WAGENINGEN WORLD

MAGAZINE OF WAGENINGEN UNIVERSITY & RESEARCH ABOUT CONTRIBUTING TO THE QUALITY OF LIFE

no.3 2022

‘The Netherlands is bottom of the class for water quality’

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Making cheese without cows

With one fifth of the CO_2 emissions caused by traditional production

A sixth sense for the farmer

Sensor technology and artificial intelligence keep an eye on the cows

Wind farm or nature reserve?

How will all those turbines affect the ecology of the North Sea?

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WAGENINGEN UNIVERSITY & RESEARCH

The mission of Wageningen University & 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, 7,200 employees (6,400 fte) and 13,200 students and over 150,000 participants to WUR's Life Long Learning, 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 GUY ACKERMANS

Sustainable food, uncomfortable choices

'Every time I go grocery shopping, I feel a sense of fear and paralysis. Suppose I want to buy carrots: how hard can that be? I want to buy organic carrots because I know organic is better for the soil and our health. But because of strict EU regulations for organic food, the carrots are in a plastic bag. I want to reduce my use of plastic and the non-organic carrots are sold without packaging. Moreover, the non-organic carrots are locally grown, and the organic ones are imported. I try to support the local food system and economy. And then there's the price: the organic carrots are slightly more expensive.
So what is the right decision? How can we make good decisions when the food system is so complex and contradictory? How can we organize our food systems so that we stay within planetary boundaries? How do we make sustainable food choices easier? This is a social and political issue that demands both social and political responses.
We need better, more equitable food governance systems. This demands more collective and collaborative models. We need to move away from placing responsibility on the individual and move towards systemic solutions, particularly when the main driver for this type of change is consumption. An emphasis on people buying their way to sustainability gives the wealthy a bigger say in the matter. This is incompatible with an equitable future for food. My work focuses on how we can design new governance processes to ensure that those most affected by food inequality are heard and given priority. Above all, if we are serious about keeping within the safe and just operating space of our planet, we'll have to get comfortable with the uncomfortable.'

Jessica Duncan, Associate Professor in the Politics of Food Systems Transformations

FISHERIES

PHOTO SHUTTERSTOCK

Dutch trawler fisheries in the red

In the first eight months of 2022, the Dutch trawler industry suffered estimated losses of over 20 million euros. This number comes from the 2022 Fisheries in Figures presentation by Wageningen Marine Research. Beam trawlers were affected most badly. The deployment of ships was down 25 to 30 per cent on the previous year. Many ships were out of action for long periods, mainly due to high fuel prices and crew shortages. As a result, the supply of fish and prawns also fell substantially during this year. Revenues per kilo increased, but costs increased much more steeply. Alternative, more energy-efficient fishing methods are being investigated, but innovation takes time. Analyses will be performed to see whether the alternatives are profitable.
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RANKINGS

WUR best university in Netherlands again

WUR is the best Dutch university in the Times Higher Education (THE) ranking for the fourth year in a row. The THE is a highly respected global ranking, with more than 1500 universities across all continents. The ranking assesses universities in five categories, each with its own weighting: education (30 per cent), research (30 per cent), citations (30 per cent), international outlook (7.5 per cent) and industry income (2.5 per cent). The ranking places WUR 59th in the world.
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EDUCATION

More education on landscape restoration at African universities

WUR and the Global Landscapes Forum are supporting nine African universities in developing an Africa-wide curriculum on the restoration of degraded landscapes and ecosystems.

The degradation of landscapes and ecosystems around the world is having an ever-bigger impact on biodiversity, food and water security, and economies. The restoration of landscapes and ecosystems is therefore incredibly important. 'But not many professionals know much about integrated landscape restoration,' explains programme leader Cora van Oosten of the Wageningen Centre for Development Innovation (WCDI). 'There is a big demand for education in this area. There are education options for experts already, but not for students.' Nine African universities are collaborating with WCDI on a pan-African curriculum in which students learn how to set up multidisciplinary restoration processes, for example.
This teaching project runs in parallel with the Decade on Ecosystems Restoration (2021-2030) announced by the United Nations.
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PHOTO MILOSK50 / SHUTTERSTOCK.COM

GREEN MATERIALS

Radical new approach with clothes from plants

WUR researcher Paulien Harmsen is calling on the clothing industry to radically change its approach and adopt circular textiles. She studies alternative solutions such as the use of different raw materials ranging from flax, hemp and bamboo for natural textiles to viscose or cupro for synthetic fabrics. She collated the options in her booklet *Textiles for Circular Fashion Part 2*, which also gives an overview of the textile properties and production methods.

Most clothing is made from polyester or cotton. Polyester uses fossil resources and produces microplastics when worn or washed. The production of cotton is also often very bad for the environment. Harmsen therefore recommends seeing which plant fibres are most suitable for each individual item of clothing. 'We really need to look for new materials that can be produced on a large scale. Wageningen can help in this search.'
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POULTRY FARMING

Bird flu vaccines being tested

PHOTO SHUTTERSTOCK

PHOTO MAARTEN SPOEK

Wageningen is testing the effectiveness of three bird flu vaccines. 'A vaccine has to not only protect against the disease but also stop the virus from spreading,' says Nancy Beerens, bird flu researcher at Wageningen Bioveterinary Research.

'In the past, the Netherlands never had bird flu infections in the summer,' says Beerens. 'But this year for the first time, the bird flu season did not end with the departure of the migratory birds in April.' Commercial poultry farms are having to deal with culls and a long-lasting requirement to keep birds indoors, which has been in place for more than a year in many parts of the Netherlands. Calls are therefore getting louder for an effective vaccine in the fight against bird flu, notes Beerens.

In the trial, vaccines for the current H5 virus are tested in laying hens. The trial involves new types of vaccines from three pharmaceutical companies. The team hopes the trial will reveal the effectiveness of the vaccines in preventing symptoms *and* in curbing the spread of the virus, as these are two different things.

Beerens: 'If a vaccinated flock becomes infected with bird flu and this is not picked up because of the lack of symptoms, the virus can spread undetected between farms.' That is the reason why the international trade in vaccinated poultry is restricted at present. 'The new types of vaccines are expected to offer better protection against the spread of the virus. It is also possible to distinguish vaccinated birds from infected ones.' That would be a significant step towards lifting the export restrictions.

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WAGENINGEN ACADEMY

Microcredentials for professional education

Wageningen University & Research is involved in the Dutch pilot for microcredentials in higher education. The main goal of microcredentials is to provide learners with a lot of flexibility so that they will be able to create their own lifelong learning path. Participants can choose courses and mix and match them without having to complete a full degree programme. This allows professionals greater control over their own development path. The guaranteed recognition of microcredentials gives demonstrable value to the effort made. Microcredentials are awarded for short courses of between 84 and 840 hours. This is similar to the time for ECTs, which can range from 3 to 30 ECTs per course.

We will continue to adapt the courses that we run for professionals to their needs and those of the labour market. View the current offer here: *www.wur.eu/microcredentials*

CONSUMERS AND NUTRITION

More spent on sustainable food

In 2021, Dutch consumers spent 9.5 billion euros on sustainable food, according to the 2021 Sustainable Food Monitor, which WUR carried out for the Ministry of Agriculture, Nature and Food Quality. Sustainable products grew as a share of total food expenditure from 17 to 19 per cent. The increase was seen in nearly all product groups. Meat and meat products, preserved products and composite meals were the groups with the biggest share in the sustainable expenditure. The biggest increase, of 36 per cent, was seen in drinks. That was mainly thanks to the rise of juices with labels such as Fairtrade, Rainforest Alliance and Biologisch. Total expenditure on sustainable food was up by 12 per cent in 2021 compared with 2020. The increase is greatest in supermarkets and less so in bars, restaurants and specialist shops.

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FOOD SECURITY

Informal economy crucial in stopping hunger

PHOTO JORG HACKEMANN / SHUTTERSTOCK.COM

Around the world, small informal businesses are crucial in giving people access to food, concludes a Wageningen report published in September. It is high time to involve such businesses in plans to eradicate hunger, say the researchers.

In developing countries, informal businesses such as market stalls and food stalls are the main sources of food. Governments, investors and researchers often overlook these businesses, but most people who live in poverty depend on this informal economy for affordable food. The UN goal of zero hunger by 2030 can only be achieved if the informal sector is involved too. 'And that is not happening,' says Bart de Steenhuijsen Piters, one of the authors. 'We need the informal businesses. They can help reduce waste in the food supply chain and thereby keep products affordable. We need a better understanding of the informal economy so that we can use it to help achieve public goals. We won't manage that without these small businesses.'

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PLANT ECOLOGY

Zoom in to identify plants

Estimates of the diversity of plants change as the sampling area changes in size, concludes an international team that includes WUR scientists. Small areas, for example in the steppes of Eastern Europe and the Alps, can have a relatively high degree of biodiversity.

The true biodiversity can only be seen when species are counted in a lot of small sample areas. This method has advantages in the African tropics too. Species are spread over great distances and are not always recorded when only one sampling area is studied.

That is why it was long thought that the African tropics do not have such an abundance of species as other tropical areas.

The team analysed a dataset with around 170,000 vegetation measurements in all the planet's climate zones. The conclusions were published in an article in *Nature Communications*.

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PHOTO SHUTTERSTOCK

CLIMATE

Only Planet book offers hope for the future

Tim van Hattum, the Climate programme leader at Wageningen, wrote the book *Only Planet, klimaatgids voor de 21ste eeuw* (Only Planet: climate guide for the 21st century). It contains seven routes to a more hopeful future for our planet. Most solutions for tackling climate change are already available.

Van Hattum does not deny the situation is serious, but he thinks not enough attention is given to the fact that solutions are already available. They do need to be scaled up and rolled out quickly, and that is where the challenge lies, says the researcher.
According to Van Hattum, the key solution is to bring about a better balance between society and nature. If we work in tandem with nature and deploy smart technologies on a large scale, our future will look bright again. According to the author, a change of mindset is required, from fatalism to pulling out all the stops.
Van Hattum sees nature itself as the main solution to the climate crisis. The large-scale protection and restoration of nature will make us more resilient to climate change and will also capture more CO_2 from the atmosphere. One example is combating desertification and the mass greening of desert areas.
The food supply is another one of his priorities. Van Hattum advocates the large-scale roll-out of aquaculture and the cultivation of food crops without the use of land, for instance. The city of the future also plays a major role in his book. The effects of climate change can be mitigated by making cities greener and more liveable.
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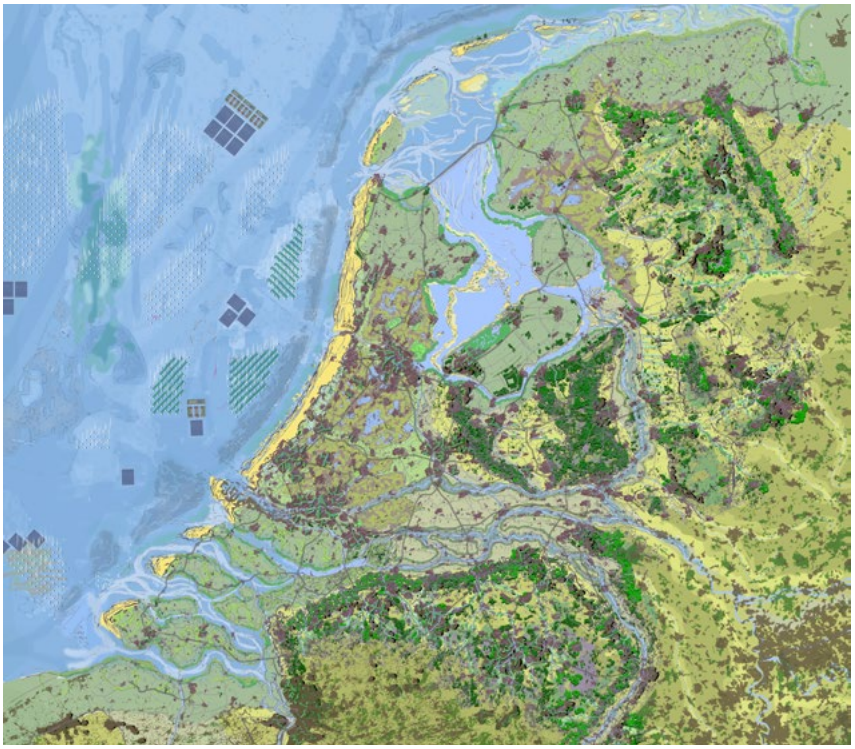

PHOTO WUR

BIODIVERSITY

PHOTO SHUTTERSTOCK

Forests are more varied

Dutch forests are becoming more mixed and varied. The seventh Dutch Forest Assessment (2017-2021) found more deciduous trees than conifers for the first time. The assessment was carried out by Wageningen Environmental Research. The variation in species is good for biodiversity and makes the forests more resilient to climate change and disease. That is sorely needed as the dry summers and ash dieback, among other things, are negatively affecting the vitality of Dutch woods.
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TECHNOLOGY

Producing hydrogen at sea could be cheaper

The cost of producing green hydrogen at sea, as a way of storing 'excess' wind energy, could be reduced, says Jolanda van Medevoort and her colleagues at Wageningen Food & Biobased Research, after a pilot project on Texel island. The reduction in costs is achieved by using membrane distillation for the production of ultrapure water (UPW). This water, consisting almost entirely of H_2O, is split into oxygen (O_2) and hydrogen (H_2) using electrolysis. The researchers were able to obtain UPW from seawater using membrane distillation. This method for obtaining UPW is cheaper than the commonly used method of reverse osmosis. Another advantage is that the process does not require chemical pre-treatment and therefore does not damage the underwater environment.
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BIRD FLU

Baby terns born in spite of bird flu

Only one breeding colony of Sandwich terns was successful in the Dutch Wadden Sea in 2022. Bird flu led to mass deaths. Around 3600 dead Sandwich terns were picked up on Texel in May and June, and many more probably died at sea. However, later in the summer a group of 600 breeding pairs settled on Texel in the Prins Hendrikzanddijk breeding area. This new start turned out to be successful: some 300 chicks ready to fly were found during a ringing effort led by Mardik Leopold of Wageningen Marine Research. This was a modest bright spot in a year full of concerning reports. The late breeding success on Texel seems to show that the removal of dead birds from infected colonies improves the chance of survival and successful breeding.

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PHOTO ANP

CORRECTIONS

Unfortunately, some inaccuracies found their way into the article on spoofing on page 9 of Wageningen World no. 2-2022. You can read the updated story here: *https://issuu.com/wageningenur/docs/ww2022_02_en/8*

STUDENT CHALLENGE

PHOTO IRINA MARKOVA/SHUTTERSTOCK.COM

Coral restoration in Sri Lanka wins challenge

A plan for restoring coral reefs in Kayaker Coral Cove, Sri Lanka, won the Nature Based Solutions Challenge, an international competition organized by WUR for student teams from around the world.

The plan involves building coral nurseries and providing information at schools about nature-based solutions for coastal areas. The jury: 'An ambitious project with lots of potential. The plan is well thought out and clearly engages the local community.'

Eight international teams made the final of the challenge, which gave them the opportunity to work out the details of their nature-based solution for a local problem related to climate change and biodiversity. They got mentoring from experts and a budget of 2500 euros. WUR is providing an additional 10,000 euros to help the finalists continue with their projects.

In the past five years, 212 teams with over 1500 participants from universities all over the world have taken part in Wageningen challenges, on topics including the protein transition and urban agriculture. A Waste Challenge will take place in 2023, along with a Nature-Based Future Challenge where participants will be asked to develop a long-term vision for the Ganges-Brahmaputra-Meghna delta in Bangladesh.

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GENETIC DIVERSITY

Collection of tree and bush seeds

The Centre for Genetic Resources (GCN), part of WUR, is working on a collection of seeds of Dutch trees and bushes. It will serve to keep genetic diversity safe for the future. This is crucially important for future-proof forests, says GCN. The Netherlands already has a field collection in Roggebotzand near Dronten with living trees and bushes. However, this is not a good solution for some species, for example because they do not grow well in those conditions.

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AGRICULTURE

Big differences in nitrogen surplus

Agriculture in northwest Europe and parts of India and China produces a surplus of nitrogen compounds, whereas Africa and South America need more nitrogen fertilizers for food production. These findings come from research published in *Nature* in October.

The planet has a nitrogen surplus. In 2015, researchers publishing in *Science* concluded that the planetary boundary for nitrogen had been exceeded. But this conclusion did not take regional differences into account. So a study performed by a team of researchers from Wageningen, Utrecht University and the Netherlands Environmental Assessment Agency compared regional losses of agricultural nitrogen around the world with calculated regional boundary values for the effects on the quality of nature and water, for example decreases in biodiversity, poorer drinking water quality and toxic algal blooms in surface water.

Nitrogen turns out to be a multifaceted problem: there are big differences between regions, both in the extent to which boundaries are exceeded and in the problems caused by a surplus. Excessive use in Europe and China contrasts with underutilization in many other countries, which actually need more nitrogen for their food production.

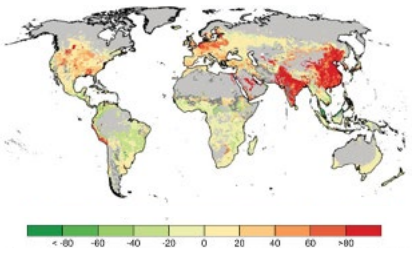

PHOTO BART FRISO

Excessive use and underuse of nitrogen in agriculture.

Wageningen professor of Environmental Systems Analysis and co-author Wim de Vries finds the redistribution of nitrogen important but, he says, 'even if the geographical distribution in the use of fertilizer around the world is optimal, the planetary boundary for nitrogen could still be exceeded.' In addition to the more efficient use of nitrogen in agriculture, he also advocates limiting losses from non-agricultural sources of nitrogen such as sewage and industry.

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PHOTO SHUTTERSTOCK

NUTRITION

It's not easy to go vegan

The Dutch are open to the option of replacing meat, eggs and dairy products with vegan alternatives but this is not always reflected in their behaviour. As the 2022 Agrifood Monitor shows, they find it difficult to switch. The Dutch lack the knowledge and skills to utilize vegan alternatives, according to the monitor. For example, they do not know how to cook vegan food, adapt recipes or eat a balanced vegan diet. Furthermore, people hardly experience any social pressure to eat vegan alternatives. For many people, personal benefits such as convenience, affordability and taste are more important than sustainability.

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NATURE CONSERVATION

The orang-utan could recover

If the orang-utan population on Borneo continues to be managed as at present, it will probably shrink by a quarter by 2032. That finding comes from a study by 33 orang-utan experts, including Douglas Sheil, professor in the Forest Ecology and Forest Management chair group, on which conservation strategy works out best for the animals. What would happen to the orang-utans on Borneo under various approaches to management. Populations can recover if a halt is called to the killing of orang-utans and the loss of their habitat. In that case, there will be one-and-a-half times as many orang-utans living on Borneo in 100 years.

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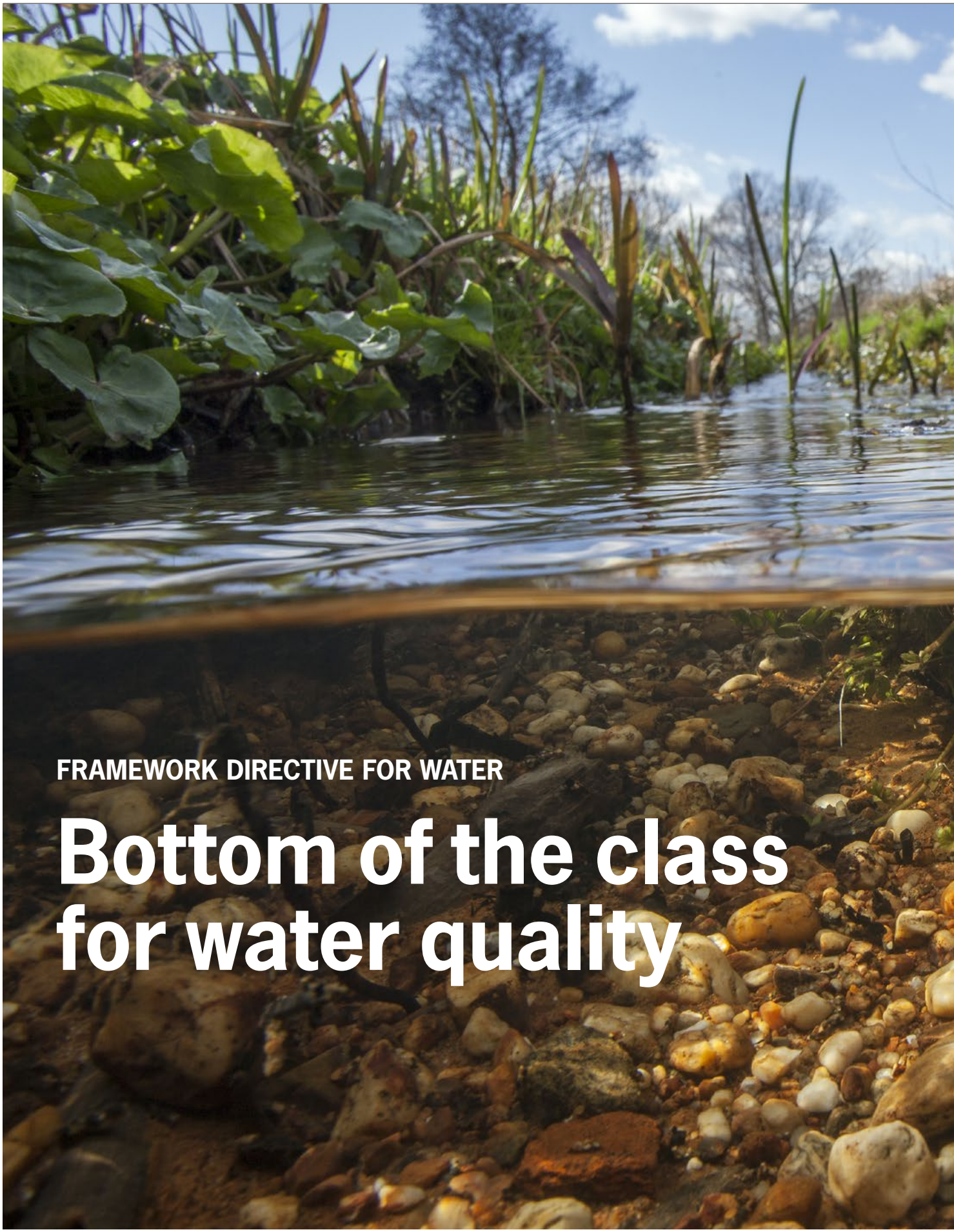


FRAMEWORK DIRECTIVE FOR WATER

Bottom of the class for water quality

The Netherlands has the worst water quality of all EU member states: only one per cent of our waters are assessed as 'good'. So we are unlikely to fulfil the European Water Framework Directive in time. 'In this watery country, we're going to have to get firmer with farmers, the general public and industry alike.'

TEXT RENÉ DIDDE **PHOTO** BLIK ONDER WATER / MATTHIJS DE VOS

PHOTO BRAM DAMMAN

PIET GROENENDIJK
Researcher into agriculture and water quality at Wageningen Environmental Research

‘It’s especially important to cut the amount of nitrogen on sensitive land’

PHOTO GUY ACKERMANS

PAUL VAN DEN BRINK
Personal professor of Aquatic Ecology and Water Quality Management and senior researcher at Wageningen Environmental Research

‘What good are norms if they are widely exceeded?’

Five years. That’s how much time the Netherlands has left to do something about the exceedingly low marks it’s been getting in water quality reports for 15 years. For years, Dutch groundwater and surface water, such as rivers, canals, streams and lakes, have contained too many fertilizers like nitrate and phosphate, and residues of chemicals such as pesticides. It’s not looking too good on other fronts either, what with the large quantities of PFAS and microplastics in Dutch waters. And the production and use of medicines and cosmetics leads to a lot of toxic micropollutants being dumped in the water.
In five years, in 2027, all European member states are expected to comply with the European Water Framework Directive (WFD). The WFD came into force across Europe in 2000, partly at the instigation of the Netherlands. The aim was for all European waters to achieve ‘good status’ for both their ecological and their chemical quality.

STAGNATION

Water pollution was substantially reduced in the Netherlands from the 1980s onwards through more and better water treatment plants and a pro-active policy on manure. The industrial discharging of heavy metals and PCBs decreased as well. But to attain that ‘good status’ the country was going to have to up its game. Ironically enough, stagnation set in not long after the introduction of the WFD. ‘In some places, we are even seeing a deterioration in the water quality,’ says Piet Groenendijk, a researcher at Wageningen Environmental Research who specializes in the relationship between agriculture and water quality. Emissions of nitrate and phosphate from agriculture began to increase again in some places, and many new industrial substances were found that had not previously been present in detectable quantities. ‘It took the Netherlands a very long time to set up a system for the WFD and to expand its monitoring. We talk a lot about PFAS at the moment. We’ve only been able to measure this group of substances since a few years ago, but they’ve been dumped for much longer,’ says Groenendijk.
‘The Netherlands is already the cesspit of Western Europe, with polluted water flowing into the country via streams and rivers,’ says Peter Schipper. He works on models for water quality, nutrient leaching and crop protection agents at Wageningen Environmental Research. ‘And of course we add to the pollution with our agriculture, industry, traffic and high population density. Pollution has intensified in a period in which no one was bothering with spatial planning anymore. Anything was allowed anywhere – that’s why we are now running up against the limits of the water and soil system.’
The Water Framework Directive is a complex European directive whose key aim is for all water bodies in the member states to achieve ‘good ecological and chemical status’. There are more than 700 designated ‘water bodies’ in the Netherlands, from a stream of two kilometres long to a river of 200 kilometres. Their ecological status is assessed based on the quality of aquatic life, from tiny organisms to fish such as salmon. Their status is determined based on the concentrations of 40 ‘priority substances’, such as benzene and pesticides like diuron and dichlorvos, and a series of further categories including nutrients like nitrate and phosphate.
The test score consists of a complicated aggregation of all these categories. The insidious thing about it is that if a water body fails on one criterion (a chemical, nitrate or whether water fleas are thriving), the whole water body fails to make the grade. This ‘one out, all out’ principle means that in the Netherlands only 1 per cent of the water scores ‘good’ in all categories, therefore complying with the

PHOTO ANP / FRED HOOGERVORST

Part of the failure to meet the European Water Framework Directive targets is due to agriculture, mainly through the leaching of fertilizers and pesticides.

WFD. Sadly then, the Netherlands comes last out of the 27 member states, according to the latest available data from 2019. In Finland, 78 per cent of the water has 'good status'. It is mainly the ecological status that falls short in Dutch waters, and is found to be middling or unsatisfactory. Only 17 per cent of the water scores well ecologically; 83 per cent of waters require urgent action.

> **'We need to renew our efforts to reduce the manure surplus'**

INTERIM TARGETS

In 2009 and in 2015, the Netherlands requested and was granted an extension on the deadline for achieving interim targets, both for water quality and for adaptations such as fish ladders and restoring meanders in straightened streams. And that while many of the waters in the Netherlands are constructed canals and waterways which do not have to meet such strict requirements as streams and rivers do. So effectively, the quality of about 300,000 kilometres of constructed ditches doesn't get assessed at all. As a result of all this, specialists from nature conservation organizations *Natuurmonumenten* and the World Wildlife Fund, as well as the Netherlands Environmental Assessment Agency (PBL), do not think Dutch water quality will make the grade in 2027.

In which case, the country faces fines of tens of millions of euros a year from Brussels. Some legal experts foresee a crisis along the same lines as the current impasse about nitrogen. Brussels has imposed fines in similar cases in the past, PBL researcher Frank van Gaalen said in the VPRO radio programme Argos. Back in 2005, for instance, France was fined 20 million for not complying with European fish directives.

The WFD is the only way to force water managers to take action, says Paul van den Brink, personal professor of Aquatic Ecology and Water Quality Management and senior researcher at Wageningen Environmental Research. One of the topics he researches is the effects of chemical stress on aquatic organisms. Another is how the aquatic system is affected by the interaction between chemicals and climate change. 'As a result of our research, the standards for application of a number of pesticides have been tightened up, so the WFD targets can now be met for these chemicals. For instance, our research >

PHOTO ANP / DOLPH CANTRIJN

Wastewater at the sewage treatment plant in Tilburg is being tested for levels of phosphate, nitrate, ammonium and dry matter.

on the effects of the insecticide imidacloprid on aquatic insects such as mayflies has led to a substantial reduction of the standards.' 'But what good is that if the standards are widely exceeded?', Van den Brink wonders. In his view, there is a failure to enforce the rules. 'In this watery country, we will have to get firmer with farmers, the general public and industry alike, and monitor industrial discharges more and withdraw licences where necessary. For instance, we should check whether farmers abide by no-spray zones along ditches,' says Van den Brink. Because the pollution in ditches – not targeted in the WFD and therefore not sampled – runs into the relatively clean water of major rivers like the Rhine. This river water gets circulated through much of the Netherlands. For example, water from the IJsselmeer lake – which originates from the Rhine – passes through the lock at Lemmer into Friesland and Groningen, eventually reaching Drenthe with all its pollution.
Roel Knoben, a WUR Environmental Hygiene alumnus, is pleased that the Public Works Directorate Rijkswaterstaat intends to re-evaluate the discharge licences of 70 large industrial companies this year. Knoben is now a water quality and monitoring specialist at Royal HaskoningDHV, one of the main consultancies working on the WFD. He too expects the Netherlands to fail to meet the WFD targets. He thinks a lot of licences may have expired, and 'extremely worrying substances' that are carcinogenic or environmentally damaging are being discharged under a general category in the licence. Knoben: 'Or we don't use the best techniques available for preventing the discharge of pollutants. For many substances that get into the water, we don't have a sufficiently sensitive measurement method to test compliance with standards. And yet they are still toxic, whether on their own or in combination with other substances.' Such substances can affect WFD scores, however, especially for ecological status. 'Possibly the toxicological effects of these types of substances need to be studied more thoroughly when assessing them for approval,' Knoben says.
He estimates that about a third of the failure to meet WFD targets is due to agriculture, mainly through the leaching of fertilizers and pesticides. About a third of the failure is down to substances in domestic wastewater and industrial sources that are not captured by sewage treatment plants. These include phosphate, ammonium, drug residues and cosmetics. The rest comes into surface water from other sources, from neighbouring countries or through precipitation and flooding from sewers and sewage treatment plants during heavy showers. 'At least 60 of the more than 300 sewage treatment plants are not up to scratch,' Knoben said. 'In some cases because they don't yet have installations to capture phosphate from faeces, so it ends up in surface water.'
Knoben also points to notorious culprits such as polycyclic aromatic hydrocarbons (PAHs), which are released from incineration processes. 'To some extent, these kinds of pollutants have been present in Dutch waterways for a very long time due to pollution in the past,' Knoben says. 'It's often impossible to trace what is added by traffic and industry back to a particular

‘One in five sewage treatment plants does not meet standards’

source. So the law-enforcing party can’t do anything about it, even though it counts for the WFD.’ Something comparable applies to ammonium and metals such as arsenic, selenium, barium and cobalt, which are naturally present in the subsoil of Flevoland, for example. ‘There is quite simply not much you can do about that kind of pollution,’ Knoben said. He therefore expects that Brussels will treat the Netherlands with leniency on these points in 2027.

GLIMMERS OF HOPE

Groenendijk and Schipper do see some glimmers of hope, though. ‘Steps have already been taken to improve things, and the results of that are not yet clearly visible. Half of the water bodies now meet the nitrogen and phosphate targets, but they don’t count for much in in the WFD system because the water still fails the grade on other factors,’ says Groenendijk. ‘And we will only see the effects of restoring meanders in a stream in a few years’ time – ecological improvements for instance.’
Nevertheless, Groenendijk points out the need to reduce the leaching of fertilizers such as nitrate and phosphate into the water. ‘We need to renew our efforts to reduce the manure surplus. For example, in large areas of eastern North Brabant and North Limburg, 20 to 30 per cent more manure has been spread than is permitted, according to calculations in several studies. In particular, nitrogen applications should be reduced on fields vulnerable to nitrate leaching,’ says Groenendijk.
In the case of phosphate, he thinks the situation is more complex. ‘In many places, the soil is still “loaded” with such vast amounts of phosphate from past fertilization - the “phosphate bomb” - that the little bit you add doesn’t make much difference. You need to take purification measures at the field edges, such as liming or adding iron-rich sludge in combination with crops that absorb phosphate. You could also protect watercourses to prevent phosphate from getting through to the larger waterways.’
Groenendijk also points to possible spatial planning measures. He thinks the government should take the lead in banning the cultivation of crops that require a lot of manure and pesticides, such as potatoes and maize, on the leaching-prone sandy soils in Brabant and Limburg. Schipper adds: ‘In sodden areas, water boards should stop draining the soils in order to keep all forms of agriculture going. That is not only bad for the quantity of water available, but also for quality. Drainage causes higher discharge rates of substances into the ditch. You would be better off designating the wettest land as nature areas.’

NEW LAND DEVELOPMENT

Groenendijk and Schipper expect a lot from the new National Rural Area Programme, the idea of which is to use an ‘area-specific approach’ to settle the many problems and the conflicting claims of agriculture and nature in the rural area. Schipper: ‘Awareness of water issues isn’t great in the Netherlands. On a positive note, though, water quality is clearly higher on the political agenda now. This is not only because the WFD deadline is approaching, but also because of growing concern about nature and biodiversity, the quality of drinking water sources and the visible effects of extreme drought on water quality. In the countryside, the WFD targets, nitrogen targets, nature development, water storage and drought management can potentially go hand in hand. Then there is some chance of success if spatial planning of land use and management is reinforced and financed.’ ■

www.wur.eu/waterquality

PHOTO GUY ACKERMANS

PETER SCHIPPER
Researcher into nutrient leaching and crop protection at Wageningen Environmental Research

‘Awareness of water issues isn’t great in the Netherlands’

ROEL KNOBEN
Water quality and monitoring specialist at Royal HaskoningDHV

‘We don’t always use the best techniques available’

Arabidopsis is infected by a virus

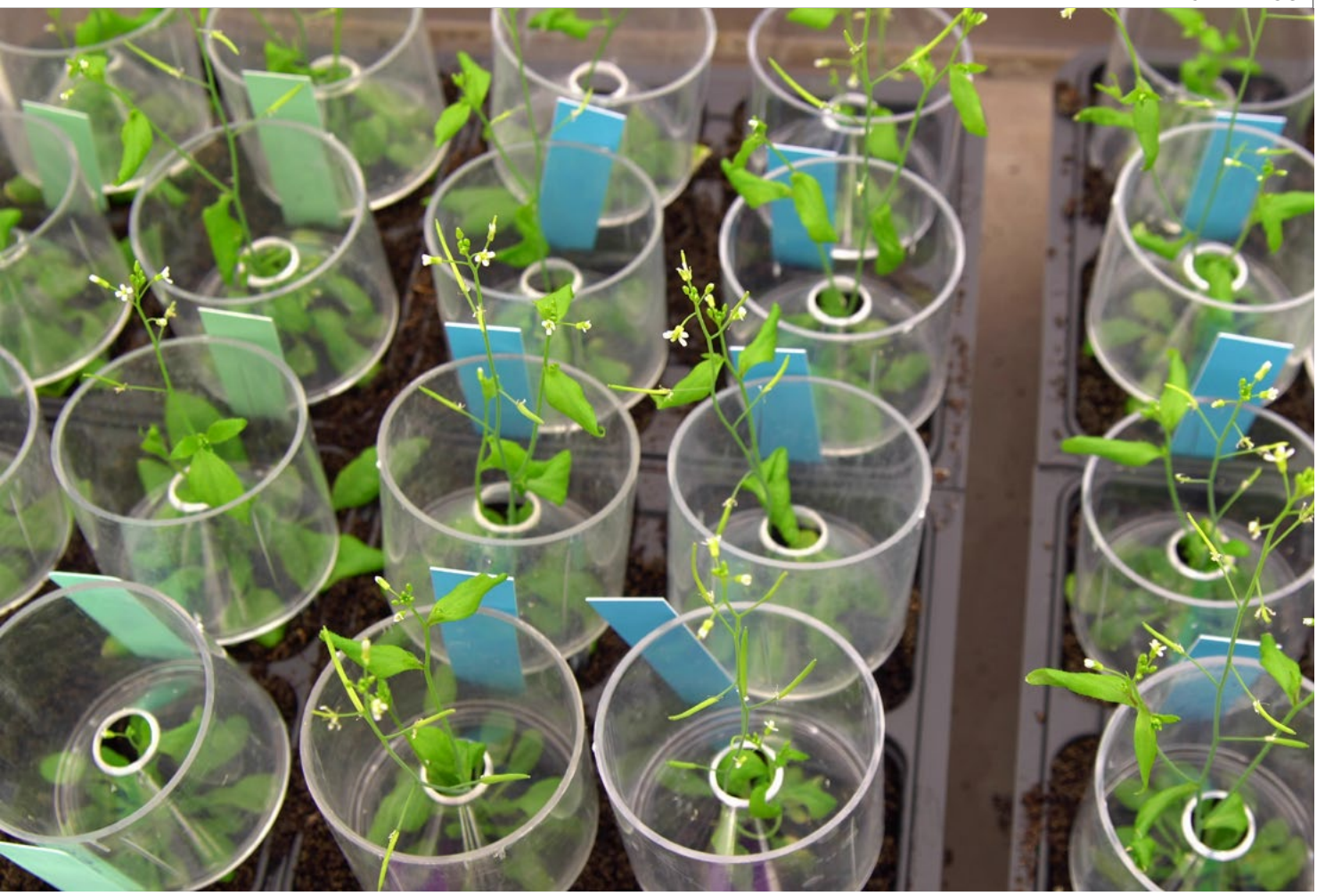
Thanks to observant researchers, it came to light that thale cress, the universal model plant for genetic research, is infected by a virus. This could affect the plants in ways that are not clear yet. What are the implications for research?

TEXT RIK NIJLAND **PHOTO** SHUTTERSTOCK

The story begins about six years ago, when entomologist Karen Kloth stumbled upon something strange in the course of her research on resistance genes against aphids. In some of her test plants – thale cress, or *Arabidopsis thaliana* – 90 per cent of the RNA she found did not come from plant genes, but probably from a virus. Kloth got in touch with René van der Vlugt, special professor of Ecological Plant Virology, in the hope that he could shed some light on what was going on.
To find out where the alien RNA came from, Van der Vlugt and recent graduate Ava Verhoeven compared it with RNA from a large international database. 'Our conclusion was that it must indeed originate from an unidentified virus,' says Verhoeven, now a postdoc at Utrecht University. 'By chance, I found out that they'd had a similar case in Utrecht. When we compared the unidentified RNA from Utrecht with that from Wageningen, it turned out to be the same unknown virus.'
The researchers decided to see if they could also find the virus in RNA datasets published online by other *Arabidopsis* researchers. It turned out they could: the virus RNA appears in over 10 per cent of the 6500 datasets they studied. And the problem has probably arisen more often, because if researchers come across a lot of RNA that does not come from thale cress genes, the test is often deemed a failure and the dataset gets binned.

25 PER CENT CONTAMINATED

In a publication in late September in the journal *New Phytologist*, the Wageningen-Utrecht team states that the virus got into the lab at some point via wild plants. The virus appears to be very easily transmitted via the seeds of infected plants, so the virus could spread rapidly as researchers all over the world exchange seeds. Globally, nearly 25 per cent of *Arabidopsis* lines could be infected, say the researchers.
So how could this stowaway stay under the radar in such a well-researched plant? Mainly because the infected plants do not get sick or show any visible symptoms. Its secret life is also behind the new virus's name: Arabidopsis latent virus 1 (ArLV1). Nor does ArLV1 disturb the gene expression of the plant very much, if at all. Only occasionally is the virus RNA present in large quantities, as it was in the experiments in Wageningen and Utrecht. Why this only happens occasionally is still a mystery. But research has revealed that plants infected with ArLV1 contain slightly less chlorophyll and can withstand drought better.



Thale cress is the universal model plant for genetic research.

In the article in *New Phytologist*, the researchers call for infected thale cress plants to be banned from laboratories. Verhoeven: 'Obviously, you don't want to let the virus have unforeseen effects on your research. Not only because that could give you unusable datasets, but also because the virus could affect plants in currently unknown ways.' Theoretically, this can be done quite simply by using only healthy plants for seed production. In their article, the researchers also describe a simple test that gives a conclusive result within a day.

REPEAT RESEARCH

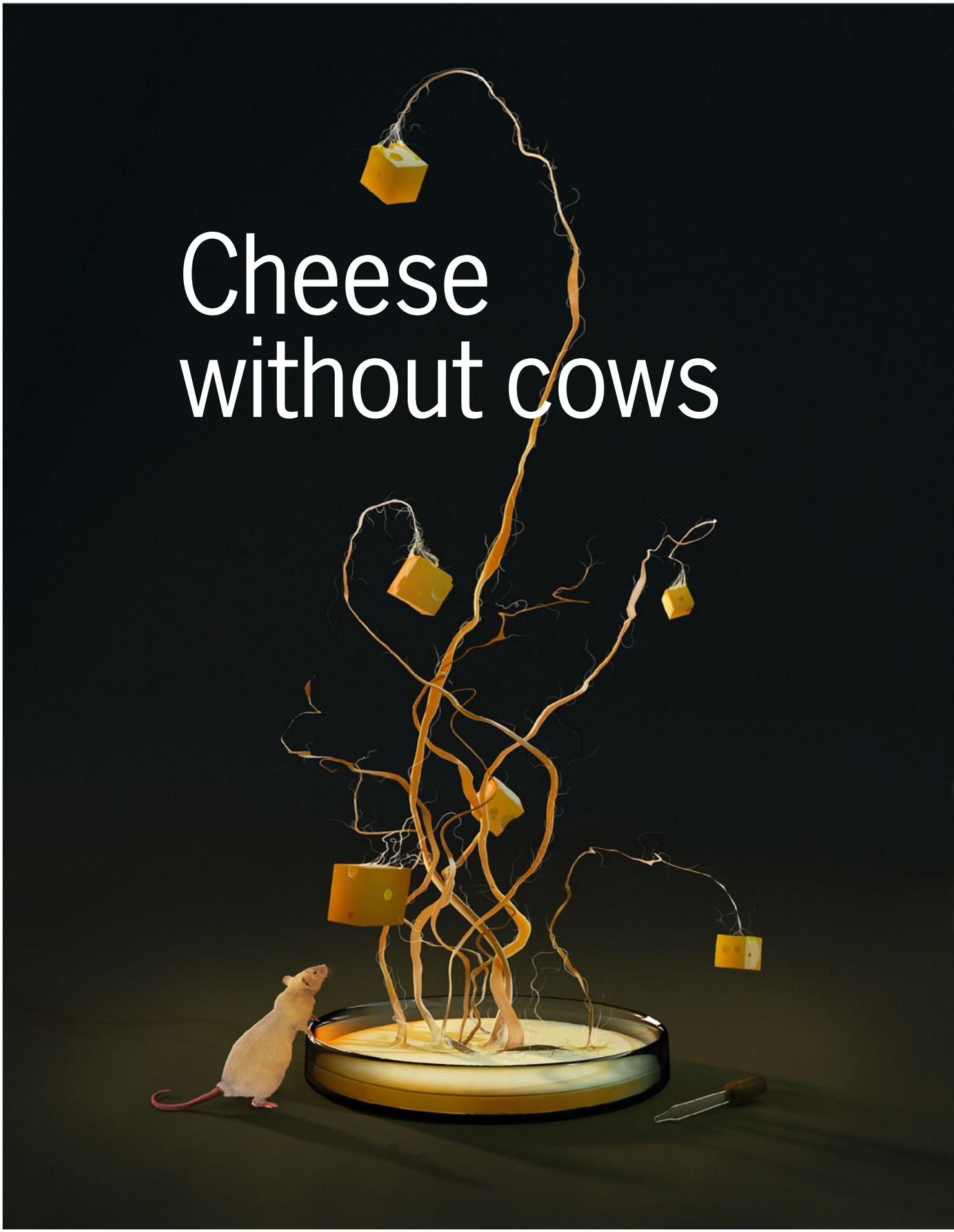
But what should be done with previous research that used *Arabidopsis*? How reliable are results from past experiments? 'Up to now, we haven't seen the virus seriously disrupting the plant's metabolism,' says Van der Vlugt. 'It is of course impossible to do all the previous research worldwide all over again. Thanks to this publication, researchers are now aware of the existence of the virus and can bear it in mind when they conduct their experiments.'

> 'You don't want to let the virus have unforeseen effects on your research'

'We have not had any problems yet with compromised RNA datasets,' says Wageningen professor of Genetics Mark Aarts, who works a lot with *Arabidopsis* as a model plant. 'Because the virus doesn't appear to affect the plants, this isn't something that has caused great alarm,' says Aarts. 'We are being vigilant now, but we are very reluctant to purge our plant collection completely because that is a lot of work and it would probably be a losing battle. Any line that goes unchecked could cause the virus to spread again. A clean-up would be most effective if it was part of a community effort, perhaps coordinated by the Arabidopsis Stock Centres in the UK and the US. But I haven't seen any initiatives for that yet. Meanwhile, it seems sensible to use virus-free plants for all RNA experiments.' ■

www.wur.eu/thale-cress

Cheese without cows



Researchers are trying to get micro-organisms to make milk protein. The idea is that this will result in cheese that tastes the same as traditional varieties, but without the use of cows, thus using less land and water and emitting much less CO_2.

TEXT ARNO VAN 'T HOOG **ILLUSTRATIONS** JEROEN MURRÉ

When you pick up a kilo of cheese, you are actually holding six to ten litres of milk. That invisible quantity of milk is why cheese is up there with chicken and pork in terms of its environmental impact. This is largely due to emissions by cows of the powerful greenhouse gas methane. Protein-rich cheese substitutes can provide a sustainable alternative, but the existing vegan cheese products still leave a lot to be desired in terms of flavour and texture.

Anyone aiming to produce a cheese substitute that smells, feels and tastes like traditional cheese should look for proteins that behave exactly like milk protein in the cheese-making process. One option is genetic modification: put the milk protein gene from a cow into a micro-organism, culture the organism in a heated stainless-steel vat and harvest the protein from the culture medium.

'A fair amount of research was being done on making milk protein in micro-organisms as far back as the 1970s,' says Julia Keppler, who works at the Laboratory of Food Process Engineering in Wageningen. 'But that turned out to be very expensive and not feasible on a large scale. Culturing technology has become more affordable over the past ten years, though.'

And Keppler has also gained personal experience of the possibilities for making milk protein by this method. Three years ago, she and her fellow researchers put a cow's milk gene into a bacterium (*E. coli*), and could then extract protein that is almost indistinguishable at the molecular level from the same ingredient in cow's milk. 'It was really an initial demonstration project to show in the lab that the technology works and that the protein is identical. *E. coli* is not an ideal host for making proteins that you want to use as a food ingredient, because some strains of this species of bacteria cause infections in humans.'

Keppler is currently working within an EU project focusing on using an animal-free version of the milk protein casein for cheese making, and is leader of the Protein Transition 2.0 consortium on the purification and application of animal-free milk proteins, which has received 1.9 million euros as part of the Dutch Research Council's Key Enabling Technologies Agenda.

CELLULAR AGRICULTURE

The technology for producing animal products such as milk and meat directly from cells, referred to as 'cellular agriculture', has been coming in for more attention over the past two years. This is partly thanks to the activities of the startup Those Vegan Cowboys, which has a 20-strong team in a Ghent laboratory researching the production of milk protein in yeast. The company has promised to give up to 2.5 million euros to whoever finds a fungus that can convert grass into the milk protein casein. The ultimate goal is to make milk products such as cheese that taste the same as traditional varieties, but without involving cows, and therefore using less land and water, with CO_2 emissions only one fifth of those caused by cows' milk products.

Cellular farming has also already found its way into the supermarket on a modest scale. The US startup Perfect Day supplies animal-free whey protein to companies, which turn it into vegan ice cream, cream cheese and protein shakes. Whey protein is the protein with the second biggest share in milk after casein, and is a >

by-product of traditional cheesemaking. 'The ice cream tastes just like dairy ice cream, because the whey protein is exactly the same,' says Etske Bijl, from Wageningen's Food Quality and Design chair group. 'Only it's a lot easier, technically, to make whey protein for ice cream than to make casein for making cheese.'

Bijl is project leader of the 'Animal-free milk protein' consortium, which received 1.7 million euros as part of the National Science Agenda. It is a Dutch Research Council-funded project, in which a dozen research institutions and companies ¬ including Those Vegan Cowboys ¬will work together over the next four years on a great many questions surrounding casein: aspects ranging from production and purification to cheesemaking, food safety, consumer behaviour, legislation and the implications for the dairy farming sector.

Bijl: 'One of the key initial research questions is: what is the best micro-organism for producing casein, preferably in a way that means the protein ends up in the culture medium?'

EXPERIENCE WITH YEAST

The research is focusing first on a yeast species: *Pichia pastoris*. The industry already has a lot of experience with this micro-organism, which is used for making enzymes for bread and beer production. This yeast grows rapidly in heated, stainless-steel vats on a simple diet of sugar or methanol.

'We are working with researchers at Wageningen Food & Biobased Research,' says Bijl. 'They have a lot of experience with making proteins in *Pichia*. They can use it to produce large quantities of gelatine and silk protein, for example. It remains to be seen whether it will work for the milk proteins we are interested in. Casein is somewhat unusual protein because there are phosphate groups on the protein. You don't just want the yeast to make casein, but also that the phosphate groups get to where they are needed. Those phosphate groups are indispensable, because thanks to them, caseins can clump together into little balls: casein micelles. Cow's milk is full of these micelles, which play a key role in cheese production.'

'Once cow's milk starts curdling during cheese-making, the micelles cause a kind of watery gel to form. If you start with isolated casein – which can be bought as powder – no gel is formed, and there is no basis for making cheese. You can use such isolated casein to make something that resembles cheese spread or pizza cheese. But we know from consumer research that there is a demand for a substitute for a cheese like Gouda, with the same flavour and texture. If you want to achieve that, you have to start with a similar micelle structure.'

PURIFICATION

Once you can make enough casein, other important questions arise: how do you remove the protein from the culture medium, and how pure does it need to be to use it as a food ingredient? The yeast itself also excretes various substances and proteins, and the question is whether these should all be removed. In Keppler's laboratory, the culture medium will be purified step by step and analysed

> ‘It won’t be easy, but potentially it could be very fruitful’

in detail. Keppler: ‘My colleagues within the consortium will then look at the protein structure, while researchers in Maastricht will test for the presence of toxic substances.’
There are other ingredients that contribute to the flavour of cheese too. Depending on the type of cheese and its age, it contains 12 to 32 per cent fat. So fat is another indispensable ingredient, for which a suitable animal-free substitute needs to be found.
During the cheesemaking process, rennet is added as well as lactic starter cultures, which are a mixture of lactic acid bacteria. According to Bijl, the flavour of cheese comes mainly from the way those bacteria break down casein, milk fat and lactose. If you replace those basic ingredients, what happens to the smell and taste of dairy-free cheese? ‘We know that if you use slightly different starter ingredients in your cheesemaking, it will directly affect the flavour of the end result. So if you use a vegetable oil as your source of fat, you can be sure the texture and flavour will be different. Cheese bacteria use lactose during the ripening process. But lactose is almost exclusively obtained from cow’s milk, precisely the source we want to avoid. So the question is whether you can use a different kind of sugar.’
This is not the only challenge, says Bijl. ‘Cheese bacteria need other milk ingredients as well to thrive, and you don’t have any of those if you start with only casein and plant-based fat. So we’re going to see whether we should add vitamins, for example, to help the bacteria grow well. Whatever you do in this project, you run up against a lot of different questions. All in all, it is very ambitious, but that was precisely one of the criteria for the Research Council funding. It won’t be easy, but potentially it could be very fruitful. If the project is successful, it will contribute to a genuinely innovative technology.’

LABELLING

The projects Keppler and Bijl are working on are not limited to questions of processing technology. Issues of legislation and labelling come in for attention as well, because getting yeast to make a milk protein requires genetic modification. If you produce food ingredients in Europe with this technology, the product has to go through an extensive registration procedure. ‘I am often asked when this kind of product will go on sale, but it partly depends on the regulations.’
Food researchers are also going to look into the digestion of the protein, and social scientists will study the wishes of consumers and the role of farmers, says Bijl. What will this technology mean for the dairy industry? ‘Ultimately, the yeasts that make the milk proteins need a source of food too, and maybe farmers can play a role there. One of the consortium partners, Those Vegan Cowboys, is looking at grass as a food source. That falls outside the scope of our project. In the lab, we grow the yeasts on methanol and sugar, but in future we do want to consider alternatives to that.’ ■

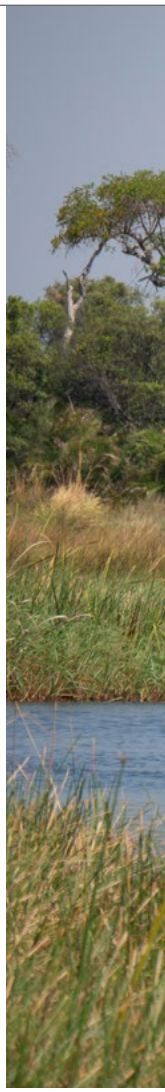
www.wur.eu/proteintransition

PUBLISHING IS MORE IMPORTANT THAN PATENTING

If interesting techniques are developed in the projects working on making vegan cheese, the participating companies will get three months to apply for a patent for specific applications before the research is published. ‘Companies can’t apply for all-encompassing patents that could block these technological developments. Clear agreements have been made on that in advance, says researcher Etske Bijl.’
Ultimately, publishing is more important than registering patents, according to Bijl. Sharing insights can speed up this technological development. ‘I’m guessing that there are lots more startups working on casein around the world, but that everyone encounters the same problems. You don’t get to hear much about that because nothing is being published. For example, Perfect Day has applied for a patent for the production of casein, but nothing has been published about their method. One of the goals of our research is to be as open as we can about the bottlenecks in the microbial production of casein, to avoid everyone continually making the same mistakes.’

GREEN APARTHEID:

Game viewing in White enclaves



The wildlife economy is flourishing in South Africa; tourists enjoy game-viewing in wildlife parks while more and more people are living on luxury 'wildlife estates'. These are in effect White enclaves from which Black people are excluded, notes sociology professor Bram Büscher.

TEXT MARIEKE ROTMAN **PHOTO** ARMANDS PHARYOS / ALAMY

'Live in a wild place you thought no longer existed!' So begins the promotional brochure for Zandspruit, one of South Africa's many wildlife estates. 'In a spacious villa on Gazelle Street, where a gazelle occasionally turns up at the poolside. Or even a giraffe, if you're lucky.' This is the picture the brochure paints of a life in the midst of South African nature. The Zandspruit villa park is located in the village of Hoedspruit, on the edge of the famous Kruger Park.

In 2016, South Africa launched a new strategy for combatting unemployment and biodiversity loss while promoting rural development: the wildlife economy, a business model that revolves around wildlife. The wildlife generates incomes through tourism, organized hunting, game meat production and luxury villas amidst the wildlife. Happy nature, happy people – that's the idea.

CLEANING

But it is mainly affluent White people who invest in Hoedspruit, where they buy land or a villa. Most of the work of maintaining, cleaning and guarding the area is done by Black South Africans. They don't live here, but depart every night to return to disadvantaged areas dozens of kilometres from Hoedspruit.

Bram Büscher, professor of Sociology of Development and Change in Wageningen, and his colleagues Lerato Thakholi and Stasja Koot, published a study earlier this year called *The new green apartheid?* They describe a new phenomenon in this article: apartheid in the wildlife economy. Many in South Africa like to think of apartheid as a thing of the past, but what Büscher and his colleagues saw in Hoedspruit led them to conclude that this is not true.

Büscher has been researching socio-political aspects of wildlife conservation in South Africa for about 20 years. His earlier research focused on issues such as the relationship between violence and conservation, in relation to rhino poaching, for example, which is a big problem in South Africa, both in the Kruger Park and in

the private nature reserves around it. These days, both poachers and park rangers are heavily armed, and violent confrontations are a regular occurrence.

SAFE HAVEN

'I had been working in the Kruger Park for a while, and I sometimes drove through Hoedspruit. I saw that the town was growing rapidly and wildlife estates were springing up all over the place,' says Büscher. 'I was curious to know exactly what was happening, so I went there to do some preliminary research with a PhD student and a postdoc. The very first interview we did was revealing. We talked to a wealthy man who had set up several wildlife estates. He explained to us that the area was becoming a "safe haven", calling Hoedspruit "unique". There were an awful lot of racist undertones in that conversation: "safe" and "unique" actually meant "very few Black people live here". Pretty bizarre.'

> 'There were an awful lot of racist undertones in that conversation'

This was the start of a five-year study on the rapidly growing wildlife industry in South Africa, supported by a Vidi grant from the Dutch Research Council (NWO). Büscher, Thakholi and Koot paid a lot of visits to the area, conducted more than 260 interviews and recorded the life histories of a number of older residents, in order to document how the area has changed. >

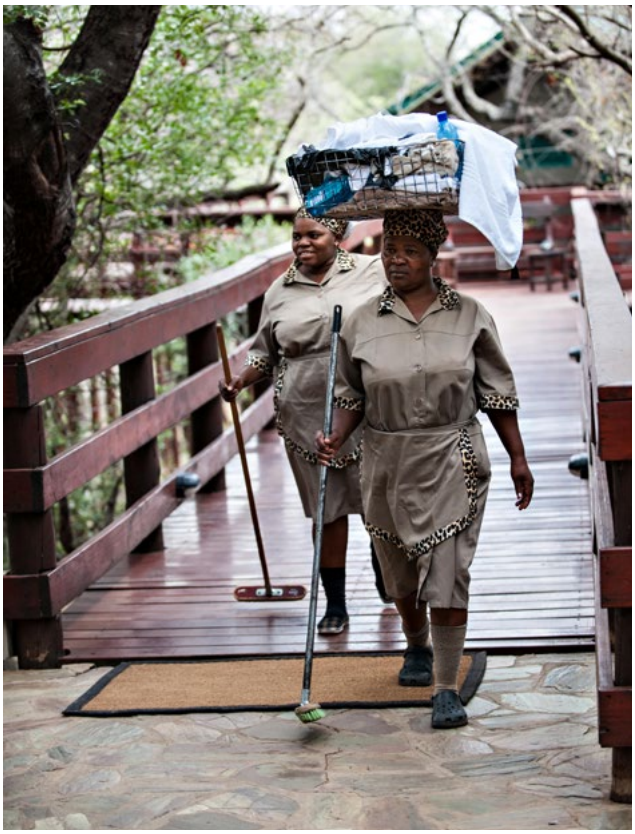


PHOTO ALAMY

PHOTO BRAM BÜSCHER

The construction workers, cleaners, shop assistants and gardeners who keep Hoedspruit going are mostly poor, Black South Africans who have to commute from far or live in the slum known as 'Plastic View' near the railway line.

They conclude that the Hoedspruit residents who benefit from the wildlife economy are generally affluent White people. The construction workers, cleaners, shop assistants and gardeners who keep the area running are mainly poor, Black South Africans who are underpaid and cannot afford to live in Hoedspruit. 'We don't claim that it was the intention of the White people in and around Hoedspruit to implement an apartheid system, but we must conclude that the effect of their activities and of the wildlife economy is that many of them are part of this new green apartheid,' write Büscher and his colleagues.

PRIVATIZING NATURE

The researchers are not alone in their findings. South African writer Sizwe Mpofu-Walsh writes in his 2021 book The New Apartheid: 'Apartheid did not die; it was privatized.' Racial segregation may not have been government policy since 1994, but privatizing things like conservation and making them a business model has sustained big disparities in who has access to what, he writes. Mpofu-Walsh's book was also the inspiration for the title of the article by Büscher and his colleagues.

'We were looking for a term that could express what we were seeing. The term "green apartheid" has been used before by researchers looking at the locations of parks in South African cities. They are nearly always in White neighbourhoods, to which Black people still have little access except when they go there to work. We go further in our use of the term; primarily to assert in no uncertain terms that apartheid has not been eliminated, and that the country and people's rights are no less systematically unequal than they were before. What we didn't know yet was how the popular wildlife economy plays a role in that.'

The dominance of White, wealthy residents in Hoedspruit is seen by many of them as something that must be maintained, the researchers write. The local council has made several attempts to launch the construction of social housing in the town, but this has been blocked by local parties and investors. Wealthy landowners told Büscher and his colleagues that they would rather not have the predominantly Black people who work in Hoedspruit move into town, for fear that would change its quiet, safe atmosphere. 'Poverty creates criminality,' one of them said.

The article even speaks of a worsening of apartheid compared to the days of the apartheid regime, because in Hoedspruit the systems of inclusion and exclusion are largely invisible.

STRUGGLE FOR LAND

The researchers also state in their article that there is still heated debate about who the land actually belongs to. Dozens of land claims have been lodged in and around Hoedspruit, through which Black

> ‘Apartheid has not been eliminated, and people’s rights are no less systematically unequal than they were’

residents are trying to regain their land. Black communities were driven off the land in the late 19th century, explains Büscher, so that white colonists could start farms there. Since the early 20th century, many farms west of the Kruger Park have been turned into wildlife reserves, which are still managed by rich White residents. In the new wildlife economy strategy, those reserves must not only be protected but also make money. And then the early 21st century saw the rise of wildlife estates: White gated communities.

Büscher explains that ever since the late nineteenth century, wildlife management has been used as an argument to give White communities access to lands that were already used or occupied by others. ‘That happened in North America too, and in other African countries such as Tanzania and Kenya. In many places, a lot of people have been chased off the land or turned into labourers. And that still happens.’ It is often difficult to do anything about it, he adds. ‘Because there is still a strong belief in the importance of creating protected areas where no people live.’

LIE DETECTOR

The inequality that is still so visible in Hoedspruit made a deep impression on Büscher. ‘For example, how readily they subjected people to lie detector tests. Rhino poaching is a big problem in this area, and armed guards drive around the reserves continuously. Many of them are Black South Africans too. A lot of employees are put through a lie detector test by their supervisors, to check that they are not infiltrators passing information to poachers.’

Büscher was particularly shocked by how systematic minor incidences of racism were. ‘At our first interview, the real estate magnate asked his servant to pour some more coffee. He called her Lerato, which was not her name, but that of my WUR colleague. She commented on that, but he replied that it didn’t interest him. We saw many similar incidences, subtle things that implied that some people don’t matter. It reminded me of David Hughes, who wrote that disregarding others is also form of racism too.’

SOCIAL JUSTICE

What is the solution, according to Büscher? ‘We wrote a book about that: *The Conservation Revolution*. Nature conservation needs to be combined more effectively with social justice. In our view, labelling business models like the wildlife economy as sustainable seriously undermines the legitimacy of nature conservation, while perpetuating inequality.’

‘We are trying to think together with local Black South African wildlife managers and scientists about what would be the best options in this area for both biodiversity and local communities. One of the promising ideas, as far as I am concerned, is “convivial conservation”. Instead of keeping nature away from local people, we need to go beyond fence-building and look for ways in which people can live with nature better, shaping a new and equitable approach to nature conservation. We are now doing research in South Africa, Brazil, Finland, America and Tanzania in order to learn more about this.’ ■

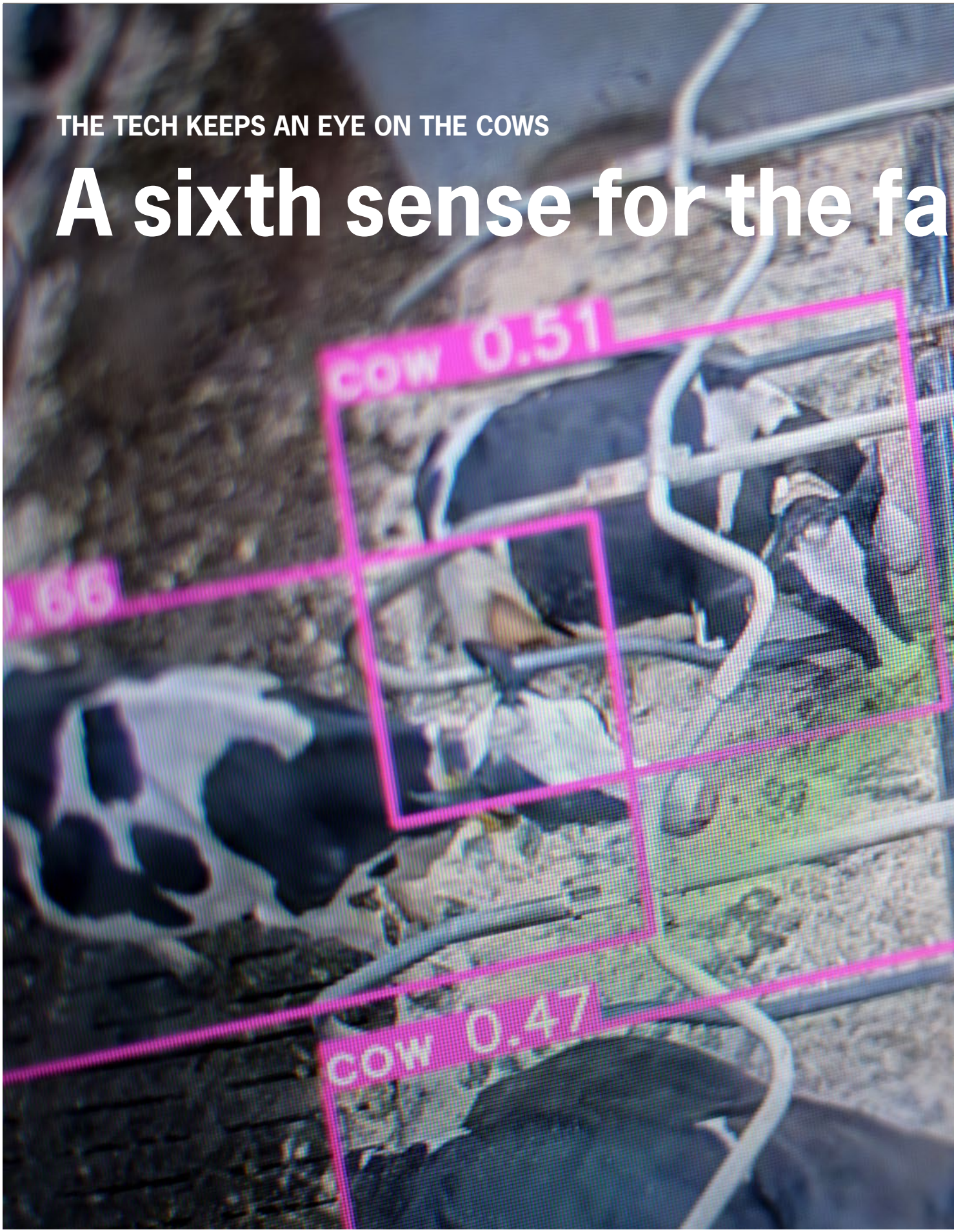
www.wur.eu/green-apartheid

BRAM BÜSCHER

Bram Büscher has been professor of Sociology of Development and Change in Wageningen since 2015. He is also a visiting professor in Johannesburg and a visiting researcher at Stellenbosch University in South Africa. He has been researching the socio-political aspects of conservation since 2003. Büscher has previously conducted research on the rise of rhino poaching and the militarized response to it, with a Veni grant from the Dutch Research Council, NWO.

THE TECH KEEPS AN EYE ON THE COWS

A sixth sense for the fa



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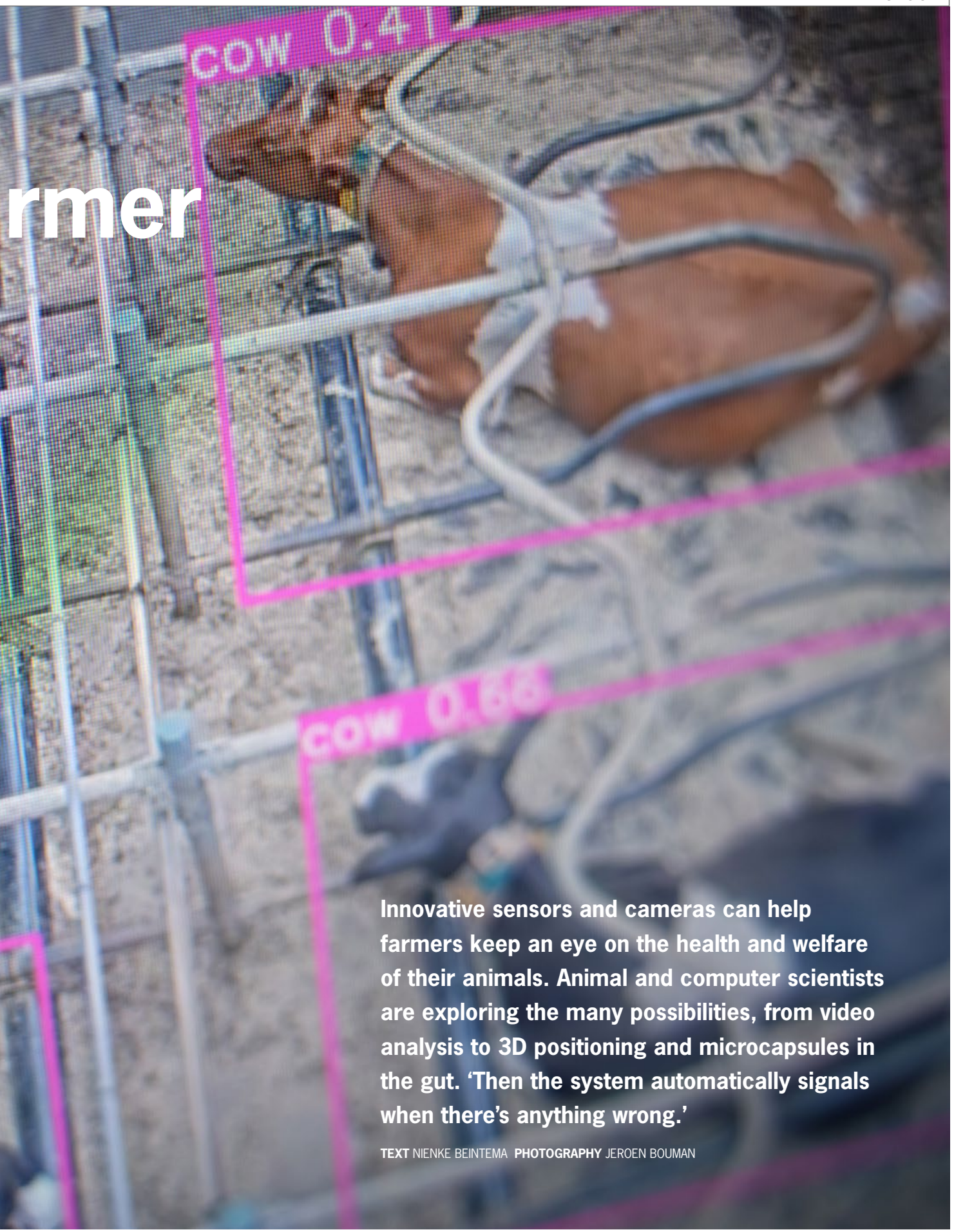
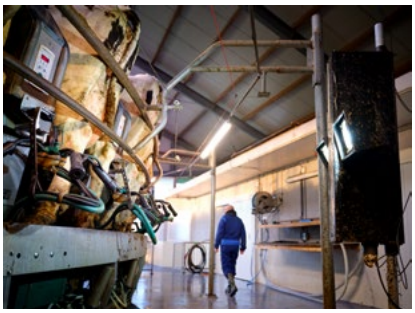


Innovative sensors and cameras can help farmers keep an eye on the health and welfare of their animals. Animal and computer scientists are exploring the many possibilities, from video analysis to 3D positioning and microcapsules in the gut. 'Then the system automatically signals when there's anything wrong.'

TEXT NIENKE BEINTEMA **PHOTOGRAPHY** JEROEN BOUMAN

The health status of the cows is monitored 24/7 using sensor technology and artificial intelligence.

Cameras record the gait of the cows passing them.



In the milking carousel the cow's hooves are automatically photographed.

Early detection of the infectious Mortellaro's disease of the hoof is the aim.

‘You can deduce information about a cow’s health from its movement patterns’

Here they come, walking through the narrow passage in an orderly line. They speed up and then hesitate for a moment, causing a minor traffic jam. But then they’re off again, back to the barn. These are the dairy cows at Dairy Campus in Leeuwarden, freshly milked and checked. There are two cameras suspended in the corridor, pointing at the cows as they pass by. Back in the milking carousel, their hooves have already been automatically photographed. And there is more equipment up ahead in the spacious barn: another eight cameras, plus four anchors positioned high up in the four corners. These anchors pick up signals from tags the cows wear on their collars: small, rectangular boxes that emit high-frequency radio waves and enable a computer to track the exact position of an individual cow over time. Together, these systems locate the cows on the farm 24 hours a day, as well as recording whether they are moving fast or slowly, eating or resting, standing or lying down.

‘This system is part of our innovation programme called Next-Level Animal Sciences,’ says Claudia Kamphuis, a researcher at Wageningen Livestock Research. ‘We are

The cows wear tags that emit high-frequency radio waves.

Anchors receive signals from the tags and track the position of individual cows.

All the information from the barn comes together in the computer.

studying the use of sensor technology in combination with artificial intelligence to monitor particular health traits and the welfare of farm animals.' NLAS is a four-year innovation programme (2020–2024) with a budget of 12 million euros, partly facilitated by the Dairy Campus Innovation Fund. The programme, Kamphuis explains, pursues three lines of research: sensor technology, complex cell systems, and data and models. The project in Leeuwarden comes under that last category and is being implemented in collaboration with Noldus Information Technology.

PAINFUL SWELLING

At the Dairy Campus the researchers are focusing on Mortellaro's disease, a common bacterial infection that occurs where the cow's skin and hoof meet. The disease can cause a painful, inflamed swelling between the two claws. Mortellaro's disease not only makes it harder for animals to walk, but also makes their stools looser and affects their general health, their fertility and their milk yield. It is a contagious disease, which, according to some estimates, affects 40 per cent of Dutch dairy cattle. Ideally, farmers aim to detect the infection before the cow has visible inflammation, explains Kamphuis. Then they can treat it with a spray or antibiotics, and prevent other cows in the barn from becoming infected too. 'We are investigating the extent to which sensor technology can help with that early detection,' she says. 'We also want a deeper understanding of how the infection spreads in a herd of cows. That might help us to develop measures to stop it from spreading.' This research is taking place at Dairy Campus, a high-tech experimental farm run by Wageningen Livestock Research that works closely with universities, colleges, the Netherlands Agricultural and Horticultural Association LTO, and a major milk producer. Here, all cows wear the kind of collar with an identification chip that many dairy farmers have adopted to make their operations more efficient. This chip is recognized by sensors at various places on the farm, such as the feed dispenser and the milking shed, and it communicates with the farmer's computer system. The computer then reports that one cow has already been milked, or that another has had enough concentrate feed. 'Those aspects of farm management are already quite highly automated in the Netherlands,' says researcher Kamphuis. 'What our sensor technology adds is behavioural monitoring. That fits in with the development we are seeing: society and farmers alike are going to give increasing importance to animal health and welfare. A farmer with a large farm cannot monitor all the cows closely 24/7. That's why we are keen to automate it.'

LAME

The cameras at Dairy Campus play an important role in the early detection of Mortellaro's disease and in monitoring the way the cows move. Those images are automatically analysed with image processing techniques, explains Kamphuis. 'Together with our colleagues in the Agricultural Business Technology chair group, we created a model that identifies 17 key points on the cow,' she says. 'Taken together, these tell us something about the cow's gait. Things like the curvature of the spine, or the stride length, or the extent to which the head moves up and down. If this system tracks an individual cow daily, it "learns" what that cow's normal gait is like, and can sound >

CLAUDIA KAMPHUIS
Researcher at Wageningen Livestock Research

the alarm if there is any change, because the cow is lame due to Mortellaro's disease or another cause, for instance.'
The researchers are now 'training' this system by manually validating the data. They do this by viewing and analysing images, and by looking at automatic photos of the hooves taken during milking. The researchers also get information from the worker responsible for hoof care, who regularly inspects the cows' hooves and treats them if necessary. 'That is the advantage of Dairy Campus,' notes Kamphuis. 'These cows are already very thoroughly monitored.'
The four sensors in the barn record the cow's position in two dimensions to the nearest centimetre. The researchers use camera images to validate the data from this system, but also to record other details about the cow, such as whether she is standing or lying down. 'You can derive a lot of information about a cow's health from those patterns,' says Kamphuis. 'How long does it take the cow to get up, for example, or to lie down? If a cow is in pain, we expect it to take longer than usual. So far, we've only collected that information on a small scale and incidentally.' Here again, the earlier you detect health problems, the better you can treat them, Kamphuis emphasizes. 'First and foremost, that is better for the cow, but it's nicer for the farmer to work with healthy animals, too.'
In time, the researchers believe they will be able to collect all the information farmers need with the cameras. 'Thanks to the combination with position measurements, we can now develop very efficient image-processing software for this purpose,' says Kamphuis. 'We expect that cows with something wrong with their hooves or legs will also display subtle behavioural changes in the barn, besides an abnormal gait. The other changes might be more obvious or be visible earlier. By comparing the information from the sensors with what employees observe themselves, we will gain insight into the added value of this sensor data.'

RAPID GROWTH

Ingrid de Jong of Wageningen Livestock Research is also focusing on an advanced camera detection system, but in this case for poultry, in a project financed by a fund and several companies. 'We want to automatically analyse the behaviour of broilers, especially how they walk,' says De Jong. Difficulty walking is among the main welfare problems in broilers, she explains. 'They are often bred to grow as fast as possible, but their bones and joints can't always keep up with that rapid growth and become prone to strain or infections.
'It would be ideal if the poultry farmer could spot that something is wrong at an early stage,' says De Jong. 'We want to achieve that with a camera system that automatically analyses the images.' But unlike Claudia Kamphuis' approach, this system does not target the chickens individually, but looks at the flock as a whole – all the poultry in the shed.
'The camera records pixel changes,' says De Jong. 'The chicks are white, and you film them against a dark background. The system can extract an amazing amount of information from that: whether the chicks are moving, and how fast, and also the variation between chicks.' These are all established measures of animal welfare, which are currently scored manually in the course of a welfare assessment of a small sample – a time-consuming and imprecise method. 'This camera system can be a big improvement on that.'
The poultry farmer can then proceed to improve the conditions in the shed, says De Jong. 'For example, by slowing down the growth rate of the chicks a bit, which can be done via the feed. The farmer can also adjust the lighting schedule to control the activity of the chicks. Or improve the barn design, by enriching it with raised platforms, for example, to get the chicks moving around more.'
The team has now delivered a prototype: a camera system plus automatic image processing. 'Now we are waiting for an investor to take this a stage further,' says De Jong. 'For us, from a scientist's point of view, this project is already highly successful. We have developed interesting new knowledge that will be very useful to us in other projects.'

A BIG PILL

Guillermo Amador of Wageningen's Experimental Zoology chair group is working within the Next-Level Animal Sciences innovation programme on a completely different sensor system: microcapsules that measure intestinal health. 'We are doing this together with a company that wants to develop this kind of measuring capsule for humans,' he says. 'We are testing them in pigs first. A nice added advantage is that

this technology can help farmers monitor the health of their animals.'
The capsule Amador is developing is ovoid and made of plastic. It is two centimetres long and three quarters of an inch in diameter. 'A big pill to swallow, but pigs can do so easily. Eventually, we do want to scale down this design, but the technology is not up to that yet.'
Inside the capsule is a chip that is connected with the outside world via little metal strips. 'That is the trickiest bit, technically' says Amador. 'The pill has to pass through the stomach, a hostile environment, and you want to protect the sensor from that. At the same time, it does need to be in contact with the contents of the stomach and intestines, to pick up chemical signals.' These include acidity, certain substances released by the metabolic process, and temperature. Together, this information provides a picture of the pig's intestinal health. The thermometer detects a fever, for example. Some proteins reveal a digestive problem, or the presence of a particular disease.

HOLLOW NEEDLE

That information goes wirelessly to a receiver in the barn, which transmits the data to the farmer's computer ¬ or, in this case, the researcher's. 'The farmer can then intervene at an early stage, for example with medication or by adjusting the diet before the animal gets really sick.'
The system already seems to be working quite well, Amador says, although the pill gets stuck in the gut now and then. 'So there is still some work to be done on the design. A next step is that we want to validate the sensor data by having the capsule take little samples from the gut along the way, as well. One way of doing that is with a hollow needle that briefly comes out and retracts again, driven by a tiny motor.'
The researchers also want to start teaching computers to recognize certain health traits among pigs. 'Then farmers won't have to monitor all the data themselves, and the system will automatically signal when there's anything wrong.'
Meanwhile, the cows at Dairy Campus in Leeuwarden are quietly ruminating in the half-open barn, while noisy starlings fly in and out to get a share of the pickings. It looks like any other modern barn ¬ apart from the high-tech gadgets on the wall. 'You see, that's a nice way of watching the ladies,' says Claudia Kamphuis. 'Those technologies are constantly keeping an eye on things, in a non-invasive way. If a cow needs special attention, the farmer gets there quickly. It's beneficial to both animals and humans.'
The innovation programme on Dairy Campus will run until mid-2023, by which time Kamphuis hopes to have a prototype ready. How realistic is it that these technologies will then be adopted in barns around the Netherlands? 'Some of these technologies can already be found in barns,' answers Kamphuis. 'But the use of cameras is definitely going to take off; I have no doubt about that. It's relatively cheap, whereas tech like the individual sensors with which you can track each cow's movements is still expensive. But eventually we hope to have a system that can monitor behaviour using cameras alone.' ■

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> **'Society is going to value animal health and welfare more and more'**

INGRID DE JONG
Senior Poultry Welfare researcher at Wageningen Livestock Research

GUILLERMO AMADOR
PhD student in the Experimental Zoology chair group

‘The first time I saw a shark changed everything’

When a South African white shark attacks, it jumps out of the water and, oddly enough, goes pale. National Geographic Explorer Gibbs Kuguru has made a documentary about this. ‘The ferocity of the attack, the teeth, the impact on the prey. When you see that, you can’t just sit and watch.’

TEXT ROELOF KLEIS

Explorers still exist, and one of them is Gibbs Kuguru from Kenya, who has been a PhD student at WUR for two years now. He was officially awarded the status of National Geographic Explorer in June this year. The renowned institution became aware of him through his shark videos for the Disney-NatGeo Channel, and the award enables him to go exploring the world in search of good stories.
Gibbs Kuguru has been studying sharks for 10 years, first for the diving school he was working for and later as a Master’s student at the University of Stellenbosch in South Africa. He then became a researcher at the Worldwide Fund for Nature and then made the move to Wageningen.

STUDYING MEDICINE

His parents actually intended for him to become a doctor. ‘I started out studying medicine in the US but I wasn’t happy doing that. My study advisor saw that too and tipped me off about a job in South Africa on a boat that took tourists out to go underwater in a cage to see great white sharks I wasn’t a diver,’ says Kuguru. ‘I actually couldn’t even swim properly and – like most people – I was scared of sharks. But the choice was: to continue my studies or to go to the sharks. I opted for the sharks.’ And his fear quickly evaporated. ‘The first time I saw a shark changed everything. Sure, it’s a hunter, untamed and fierce, but it is also an incredibly beautiful animal that deserves our respect. And much less dangerous than, for example, a lion when you come face to face.’
That’s as long as you know how to behave. ‘Not long ago, in South Africa, I fell out of my kayak into water full of great white sharks. My first reaction was: “shit!” But my training took over. “Don’t react like prey. Show that you’re not panicking or in distress. Don’t flounder.” So I grabbed my paddle, swam calmly back to the kayak and climbed in. Nothing happened. But I did paddle back to the beach very fast.’

> ‘I actually couldn’t even swim properly and I was scared of sharks’

COLOUR BOARD

At the time, Kuguru was in South Africa to film a documentary about a remarkable phenomenon: the way great white sharks change colour when hunting. This phenomenon has never been studied before. Kuguru: ‘My former boss on the boat once said: hey, that shark we just saw seems to have gone paler. I thought: he’s crazy. But later I heard similar stories from other people.’ So Kuguru and his shark mentor Ryan Johnson decided to research this, and got the backing of National Geographic. ‘Things like colour change

PHOTO GIBBS KUGURU

The colour of the attacking great white shark can easily be compared with the shades of grey tints on the colour board.

makes for an interesting story, of course'. The researchers make smart use of the behaviour of the sharks, which jump out of the water when they attack, showing themselves in all their glory. 'Only in South Africa do the great white sharks do that.' Kuguru and his colleagues designed an experiment with a fake seal dragged behind the boat on a cord. On a floating rack in front of the seal is a colour board. As soon as the shark jumps out of the water to attack, it is photographed from the boat. It is then easy to compare the shark's colour with the shades of grey on the board. Kuguru has dozens of photographs of such attacks, which he never tires of. 'The ferocity of such an attack, those teeth, the impact on the prey. When you see it, you can't sit still. YES, it happened again!'

HORMONES

Kuguru thinks he now understands the mechanism behind it. 'I think it's an unconscious response of the nervous system, just like blushing. Our hypothesis is that several different hormones induce this colour change. Adrenaline, for example, which is released when the shark feels threatened or scared.'

This is still a hypothesis at this stage, but one that is supported by lab tests, in which skin tissue from the great white shark was exposed to adrenaline. This produced the same colour change.

So the colour change is an effect of the age-old fight-or-flight response. Kuguru: 'The shark's muted colour pattern matches the colour of the deep ocean, so I think it is a natural adaptation that sharks have developed to gain an evolutionary advantage. But much of this is still hypothetical.' ■

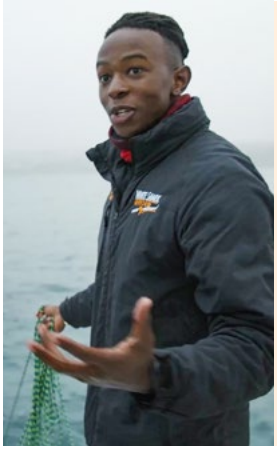


PHOTO GIBBS KUGURU

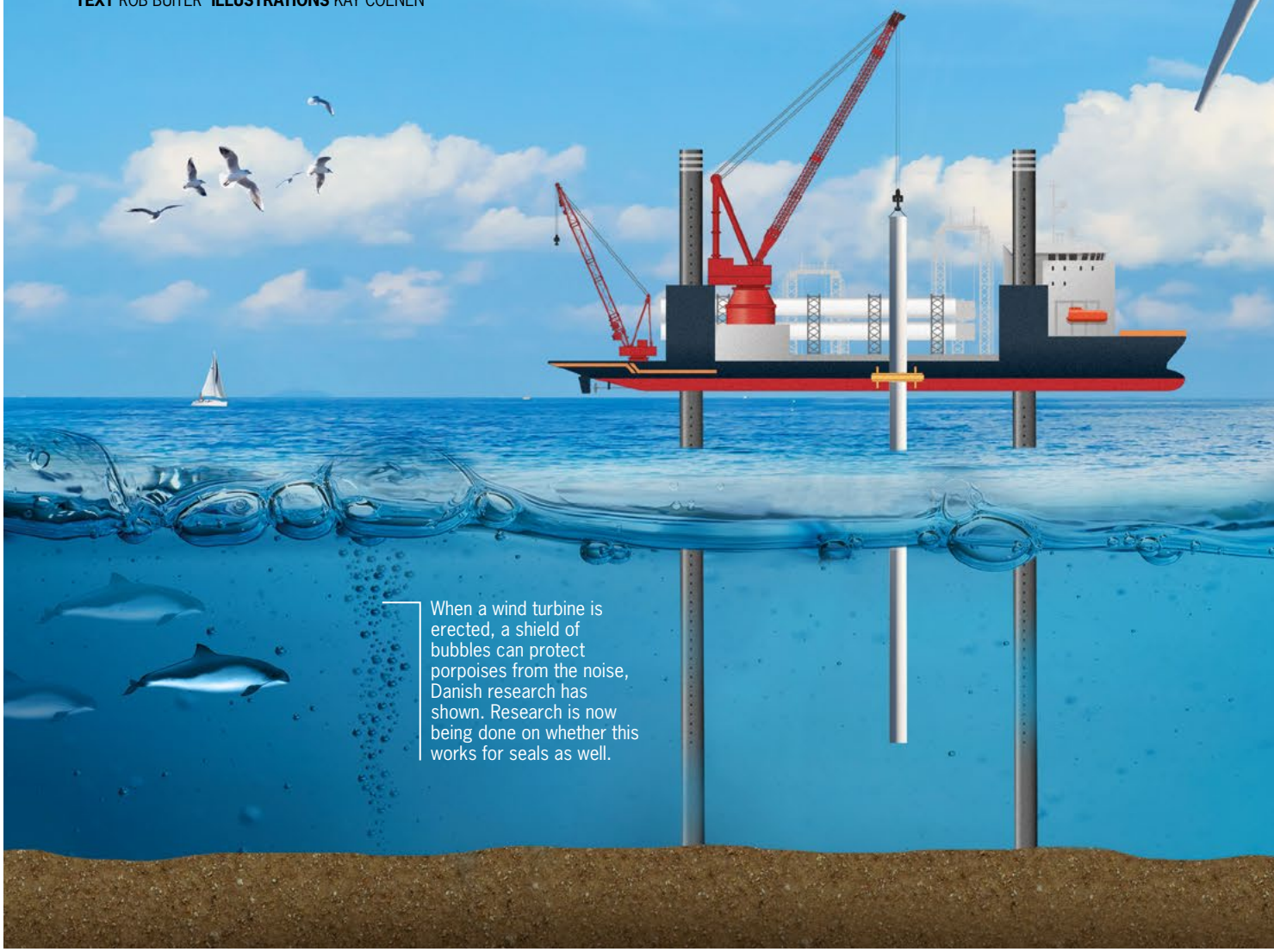
LEUCISM IN BLACKTIP REEF SHARKS

Besides his research for National Geographic on the colour change in great white sharks, Gibbs Kuguru is a PhD student in the Wageningen Breeding and Genomics chair group. He is studying the genetic basis of leucism in blacktip reef sharks in the Indian Ocean near the Maldives. Leucism leads to spotted depigmentation of the skin. Pigment cells (melanocytes) play a role in this, as they do in in the colour change observed in the great white shark. In addition to the genomics of it, Kuguru is also investigating the effect of leucism on the sharks' chances of survival.

Wind farm or nature reserve?

The intention is that by 2050, the North Sea will be Europe's green power station. That will require 10 times as many wind farms as there are today. Research is aimed at revealing what all those turbines will do to the ecology of the nature reserve. 'What makes it a bit worrying is the fact that construction of the wind farms is already in full swing.'

TEXT ROB BUITER **ILLUSTRATIONS** KAY COENEN



When a wind turbine is erected, a shield of bubbles can protect porpoises from the noise, Danish research has shown. Research is now being done on whether this works for seals as well.


New wind turbines have a capacity of over
10 megawatts
Wind turbines producing 13 to15 megawatts are under development.
The latest wind turbines, planned for the Hollandse Kust Zuid wind farm, will be
252 metres tall.
That is the height to the tip of a blade at its highest.
New wind turbines have a rotor diameter of about
165 metres
Wind turbines stand about
1 kilometre apart.
Activity is possible in between the turbines.
‘How do you weigh up the ecological risks against the sorely needed gains?’

Flat oysters

Research is being done to clarify whether wind farms are a suitable location for restoring the flat oyster reefs that have disappeared from the North Sea.

On a clear day, you can already see them from many places along the Dutch coast: wind turbines of more than 150 metres in height. They are also visible on a clear night, incidentally, thanks to their synchronized flashing red warning lights. Already now, one of these modern turbines has a capacity of more than 10 megawatts. And the ambition expressed by the energy ministers of the North Sea countries – excluding Britain – of reaching 150 gigawatts of power by 2050 would require nearly 15,000 large turbines in the North Sea, or somewhat fewer if the capacity per turbine increases further.

The potential impact of so many turbines on the North Sea is massive, and not just on the view from the beach. That is why the Dutch Ministry of Economic Affairs and Climate Policy launched the research programme WOZEP, the Wind at Sea Ecological Programme, in 2016. Wageningen Marine Research is one of the institutes carrying out the studies. Others include water and subsurface research institute Deltares and the Netherlands Organization for Applied Scientific Research TNO. 'The key question for this programme is which legally protected species could clash with the ambitions for the energy transition,' says Josien Steenbergen, Offshore Wind research coordinator at Wageningen Marine Research. 'This can refer to birds or bats that can literally collide with the turbines, but it can also be about effects on life below sea level.'

BIRDS AND BLADES

The most visible potential victims of wind farms are birds. 'But collisions between birds and blades are extremely difficult to establish at sea,' says marine ecologist Floor Soudijn of Wageningen Marine Research. 'You hardly ever witness the collisions themselves. On land, you sometimes find the victims still lying beneath the turbine, but at sea that's pretty much impossible too.'

Research into the effects of wind turbines on birds is therefore dependent on the analysis of radar images, tagged birds and theoretical models. Soudijn: 'A lot of work is going into the development of those models. They start with probability calculations that treat birds like random particles in the air, but then they have to be optimized with data on the actual behaviour of birds.'

The researchers are mapping the natural flight behaviour of birds using tagged lesser black-backed gulls. Soudijn: 'The flight altitudes and speeds we measure can be used in calculating collision probabilities. Because we don't have any data yet on tagged birds from colonies near wind farms, it remains to be seen how their flight behaviour changes when they approach turbines. But so far the evidence suggests that in the vast majority of cases these birds avoid the turbines and often in fact the wind farms in their entirety.'

STEERING CLEAR

The most specific information is obtained from field observations near the wind farms. 'Then we clearly see that many bird species keep out of the way of the turbines. Gannets in particular, but also guillemots, razorbills or the various divers: they all steer clear. This means they lose a bit of their usual habitat, but it would be hard to establish whether that means that the wind turbines also affect population sizes,' Soudijn said.

On the other hand, there are also species that don't seem very bothered by the turbines. 'For cormorants, for example, it seems to be no problem to sit on the structures in a wind farm. Maybe these new perches further out to sea even offer advantages when they are fishing,' suggests Soudijn.

Collisions

Collisions between birds or bats and blades are extremely hard to prove at sea. A combination of radar images, tagged birds and bats, and theoretical models should provide conclusive evidence.

Many bird species avoid the turbines: gannets in particular, but also guillemots, razorbills and several divers. Except cormorants, which like to sit on the structures in a wind farm to fish.

Sophie Brasseur of Wageningen Marine Research has been using adhesive transmitters to track seals in the North Sea and Wadden Sea for many years. At the behest of WOZEP, Brasseur and her colleagues have spent the past three years studying the behaviour of seals this way during the construction of the new Borssele wind farm, off the coast of Zeeland. 'When this farm was under construction, a bubble screen was used around the pile-driving,' Brasseur says. 'Danish research has shown that those bubbles in the water dampen the noise, particularly the higher tones. It is thought that porpoises, especially, suffer much less from the pile-driving as a result. But seals are sensitive to the low tones as well as the high ones. With our study we aimed to find out at what distance from the bubbles and at what volume seals are still bothered by the pile-driving'.

The results of the study were somewhat disappointing. 'By which we mean that we couldn't really draw clear conclusions, because for some reason seals seem to avoid this area with lots of wind farms anyway. And if there are no seals, it's hard to measure effects,' Brasseur said. 'At the same time, of course, this is an important pointer. There are already wind farms in our research area. So far, seal research has always been focused on the effects of construction, but we should also do research to find out whether animals stay away because of the existing parks. It is all very well to say that once wind farms are established, they will become a kind of reserve where no fishing boats are allowed and there is therefore more food for birds or marine mammals. But we have no evidence yet that seals will be attracted to that presumed extra food supply; in fact, the initial findings suggest the opposite.'

Because seals regularly come ashore, Brasseur and her colleagues can track population trends accurately. Of the 50,000 common seals counted on North Sea coasts, the majority, nearly 30,000, live in the international Wadden Sea. 'Precisely this population has not been growing for a decade. In fact, its numbers have declined significantly over the past two years. I would very much like to rule out the recent construction of wind farms, mainly in Germany and Denmark, as the cause of this decline.'

Besides birds, bats are sometimes hit by the blades of a wind turbine on their flight, or even by the air pressure waves around the blades. The corpses under wind turbines on land are a silent witness to this. But it can happen at sea too, argues Sander Lagerveld of Wageningen Marine Research. 'For example, it has long been known from ringed bats that Nathusius' pipistrelle bats migrate across the North Sea to Britain. We now have rather more high-tech ways of tracking the bats. The tiny 7-gram creatures – the weight of two sugar lumps – are fitted with transmitters weighing just 0.26 grams. Data from the transmitters is then collated using a network of 50 receiving stations along the Dutch coast and a few more in Belgium and in England.'

Lagerveld continues: 'We detected a crossing of the sea by 15 bats tagged by the Norwich Bat Group in England. This is telling us things about the timing of their migration over the sea and the weather conditions under which it takes place.'

The researchers also hung up 14 bat detectors at wind farms, on gas production platforms and on measuring islands in the sea. 'The first surprise we got from the sound recordings was that the bats certainly don't >

Food extraction

Research is ongoing to see if alternative forms of food extraction are feasible, such as fishing with static nets, seaweed farms or mussel farms.

always fly across the sea in one go. We sometimes record bat sounds at the end of the night and just after sunset. That can only mean that they have spent the day on the platform, or perhaps on a nearby wind turbine or boat.'

In autumn, when some pipistrelle bats migrate from mainland Europe to the British Isles, most of them can be identified. They mainly seem to venture across the sea when there's a moderate east wind, i.e. a tailwind. But some of them also migrate in crosswinds or even in headwinds of up to about five metres per second. Lagerveld does not rule out that bats will even migrate in stronger tailwinds. 'Only we don't pick them up on the detectors. I suspect that, like migratory birds, they fly at higher altitudes at such times. But we don't know whether that is then still within the range of the rotor blades. So it would be good to do more research to find out exactly how high the animals fly over the North Sea.'

At the wind farm near Borssele, measures have been taken to protect flying birds and bats. Lagerveld: 'Computer models use radar images to predict the peak in bird migration, and at that point the turbines can be shut down. The turbines are also stopped during the bat migration period when there's a light east wind, but at present that doesn't coincide precisely with the behaviour we are seeing. There is also a risk of collisions with bats in crosswinds and headwinds, and probably in strong tailwinds too. It is very important to know at what altitude the bats fly during different wind conditions. We need to research that better.'

NATURE CONSERVATION IS LAGGING BEHIND

The North Sea Foundation, an organization for the protection and sustainable exploitation of the North Sea, notes that a lot of information on the impact of wind farms on nature is still lacking, while construction is already in full swing. Agreements have been made on the construction of wind turbines up until 2030. These are enshrined in the North Sea Agreement between the state, the wind energy sector, some players in the fishing industry, and nature conservation organizations. 'But to fulfil the ambitions for 2050, additional measures to protect and strengthen nature must be agreed quickly,' says the foundation spokesman Gilles van Santvoort. 'The energy transition is bowling along, but nature protection is now lagging behind.'

As well as risks, however, the North Sea Foundation also sees opportunities. 'If we want to give nature additional opportunities when we build wind farms, by restoring oyster reefs for instance, we must do research on that too, alongside research on the possible threats to nature. Ecology must be included early in the roll-out of offshore wind farms. And we also need to speed up the creation of protected areas in the North Sea, where no wind farms should be allowed,' Van Santvoort says. 'By the end of 2023, according to the agreements, 13.7 per cent of the North Sea should be protected. Currently that is only 0.3 per cent!'

OPTIMIZING ROCKY BASES

Things that are positive for nature seem to happen underwater in wind farms too, says Oscar Bos of Wageningen Marine research. 'You put a hard substrate in a place where there used to be only sand. In pilot projects in the first wind farms, one of the things we are looking at is whether these are good

‘Wind farms create opportunities for additional ecosystems’

places to bring back the flat oyster reefs that have vanished from the North Sea. We are also looking at how to optimize the mix of rocks deposited at the base of the turbines as erosion protection, to create a reef where top predators such as cod can take refuge as well. So the wind farms also bring opportunities with them for additional ecosystems.’
Bos is not expecting very major ecological shifts, however. ‘At the locations where wind farms are planned, there is usually only sand at the moment. But there are many thousands of wrecks in the North Sea. So “artificial ecosystems” like the ones we will be adding already exist at various locations.’

APPLES AND ORANGES

Broadly speaking, some initial conclusions can already be drawn from the ecological research, but at least as many questions remain to be answered. ‘Actually, we are collecting a big bowl full of apples and oranges,’ concludes research coordinator Steenbergen. ‘Because how do you balance the interests of a gannet that has to avoid a wind farm against those of a flat oyster that might get new opportunities there? And even trickier: how do you balance the ecological risks against the sorely needed gains in renewable energy, and how do you balance that against the losses of fishermen, whose trawlers are not allowed into the growing number of wind farms? Research is ongoing into whether alternative forms of food harvesting are possible within the wind farms, for example using static gear (like gill nets, pots and longlines) instead of towed nets, or in the form of seaweed farms or mussel farms. Fortunately, these are all issues for politicians to decide on.’
‘What makes it a bit worrying,’ says Steenbergen, ‘is the fact that construction of the wind farms is already in full swing. Eight years can go by between the moment a wind farm is designated and when the last plug is connected. If we discover major ecological problems now, you can’t just say “we’re stopping” without costing the taxpayer vast sums of money. Needless to say, you don’t want your ecological research to be redundant because the processes in question are already under way.’

ADAPTIVE APPROACH

One thing at least is clear: there is no shortage of attention being paid to ecological research. The WOZEP programme, implemented by the Directorate-General for Public Works and Water Management on behalf of the Ministry of Economic Affairs and Climate Policy, will enter a second phase in 2024. And 2023 will also see the start of the Monitoring Research-Nature Enhancement-Species Protection programme, MONS for short. Steenbergen: ‘That programme will examine the ecological carrying capacity of the North Sea and the effects of the energy and food transitions on North Sea nature. MONS takes an adaptive approach. That means that the plans for wind parks should always be adaptable in light of the latest ecological insights.’
Steenbergen also points out that a recent tender for the construction of the Hollandse Kust (west) wind farm included an additional requirement. The government specifically asked for innovative ecological plans to be included in the project, thus handing some of the responsibility back to the operators. ‘And they might have some great ideas,’ she says. As an example, land-based wind turbines are already fitted with smart cameras that stop a turbine when the computer sees that a bald eagle is approaching. ‘We want to use such innovations at sea as well, to ensure that the ecological knowledge that’s gathered gets incorporated.’ ■

www.wur.eu/offshore-wind-energy

Pressure wave
The pressure waves from the rotating blades can damage bats’ organs, sometimes fatally.

‘The benefits go beyond clean water’

When Lieselotte Heederik and Guido van Hofwegen moved to Indonesia, they discovered how difficult it was to get clean drinking water. They started a shop selling water filters and now they produce them themselves in Indonesia and Kenya. ‘When someone buys a filter from us, it helps that person directly. That is *so* motivating.’

TEXT TANJA SPEEK **PHOTOGRAPHY** ALGI FEBRI SUGITA

Lieselotte Heederik shares her story from the back seat of a moving minibus in Kenya. Her husband Guido van Hofwegen chips in from their home in Bandung in Java, Indonesia. In the background chanting can be heard: evening prayers in a mosque in Bandung. Beside the dining table stands a water filter.
It’s one of their own, produced by their company Nazava.
The filter consists of two light blue 16-litre containers, one on top of the other, connected by a hole and with a tap at the bottom. The hole holds the ceramic filter element, a long white oval component the size of a hand. ‘The dirty water goes in at the top, and flows through the filter into the bottom container,’ explains Guido.
They got the idea for the water filters soon after moving to Indonesia. After studying Rural Development in Wageningen, Lieselotte got a job with the Dutch NGO Hivos in Aceh, Indonesia. The Aceh region had been hard hit by the tsunami in 2004, and she came there to help with the reconstruction. Guido, who had just graduated in Tropical Land Use, went along as her newly-wed husband. ‘If we got married, Lieselotte got 300 euros extra pay to support me. So we tied the knot before we left.’ >


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PHOTO NAVAZA

PHOTO NAVAZA

Nazava sells water filters in Indonesië en Kenia.

And you set about getting hold of a supply of clean drinking water?

Lieselotte: 'For ourselves yes; that wasn't part of my job. We had a well which we could get our drinking water from, but the water was brown. Boiling was not enough to make it drinkable. So we bought bottled water from a shop, but that proved to be unsafe too. There was a report in the newspaper about bacterial contamination nearly every week. That water is usually filtered and sold by small companies that often don't maintain their filter systems properly. And there is no quality control by the government.'

Guido: 'In Brazil I had seen how everyone has a water filter at home. You can just buy them in the supermarket there. So I ordered a few filters from Brazil. Our neighbours and colleagues proved to be interested too: there was a need. We used our own money to buy enough filters in Brazil to open a small shop. At the time, I had a part-time job with Royal Haskoning, an international consultancy and engineering firm, and I started selling the filters on the side.'

> **'We got investors supporting us – super cool'**

And you built that up into the current company?

'It was a bit of a quest to start with,' Lieselotte says. 'After three years in Indonesia, we decided to go back to the Netherlands for a while. I was pregnant with our daughter and wanted to give birth in the Netherlands.' Guido: 'It felt like a crossroads. Were we going to carry on with this? Would I want to do a PhD, maybe?' Lieselotte: 'We decided to enter an international pitch competition to find investors for products that benefit society. I can still see myself standing there, with my big belly. We were successful and we got investors supporting us. That's super cool, of course, and it was a turning point for us.' But the investors did want them to live in Indonesia and run the company from there, says Guido. 'And rightly so, of course. So we left for Bandung, Java, with our daughter, and we are still living there now. It's a more central location in Indonesia.'

They now produce the filters in Indonesia. The white outer part is ceramic, a porous material with small holes that water can pass through, but dirt and most bacteria cannot. A layer of nanosilver on the inside kills any remaining bacteria. A carbon core filters pollutants out of the water. 'It was never our goal to become a tech company,' says Guido. 'Every few months we read about a new water filtration innovation that never ends up being marketed. We mostly focus on sales. We started producing the filters ourselves because we thought the existing suppliers were too expensive or not good enough. The World Health Organization (WHO) has approved our filters, which remove more than 99.9 per cent of bacteria and last for three years. The whole system costs about 30 euros, and replacement filters cost eight euros.'

The filters are intended for domestic use, Lieselotte explains. 'A lot of clean drinking water projects run by aid organizations focus on large water companies. When someone buys a filter from us, it helps that person directly. That is *so* motivating.' The couple don't encounter much competition. 'Other companies produce for NGOs or are from the outdoor industry. We started selling directly to our customers, which makes us a better fit with the market,' explains Guido. Thirteen years on, they have sold more than 200,000 water filters, and are running a company with 25 employees in Indonesia and 15 in Kenya.

Checking our cash flow to see how it's going makes it very tangible'

What did you learn in Wageningen that still benefits you today?

Lieselotte: 'A degree course has academic goals, of course, and entrepreneurship hardly came into it at all. We had to learn that on the side. I learned the most from my time at the Wageningen branch of the students' union, thinking up and implementing campaigns.'

Guido: 'We were on the union board at the same time. After one month, we organized a demonstration in The Hague. With the slogan "Education is being stripped", we played football in our underwear in the courtyard of the Binnenhof (government buildings in The Hague, ed.) The police were there in no time. That made for a great photo in the papers: us in our underwear, the policemen in uniform. We got together two months after that campaign.'

During an internship in Bolivia, he learned to give priority to things that help people really effectively, says Guido. 'The project I was working for was trying to encourage Bolivian farmers to take better care of their land. What did it take to get them to do that? As it turned out, those farmers' first priority was a well. They were travelling four hours a day to fetch water. There was absolutely no time left for other matters. Our filters help save time too. Users don't have to boil the water or gather firewood for a fire. The benefits go beyond clean water.'

Lieselotte: 'I see the reality of things I learnt about gender during my degree programme. Women are often hit harder by poverty. And it is usually women who provide drinking water, so they're the ones who save time.'

Guido: 'Although we are big in our market for domestic water filters, there are 40 million households in Indonesia that could benefit from our filters. So there is still plenty to do.'

Why are you expanding to Kenya when there is still so much to do in Indonesia?

Lieselotte: 'I took part in an international programme for entrepreneurs with a social mission, and there were a lot of Kenyan companies participating in it. Outside the city, everyone there lives off-grid. People have no access to electricity or gas, but they often have good facilities like solar-powered lamps and efficient cookstoves. So the sales channels for these products are already there. And the beauty of it for us is that all those people could do with a water filter as well. I could see that the Kenyan government and local officials are committed to helping a company like ours. So I thought, let's take the plunge.'

And now you are also supplying filters for emergency relief in Ukraine.

Guido: 'Yes, shortly after Russia invaded this year, we got a request from UNICEF to supply 10,000 water filters. And there is a crowdfunding campaign for even more filters for Ukraine. It is run by Kees Huizinga and Emmeke Vierhout (also alumni) and supported by WUR. We have decided to organize the sourcing of the water containers and the setting up of the whole thing in Ukraine ourselves. That way we can offer work to Ukrainians who have fled the war within their own country.'

Lieselotte: 'It feels heartening that as alumni, we are supported in this by WUR.'

Are you living your dream?

Lieselotte: 'Yes, absolutely. Every day, we work towards what we want to achieve. It also feels good that our sales figures tell us straightaway whether we are doing well. If there are no sales, we must be going about something the wrong way. I feel we are achieving more now, in practical terms, than we would by writing reports. Checking our cash flow to see how it's going makes it very tangible.' ■

LIESELOTTE HEEDERIK

1997-2004 Rural Development Studies, WUR
2006 Master's in Development Studies, Radboud University, Nijmegen
2007-2010 Hivos in Aceh, Indonesia
2009 Co-founder of Nazava water filters, director of Kenyan branch

GUIDO VAN HOFWEGEN

1999-2006 Tropical Land Use, WUR
2004 Co-founder of Resilience BV
2008 Royal Haskoning, Indonesia
2009 Co-founder of Nazava water filters, director of Indonesian branch

Support for Wageningen talent

University Fund Wageningen seeks to support talented people involved in Wageningen education and research. Three high-potential students or graduates talk about what one of the University Fund's named funds has meant to them.

'Studying in Wageningen has opened up new avenues'

Monica Agaba from Uganda obtained her Master's degree in Nutrition and Health from WUR, thanks to a scholarship from the Anne van den Ban Fund. This fund enables promising students from developing countries to study at Wageningen University & Research so that they can then contribute to the sustainable development of their country.
Agaba: 'This was such a great opportunity for me to gain more knowledge and develop professionally.' When she finished her Master's thesis, her supervisor encouraged her to write an academic article based on the thesis. 'That took a lot of time but it has paid off and now the article has been accepted for publication in the *Journal of Nutritional Sciences*. I am so proud of that. The opportunity to study at WUR has opened up new avenues for me.'
Agaba is back in her home country now, and working in the Family Life and Consumer Studies department at Kyambogo University, in Kampala. 'We are developing a proposal that looks at the current health-beauty paradox in Uganda, where overweight and obesity in women of reproductive age are seen as beautiful and as evidence of health and wealth. It is a multidisciplinary study which combines Nutrition Sciences with Behavioural Sciences.'
'I believe there is still so much we in Uganda can invest in when it comes to research. Hopefully I can make a serious contribution to our health.'

Monicah Agaba

UNIVERSITY FUND WAGENINGEN

University Fund Wageningen enables activities for students and researchers at Wageningen University & Research that cannot be financed through other channels. The fund supports talented individuals, facilitates groundbreaking research and boosts the impact of Wageningen expertise by stimulating entrepreneurship. All this is made possible by the support of thousands of donors and philanthropic contacts through, for example, annual donations, legacies or the establishment of a named fund.

‘I have gained new insights and contacts’

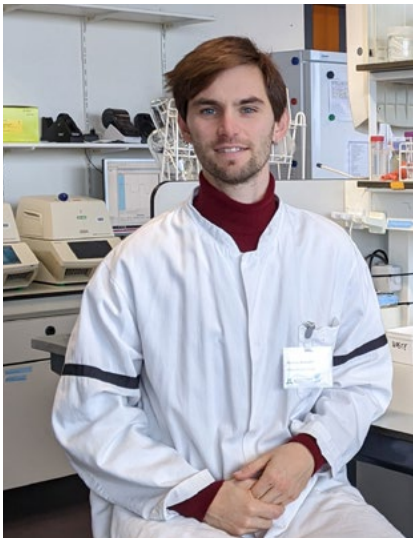
Niccolò Bassetti, a PhD student in the Biosystematics Group, received a grant from the Huub and Julienne Spiertz Fund (HJS). This fund invests in young agrobiologists and crop scientists to promote research, with a particular focus on sustainable food production. To this end, the fund offers an annual stipend of up to 1500 euros to be spent on an international study tour or attendance at a conference.

Thanks to the grant, Bassetti was able to go to the 2019 Congress of the International Society for Molecular Plant-Microbe Interactions in Glasgow. ‘This is one of the biggest conferences in this field. Thousands of people attend, including many top scientists.’

It would have been difficult for him to attend without the grant. ‘You do have funding as a PhD student, but conferences are extremely expensive.’

For him the conference was a great opportunity for discussions with other researchers. ‘My research focuses on interaction between plants and insect eggs. Which is in some ways similar to the interaction between plants and microbes. And the only other lab in the world that is working on the same topic was at the conference.’

He also got the chance to draw attention to his research and to look around at other research related to his field. ‘I gained new insights into the issues and which techniques you can use. I also did some networking that could lead to new collaborations outside my national network.’



Niccolò Bassetti

‘The recognition I got has helped me’

‘I started at university in 2016 and was also training fulltime at the top sport centre Papendal,’ says Emma Oosterwegel, student of Soil, Water, Atmosphere and a heptathlete. It proved difficult to combine student life with elite sport. ‘I had injury trouble and my university results suffered. That was a wake-up call for me to take things a bit easier so that I had time to train and to go to the physio.’

Oosterwegel submitted an application to the Fund Niels Smith, which offers one talented young top sportsperson per year a ‘helping hand’ in combining their passion with their studies. In 2019, she received a grant worth 1500 euros. ‘It helped me enormously. As a novice top athlete, you haven’t had many “real” successes yet, which makes it hard to find sponsors. And yet elite sport isn’t cheap, especially on a student budget. I take expensive supplements, for example, and extra protein to support my training.’

The grant not only gave Oosterwegel a financial boost. ‘It was also tremendously motivating, because people believed in me even though I hadn’t had any major successes yet.’ She has certainly had such successes since then. In 2019 she came seventh in the athletics World Cup in Qatar, and in 2021 she got the bronze medal in the heptathlon at the Olympic Games. ‘I’m really proud of that! The recognition that I got and the fact that people believed in me have helped me get where I am now.’ ■

www.universityfundwageningen.eu/namedfunds

PHOTO ANP

Emma Oosterwegel

WAGENINGEN EXPERIENCE DAY

A glimpse behind the scenes at Wageningen





PHOTO'S GUY ACKERMANS

On 8 October, over 800 alumni from the Netherlands and abroad explored the campus during the second Wageningen Experience Day, participating both online and in person.

Alumni got a glimpse of Wageningen's research by visiting various campus buildings, whether in person or virtually. They also engaged in discussions with one another and experts, and joined various talk shows that were streamed live for online visitors.

As of two years ago, the Wageningen Experience Day has become the main annual alumni event. Last year the event was held online because of the coronavirus pandemic; this year it was a hybrid event. Around 250 alumni came to Wageningen while the online campus attracted 400 participants.

Corrie Roeper, Tropical Soil Science 1980, found it a lively and sociable day. 'Even if the sound system didn't always function properly.' Roeper attended a session on how to measure food intake. 'It was about how to measure someone's eating experience so as to get a better understanding of why people eat something, and how much. It was interesting to see so many new techniques being developed, and it was fun to get a glimpse behind the scenes of the research.'

Douwe Ybema, Environmental Sciences 1995, attended a talk show on campus in which alumnus Emmeke Vierhout talked about the situation on the farm she and her husband run in Ukraine and their project to import 10,000 water filters. 'It was interesting. I noticed however that the stories and information were mainly aimed at online viewers. That made it somewhat tricky to follow for the audience on campus. I was also interested to learn more about current developments and issues at WUR, and the university's plans for the future. I got a partial answer to those questions, mainly by talking to people. I'd expected to see more people I knew, but even so, I had a good time.'

The next Wageningen Experience Day is provisionally scheduled for 7 October 2023.

For photos and videos of the day: www.wur.nl/wed and wur.eu/wed

NETWORKS

Northern Netherlands alumni pay a visit to the Afsluitdijk

On 8 September, Wageningen alumni visited the Afsluitdijk, where alumnus Meinard Bos gave them a guided tour of the fish migration river. This project is about connecting up the Wadden Sea and IJsselmeer again to enable fish to swim in a gradual transition from salt water to fresh water.

Erwin Winter, a researcher at Wageningen Marine Research – Environmental Hygiene (water purification) 1994 – gave a presentation about the scientific research on fish migration. The networking event was organized by the Wageningen North Alumni Group.

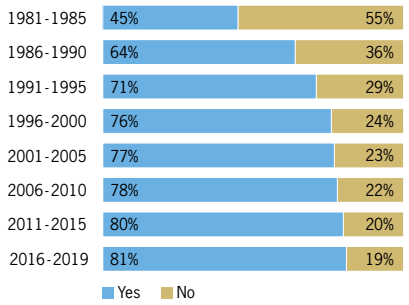
wur.eu/alumni-events

LABOUR MARKET

Alumni don't stop developing

Lifelong learning is popular with Wageningen alumni. Graduation does not signal the end of their development, as is clear from the five-yearly career monitor.

At the end of March 2022, over 31,000 WUR alumni (who graduated or obtained their doctorate after 1980) received the Wageningen careers questionnaire. Just under a third filled it in. Questions about 'lifelong learning' and 'professional development' formed a new element this time.



Courses or training taken in the last three years for professional development.

The survey showed that nearly all alumni (98 per cent) continue learning after graduation. About three quarters of the alumni have followed courses or training for their professional development in the past three years. The job opportunities are good: 86 per cent of the alumni had a paid job for more than 12 hours a week. In the previous monitor, the figure was 84 per cent. At the start of 2022, just 1 per cent of the alumni were involuntarily unemployed, compared with 3 per cent five years ago. On average it takes alumni four to five months to find paid work after graduation, about the same as five years ago. Recent graduates who are self-employed or freelancers earn slightly less than salaried alumni (€31,500 versus €40,000) but they make up for that later. After 25 years of experience, their gross annual salary is €95,000 compared to €80,000 for employees.

MEETING

Alumni meet up in Rome

In October, the president of WUR's Executive Board Sjoukje Heimovaara and a Wageningen delegation took part in the Science & Innovation Forum of the FAO, the United Nations Food and Agriculture Organization. An alumni meet-up was also organized to mark the Wageningen visit.

Some 35 alumni of various nationalities attended, most of them employed by the FAO in Rome. 'I found it great as a 25-year-old to talk to alumni who have been working for the FAO for more than 25 years,' says Sander Verhulst, a Master's student of International Development Studies at WUR and an intern at the Dutch Permanent Representation to the UN institutions in Rome. 'I found swapping experiences very valuable'.
WUR and the FAO have worked together for a long time. 'With concrete collaborations such as this one, FAO and WUR are promoting effective science communication, sharing science- and evidence-based knowledge that has the power to accelerate the transformation of our agri-food systems,' said FAO's Chief Scientist Ismahane Elouafi.

CONNECT!

'Stay connected'

All Wageningen alumni are welcome to tap into the network of alumni platform WUR Connect. Create an account and search by degree programme or name, for example. Yodit Kebed: 'I lived in Wageningen for over 10 years and should have joined ages ago! There are so many alumni in Ethiopia... join too and stay connected!'
www.wurconnect.nl

Soil Network Day

On 13 April 2023, the Dutch Soil Association will be running a symposium called *Bodem Breed* (Soil, broadly), together with the Municipality of Arnhem and the Province of Gelderland. A networking event for everyone who has anything to do with soil.
Register via
bodembreedsymposium.nl

Job market for alumni?

In November, an online questionnaire was sent to recent WUR MSc graduates about their degree programme's fit with the labour market.
The results help the university to improve the Master's programmes and provide information for young people choosing their degree programmes on the job prospects.
www.nationale-alumni-enquete.nl/achtergrond/

Why a Wageninger?

In 2022, dozens of alumni and students shared a video in which they answered the question, 'Why are you a Wageninger?'. This upbeat and inspiring compilation is now on YouTube. Three of the testimonials will feature in the new graduation ceremonies.
youtu.be/6Z4G1F8Tezs

Jouke Dykstra PhD, WUR Environmental Sciences 2013, received a Veni grant worth 280,000 euros from the Dutch Research Council (NWO). He will use the money to study the removal of low concentrations of toxic substances that remain after conventional treatment of drinking water. 11 April 2022.

Jeroen Dijsselbloem MSc, WUR Economics of Agriculture and the Environment 1991, chair of the WUR Supervisory Board and former Finance Minister, has been appointed mayor of Eindhoven. 13 September 2022.

Jan Andries van Franeker PhD, researcher at Wageningen Marine Research, received the royal honour Knight of the Order of the Netherlands Lion on his departure. 30 September 2022.

Prof. Hinke Haisma, WUR Human Nutrition 1992, has been appointed professor of Child Nutrition and Population Health at the University of Groningen. 28 October 2022.

Lieselotte Heederik, WU Rural Development Studies 2004, and Guido van Hofwegen, WU Tropical Land Use 2006, won the Bayer Social Innovation Award worth 35,000 euros for their home use water filters, produced by their company Nazava (see also page 40). 14 November 2022.

Prof. Bert Holtslag, WUR PhD 1987 and emeritus professor of Meteorology, received the Langerhuizen Oeuvre prize for the field of Earth & Environmental Sciences. The prize of 25,000 euros is awarded annually to a scientist working in the natural sciences. 15 September 2022.

Prof. Hans Mommaas, WUR Rural Sociology of the Western Regions 1982, is the new chair of the Environmental Impact Assessment committee. He stepped down as director of the Netherlands Environmental Assessment Agency after seven years. 1 November 2022.

Erik Poelman PhD, WUR Biology 2003, has been appointed professor holding a personal chair in the Entomology chair group at Wageningen. Poelman has done much acclaimed research on the defence strategies of plants that are attacked by insects. 1 September 2022.

PHOTO PROVINCE OF OVERIJSSEL

Johan Osinga MSc,
Johan Osinga MSc, WUR Land Development 1988, has been appointed director-general in charge of coordinating the transition of rural areas, at the Ministry of Agriculture, Nature and Food Quality. 1 October 2022.

Ellen van Selm MSc, WUR Rural Sociology 1988, has been appointed mayor of Purmerend. She was previously mayor of Opsterland. 22 September 2022.

Laan van Staalduinen MSc, WUR Economics of Agriculture and the Environment 1992, former managing director of the Social Sciences Group of WUR, has been appointed executive director of Milieudefensie (Friends of the Earth Netherlands) together with Donald Pols. 1 October 2022.

Inez Trouwborst MSc, WUR Nutrition and Health 2017, received the Foppe ten Hoor Prize for her presentation at the Nutritional Science Days. 6 October 2022.

Martin Scholten PhD, former managing director of the Animal Sciences Group at WUR, has been appointed Honorary Fellow of Scotland's Rural College (SRUC) in recognition of the role he played in international collaboration on research. 29 August 2022.

Prof. Patrick Verkooijen, WUR PhD 2010, received an honorary doctorate from the University of Nairobi in Kenya for his achievements in advocating global action on the climate. 23 September 2022.

Rubicon grant

Two Wageningen alumni have been honoured with a Rubicon grant from NWO. The Rubicon programme gives promising young scientists the opportunity to gain research experience abroad. **Inge Bos PhD,** WUR Molecular Life Sciences 2017, will do research in France on the role of the nucleus in cell migration. This can help get a better understanding of the spread of cancer cells. **Mihris Naduthodi PhD,** WUR Biotechnology 2017, will spend two years at the University of York. He does research on photosynthesis. 26 July 2022.

A second PhD

Prof. Anton Haverkort, WUR Agricultural Plant Breeding 1978, obtained a PhD at Wageningen in September for his thesis on processing potatoes. He got his first PhD in 1985 at the University of Reading in the UK. A successful career in the world of the potato followed. That career ended on 9 December 2016, the day he became 65. 'I always said I would stop working when I reached 65.' But stopping turned out to be a relative concept. Haverkort worked on the Aardappelhandboek (potato handbook), a 600-page reference work on the potato that was published in 2018. The book has been published in English, Dutch and French, and is being translated into Spanish. And it earned him his second PhD.

PHOTO GUY ACKERMANS

Rowing across the Atlantic Ocean

Ilja Kok, MSc WUR Leisure, Tourism and Environment 2011, will be crossing the Atlantic Ocean in a rowing boat in December. A team of four rowers will attempt the journey of nearly 5000 kilometres. From La Gomera in the Canary Islands to Antigua in the Carabbean. They will be competing with 42 other boats in the Talisker Whisky Atlantic Challenge. The team hopes to raise donations for the Ocean Cleanup.

PHOTO RAOUL CARTENS

PHOTO GUY ACKERMANS

Teacher of the year

Birgit Boogaard PhD, WUR Zootechnics 2003, won Wageningen's 2022 Teacher of the Year election. Boogaard teaches Knowledge Technology & Innovation at WUR. 'This prize is important recognition for the incorporation of African perspectives in teaching at Wageningen University,' said Boogaard in her thank-you speech, referring to her two main courses: African Philosophy and Social Justice Technology & Development.

Sexy Farmers' Calendar

The 2023 Farmers' Calendar, with a hot photo of a farmer for each month, was published in October. Two of the models are WUR students **Fabian van Grevenbroek** (25) and **Rick Baats** (31). Van Grevenbroek (pictured here) grew up in Leiderdorp on his parents' dairy farm. After he completes his degree in Biosystems Engineering, he wants to work in agriculture. Baats studies Management, Economics and Consumer Studies. He is not from a farming family but he regularly works on farms.

PHOTO AGNE KUCEVICIUTE

IN MEMORIAM

Alumni and current and former employees of Wageningen University & Research who have recently passed away.

Mr J.C. Arends PhD, WUR Horticulture 1969. 13 April 2022.
Mr H.A. Boekholt PhD, WUR Zootechnics 1968. 28 September 2022.
Mr J. Doeksen MSc, WUR Agrarian Economics 1977. 25 June 2022.
Mr E.J. van den Ent MSc, WUR Forestry 1960. 11 October 2022.
Mr M.A.G. ter Huurne MSc, WUR Zootechnics 1977. 14 June 2022.
Mr M.K. Joustra PhD, WUR Horticulture 1963. 10 July 2022.
Ms E.M.J. Maase-Gerard MSc, WUR Phytopathology 1966. 10 July 2022.
Mr A.J.M. Miltenburg PhD, WUR Rural Economics 1968. 30 October 2022.
Mr A.W. Mol MSc, WUR Rural Economics 1972. 25 August 2022.
Mr G.J. van Norel MSc, WUR Zootechnics 1961. 12 October 2022.
Prof. R.A.A. Oldeman, WUR Forestry 1964. 3 September 2022.
Mr M.P.A. van Ooteghem MSc, WUR Economics of Agriculture & the Environment 2001. 8 April 2022.
Ms M. Pieters-de Roon MSc, WUR Zootechnics 1954. 28 April 2022.
Mr H.W. Ploeger PhD, WUR Zootechnics 1986. 8 October 2022.
Mr B.C. van der Pol MSc, WUR Phytopathology 1975. 12 September 2022.
Mr C.W.M. de Ranitz MSc, WUR Rural Sociology of the Non-Western Regions 1972. 20 July 2022.
Mr D.A. Rijks PhD, WUR Tropical Land Development 1959. 29 September 2022.
Mr J.R. Terbijhe MSc, WUR Tropical Land Development 1960. 21 August 2022.
Ms P.W. van Vliet PhD, WUR Human Nutrition 1979. 30 December 2021.
Mr N. Zwiep MSc, WUR Tropical Animal Husbandry 1950. 14 July 2022.

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, Wageningen University & Research, Droevendaalsesteeg 4, 6708 PB Wageningen,The Netherlands

BOOKS BY ALUMNI

The new planter

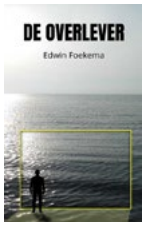
Jos Schouwenaars, WUR Land Development 1978, wrote a novel about dreams and trees, and families and their land. The main character moves to the Vosges with his mother and sister, where he develops a love of forests. He wants to combat climate change by planting woods. Back in the Netherlands, he continues to implement his plans fearlessly, despite resistance from his own family. Schouwenaar's Wageningen background is clearly evident in his story.

Elikser BV, 17.50 euros

The secret of the Veluwe battalion

Regien Stomphorst PhD, WUR PhD Molecular Physics 2001, describes the colonial exploitation that her ancestors played a role in. Her novel is not a scientific search for the truth; rather she creates a world in which fact is blended with fiction. When the main character Jolien delves into her uncle's past in the colonial war, she makes a painful discovery.

Gopher, 20.00 euros



The survivor

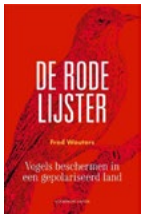
Edwin Foekema, WUR PhD Ecotoxicology 2013, has written a book that was inspired by the fascination he developed for the Greenland shark during his PhD research. This shark is a metres-long fish that lives deep down in the polar waters. It has recently been shown to be able to live to over 400 years, making it the longest-lived creature on Earth. In this story, a biologist faces the question of how much responsibility he bears for the life of people and animals around him. Do you, for example, continue to be responsible for a life you have saved?

Brave New Books, 19.50 euros

Inspired work

In addition to your personality you also have a soul, says **Peter Gerrickens,** WUR Farming Technology 1983, in his latest book. You feel a strong inner motivation for certain things, which he terms your 'inspiration themes'. Gerrickens uses a wide range of examples from daily practice to illustrate the process of searching for renewed inspiration and meaning.

Gerrickens Training & Advies, 27.95 euros



The red thrush

The decline in biodiversity is the subject of debate in talk shows and newspaper articles. But should every species of bird be protected? At all costs? In this essay, **Fred Wouters,** WUR Forestry 1981 and former director of the Netherlands Society for the Protection of Birds, looks for answers to these questions and similar complex and sensitive issues. He does this by examining examples from his period as director. Wouters analyses the problems studies political decisions and the latest scientific findings, and talks to a lot of people who are involved in them. The actions of the Society come under scrutiny as well.

Noordboek, 17.90 euros

Albatross eats spiky fish

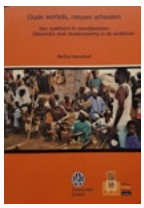
Nynke de Jong, WUR Human Nutrition 1994, wrote a children's book about the plastic in the sea. Albatross Aaltje is the main character. Every now and then, she eats a fish that spikes her stomach. The story is based on the documentary *Albatross* from 2017.

BoekScout, 15.50 euros

Too true to be good

A duel at an altitude of 8000 metres in the Himalayas, murder and manslaughter on Spitsbergen as seen by a polar bear, ring-necked parakeets as undesirable aliens in Amsterdam's Vondelpark, Venice drowning, palaces and all – or not quite, after all? Frank Westerman, WUR Tropical Land Development 1989, takes the reader on a journey through the territory of the improbable in 14 unbelievable but true stories.

Singel, 20.00 euros (e-book 13.99 euros)



Old roots, new shoots

Bertus Haverkorts book *Oude wortels, nieuwe scheuten* is an account of his personal journey in the world of international development cooperation, with a focus on dilemmas around the modernization of agriculture. Haverkort (Western Agrarian Sociology, 1973) worked in Colombia, India, Bolivia and Ghana in programmes that sought to pass on Western knowledge. He gradually began to question the relevance of Western knowledge in contexts where the ecology, economy and culture are so different.

African Studies Centre Leiden, webshop, 17.50 euros

'My professional football career lasted 12 years'

Arco Jochemsen, maths teacher and former professional footballer

Food Technology, 1995

'I started playing football at the age of six. I was good at it, but I never wanted to become a professional footballer; I thought that was too risky. So I went to university. I was interested in nutrition and I wanted a broad degree programme, so I went for Food Technology. Towards the end of my studies, I was offered an internship with the professional football club NAC. I didn't do it because I thought it was important to finish my degree first. At the end of the season, I joined the Dutch Universities team and we played against Vitesse from Arnhem. I was then allowed to join the A team of that club and that year I combined football with my graduation project.

My professional football career lasted 12 years, during which time I played for Vitesse, Feyenoord, FC Utrecht, FC Twente and FC Zwolle. At some point you realize you're getting older and it's time for something else. I stopped at 35, but stayed involved as a youth coach. I looked for a flexible job that I could combine with that, so I became a maths teacher.
As you get older, you start to get a bit creaky, physically, and that does make it less fun. In recent years, I have been cycling and walking a lot. I still teach maths, but I'm no longer involved in the football world.'

PHOTO APA PHOTO

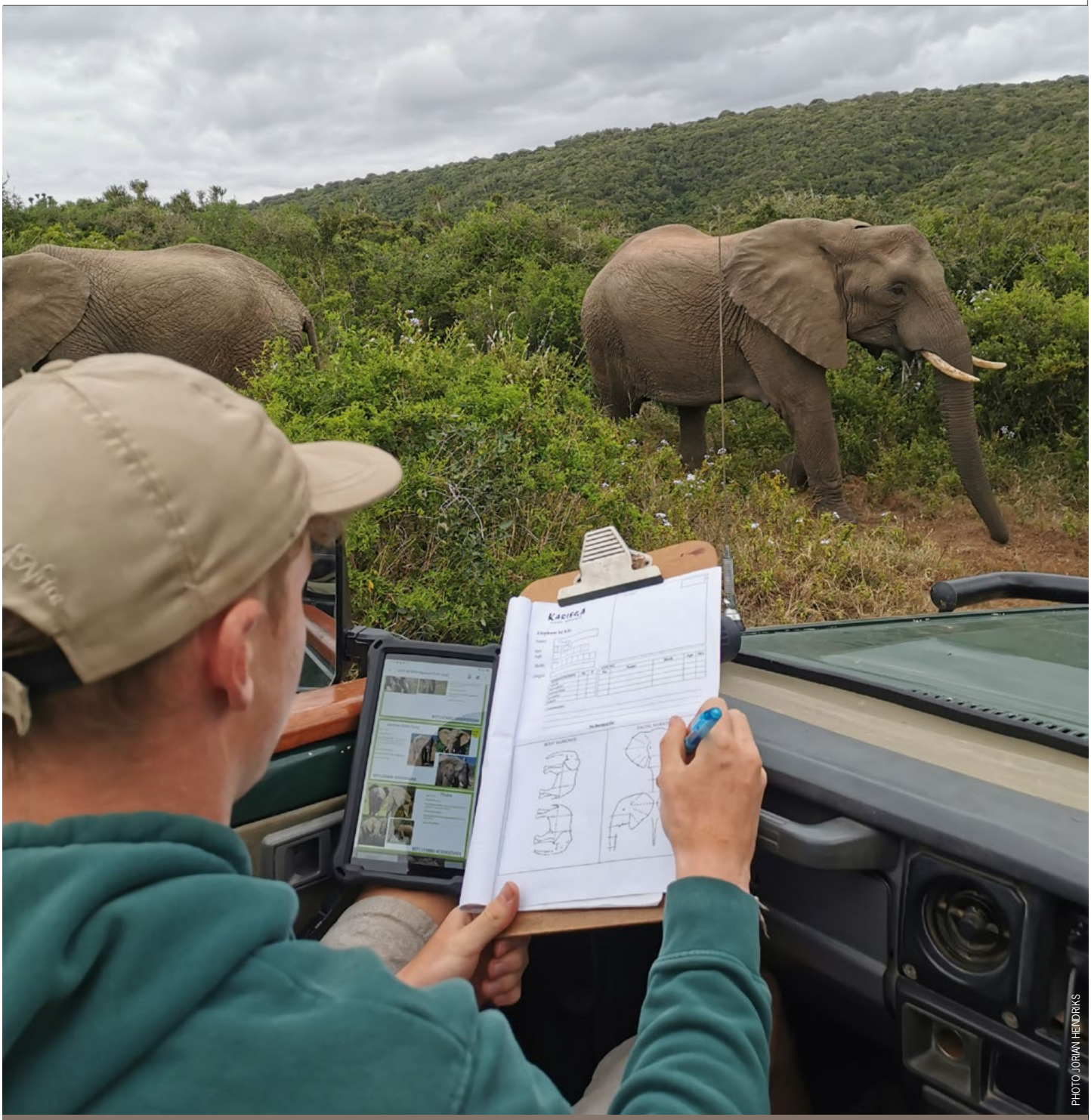


PHOTO JORIAN HENDRIKS

Identifying elephants in South Africa

'The number of African savanna elephants in nature reserves in South Africa is increasing,' says Master's student of Forest and Nature Conservation Jorian Hendriks. 'There is only limited space there and elephants have a big impact on vegetation.' To keep the number of elephants per hectare within viable limits, park managers need data on individual animals, explains Hendriks. 'They want to know which females to give contraception to, for example.'

Hendriks worked on creating an identification system in Kariega Game Reserve, with lecturer Ignas Heitkonig as his supervisor, and in collaboration with the elephant conservation organization Bring the Elephant Home. Research methods that use drones or helicopters are inadequate for identifying individual elephants, says Hendriks. You need to go into the bush and look. Hendriks: 'We mapped individual elephants with codes: numbers representing different characteristics of an elephant, such as sex and age. And injuries too, because they help you assess the elephant's position on the social ladder. That's important too. For instance, one elephant got injured in a fight with an intruder from a different territory. Should you try to save it?' 'Thanks to our research, we knew that this elephant was the intended successor to the current leader, the bull, so it did undergo surgery.'

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