUNGER

‘If you zoom out, you see a lot going on at the same time’

Ridding the world of hunger without severely harming the environment. That is no easy task given the growing world population. But Ivo Demmers thinks that with the Food Systems Approach you can at least see all the pieces of the puzzle. ‘With a good plan in your hands, it must be possible.’

TEXT JANNO LANJOUW **PHOTOGRAPHY** ERIC SCHOLTEN

Ivo Demmers, programme leader for Food Security and Valuing Water in Wageningen

‘Anyone who has ever attended a meeting about the food issue knows there is no one-stop solution’

How do you provide the entire world population with sufficient food that is not only healthy but also sustainably produced? The world is large and diverse, its population varying hugely in circumstances, preferences and customs, so not many solutions will work equally well everywhere. What is more: as soon as you solve one problem – boosting food production, say – there is a fair chance that another one will crop up. Like declining biodiversity, pollution and increasing greenhouse gas emissions. Anyone who has ever attended a meeting about the food issue in recent years knows that the only conclusion in the end is that there is no one-stop solution. This is a ‘wicked problem’ and there is no ‘silver bullet’.

‘No, there is no silver bullet,’ Ivo Demmers confirms calmly over the phone. ‘But you can definitely do something. What you need to bear in mind is the interdependence of many factors. You’ve got to keep all your juggling balls in the air `at the same time.’ Demmers leads the Food Security and Valuing Water research programme, one of the main strategic themes for Wageningen’s research investments. ‘Very specifically, Food Security and Valuing Water focuses on helping to reach zero hunger, the second of the United Nations’ Social Development Goals. But ‘zero hunger’ is a somewhat narrow title: banishing hunger from the world entails more than just producing enough food. If you look at the volume of cereals it takes to provide everyone on Earth with sufficient calories, we are already producing enough food. But are those cereals available in the right places? And are cereals alone sufficient for a healthy diet?’

How do you get a grip on a hydra like the global supply of healthy, sustainable food?

‘That is extremely tricky. All sorts of issues play a role in a food system. And they do so at several scales. If a plot of farmland is too dry, it would seem logical to irrigate it. But if you look at the bigger picture, you see that water shortages occur further downstream. The spatial scale makes a difference. You have to weigh up the advantages of irrigating a farm, or perhaps even a whole rural area against the disadvantages for the entire province or country. Besides the spatial scale, there is also the temporal scale: something that seems like a good idea today can cause big problems tomorrow.’

For example?

‘The situation in the Himalayas, where climate change is affecting the water supply through the year. The meltwater is now coming down at different times and in different volumes, so you have to adapt the farming

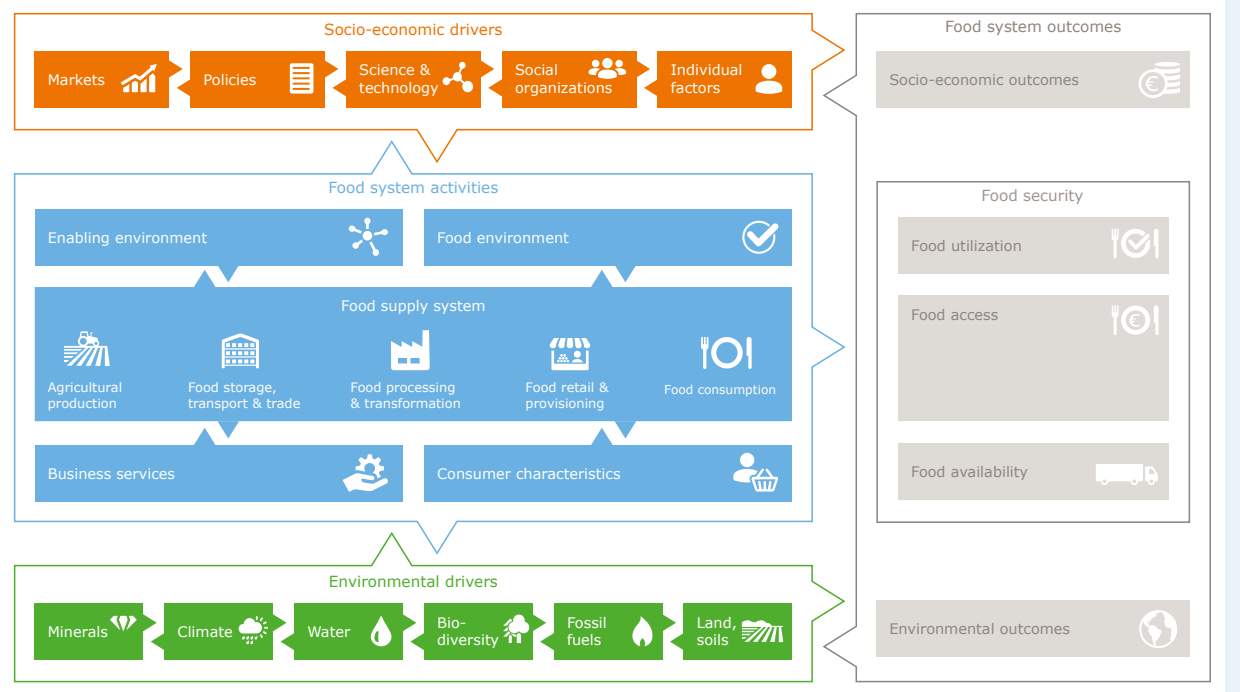
system to that. That is already being done in India, further downstream, but without taking the long term into consideration. Irrigation water is being pumped from deeper and deeper layers, which is speeding up the rate of salinization. Whereas what you should be doing is to use the meltwater when it is available.
Another example is a project in Indonesia in which we are researching how seaweed cultivation in the coastal zones can contribute to the local food supply. If you zoom out, you see that there's a lot going on at the same time: the area currently under cultivation is becoming salinized due to rising sea levels and soil subsidence. So it is a logical step to look at saline crops such as seaweed, which fetch good money internationally. But it doesn't help directly with the local food situation, because how much seaweed can you eat? Nevertheless, the crop does have a positive effect because the money that comes in helps the local community to develop. The progress it makes ensures that people go on investing in the system and the profits can be used to improve the regular local crops as well.'

How does the Food Systems Approach help improve a situation like that?

'It provides a kind of checklist and reflects the interplay of factors. Take seaweed farming, for example. The community earns money from it, so that is a good development in itself. So you can put a tick next to socio-economic factors. But zoom in a bit more on the socio-economic situation and you'll see that it's massively inefficient. It is a complex system with a lot of intermediate trading, and as a result the ultimate goal – providing the >

FOOD SYSTEMS APPROACH

In seeking solutions to the global food problem, the Food Systems Approach pays attention to all the elements of a food system that work together and affect each other, such as agricultural production, biodiversity, the availability of water, land use and the risks of climate change. There are also purely human factors such as the purchasing and eating habits of consumers, policy, and the civil society organizations concerned with food and food trade.



IVO DEMMERS

Ivo Demmers (43), programme leader for Food Security and Valuing Water, studied Land Use Planning at Wageningen University. Previously, he worked as a consultant for RoyalHaskoning/DHV in the Netherlands, Europe, Africa and Asia, as director of business development at the Netherlands Water Partnership and as director of operations and business development at water technology company Kalsbeek. He came to Wageningen in 2014 to work on business development and programme leadership in sustainable water management.

‘The Food Systems Approach exposes unintended side effects of changes’

community with an adequate supply of healthy and sustainably farmed food – stays out of sight. And on top of all that, it is obvious that the crop is not very sustainable. The float lines the seaweed is grown on are tied to plastic bottles and jerry cans that get worn down by the sun, sea and wind, forming a serious threat to the local ecosystem. So you have to put a cross next to environmental factors. That is another important function of the Food Systems Approach: exposing unintended side effects that you have to take into account so you don’t face unpleasant surprises later on.’

Is the Food Systems Approach fundamentally new? It seems obvious that there is more to food security than food production.

‘No doubt there was always an awareness that you have to look at the system as a whole, but it is only in the past decade that the problem has been tackled systematically so explicitly. In scientific circles, the need for an interdisciplinary approach to tackling food problems became increasingly apparent. Don’t underestimate the effects of compartmentalization in organizations. When I was still head of the Wageningen Sustainable Water Management programme, I was once asked by the World Bank to come and talk about food security. I asked if they also considered the links with water. They did do that, but in a different department. The people I was talking to worked on the topic of primary food production, but irrigation and water management were not in their portfolio. And yet you can’t grow food without water. The Food Systems Approach grew out of the recognition that you must look at the system as a whole. This approach is now in use all around the world.’

The approach seems comprehensive, but reality is intractable. For example, how do you cope with an unexpected event with a huge impact – like the current coronavirus pandemic?

‘In our research programme, we take the possibility of extreme events into account. What if a crop disease breaks out in a system? What if a global food crisis arises, as it did in 2008? We were not well prepared for a pandemic – nor was the rest of the world, incidentally – but we can make use of it to learn from previous extreme events and link those models together. If you do that, you can see that the effects of Covid-19 on the global food supply are the direct result of current policy: the massive surplus of potatoes used for French fries in the Netherlands is a direct consequence of the policy of closing all bars and restaurants. Internationally, governments are taking protectionist measures. That can be entered into the table under “socio-economic impact”.

‘You hope people will be prepared to change, even if it doesn’t produce immediate short-term benefits’

If things were to get out of hand, food system activities would get squeezed out. For example, if large numbers of farmers or factory workers were to fall ill. The Food Systems Approach provides a model for seeing which problems are at play where, and what is the best way to tackle them.’

A comprehensive overview is nice, but that is not a silver bullet either. You can’t feed the world with it.
‘That’s true. We use the approach primarily to provide input on what ought to be done differently. And for that too, we have a very structured model with different levels of transition. By paying constant attention to what needs to change at different levels, we get a fuller picture and arrive at an action plan.’

So a great deal of your work comes down to convincing the relevant people that certain actions should be undertaken?
‘That’s right: we involve people who have a crucial role to play in the solutions we propose within a food system. We help them understand what that role is, and how it relates to the other elements in the system. You hope people will then be prepared to change, even if it isn’t necessarily profitable in the short term. That is quite difficult, if you want to persuade a farmer in Bangladesh who can barely make ends meet to do something that will only cost him money. But that investment will provide him with a better future and the capacity to cope with future challenges.’
‘So the approach is also an attempt to find answers together with all the parties involved. “Finding answers together” is Wageningen’s express strategic policy, in recognition of the fact that you might be right scientifically, but that is not worth much if you don’t get the wider society on board. That went wrong in gene technology, for instance: scientists had big plans for it, but they were misunderstood and sometimes roundly rejected by the general public. We have learned from that.’

Big challenges lie ahead of us: a growing world population, global pressure on farmland due to soil exhaustion, climate change, and increasing water shortages. Doesn’t all that zooming out to the bigger picture get you down?
‘I sometimes wonder how it will all end up, yes. But people are amazingly innovative. We are learning all the time. The current crisis is teaching us a huge amount too. Also, we know that there is still a lot we can do. With improved irrigation techniques, farmers in many places could save at least 20 per cent on water. That is a vast amount of water. And a lot can be achieved, even in Africa, which, with a population set to double in the next couple of decades, is the weakest link when it comes to food security. Harvests now are a fraction of what they could be. That “yield gap” – the difference between what is possible and what is actually harvested – could be reduced a lot.’

Demmers concludes: ‘If you look at the figures, it must be possible to provide the world with enough healthy and sustainably farmed food. It takes massive changes, but if you tackle them together, step by step and with a good plan in your hands, it is possible.’ ■

www.wur.eu/foodsecurity-valuingwater

WCDI COURSES

Wageningen Centre for Development Innovation runs two courses relevant to this domain: Food Systems for Healthier and Sustainable Diets, and Resilient and Sustainable Food systems for a Food Secure Future. *www.wur.nl/wcdi*

Forecasting with digital doppelgängers

Digital twins are dynamic models that keep in touch with reality. Wageningen develops models that know exactly what needs to happen on the farm, what the best humidity level is in the tomato greenhouse, and what fattening foods do to your blood count.

TEXT TESSA LOUWERENS **ILLUSTRATIONS** SHUTTERSTOCK, PETRA SIEBELINK (WUR)

'When scientists want to predict what is going to happen in a system, they usually do so using a model that approximates to the reality,' says Dick de Ridder, professor of Bio-informatics in Wageningen. 'Digital twins are models too, but these models are continuously fed with the latest data.' The added value of that is that the model's knowledge of reality is always improving. 'The model keeps pace with the reality,' says De Ridder. He is one of the coordinators of the Digital Twins investment theme with which Wageningen University & Research wants to give some impetus to the application of the technology in the Wageningen domains.

Digital twins have been up-and-coming in industry and the construction sector for a number of years, in the form of digital versions of aeroplane engines, cars, wind turbines and buildings. To obtain real-time data to feed into the digital twin, a machine's functioning is monitored in all sorts of ways, for example using sensors. But a digital model of a living organism or an ecosystem is a different ball game altogether. 'Because an amazing number of factors play a role in living systems, it is a lot more complicated to make a digital twin of those than it is for a machine,' says Willem Jan Knibbe, head of research at the Wageningen Data Competence Centre and one of the -coordinators of the investment theme. 'But the rise of sensor technology, the internet of things and the possibility of storing and analysing large amounts of data have brought this kind of digital twin a step closer.'

> 'It shouldn't just be a technical trick'

Wageningen is investing almost four million euros in three digital twin projects over three years: greenhouse tomato cultivation, the digital farm, and the link between nutrition and blood count. 'We have selected projects that could have a big scientific and social impact,' says Knibbe. De Ridder adds: 'It is a marvellous concept with a lot of potential. The challenge is to collect enough data of high quality so we can do something meaningful with it. It shouldn't just be a technical trick.'

SOIL TEMPERATURE

'Imagine you have a field and you want to know what effect the soil temperature has on the harvest,' explains De Ridder. 'You can use a harvest model for the crop, and make use of general data about the average ambient temperature. But you could also put sensors in that particular field, which measure the actual temperature.' Then the model is continuously fed with the latest data, so that it keeps pace with the reality and shows exactly what is happening at a particular moment. What is more, the digital twin does this using specific data from the field in question, rather than a collection of data representing a broadly similar field.

SELF-CORRECTING

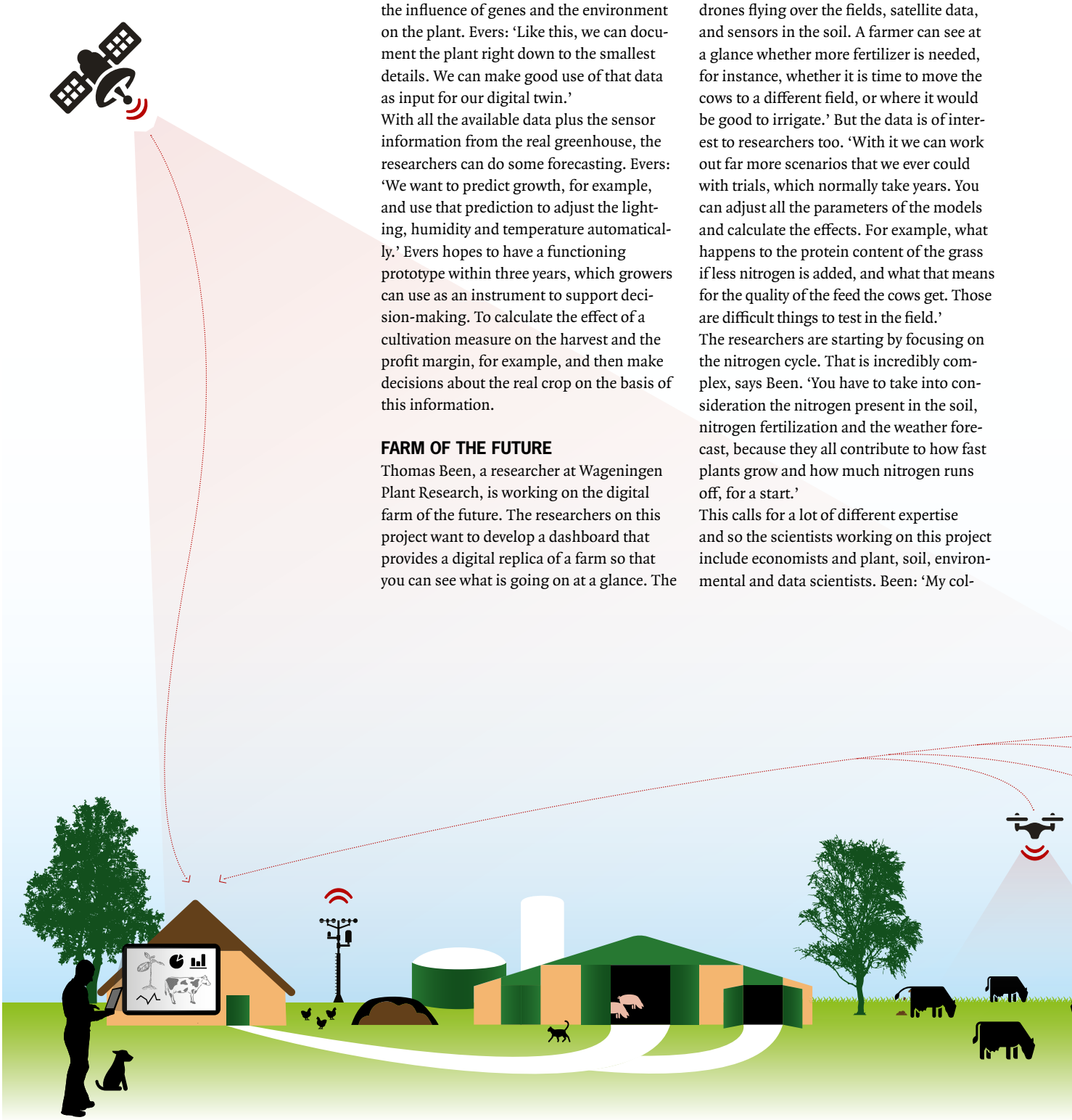
'The best thing would be to make a digital twin that is self-learning,' says Knibbe. 'It can then do things like compare the sensor information with the predictions of the model. If the soil is warmer than the model had predicted on the basis of the ambient temperature, the model can correct itself. Then it is no longer a person but the computer itself that makes the algorithms for the model.'

Researcher Jochem Evers of the Crop and Weed Ecology chair group is working with a diverse team of 12 scientists on virtual tomato cultivation with a 3D simulation model that is continuously fed with sensor information from a real greenhouse. That makes this digital twin more advanced that the existing simulation models. 'The model is becoming more and more accurate as well,' says Evers. He hopes to use the digital twin in future in the quest for optimal permutations of plant characteristics and environmental factors. To look, for instance, at what happens if you use a different kind of glass in the greenhouse, or if you use a new tomato variety, maybe even one that has still to be created. The researchers want to make use of data from the Netherlands Plant >

Eco-Phenotyping Centre, which is to be built on the campus, in order to do research on the influence of genes and the environment on the plant. Evers: 'Like this, we can document the plant right down to the smallest details. We can make good use of that data as input for our digital twin.'
With all the available data plus the sensor information from the real greenhouse, the researchers can do some forecasting. Evers: 'We want to predict growth, for example, and use that prediction to adjust the lighting, humidity and temperature automatically.' Evers hopes to have a functioning prototype within three years, which growers can use as an instrument to support decision-making. To calculate the effect of a cultivation measure on the harvest and the profit margin, for example, and then make decisions about the real crop on the basis of this information.

FARM OF THE FUTURE

Thomas Been, a researcher at Wageningen Plant Research, is working on the digital farm of the future. The researchers on this project want to develop a dashboard that provides a digital replica of a farm so that you can see what is going on at a glance. The researchers will be making use of real-time information from a real farm. Been: 'Think: drones flying over the fields, satellite data, and sensors in the soil. A farmer can see at a glance whether more fertilizer is needed, for instance, whether it is time to move the cows to a different field, or where it would be good to irrigate.' But the data is of interest to researchers too. 'With it we can work out far more scenarios that we ever could with trials, which normally take years. You can adjust all the parameters of the models and calculate the effects. For example, what happens to the protein content of the grass if less nitrogen is added, and what that means for the quality of the feed the cows get. Those are difficult things to test in the field.'
The researchers are starting by focusing on the nitrogen cycle. That is incredibly complex, says Been. 'You have to take into consideration the nitrogen present in the soil, nitrogen fertilization and the weather forecast, because they all contribute to how fast plants grow and how much nitrogen runs off, for a start.'
This calls for a lot of different expertise and so the scientists working on this project include economists and plant, soil, environmental and data scientists. Been: 'My col-



> ‘The challenge is to collect high quality data so that we can do something useful with it’

leagues have already made models for a lot of situations. The challenge now is to bring them together and get them to communicate with one another, so we obtain an integrated overview.’

PERSONAL DIETARY ADVICE

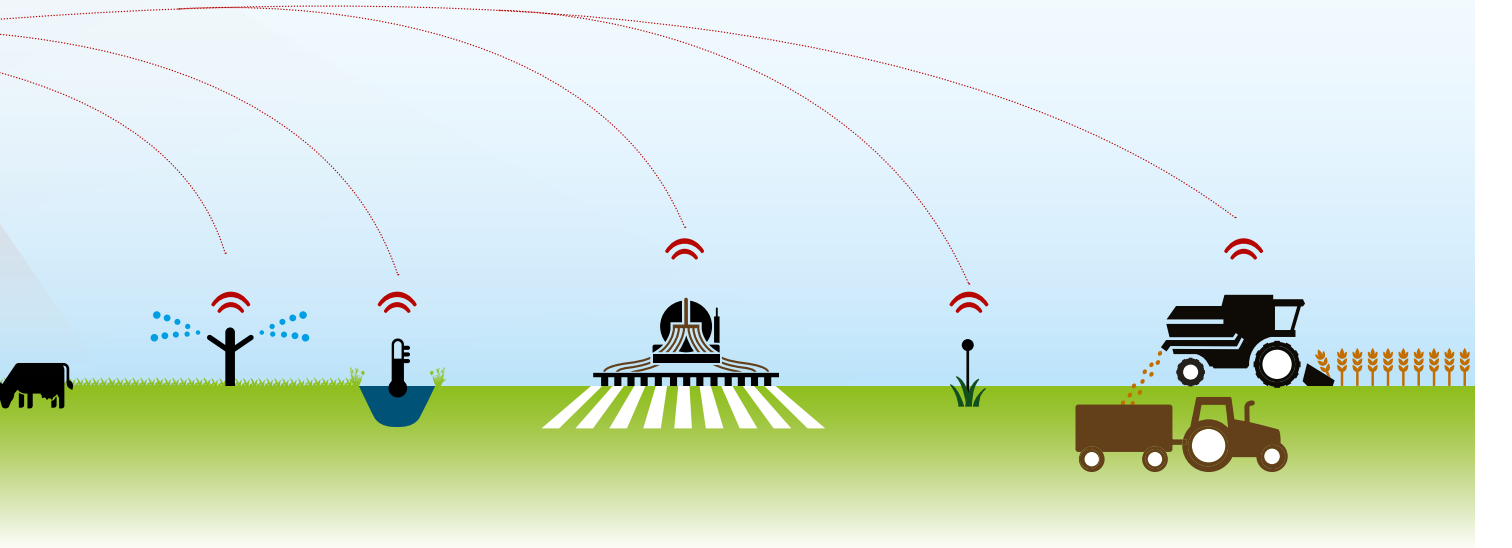
Lydia Afman, a researcher at Human Nutrition, is working with her team of biologists, computational biologists, bio-information technologists, economists and consumer science researchers on a very different kind of digital twin: a virtual replica of the blood count values in the body. She wants to use it to create an app that can give people personal dietary advice. This app takes into account things like blood sugar, blood fat levels after a meal, and factors such as behaviour and personal preferences, including vegetarianism and religious convictions.

The researchers will start by working out which factors influence how the human body processes fats after a meal. ‘Whether you are a man or a woman, your age, or whether you have just taken some exercise: all of this has an influence,’ says Afman. The researchers already have data on lipids from nearly 500 overweight people. In the next phase, they will research whether they can make predictions based on the data in reality. This involved measuring the actual fat and sugar levels. If that works, that data can be used as a starting point for the app. ‘We eventually want to work towards an app that gives advice based on a digital twin of the app user. On the basis of unique individual data, the app can predict how high the person’s blood fat levels will go after a meal, and can adjust its dietary advice accordingly.’

Because the app collects more and more data and gets feedback, comparing the predictions with the real blood counts for fats and sugars makes the predictions increasingly accurate.

The app will also have to take into account factors such as a person’s behaviour or personal preferences. Whether they are morning people or evening people, for instance, or whether they eat meat. Afman: ‘Because personal preferences are taken into account, there is a better chance that people will actually follow the advice.’ ■

www.wur.eu/digitaltwins



Gathering data in the polar night

It takes dedication to be a polar researcher, living in the dark for weeks amidst severe storms and temperatures of down to -40 degrees. From the research vessel the *Polarstern*, frozen into the ice in the Arctic, Wageningen researcher Serdar Sakinan is braving the elements to do research on plankton and fish.

TEXT TESSA LOUWERENS **PHOTO** MICHAEL GALLAGHER /AWI

'We work from the ship or from tents set up on the ice. The tents are heated to about 15°C. Not just for the people working in them, but also because our instruments can't withstand such extremely low temperatures. The temperature outside sometimes goes down to -40°C. At lower temperatures we stop going out of doors,' says Serdar Sakinan of Wageningen Marine Research, speaking from the German icebreaker *Polarstern*.

The ship serves as both lab and hotel for meteorologists, biologists, oceanographers, physicists and chemists from 17 different countries who want to learn more about the impact of climate change on the atmosphere and the ecosystem. Russian, Swedish and Chinese icebreakers supply the ship and bring new teams of the researchers and crew to take over. The ship will accommodate In total about 600 people in the course of the year. The MOSAIC expedition (Multidisciplinary drifting Observatory for the Study of Arctic Climate), for which preparations started back in 2011, costs about 160 million euros. Dutch projects from the Universities of Wageningen and Groningen are being conducted on board, thanks to a financial contribution from the Dutch Research Council NWO.

FLOATING AROUND

The *Polarstern* embarked from Tromsø, Norway, on 20 September 2019, to float for a year around the North Pole, frozen to an ice floe. Sakinan boarded the ship at the end of January, to do research on the diet of the Arctic cod. On a previous expedition, young cod were found under the sea ice. It appears that they use the sea ice as a means of transport to get from their birthplace – the Russian and Canadian coasts – to the central Arctic Ocean. One of the aims of the study is to find out what the cod eat during the different seasons. These data will be collated with results from other studies on topics such as the distribution of cod.

The zooplankton under the ice form a potentially significant source of food for small shellfish such as amphipods, which are in turn food for cod. 'We are collecting zooplankton in Ocean City, a large tent standing on the ice about 300 metres from the ship. We walk over there, pulling our equipment behind us on a sleigh. The tent is located over a big hole in the ice that we can lower nets into. Once we are finished, we make way for other scientists, who can then do whatever they need to do, like taking water samples. In the afternoon, we process the samples in the lab on board ship.'

'At -40 degrees we stop going out of doors'

PHOTO'S: ALFRED WEGENER INSTITUT

Clockwise from top left: researchers walk to their research location with their equipment on a sleigh; the Polarstern; the ice cracks; two polar bears visit the research location.

ACOUSTIC SIGNALS

When Sakinan started work on his research in February, it was dark around the clock, but it has gradually been getting lighter since March. 'The Arctic Ocean is covered by a thick layer of sea ice for most of the year. So not

POLARSTERN FLOATS ALONG

Climate change is causing major changes in the polar region, but we lack data on this for half the year, the polar night. In this period, the pack ice and the low temperatures make it practically impossible to do research. Now, for the first time, the MOSAIC expedition (Multidisciplinary drifting Observatory for the Study of Arctic Climate) has been collecting data on a wide range of scientific subjects. When the Dutch delegation arrived on the research vessel *Polarstern* at the end of January 2020, it lay frozen into the ice about 300 kilometres from the geographical North Pole on the Russian side. The expectation – and the subject of a research question – is that ocean currents will carry the ship out of the ice somewhere between Greenland and Iceland by the end of summer 2020.

much light gets through, whereas everything needs light to grow. At lower latitudes, the plankton comes up at night, and sinks back down into the depths during the day. I was very curious to see how the plankton would behave under the specific diurnal variations in the Arctic region,' says Sakinan.

Sakinan detects the presence of plankton using acoustic signals, sending sound pulses down into the water and measuring the echoes that return. 'Zooplankton are very small, but there are a lot of them and they produce weak but measurable echoes. It was great to see that our acoustic measurements were right: when we pulled up the nets, they were teeming with plankton.'

A new team was due to arrive on the *Polarstern* in April, to take over from the present group, but that has been postponed by about six weeks due to the coronavirus. 'We don't get so much news here, so at first we didn't realize what the scale of the coronavirus outbreak was,' says Sakinan. 'As soon as it did become clear, we were told we wouldn't be able to leave the ship for a while because the travel restrictions meant the new group of scientists and crew couldn't get here. At first I was very worried about my family in Turkey, especially my parents, who are getting on in age. But I've had more contact with them since then, and I know they are doing well.' ■

www.wur.eu/arctic

Minilab never misses a tumour

A new nanosensor developed by the Universities of Twente and Wageningen is designed to track down cancer in the body with a single drop of blood. No tumour particle will escape notice, think the researchers, thanks to antibodies and smart electrochemistry. 'This sensitivity is unprecedented.'

TEXT ROELOF KLEIS **PHOTO** SVEN MENSCHEL

Pepijn Beekman, a PhD candidate in the Organic Chemistry chair group, carefully holds out a Petri dish. In it are two ultrathin chips barely two centimetres wide. These are nanosensors, a kind of miniscule laboratory on a chip. Once the chip is fully developed, it should be capable of detecting the presence of tumour cells in the body with just a drop of blood.

Body cells are constantly secreting tiny sacs containing substances with which they communicate with one another. Called extracellular vesicles, these little sacs are also secreted by tumour cells, in which case they are called tumour-derived extracellular vesicles (tdEVs). Beekman uses these vesicles to demonstrate the presence of tumour cells. On the surface of the vesicles of the tumour cells is a particular protein (EpCAM). The sensor distinguishes between tumour vesicles and those from other cells.

The sensor makes use of antibodies and electrochemistry. The antibodies detect the tumour vesicles and an enzyme that is attached to the antibody causes a measurable electrical signal to be produced.

The electrodes that detect the signal are spaced 120 nanometres apart. The vesicles themselves are no more than 100 nanometres in size. 'If you stare at your thumbnail for one minute, it will have grown 100 nanometres': this is Beekman's favourite analogy to show how small yet how high-tech this technology is.

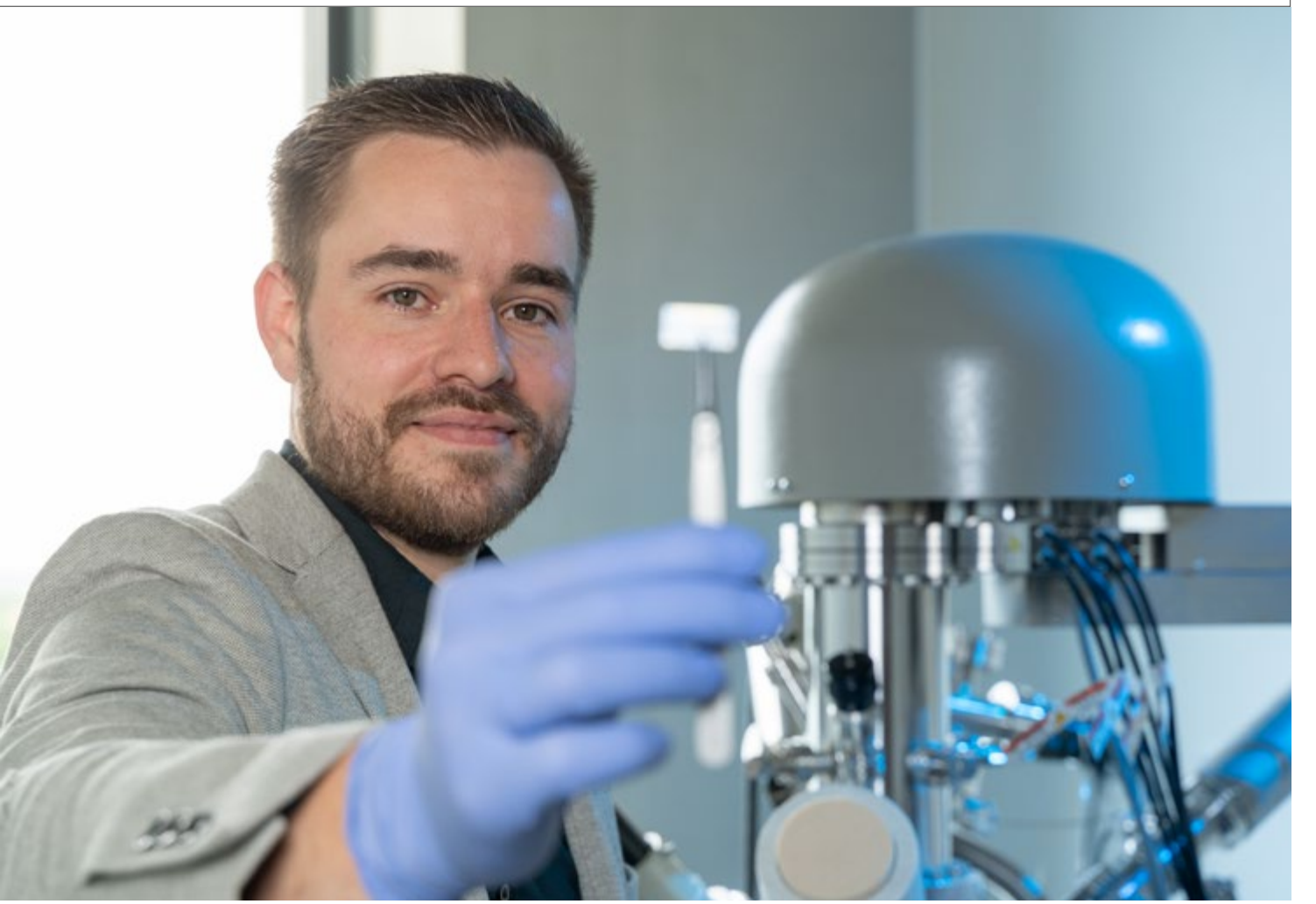
BIOMARKERS

Beekman, who also does research at the University of Twente, developed the nanosensor with his colleague at Twente, Dilu Mathew, in their start-up ECsens. They met on their MSc programme in Nanotechnology at Twente, and decided to join forces.

Beekman: 'My research is focused on biomarkers and Dilu concentrates on the sensor technology.'

Their first nanosensor only worked with a concentration of at least 10 tumour vesicles per microlitre of fluid from tumour cells cultured in the lab. It nevertheless got Beekman and Mathew onto the cover of *Nano Letters*, a leading journal published by the American Chemical Society. 'We're very proud of that,' says the PhD candidate. 'But that sensitivity is not good enough for proper detection. The sensor needs to be at least 100 times more sensitive.'

They have now achieved that. But Beekman is a bit secretive about the improvements they have made. 'We haven't described this new technique in the scientific literature yet, but we have done so in a patent application. We've used electrochemistry to ensure that the tumour particles come to



Pepijn Beekman displays the nanosensor, a lab on a chip.

> ‘Tumour particles come to the detector themselves’

the detector of their own accord. That way you don’t miss a single one. That sensitivity is unprecedented.’

WORLD EXPO

At the end of 2019, Beekman and Mathew’s invention won them the 4TU Impact Challenge, an innovation competition run by the four science and technology universities in the Netherlands. The prize will take the researchers and their company to the World Expo in Dubai in early 2022. ‘It’s nice to be allowed to present it at the same event at which innovations such as the television and the computer were introduced to the world. It is the ultimate opportunity to draw the attention of potential investors to our technology.’

Beekman and Mathew also received grants to the tune of nearly half a million euros to perfect the sensor. That means testing it with real blood rather than material from cultivated tumour cell lines. ‘The question is whether we can improve the chemistry so that it also works in blood plasma. Plasma contains a lot of biomaterials that could disturb the signal,’ says Beekman.
The prospects look promising at this early stage. ‘We are introducing measures involving a coating on the electrons that repels certain components in blood. That worked fine in the experiments we have done with healthy donor blood. We are now ready to repeat those experiments in combination with actual detection, but that research has been held up due to the coronavirus crisis.’ ■

https://ecsens.com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any wind

So hot!

Cities can quickly become unbearably hot, which reduces productivity and causes health problems. Wageningen researchers are measuring what goes on at the street level, and making weather models for cities in an effort to bring relief.

TEXT MARION DE BOO **ILLUSTRATION** JORRIS VERBOON

It is no longer a rare occurrence for us all to be wilting in the heat. According to the Royal Netherlands Meteorological Institute, the number of days with summer temperatures– defined as over 24 degrees Celsius – will double between 2015 and 2085. The number of days defined as tropical – with temperatures over 30 degrees Celsius – will increase too. This will create more heat stress, especially in the cities, where people live close together and generate extra heat with all their activities. The human body then has to work hard to avoid becoming overheated. Healthy adults, including those in hot countries, feel most comfortable at temperatures of between 18 and 23 degrees. Outside that range, the body has to work harder to stay comfortable.

‘In summer, it is seven degrees hotter in cities than in the countryside’

Last summer, when all the heat records in Europe were broken, Wageningen researchers set off for Dam Square in the middle of Amsterdam on a hot July day. Every two hours over a 24-hour period, they sent up a weather balloon with a beaker containing measuring equipment. At the same time, some colleagues of theirs were doing the same thing in a meadow near Breukelen, a few kilometres outside the city.

The weather balloons measured the temperature, humidity, wind speed and wind direction at an altitude of 2.5 kilometres every two seconds. Their activities got into all the news programmes. Amsterdam city centre turned out to be seven degrees hotter than the meadow outside Breukelen, and this heat was measurable up to a great height, says Wageningen meteorologist Gert-Jan Steeneveld. ‘Even within the city we see big temperature differences. Industrial estates and suburban concrete jungles without much vegetation store extra heat, while the parks usually stay cooler.’

MODELS TOO CRUDE

These measurements are useful to the researchers for refining their urban weather models, says Steeneveld. ‘In those models, the upper layers of the earth’s atmosphere play a bigger role. Urban planners and landscape architects can use such models to improve their designs for limiting heat stress in the city. Up to now, that was done very little or not at all because the existing models are too crude.’

‘The city absorbs more solar heat than the rural areas, because there is more dark material such as asphalt, dark cobblestones and roofing tiles,’ says Steeneveld’s colleague Bert Heusinkveld. And then of course, it is during a heat wave that the use of air-conditioning in the city goes up enormously. ‘Those anthropogenic heat sources make it even hotter in the city, reinforcing the effect,’ says Heusinkveld. ‘There is less wind in the city too, so “heat islands” are created. Above and between the buildings hangs a dome of heat, even in the evening, which doesn’t get absorbed much into the higher, cooler layers of air. As a result, urban heat can hardly escape in the evening. Smog, exhaust fumes and other forms of pollution also linger in the streets under this warm blanket for a long time, and in higher than normal concentrations.’

MORE DEATHS

Heat makes the city less liveable, heat stress sends labour productivity into decline, and city dwellers get health problems. Hot, sticky nights lead to loss of

> ‘We can make weather forecasts with a resolution of 100 metres’

sleep, and people who don’t drink enough become dehydrated. Sunstroke can even be life-threatening. The elderly and people with chronic heart or lung conditions are particularly at risk of dying. According to the Netherlands National Institute for Public Health and the Environment (RIVM), there are an average of 30 additional deaths per week per degree Celsius above the normal summer temperature (the long-term average of the last 30 years).

The police are also called out more often during a heat wave because people are on a shorter fuse; drinking water companies find it harder to keep the drinking water under the safety limit for legionella; and water boards have to deal with blue-green algae and botulism in surface water. Energy companies are allowed to transport less electricity to prevent underground power cables from overheating. Heusinkveld: ‘On hot days, the electricity network is overloaded anyway, because so much solar energy is generated and transported.’

HEAT PROTOCOLS

The government’s Spatial Adaptation Plan lays down that water boards, provincial and national government bodies and other stakeholders should prepare for the expected increase in heat waves. Various parties such as municipalities, health services, drinking water companies, water boards, and the police are drawing up their own heat protocols. Steeneveld: ‘For those heat protocols, all sorts of heat maps were in circulation, showing the number of tropical nights, for example, or the highest recorded daytime temperatures. You can make heat maps on a metre scale or on the neighbourhood scale. Until recently, different parties had their different methods for that.’

So, at the behest of the central government, Heusinkveld and Steeneveld designed a standardized method based on the ‘apparent temperature’. ‘This indicates how hot a person feels in given weather conditions, so how easily they can cool down,’ explains Steeneveld. >

HEAT AND AIR POLLUTION GO HAND IN HAND

Research by the Wageningen professor of Air Pollution Maarten Krol shows that air quality and the weather are closely linked. Smog, exhaust fumes and other forms of air pollution accumulate in urban heat islands along with heat. ‘The life expectancy of people living on a busy road in Rotterdam is two years shorter than that of residents of the Wadden islands,’ says Krol. ‘An important source of urban pollution is the traffic. Traffic emits nitrogen oxides, and old diesel vehicles often emit soot as well. Years of inhaling polluted air can take its toll.’

More people die than usual during a heat wave. Krol: ‘During heat waves in the Netherlands we often have land breezes, bringing pollution from Germany and Belgium to the Netherlands. This air is already dirty, and once over the Netherlands it picks up more pollution from traffic, farming and industry. It is often very sunny during heat waves too, which causes photochemical smog. During last year’s heat wave, extremely high levels of ozone were measured in the Netherlands. The formation of this poisonous gas is partly influenced by sunlight and emissions from traffic and industry, a process that is very efficient at high temperatures. All these factors came together last year.’

'The apparent temperature is not just a matter of the air temperature but is also affected by radiation, wind speed and humidity. It can feel five degrees warmer if you are standing in the sun and out of the wind than it does in the shade.'

Engineering consultancy firms are going to roll out this map nationally. Steeneveld: 'They are going to make heat maps for various cities using the Wageningen method, and we shall then validate them.'

The two researchers made a heat map for Wageningen first. They rode around on a 'climate delivery bike' full of measuring equipment for documenting differences in temperature and radiation from street to street around the town. The map represents the average apparent temperature in the town on a hot summer's day, and shows where the hottest parts of the town are during periods of extreme heat.

They then went on to make heat maps of Amsterdam and Rotterdam. Remarkably, the hottest daytime temperatures during a heat wave in Amsterdam were not in the city centre but in suburban areas such as Holendrecht, Osdorp and Amstelveen. One possible explanation for this is that the narrow streets of the city centre provide more shade. The Rotterdam map also show how the Kralingse Plas, a lake, forms a cool oasis. And how the suburb of Hillegersberg, with its shady parks and gardens, and the Noordereiland, an island in the River Maas, stay a lot cooler than the densely populated Oude Noorden neighbourhood.

FORECASTS AT STREET LEVEL

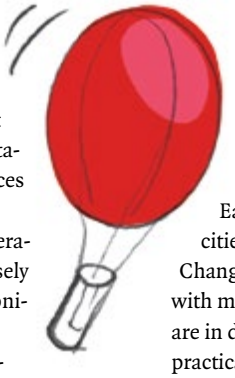
The researchers went on to develop weather forecasting models with which they can forecast the weather down to the street level. Steeneveld: 'Weather models at the global level work with a resolution of nine kilometres, in which you barely see the Dutch cities at all. Because we use highly detailed information, we can generate weather forecasts with resolutions of up to 100 metres. That was unimaginable five years ago. And the models are becoming more and more refined.'

Very large data sets of geo-information and meteorological data are being collected with a view to getting a good picture of the various microclimates. The Wageningen researchers made use of highly detailed relief maps, on a 50-centimetre scale, and of aerial photos. With such information, you know the exact height of buildings, walls and vegetation. From that you can deduce what time shade falls on a street, and how much heat stress residents are likely to experience, depending partly on local meteorological conditions and the play of sun and shade, radiation and wind. The effect of the vegetation or a feature such as an urban canal becomes visible too. Engineering consultancy Witteveen & Bos is now using the method developed by Wageningen scientists to create a heat map of the whole country which government bodies and health services can use to take timely precautions against heat stress. To decide, for instance whether they should publish warnings of a heat wave, or whether a pop festival should be cancelled.

ON THE BALCONY

A lot of the meteorological research is being done in collaboration with Amsterdam Institute for Advanced Metropolitan Solutions (AMS Institute), an expertise centre on innovation in urban areas. The institute is a collaboration among the Technical University of Delft, WUR and Massachusetts Institute of Technology (MIT), and is co-financed by Amsterdam municipality. AMS Institute co-financed 24 weather stations that measure the temperature continuously in the neighbourhoods. Steeneveld: 'Using delivery bikes and weather stations is relatively expensive, so we also use data from amateur weather stations. In the Netherlands there are about 15,000 of those mini-weather stations in people's back gardens or on their balconies. They are not very

‘Urban planners mainly see climate change in terms of flooding, but heat stress in the city deserves more attention’



sophisticated and you shouldn’t hesitate to chuck out strange datasets, but in combination those weather stations do provide a pretty good impression of differences between neighbourhoods.’

Smartphones are another source of data, as the temperature of their batteries turns out to correlate very precisely with the outdoor air temperature. A company that monitors the network connections of providers also keeps a record of battery temperatures. This provides the researchers with one and a half million measuring points in the Amsterdam region alone. Steeneveld: ‘In the next few years, I would love to do more research on indoor temperatures. The temperature in some bedrooms is 27 or 28 degrees as early as May, which is shocking. I would like to correlate those readings with types of building, building density and, say, energy labels.’

URBAN PLANNING

The two researchers emphasize that smart urban planning can make for a more pleasant climate to live in. Fountains have a cooling effect as the mist they create evaporates, cooling the air around them. Heusinkveld: ‘In some German cities, city squares are sprayed from time to time with a shallow layer of water, which then evaporates. That is a very effective way of cooling down squares. The little fountains that suddenly spurt into the air at random intervals, and in which children can play, also help to cool down the city.’

‘Hitherto, urban architects mainly saw climate change in terms of flooding,’ says Heusinkveld, ‘but heat stress in the city deserves more priority. Heat maps and weather models can be of service here. Urban planners know, for instance, how much wind city residents are comfortable with, and our urban weather models show exactly where the windy corners are in the city, how gusts are formed, and how the flow of air around buildings develops under particular meteorological conditions. Planners can use our micrometeorology to optimize their designs.’

Over half the world population is now urban. And the average summer temperature is over 35 degrees in 354 cities, most of them in the Middle East and Asia. By 2050, that will be the case in 970 cities, according to research by the Urban Climate Change Research Network. Cities in tropical regions, with much higher humidity levels than the Netherlands, are in danger of becoming uninhabitable. And whereas practically every square metre of land in the Netherlands has been documented, there is much less information available in poorer countries. Many big cities do not go beyond placing neighbourhoods on a heat scale of 1 to 10. ‘People in slums in hot regions can’t afford air-conditioning or other cooling methods,’ says Heusinkveld. ‘We can expect many more additional deaths due to heat stress in those places. Our research results can be used immediately to make these cities more habitable.’

Meanwhile, the Wageningen meteorologists are doing their best to quantify the effects of urban planning measures against heat stress. For example, they are involved in a project in Breda in which the filled-in sections of the river Mark will be dug out again to make the city centre more attractive. There are several scenarios for the redesign and landscaping of the river banks, paying careful attention to the potential for providing cooling in the summer. Heusinkveld: ‘We made calculations for the current situation and tested the design, after which it went through several more rounds of improvement. You need to be aware of wind direction and shade, for instance. Trees provide shade, but too many trees block the wind. And much use will be made of lighter coloured brick, which absorbs less sunlight, keeping the quayside cooler.’ The Wageningen meteorologists will take baseline measurements this summer and will then continue to take measurements to see how the urban climate changes when the New Mark flows through Breda once again. ■

www.wur.eu/climate-resilient-cities

DEVELOPMENT ECONOMIST THIJS BOER:

‘You know what, I’m going to set up that factory myself’

Five years ago, Thijs Boer embarked on a great adventure: setting up a crisp factory in Rwanda. ‘If the urban youth are going to snack, they might as well buy a bag of crisps made from potatoes grown by Rwandan farmers.’ The factory is now breaking even, while hundreds of local farmers are getting a good price for their potatoes.

TEXT RENÉ DIDDE **PHOTOGRAPHY** SVEN TORFINN / HH

Thijs Boer (33) buys up the potato harvest from 250 farmers in the north of Rwanda. Some have half a hectare of land and supply a maximum of 5000 kilos, and one or two have 20 hectares, says Boer in a conversation on Zoom. Some farmers have been able to expand thanks to Boer. ‘Because they get a 15 to 20 per cent higher price from me than from the local traders,’ he explains. ‘As long as the quality is good. That is a must. Sometimes I and my team, which includes three young agronomists from the University of Rwanda, advise them to leave the potatoes in the field two weeks longer. They have to be at precisely the right level of ripeness, so the crisps don’t go brown because of the sugars. We also teach them the importance of the dry matter content level. If they don’t listen, they just have to go to someone else. I’m not an NGO.’

Farmers in this small East African country are not very used to these kinds of requirements. But Boer is not a typical potato buyer. He makes crisps in a factory between the potato fields just outside Musanze, the potato capital of Rwanda, 90 kilometres or two hours’ drive north from the capital city, Kigali. The crisp brand name is ‘Winnaz’ – which sounds like ‘winners’. Since 2015, the potatoes have been going to Boer’s factory, where they are washed, peeled, cut, inspected, fried, flavoured and weighed. Twenty minutes later, they leave the factory in red, blue or green bags (salted, salt & vinegar, paprika) with the factory’s black-and-white logo. Thirty-five people are employed in Boer’s crisp factory.

Is this fatty, salty snack the right form of added value to introduce in Rwanda, though? Boer has been asked this before. ‘Crisps from big multinationals like Lays are imported from Kenya, South Africa, and even Europe. The growing middle class, especially the young urban population, buy crisps to snack on with a drink. So if they are doing that anyway, they might as well buy a bag of tastier, less salty crisps that are made with potatoes from Rwandan farmers.’

Boer thinks it is important for developing countries to be self-sufficient in food production. It annoys the young Dutch businessman that in spite of its economic growth, this country imports as much as 85 per cent of the food it needs from Egypt, South Africa, India, China and the United States. ‘While 95 per cent of Rwandans are farmers. I have seen studies that make it clear that 40 per cent of the food needed could easily come from Rwanda itself.’

How did you come up with the idea of a crisp factory in Rwanda?

‘It started with field research for my Master’s in Development Economics in Wageningen. At first I was supposed to go to Ethiopia, but when that fell through I ended up in Rwanda, a smaller and less heterogeneous country. For my research I needed to look for ways of boosting the productivity of small potato farmers in the north. And that’s when I hit upon crisps. My idea then was: the farmers would start collaborating to improve the quality of the potatoes, and form a cooperative that would set up a crisp factory. But the plan for a cooperative factory came a bit too soon for them. >

Thijs Boer, founder of the Winnaz crisp factory in Rwanda, tastes his crisps.

Thijs Boer with a colleague at his crisp factory just outside Musanze in Rwanda.

‘Farmers get a 15 to 20 per cent higher price from me’

‘I liked this location. Not just because of the climate, the way of life and the absence of crime and corruption, but also because everyone is working hard to turn Rwanda into a successful economy. I’m a bit of an adventurer, so I thought, you know what, I’ll set up that factory myself, and the farmers can buy me out later. I got help with the investments from the Dutch ministries of Economic Affairs and Foreign Affairs. My parents invested in my company too. It is quite easy to go into business here. I can just drop in on the minister if I want.’

It still seems a big step, and a rather uncertain market.

‘That’s true. It goes against all the rules of economics: starting something in a small country with a very small economy and with a product there is hardly any demand for. So for the first few years I might actually have worked for nothing. But my aim of providing small farmers with more security got off the ground from day one. And we were soon collaborating with at least 10 young Rwandans who had just graduated in the domains of agronomics, agribusiness and quality management at universities and vocational training colleges. They assess potatoes on the farms, in the field, they are quality managers in the factory, and they sell the crisps in the city.

‘Only now, after five years, are we breaking even, meaning we are selling more than we

spend on the costs. In figures: our turnover is 225,000 euros in crisps, based on 130,000 kilos of potatoes. The task now is to expand. We are working on the export of our Winnaz crisps from Rwanda to neighbouring Uganda and Congo. These are much bigger countries with much bigger economies. But even in Rwanda itself, there are opportunities. We analysed the supermarket shelves recently. It turns out we have a market share of at least 65 per cent. We are bigger than Lays! We are now actively involved in the Made in Rwanda campaign, which promotes national products and encourages people to spend their money supporting the national economy.'

Are you thinking of other potato products?

'No. It is very difficult for me to influence the potato sector. Dozens of varieties are grown here, with different traits, and it's not easy to get hold of good seed potatoes. But I am thinking of equipping our machines for making crisps out of vegetables such as beetroot and carrots. That fits the health trend, which is on the rise here too. Another option is to strengthen our business model by using our packaging line to provide local and regional producers of beans or nuts with relatively fast and cheap packaging for their products.

So how did you end up in Wageningen?

'I first did Management, Economics and Law at the applied sciences university in Groningen. When I had a temporary job at the land registry, a colleague there had recently graduated from Wageningen, and persuaded me to go there. Once I started going to lectures and discovered the night life, I was a convert. I made friends with a lot of international students, mainly Africans. And I enjoyed getting to know different cultures and their cuisines. Wageningen was much more fun than Groningen. When I'm in the Netherlands, I still go for a beer or a coffee at a pavement cafe in the market square.'

Did you benefit from your degree programme? And did you learn business skills at university too?

'I learned that the economy is bound up with politics. Thanks to Erwin Bulte's lectures, I understand the economics of developing countries better. And thanks to Liesbeth Dries, I have a better grasp of how it works in those countries institutionally. I also took courses in Wageningen for future entrepreneurs. One thing I learned was that 90 per cent of enterprises, both in the Netherlands and elsewhere, fold within five years. In that sense, I've already been quite successful. Ha ha. No, but seriously: how to do business is something you can't learn from books. For the first two years, I made all the crisps myself and I kept a close eye on my staff. By now I've realized they can make better crisps than I can. I am someone who thinks up concepts. I have ideas. I'm doing more marketing now. Once that is up and running, I'll get managers to do it.

'Maybe I can work myself out of a job here'

'The main thing is to make your peace with the fact that you enjoy a lot of freedom in the prison you've chosen. I am the son of a dairy farmer in the north-east polder who grew some potatoes on the side. My mother was just as enterprising. Maybe I've got a gene for entrepreneurship.'

Do you miss the Netherlands badly? I imagine it's a lonely life, especially in this corona year.

My girlfriend Judith studied in Wageningen too; we were housemates on the Stationsstraat. She came along to Kigali, got a job here, and was the breadwinner for the first year. She recently went back to the Netherlands, where she's working in The Hague. That is far from ideal, even though I knew it would happen. Luckily we are used to travelling a lot.

'Maybe I can work myself out of a job here. I am making this call from Kigali and I haven't been to the crisp factory in Musanze for a week now. I do check the books and the turnover is great: no problems – and without me. Eventually I might be able to run the business from a distance. It isn't my dream to stay here all my life. I'd like to start other businesses, preferably in the agri-food sector. And it's important to me to change things, like I am now changing the potato value chain for the better.' ■

THIJS BOER (33)

Studies: BSc in Management, Economics and Law at Hanze University of Applied Sciences Groningen (2009), MSc in International Development Studies, Wageningen (2013)
Work: Founder and general manager of the Winnaz crisp factory in Rwanda


PHOTO WUR


PHOTO WUR

Ingrid van der Meer does research on water lentils as a new and sustainable food crop.

Water lentils as a new so

Ilse Bastmeijer, founder of the Goeie Grutten foundation, would like to see water lentils on the menu within a year or two. These protein-rich plants could contribute to the much-needed global protein transition. That is why the foundation supports Wageningen's water lentil project, which is harnessing all the relevant knowledge to launch this novel food on the market.

TEXT ANJA JANSSEN

As soon as Ilse Bastmeijer had set up the Goeie Grutten foundation, which aims to improve access to healthy, sustainable food, she came knocking at University Fund Wageningen's door in search of projects to support. 'Sustainable nutrition is an important theme of ours, so I thought: we should go to Wageningen.' After exploring the territory, evaluating project proposals and talking to the researchers involved, Bastmeijer chose the water lentil project run by Ingrid van der Meer and Jurriaan Mes. 'We think the protein transition is important, and they had set up their project very thoroughly and systematically, with clear milestones and assessable goals,' says Bastmeijer. University Fund Wageningen played the role of account manager in this process.

Water lentils, more commonly but less appetizingly known as duckweed, are a new source of protein that could facilitate the transition to more plant-based proteins in the food system. The little water plants contain 30 to 40 per cent protein and reproduce vegetatively by dividing, so they don't waste any energy and time on making flowers and seeds. 'By growing water lentils, you can produce six times more protein per hectare than with soya,' says Van der Meer.

Because the plants are not yet eaten by many people in Europe, they are counted as a novel food in the EU, which means they must first be proven to be safe for human consumption. To that end, an extensive dossier must be submitted to the European Food Safety Organization EFSA. Completing this dossier was the first task of the water lentil project funded by Goeie Grutten, which started in 2019.

Van der Meer and Mes had already done several important studies for the dossier, with funding from another foundation, the British Wellcome Trust. These included studies with volunteers who were served water lentils. The results were encouraging, says Van der Meer. Consuming the water lentils had no negative health effects. And in taste tests, the dishes containing water lentils were rated just as highly as dishes with spinach, which is very similar.

What had not been studied yet were possible allergens; this has been done over the past year in the project with Goeie Grutten. 'We didn't find any protein fragments in water lentils that matched known food allergens,' says Van der Meer. This means the dossier is as good as ready for submission by WUR to the EFSA. This is the first time WUR has submitted a dossier of this kind. 'In doing


PHOTO GJ VLEKKE


PHOTO VERSE BEELDWAREN

‘You can produce six times as much protein with water lentils as with soya’

urce of protein

so, we make all the documents available, so that anyone else can continue working on this later.’

FROZEN WATER LENTILS

Meanwhile, the researchers are working on frozen products containing water lentils. ‘We have done tests using cubes of blanched and deep-frozen water lentils. You can buy spinach in the form of frozen cubes, and we think it would be easier for people to use water lentils in this form too.’ So the researchers have investigated how long you have to blanch water lentils for to get an optimal flavour and the lowest possible risk of microbial infection. They are also testing the product’s shelf life.
‘We are also going to develop ready-made products such as lasagne or *stamppot* [a Dutch mashed potato dish, ed.]. We’ll get tasting panels to evaluate them,’ says Van der Meer. Further important aspects are consumer acceptance of water lentils, and communication when you launch them on the market. There is a reason for choosing the name water lentils over duckweed, which tends to remind people of ditch water. ‘We would also like to know how you can entice people to try water lentils. Should you tell them about how sustainable the crop is, and how well it fits into the protein transition, or about all the useful nutrients water lentils contain, or should you just show them what nice little plants they are?’

Marketing is Ilse Bastmeijer’s profession. She is pleased that market research is part of the project. ‘I come from a supermarket family. My father started the Nettorama supermarket chain, so I have always had an interest in food. If I wasn’t looking at supermarkets when we were on holiday abroad, then I was testing products that purchasers brought in.’
Bastmeijer used to work in marketing at Superunie, a purchasing organization for supermarket chains, and then went on to start her own marketing firm. After a while she wanted a change from the profit sector, and came up with the idea of setting up a foundation in which she could combine her enthusiasm and knowledge with donations to good causes in the area of sustainable food. The foundation’s money comes from the Bastmeijer family’s capital. Bastmeijer’s aim is for the water lentil project to help further the protein transition. ‘The outcomes of the research and the products developed need to be usable by everybody. I hope as many organizations as possible will benefit from them.’ ■

www.wur.eu/duckweed


PHOTO GOEIE GRUTTEN

Ilse Bastmeijer

THE GOEIE GRUTTEN FOUNDATION

The Goeie Grutten foundation was established at the end of 2016 by Ilse Bastmeijer and her husband Bernd Voorsluijs. The foundation supports long-term projects working on responsible, healthy and varied nutrition and on the sustainable energy transition. Bastmeijer and Voorsluijs also founded the Goeie Grutten Impact Fund, with which they invest in businesses in these branches.
www.Stichtinggoeiegrutten.nl/en
www.goeie-grutten.nl/en

DONATIONS

100-year-old alumnus collecting money for students

On his 100th birthday, Bessel Vrijhof (WUR Horticulture 1947) raised funds for the Anne van den Ban Fund, which enables students from developing countries to study in Wageningen.

When Vrijhof finished secondary school at the age of 18, he really wanted to study in Wageningen. But that seemed impossible as his family had very little money – his father was unable to work due to chronic rheumatism. Yet Vrijhof was still able to go to Wageningen in 1938 thanks to help from an unexpected source. 'My youngest sister got a letter from relatives saying they had found a friend who was willing to give me a scholarship. That was quite exceptional and I have felt grateful my whole life.'
As soon as Vrijhof heard about the Anne van den Ban Fund, he thought it sounded like a good cause to donate to. 'I received help once so now I want to help others,' says Vrijhof, who now enjoys growing red geraniums at his home in Eerbeek. When he turned 95, he asked the guests to his party to donate to the fund, an initiative that raised a couple of thousand euros. When he turned 100 on 24 February 2020, he held another collection. '2980 euros came in via WUR and 455 euros at my party. I made up that latter amount to 2020 euros to give a round total of 5000 euros.'
After his degree, which was interrupted by military service and a spell in hiding from the Nazis, Vrijhof had jobs that included deputy director of the Municipal Parks department in The Hague. At that time he got into contact with Wageningen as the chair of a committee studying tree deaths in streets where natural gas was introduced. They finally managed to discover why this was happening and find solutions.
Vrijhof wrote an article about this for the WUR centenary; see (in Dutch only): *www.wur.nl/100jaarvrijhof.*
Info: www.annevandenbanfund.eu

'I received help so now I want to help others'

FUNDS

Sports grant for student sailor

On 26 March 2020, student and sailor Floortje Hoogstede received a grant of 1500 euros from the Niels Smith Fund. This fund supports Wageningen students who want to combine elite sport and a university study.

Hoogstede, a third-year BSc student of Nutrition and Health, sailed in the Laser Radial, a one-person boat, before the coronavirus crisis. 'I am very pleased with the award because the financial support will let me continue sailing,' says Hoogstede. She was actually planning to stop participating in the big sailing events because of the cost: over 500 euros per event. 'I have to pay nearly everything myself except for the clothes, which I get from my sponsor Magic Marine; I basically emptied my savings account last year.'

Sailor Floortje Hoogstede with her one-person boat.

Hoogstede will not be going to any major sailing competitions for the time being as they have been cancelled because of the coronavirus. When they restart, she will be sailing in a team as she has outgrown the youth class with the Laser boats. 'I am in a new team, where we will be competing in four- and five-person boats.'
Info: www.universityfundwageningen.eu/nielssmith

SURVEY

What do young alumni want?

University Fund Wageningen has conducted a survey to find out what alumni who left no more than 10 years ago expect from the university. This group is underrepresented at alumni events, says project member Eline Nell. The survey showed that the alumni mainly require professional know-how, career development and networking possibilities.
It also transpired that young alumni are often not aware of the current activities programme or feel the activities are not for them because of the way the communication is done. 'That is why changing the communication and the tone of voice will be important,' says Nell. 'We will also inform students better before they graduate about what we offer alumni.' The project team is incorporating the results in a new approach aimed at reaching and serving this young target group better.
Info: alumni@wur.nl

FUNDS

Wood chipper for arboretum

The Belmonte Arboretum fund has been able to buy a wood chipper and a grass trimmer for park maintenance thanks to donations of around 5000 euros. The chipper will be used to turn wood into chippings. 'It will save a lot of time if we can do this on site, and being able to use the wood chippings in the park again fits in with the circular philosophy,' says director Dedde Smid of the Belmonte Arboretum Foundation, responsible for the maintenance. 'The grass trimmer is for strips of grass that we had difficulty reaching before.'
Info: www.universityfundwageningen.eu/belmonte

NETWORKS

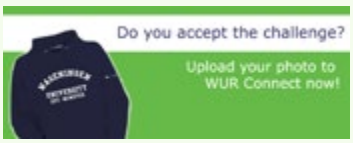
First online alumni event

After the in-person events in Norway, Sweden and Finland had to be cancelled because of the coronavirus, the Dutch Engineers Alumni Network (DEAN) of the four technical universities (4TU) organized the first online gathering for alumni working in Scandinavia on 26 March 2020. Fiona van Schaik (WUR Environmental Sciences 2019), who moved to Stavanger in Norway for her PhD at the start of 2020, was one of the 50 participants. 'I enjoyed sharing experiences with other alumni in the far north, especially at such times as this,' says Van Schaik.
'The virtual get-together was much more like the real thing than I could ever have hoped,' says co-organizer Denise Spiekerman of WUR. She sees opportunities for online alumni meet-ups in future even once the coronavirus measures have ended. 'An online event could be a good alternative in large countries where it is difficult to get everybody together in person.'
Info: alumni@wur.nl

WUR CONNECT

Photo challenge

University Fund Wageningen has set four photo challenges as a way of uniting the WUR community during the coronavirus pandemic. Until the summer, alumni can upload photos on specified themes to WUR Connect. There have already been a lot of submissions. All participants will receive a WUR gadget and the winner of each competition will get a WUR hoodie.



Leafcutter ant

What did you take home with you from WUR? That was the question for the first challenge. Jitte Groothuis was the winner with his macro-lens photograph of a leaf-cutter ant.

Creative

In the second challenge, alumni were able to share their creations. That resulted in a diverse collection of drawings, paintings, embroidery, origami, jewellery and other creative works.
Take the example of Joshua Guinto who drew inspiration from Star Wars for his kiln-fired clay R2D2 robot.

If you want to take part too, go to www.wurconnect.eu

PHOTO WILLEM ANDREE

Tessa Canoy BSc, WUR BSc Food Technology 2016, Master's student in Food Safety and Food Technology, has won the Jan Brouwer thesis prize for her thesis on a legal and ethical analysis of the application of the General Data Protection Regulation in the field of personalized nutrition. 20 April 2020.

Leónie Bentsink PhD, WUR PhD 2002, has been appointed professor holding a personal chair in the Plant Physiology chair group in Wageningen. Bentsink studies the regulation of germination in seeds. 1 February 2020.

Jan van den Berg PhD, WUR Agricultural Plant Breeding 1989, who works at BASF Vegetable Seeds, has been appointed professor holding an endowed chair in Plant Envirogenetics at the Science & Engineering faculty, Maastricht University, for 0.2 FTE for five years. Van den Berg investigates the relationship between vegetable genetics and environmental factors. 1 January 2020.

Jappe de Best PhD, WUR Biology 1992, has been appointed lector in Biobased Resources & Energy at Avans University of Applied Sciences. He focuses on extracting value from waste streams. 1 February 2020.

Marieke Bruins PhD, WUR Bioprocess Technology 1996, senior researcher at Wageningen Food & Biobased Research, has received a donation from the Good Food Institute in America. A total of four million dollars was allocated to 21 research projects. Bruins uses vegetable proteins from agricultural waste streams to produce sustainable meat substitutes. 23 March 2020.

Tom Buijse PhD, WUR Biology 1987, who works at Deltares, has been appointed professor by special appointment in Freshwater Fish Ecology at WUR. 1 April 2020.

Ernst van den Ende PhD, WUR Phytopathology 1988, managing director of the Plant Sciences Group at WUR, has joined the supervisory board of 30MHz, a company that provides a data platform for the horticulture sector. 29 January 2020.

Prof. Louise O. Fresco, WUR Rural Sociology of the Non-Western Regions 1976, President of the Executive Board of WUR, has received an honorary doctorate from the University of Montpellier in France. 3 March 2020.

Jelke Fros PhD, WUR Biotechnology 2010, has received the Beijerinck Premium, an award of 25,000 euros from the Royal Netherlands Academy of Arts and Sciences, for his research at the WUR Laboratory of Virology. He combines data on mammal, insect and plant viruses. 3 March 2020.

Bart Kuiter MSc, WUR Climate Studies 2015, has been appointed agricultural attaché to the Dutch embassy in Nairobi. This is a training position within the Agricultural Counsellor's team. Kuiter is currently an advisor to the Netherlands Enterprise Agency and he will start in Nairobi in the summer. 25 February 2020.

Prof. Sanda Lenzholzer, WUR PhD 2010, has been appointed professor and Landscape Architecture chair holder at WUR. She succeeds Prof. Adri van den Brink, who has retired. 1 February 2020.

Prof. Gerben Messelink, WUR Plant Breeding and Crop Protection 1997, has been appointed professor by special appointment of Biological Pest Control in Greenhouse Horticulture in the Entomology chair group. 25 February 2020.

Kelly Nichols PhD, WUR PhD 2019, researcher in the Animal Nutrition chair group at WUR, has won the Pieter Walstra

Dance your PhD

Katharina Hanika MSc, WUR Plant Biotechnology 2016, has won the Dance your PhD competition in the Biology category with her belly dancing video about her doctoral research. Hanika used her belly dancing skills to visualize her research in Wageningen on resistance to fungi in tomato plants. Hanika will use the prize money of 1000 dollars to make new costumes for her belly dancing group in the International Students Organization Wageningen (ISOW), who helped her make the video.

PHOTO GUY ACKERMANS

Sjoukje Heimovaara PhD, WUR Plant Breeding 1989, has been appointed managing director of the Agrotechnology & Food Sciences Group (AFSG) at WUR. She succeeds Raoul Bino, who stepped down on 1 January 2020. She was previously CEO of the ornamental plant company Royal van Zanten and has been a member of the Advisory Council for Science, Technology and Innovation for several years now. 1 March 2020.

Award. Nichols received the prize for her exceptional scientific publications on dairy products and technology as part of her PhD research on protein metabolism in dairy cows. 13 March 2020.

Emma Oosterwegel, WUR student of Soil, Water and Atmosphere, won the Dutch indoor championships for the heptathlon in Apeldoorn. 9 February 2020.

Prof. Rob Roggema, WUR Landscape Architecture 1990, has been appointed visiting professor at the Western Sydney University in Australia. Roggema will remain lector in Spatial Transformations at Hanze University of Applied Sciences in Groningen. 1 June 2020.

Martin Scholten PhD has stepped down as managing director of the Animal Sciences Group at WUR. He held this office for three terms as of 2008. Scholten is now a strategic advisor to the Executive Board. 1 June 2020.

Daniel Somma PhD, WUR Geo-information Science 1996, has been appointed director of Parques Nacionales de Argentina. He was previously director of the Buenos Aires North Regional Center of the National Institute of Agricultural Technology. 13 January 2020.

Jan van der Stoep PhD, WUR Biology 1993, has been appointed professor holding an endowed chair in Christian Philosophy at WUR. He succeeds Prof. Henk Jochemsen, who retired in 2018. Van der Stoep will study ethics in food and agriculture. He will continue to work at the Christian University of Applied Sciences in Ede as well. 1 March 2020.

Prof. Pablo Tittonell, WUR Plant Sciences 2003, has been appointed professor of the new chair Resilient Landscapes for Nature and People at the University of Groningen. 18 February 2020.

Edwin van der Vossen PhD, WUR Plant Breeding 1991, is the new director of R&D at the potato breeding company Solynta in Wageningen. Van der Vossen was previously a member of the KeyGene management team. 1 March 2020.

Research Award 2020

Jorge Navarro-Muñoz PhD, former postdoc at WUR Bioinformatics and now working at the Westerdijk Fungal Biodiversity Institute, has won the University Fund Wageningen Research Award 2020. Navarro developed the open-source software BiG-SCAPE, which allows thousands of genomes to be analysed simultaneously. This enabled the discovery of a microbial gene cluster that is crucial for the suppression of plant pathogens. He published an article about this entitled 'A computational framework to explore large-scale biosynthetic diversity' in *Nature Chemical Biology*. The prize of 2500 euros is intended for young scientists who have published an outstanding and original article.

IN MEMORIAM

Alumni, KLV members, staff and former employees of Wageningen University & Research who have recently passed away.

Mr R. van Aart MSc.
Land Development 1959. 9 April 2020.
Prof. M.S. Elzas. Emeritus professor WUR. 12 February 2020.
Mr G.J. de Fijter MSc. Land Development B 1982. 16 November 2019.
Mr R.J. Florijn MSc. Phytopathology 1991. 2 November 2019.
Mr F.J. Geurten MSc.
Tropical Forestry 1956. 9 April 2020.
Mr J.H. Jansen MSc.
Dairy Production 1961.
Mr J.J. Kalb MSc.
Forestry 1968. 18 January 2020.
Mr T.P.C. Kuijer PhD. Agricultural Plant Breeding 1955. 3 August 2019.
Mr J.W. van Lieshout PhD. Agricultural Plant Breeding 1951. 28 July 2019.
Mr G. Meester PhD. Rural Economics 1970. 27 February 2020.
Mr W.L. Pas MSc.
Biology 1976. 12 February 2020.
Mr A.J. Pieters MSc.
Tropical Plant Breeding 1954.
Mr G.A. Pieters PhD.
Tropical Agriculture 1955. 6 March 2020.
Ms J.J.L. van der Ploeg-Voogd MSc.
Plant Breeding 1972. 6 December 2019.
Mr E.J. Remmelzwaal MSc.
Environmental Protection 1977.
15 December 2019.
Mr N.T.C.J. Salden MSc.
Zootechnics 1977.
Mr J.C. Schaik PhD. Tropical Plant Breeding 1950. 17 December 2019.
Mr A. Tempel PhD. Agricultural Plant Breeding 1956. 28 April 2019.
Mr A. van Wagenberg PhD. Former WUR professor holding an endowed chair in Facility Management. 10 March 2020.
Mr A.G. van Wijngaarden MSc. Rural Economics 1974. 20 January 2020.
Mr J.W.F. Zijlker MSc.
Zootechnics 1982. 21 March 2020.

If you would like to inform us of the death of a fellow former student or relative, you can email alumni@wur.nl or send a death announcement to the Alumni Department, University Fund Wageningen, Droevendaalsesteeg 4, 6708 PB Wageningen, Netherlands.

In search of Troy

Henk van Oosten PhD, WUR Horticulture 1968, wrote *Trojaanse tin-oorlog en Odysseus' oceaanroute* ('Trojan tin war and Odysseus's ocean route'), a book about his search for Homer's Troy. There is a debate about the site of this legendary city, explains Van Oosten. 'People have only been searching the world of the Ancient Greeks; suggestions that Troy could have been in the Atlantic world have been ignored.'

'I am trying to engineer a paradigm shift'

Van Oosten, who is retired, noticed the protagonist Achilles' new shield in the *Iliad*. 'That is a powerful image that contains all the keys to unlocking the origins of the *Iliad* and the *Odyssey*, such as the metal tin – needed to make bronze for strong weapons – and the four constellations that let you navigate the Atlantic Ocean.' Van Oosten concludes that the Trojan War was actually about tin, not Helen of Troy. And that the war took place in a part of the Atlantic world where a lot of tin was mined – Cornwall. 'I am trying to engineer a paradigm shift with my book.'
Brave New Books, 24.50 euros.

New plant species named after Claudia Veliz

Daniel B. Montesinos Tubée PhD, WUR Forest and Nature Conservation 2011, named a new plant species in memory of Claudia Veliz (WUR Forest and Nature Conservation 2012). Veliz passed away last year at the age of 41. The new species has been named *Drymaria veliziae*. It is a rare plant that is similar to gypsophila and grows at altitudes of around 3500 metres in the Andes. 'This endemic plant was found by Carolina Tovar in 2009 during fieldwork in the Cajamarca region in Peru,' says Montesinos, a specialist in plants from the carnation family in the Andes. 'When I confirmed the new species in the herbarium of Cajamarca in October 2019, I proposed honouring Claudia Veliz with the species name, as she was a close friend of mine and Carolina's. I was most distressed by her death.'
Montesinos and Tovar's publication on the new species appeared on 24 February 2020 in *PhytoKeys*.

KLV

KLV WAGENINGEN ALUMNI NETWORK

KLV, the alumni association for Wageningen University & Research, is preparing for its dissolution in September 2020. Until the dissolution comes into effect, KLV will continue to organize activities such as career support and study circle network meetings. Incidentally, the study circles will continue after KLV is wound up. A complete overview of activities can be found at www.klv.nl/events.

KLV – Dissolution AGM 1
First members' meeting with a vote on the dissolution of KLV.
30 June 2020

WUR – Opening of Academic Year 2020
28 August 2020

KLV – Dissolution AGM 2
Second members' meeting with a vote on the dissolution of KLV.
22 September 2020

KLV – Farewell event
Saying goodbye to KLV in a programme preceding the Alumni Open Day.
3 October 2020

KLV Wageningen Alumni Network is the alumni association for Wageningen University & Research. The network has about 7000 members.

More information
www.klv.nl

KLV

Piet Wit

Crop Science, 1971

PASSION FOR Chimpanzees

'The chimpanzee is a fascinating animal,' says Piet Wit, co-founder of two linked foundations for the protection of the chimpanzee, one in the Netherlands (Chimbo) and one in Guinea Bissau (Daridibó). 'You can see how close to us chimpanzees are in every way: in their social organization, their empathy, and in their aggression too – you certainly shouldn't idealize them.' Wit and his wife Annemarie Goedmakers established the foundations in 2006 when their son David died at the age of 18. 'Since then, we aim to give the future that was taken away from him to the chimpanzees and the population of the Boé area of Guinee Bissau. That gives us a very powerful motive.' The savannah chimpanzees in the Boé region display unusual behaviour, says Wit. 'For example, they use trees to drum up the group, so trees are a means of communication for them. We collaborated on a major publication in *Nature* about that.'

In this feature, KLV alumni talk about what makes them tick.

Visit our website www.klv.nl

PHOTO: ANNEMARIE GOEDMAKERS

PHOTO WUR

Big increase in fish stocks at mangrove project on Java, Indonesia

The northern coast of Java suffers from coastal erosion and soil subsidence, partly due to the loss of protective mangrove forests. A mangrove restoration project along 20 kilometres of coast, which started in 2013, has not only served to protect the land but also to boost mangrove fisheries, says Dolfi Debrot, a marine ecologist at Wageningen Marine Research. 'More than 48 hectares of mangrove forest have been restored between 2014 and 2018. Half of it was done by planting new mangroves, and the other half through natural restoration, helped by the construction of woven semi-permeable dams behind which sediment piles up and seeds can germinate.' The mangrove forests provide natural nurseries for shrimp and fish. Debrot: 'In those four years of mangrove recovery, 38 lift-net installations have been set up in the area. So fishing activity is increasing fast.'

Mangrove fisheries are therefore providing a significant new livelihood. 'But one cause for concern,' says Debrot, 'is that the fisheries concentrate on young fish.' Initiatives are being taken to develop other sustainable livelihood options such as seaweed cultivation and oyster and shrimp farming.

The Ecoshape Foundation's mangrove restoration project, which Wageningen Marine Research collaborates on, focuses mainly on socio-economic recovery in the coastal zone. The project's funding comes from the Netherlands Enterprise Agency's Sustainable Water Fund.

Info: dolfi.debrot@wur.nl