WAGENINGEN WORLD
MAGAZINE OF WAGENINGEN UNIVERSITY & RESEARCH ABOUT CONTRIBUTING TO THE QUALITY OF LIFE no.3 2019

Tropical viral diseases are on the rise worldwide

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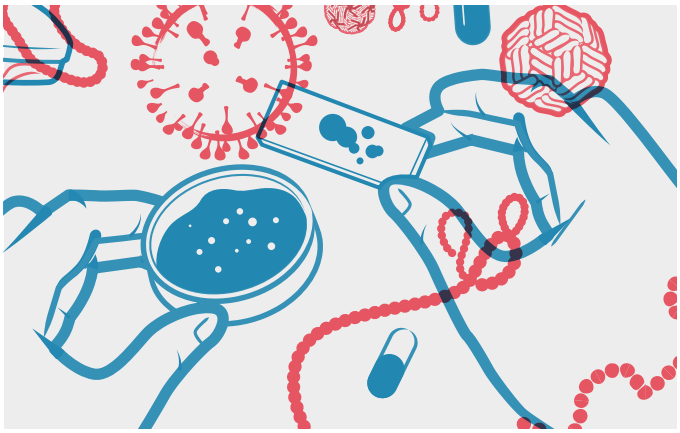
Where next with CRISPR-Cas?
An open exchange on CRISPR-Cas took place at CRISPRcon conference

The promise of fermentation
The future holds new chemicals, tempeh and biofuels in store

Forest research underground
Global soil data can predict how forest types shift to new zones



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PREPARING FOR VIRUS X

Tropical viral diseases are on the rise worldwide. Virologists are researching ways of preventing new outbreaks and epidemics. ‘There is no doubt at all that a new virus will turn up somewhere some time.’

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WHERE NEXT WITH CRISPR-CAS?

The introduction of CRISPR-Cas and related technology was discussed at the international conference CRISPRcon in Wageningen at the end of June. How do you enable the general public to arrive at an informed assessment of its uses?

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FERMENTATION’S GREAT PROMISE

Much of our food is the product of fermentation: it has already been digested by bacteria or fungi. But these micro-organisms can do a lot more than that. Researchers are working on new tempeh, chemicals and biofuel.

WAGENINGEN UNIVERSITY & RESEARCH

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The mission of Wageningen University and Research is ‘To explore the potential of nature to improve the quality of life’. Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 5,000 employees and 10,000 students, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.

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PHOTO SVEN MENSCHEL

Science or religion?

'The position of the university as a haven of free thinking is under pressure. Universities increasingly follow societal trends and try to adapt to them, rather than forming society.
This is partly the result of a development that started decades ago, whereby the quality of research is measured by the number of citations it gets in academic journals. There is nothing wrong with that in itself, but it does have a disadvantage. If you want to get a lot of citations, you are best off doing research in a well-established scientific field. So this way of measuring research quality leads to conformism.
Science nowadays is also expected to work towards society's aspirations, to allay its fears, and to provide watertight answers to all its questions and problems. This has lent a religious dimension to science, complete with a classic drawback: the blurring of the line between content and ethics.
In discussions of subjects such as food consumption, climate change or gender diversity, moral arguments count as well as rational ones. It is not problematic for scientists to propose that meat consumption should be drastically reduced in order to curb climate change. But it is a different matter if they suggest limiting the number of children per family. That is harder to sell from an ethical point of view.
It is legitimate for there to be moral barriers. But it is important that scientists specify the moral compass or ethical framework used in their argumentation. The science should be clearly distinguished from the ethics. Finally: all academics should ask themselves whether there are research fields they would rather have studied. And whether they have not done so because they generate less funding and encounter more scepticism or problems at research institutes. If that is the case, they are contributing, if only a little, to the demolition of the university as a haven of free thinking.'

Rik Torfs, professor of Canon Law and former rector at the Catholic University of Leuven. Torfs spoke at the opening of the academic year in Wageningen.

ROBOTICS

PHOTO AGROBOFOOD

16 million for European robotics project

Wageningen is heading the new EU project agROBOfood, which will explore how robots can help improve the productivity, efficiency and competitiveness of the European agri-food sector. The project has a budget of 16 million euros. Janneke de Kramer, Agro Food Robotics programme manager at WUR, is coordinating it.

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MICROBIOLOGY

Hopeful results with slimming bacterium

Nutritional supplements with the so-called 'slimming bacterium' have been tested on people. The initial results are promising.

Willem de Vos, professor of Microbiology at Wageningen, discovered the gut bacterium *Akkermansia* in 2004. He found that it combated overweight in mice. Now De Vos and his colleagues at the Catholic University of Louvain have run the first tests on people. The trial involved 32 volunteers with an increased risk of cardiovascular diseases and type 2 diabetes, for example due to obesity. It turned out that the bacterium could be administered safely. The risk of cardiovascular disease also seemed to increase less. 'That doesn't mean the bacterium cures cardiovascular diseases but it may reduce the risk of those diseases developing,' says De Vos. The results were published in the scientific journal *Nature Medicine*. De Vos now wants to carry out a large-scale, long-term study and he hopes to launch a nutritional supplement with the bacterium on the market within two years.

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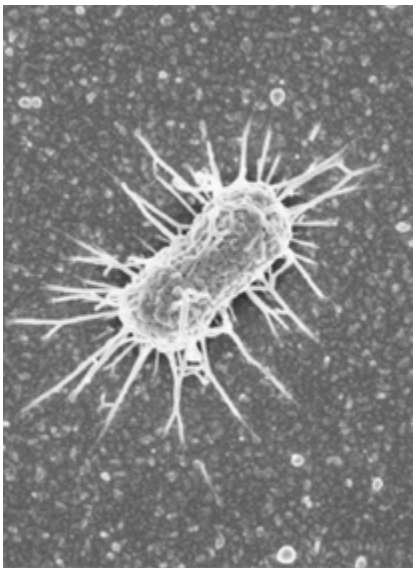

WUR/WILLEM DE VOS

WAGENINGEN WORLD

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Info: wageningen.world@wur.nl

ORGANIC CHEMISTRY

Peacock is inspiration for colour-fast paint

Researchers in the Physical Chemistry and Soft Matter chair group have developed paint that never fades and does not contain toxic pigments. It is based on the nanostructures in butterfly wings and peacock feathers.

Colours normally arise because pigments in the paint absorb some parts of the spectrum and reflect others. That reflected light is what we see. However, pigments are broken down as they absorb the light, which makes the paint gradually lose its colour. Butterfly wings and peacock feathers do not absorb light; they let some colours pass through and reflect others. That creates what is known as a photonic colour that retains its intensity. The researchers have produced paint based on this principle by replicating the nanostructures of the animal kingdom. Blue and green pastel shades work well but reds and bright colours are proving more of a challenge. The researchers published their findings in the journal *Advanced Optical Materials*.

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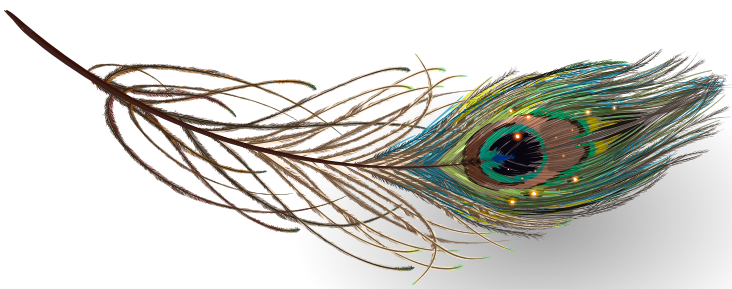

LAND AND WATER MANAGEMENT

Learning to live with fire

PHOTO GETTY

The EU is providing four million euros to train 15 wildfire specialists. Wageningen is coordinating the project. We will have to learn to live with fire, says wildfire expert Cathelijne Stoof, who is heading the European project.

Climate change means Europe is increasingly plagued by fires in nature. Even northern European countries, which barely saw any wildfires in the past, are having to cope with them. That means nature areas need to be designed differently and people need to be better prepared. The PyroLife project will turn 15 PhD candidates, four of them from Wageningen, into experts on the integrated management of wildfires. There will also be a lot of opportunity for swapping know-how. Southern Europeans' knowledge of wildfires could be useful in predicting fires in northern regions, while northern Europe's experience with landscape design and water management could be put to use in southern Europe. 'The Dutch are world famous for their water management. We will work with experts in water management and landscape architects and use their expertise to design resilient landscapes and prepare communities for life with wildfires,' explains Stoof. The Wageningen PhD candidates will be researching the effects of wildfires and their ash on soil and water quality, landscape designs that take account of the increasing risk of wildfires, and the application of relevant knowledge about water management to 'living with fire'.

PyroLife is funded through the EU research programme Horizon 2020. The project includes 10 European universities and institutes, and various European public authorities, fire-fighting services, companies and non-profit organizations are involved too.

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WAGENINGEN ACADEMY

Towards data-driven agri-food business

There is a need for education and research on big data and digitalization, and for them to become more socially embedded. Fast, integral access to large quantities of connected data is increasingly important, as are the skills needed to analyse and interpret this data. Data-driven agri-food business also requires re-thinking changing institutional arrangements and fair business models. Wageningen University & Research has launched the Wageningen Data Competence Center for innovation and research in this field in relation to agriculture, food, the environment and health. This autumn, expertise will be shared in the course *Towards data-driven agri-food business*, a programme for professionals with an interest in big data applications and organizational issues concerning new business models for data sharing in agri-food business.

www.wur.eu/academy

The North Sea is full of herring and plaice again

Herring, sole and plaice are doing well in the North Sea. That is clear from the recommendations on fishing made by the International Council for the Exploration of the Sea (ICES), which Wageningen Marine Research was involved in.

PHOTO ALAMY

Stocks of both herring and plaice are in excellent condition. 'Both species have been fished sustainably for decades now. That is beginning to pay off,' explains Niels Hintzen, a researcher at Wageningen Marine Research. The Dover sole, the third species that Dutch fishing concentrates on, is also looking healthy and the burden from fishing is gradually reaching the target level. The researchers use annual random samples and mathematical models to get a picture of fish stocks. ICES also gives advice on five fish species that constitute the bycatch from commercial fishing for flatfish. Populations of turbot and brill are above the specified minimum level. Whiting numbers are just below that limit but stable. Cod and sea bass are doing less well. Hintzen: 'Cod is being systematically overfished despite all the measures. The recommended catch levels were also too high for several years because the picture of fish stocks was incorrect. And we have been getting too few young cod for the past 20 years.' There is also a shortage of young sea bass. The population is failing to recover despite the fact that there is little fishing of sea bass these days.

The researchers submitted their findings to the ministry of Agriculture, Nature and Food Quality, the fishing industry and civil society organizations at the end of June. The EU council of fisheries ministers will set the new fishing quotas for 2020 at the end of 2019, based in part on the catch recommendations of ICES.

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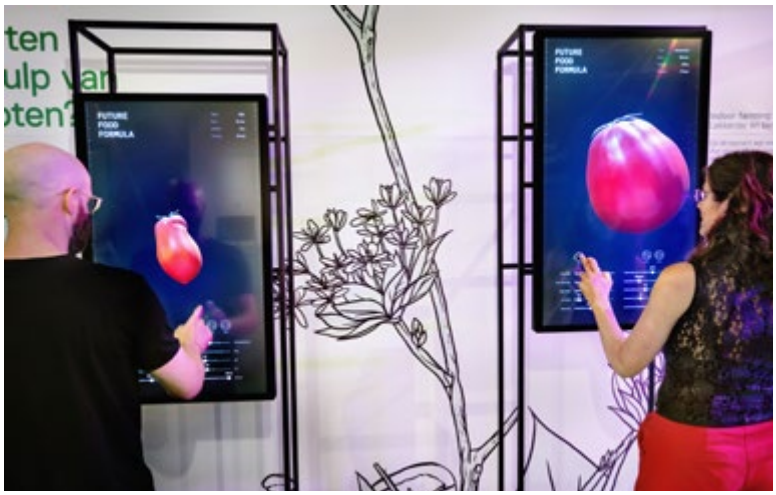

Futuristic food trip

The exhibition *Future Food* opened in the Studio, part of Nemo Science Museum in Amsterdam on 10 July. This futuristic food trip encourages visitors to think about solutions to the problem of how to feed the world. A lot of the input for the exhibition came from Wageningen. There is an algae bioreactor and a lab version of a machine that turns vegetable proteins into meat-like structures. The exhibition also looks at plant breeding, CRISPR-Cas and edible insects. The exhibition runs until 7 October.

Info: www.nemosciencemuseum.nl

PESTS

Oak processionary caterpillar in woods

There has been a big increase in the number of oak processionary caterpillars throughout the Netherlands since the peak year 2018, conclude Wageningen researchers after a count. Numbers are as much as a factor three higher in some places. The caterpillars are a nuisance as their hairs cause itching and health problems.

In June, 20,000 oak trees in Brabant, Gelderland and North Limburg were inspected. Three-quarters of the 11,500 oaks that had not been sprayed as a precautionary measure had oak processionary caterpillar nests; 80 per cent of those trees had more than one. About one-third of the 3500 trees inspected in Amsterdam region were affected. What is more, a quarter of the oaks that had been treated with a bacterial preparation as a preventive measure still had caterpillar nests, although those nests *were* smaller.
In 2018, the caterpillars were mainly to be found in urban settings. Interestingly, they now often nest in woods, sometimes in more than half of all oak trees. The Wageningen researcher Arnold van Vliet says that could be because so many oak processionary moths flew out last year. They needed to find new habitats.

The oak processionary caterpillar comes from southern Europe but has been moving northwards for years. The caterpillar has an easy time of it in the Netherlands thanks to the monoculture of oak trees in some places, such as oak-lined avenues. Numbers of the beetles, flies and birds that eat the caterpillar are also declining. Vegetation management measures could help boost populations of the caterpillar's natural enemies.
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PHOTO HOLLANDSE HOOGTE

ZOOLOGY

PHOTO SHUTTERSTOCK

Mystery of tree frogs' adhesion solved

The adhesive power of tropical tree frogs' feet is thanks to electromagnetic forces. In his thesis *Getting a grip on tree frog attachment*, Wageningen PhD candidate Julian Langowski unravels the mystery of how tropical tree frogs manage to stick to things. Together with his colleagues, the researcher mapped the internal structure of the frog's sticky pads in 3D. The subcutaneous structures of the adhesive pads indicate that the frogs derive their adhesive power from weak electromagnetic forces. These are known as Van der Waals forces after the Dutch Nobel Prize winner Diederik van der Waals. The study could eventually lead to the development of glues and grippers for picking up fragile objects in a wet setting. Examples are surgeons' instruments or the grippers on robots used to pluck fruit and vegetables.
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GREENHOUSE HORTICULTURE

Studying greenhouses' CO_2 requirements

Greenhouse horticulture must stop carbon dioxide emissions by 2050. This can be achieved by saving energy and by using sustainable energy instead of natural gas, according to a study by Wageningen Economic Research for the ministry of Agriculture, Nature and Food Quality. But the CO_2 in the flue gases from natural gas is also needed for crop growth. If greenhouse businesses use less natural gas, that CO_2 will have to come from elsewhere. In the densely populated west of the country, where most greenhouse horticulture is based, industry and waste processing companies can supply the necessary CO_2 as a residual product. Elsewhere the gas can be obtained from organic materials such as timber and crop remains, suggest the economists. Research is also needed to determine whether the crops can be grown with less CO_2.
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RANKING

Wageningen still the best agricultural university

Wageningen is once again the best agricultural university, according to the 2019 Shanghai Ranking. In the Food Technology category, WUR has dropped to second place, behind Jiangnan University in China. In the field of Ecology, WUR has climbed from fifth place to fourth.
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BIOBASED RESEARCH

Biomass and the circular economy

Researchers at Wageningen Food & Biobased Research have written a booklet about the role of biomass in the circular economy. What is biomass? What are its applications? How can you use biomass in a circular economy? The booklet answers these and other questions, and provides up-to-date facts and figures plus an overview of existing and new technologies. *Biomassa en de circulaire economie* (Biomass and the circular economy) is part of a series on green raw materials. It can be found online at wur.nl/biomassa. For hardcopies, send a request to harriette.bos@wur.nl.

GREENHOUSE HORTICULTURE

Robot assesses ripeness of tomatoes

The self-operated Plantalyzer can ride autonomously along rows of tomato plants and record the number, size and stage of ripeness of the fruits. The robot then transmits this data, giving the grower information about the harvest. The robot was co-developed by Wageningen Plant Research. The upgraded version has six 3D cameras. Software developed by Wageningen analyses the images taken by the cameras. This project is funded by the Horticulture and Propagation Materials top sector.
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PHOTO HORTIKEY/MICHEL HEERKENS.

WATER AND FOOD

PHOTO GETTY

Millions of farmers use Himalayan meltwater

There are almost 130 million farmers who depend on meltwater from the Himalayas. They will have to make changes, according to an international study. It is estimated that a third to half of the volume in glaciers will have gone by the end of the 21st century.

The researchers have produced a picture for the first time of how important Himalayan meltwater is for agricultural production and how many people depend on it. The sources of the Indus, Ganges and Brahmaputra rivers are all in the Himalayan mountains. Their drainage basins are in Pakistan, India, Nepal and Bangladesh. The inhabitants of these often densely populated areas use the water from melting snow and ice in the Himalayas to irrigate their crops. According to the study, 129 million farmers depend on water from the mountains for at least 10 per cent of their irrigation water. This water is used to grow sufficient food for 38 million people.
The researcher reached this conclusion by combining hydrological models for mountain regions and crop growth models. 'The production of rice and cotton turns out to be highly dependent on meltwater,' says the Wageningen researcher Hester Biemans. The farmers in the Indus drainage basin in particular depend heavily on the meltwater, but that water is also important for land along the Ganges in the dry season, for example in cultivating sugar cane.
The study is part of the Hi-Aware research project on climate adaptation in the drainage areas of the Indus, Ganges and Brahmaputra. The findings were published in July in the journal *Nature Sustainability*. Previous research indicated that one third to half of the ice in the Himalayas would melt by the end of the century. Biemans stresses that it is important for the farmers to adapt in good time. 'Farmers can sow earlier, or grow crops that need less water. Cotton is a crop that requires a lot of water, so that might be better cultivated elsewhere.'
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NATURE AND COASTAL DEFENCES

Sowing samphire to beat the waves

In late May, researchers sowed samphire in a new salt marsh on the coast of Delfzijl. They want to know how samphire can help the development of salt marshes as a way of mitigating the effects of rising sea levels.

Salt marshes are land covered with vegetation that borders the sea. They are inundated during high tides and storms. They form an extra buffer zone along the coast as they dampen the waves. Many salt marshes have disappeared in the Netherlands, as in other countries. That is why researchers are investigating how to construct new ones.
Sand, clay and plants were used to build the new marsh in Delfzijl, says Martin Baptist of Wageningen Marine Research. The pioneering salt marsh has been divided into experimental plots with varying ratios of sand to clay. Some of the plots were sown with samphire at the end of May; the plant is expected to spread naturally to other plots. Samphire is often the first plant to settle in new salt marshes. 'If this experiment works, we hope to apply the samphire method around the world in the fight against rising sea levels,' Martin Baptist told the broadcaster RTV Noord. In the Delfzijl project, Wageningen Marine Research is working together with the EcoShape foundation, Royal Haskoning DHV, Arcadis and Deltares. The Wadden Fund is the main financer.
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PHOTO ECOSHAPE

MARINE ECOLOGY

PHOTO REINDERT NIJLAND

Fish hotels on the bare sea bed

Artificial shelters for fish and other sea creatures could improve biodiversity in the North Sea, thinks Tinka Murk, professor of Marine Animal Ecology. Nearly all the natural reefs have gone as a result of fishing and disease, and with them the shelters used by fish, shellfish and crustaceans. The idea is that 'fish hotels' — hexagonal concrete tubes with 10 chambers — will change this. The first fish hotels were constructed in July: three in Haringvliet inlet and two out at sea. Divers will monitor developments and any hotel guests. The project received 8.5 million euros in funding from the National Postcode Lottery.
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CROP PROTECTION

Daisy misleads aphids

The daisy species *Tanacetum cinerariifolium* has a natural resistance to aphids. The plant dupes the insects by producing a pheromone that the aphids themselves generate whenever there is a threat. That aroma makes the aphids flee the scene. What is more, it attracts ladybirds looking for an aphid dinner. The Wageningen researcher Maarten Jongsma saw fields of the plant in China 10 years ago where the flowers were full of ladybirds. He suspected then that a scent was attracting the beetles. Jongsma and scientists at Huazhong Agricultural University in Wuhan investigated the phenomenon. The researchers managed to figure out the double protection mechanism and isolate the gene for the alarm pheromone. The study was reported in May in the journal *New Phytologist*.
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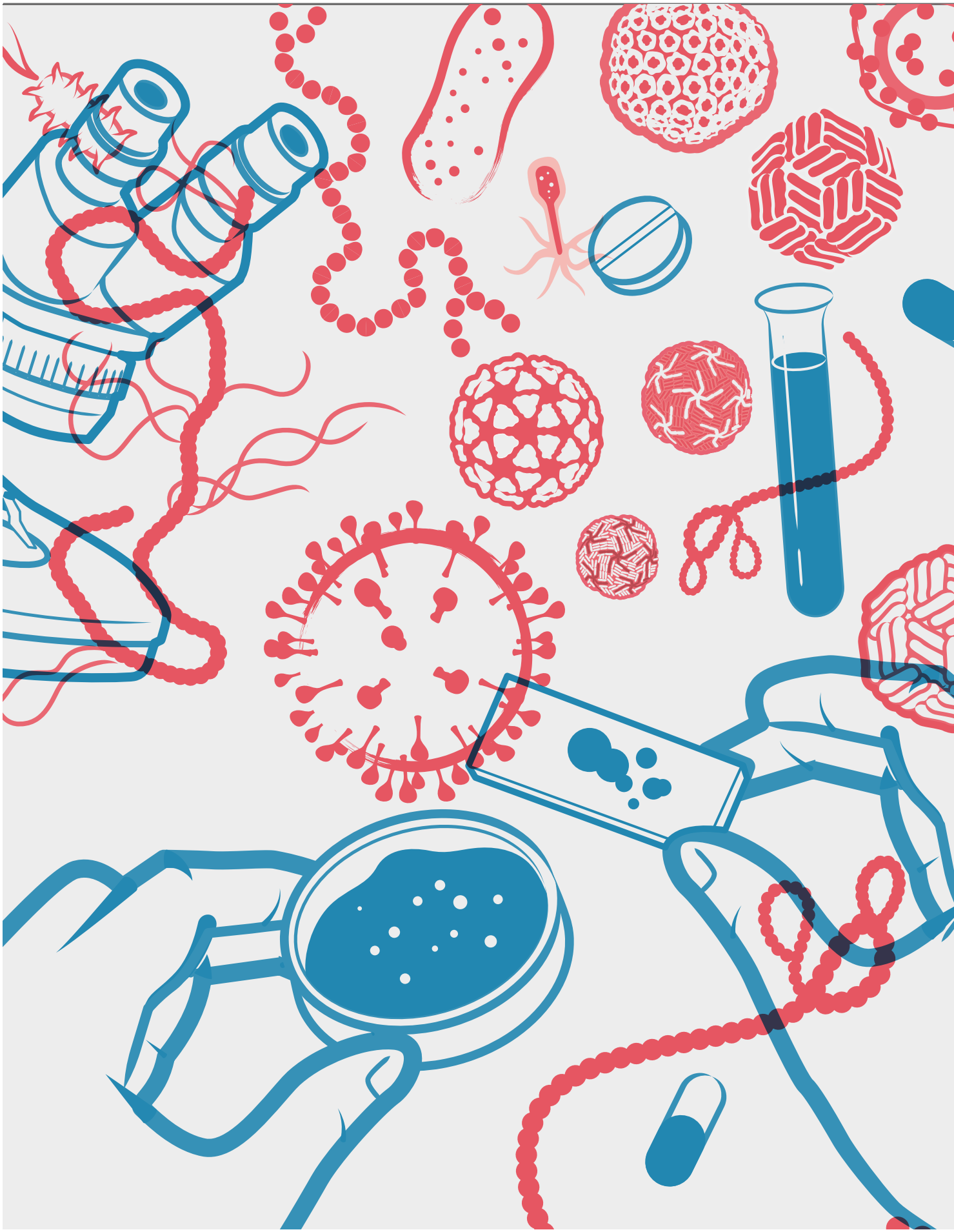
PHOTO SHUTTERSTOCK



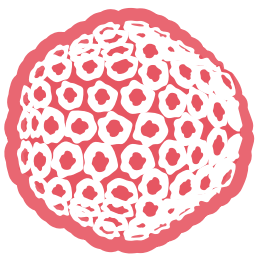
Preparing for Virus X

Tropical viral diseases are on the rise worldwide. Zika, swine flu, Rift Valley fever and SARS are just a few of the many diseases threatening humans or animals. Virologists are researching ways of preventing new outbreaks and epidemics. 'There is no doubt at all that a new virus will turn up somewhere some time.'

TEXT ARNO VAN 'T HOOG **ILLUSTRATIONS** KAY COENEN

An unusual species of mosquito was caught in a mosquito trap in Flevoland, the Netherlands, in June. *Aedes flavopictus*, a species from Japan and Korea, can potentially transmit Dengue virus. A local eradication campaign has been launched to prevent the species getting established in the area. Several other exotic mosquitoes have been found in Flevoland in recent years, among them the Asian tiger mosquito and the Asian bush mosquito, both of which are thought to have entered the country via used car tyres. Attempts to wipe them out are not always successful: since 2014 the Asian bush mosquito has been so widespread around the town of Lelystad that the eradication campaign has been abandoned. It turned out that these tropical mosquitoes were not carrying any pathogens, but they do raise the risk of a tropical virus spreading should it enter the country in future.

'It is logical for the media to pay attention to these kinds of reports,' says professor of Veterinary Arbovirology Jeroen Kortekaas, who works at Wageningen Bioveterinary Research. Something is definitely going on, he thinks. Population growth, globalization and climate change are creating a world in which diseases can spread faster and further.



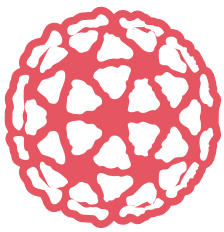
RIFT VALLEY FEVER

Transmitted by Aedes and Culex mosquitoes
Hosts Wild and domesticated ruminants, humans

PUBLIC HEALTH EMERGENCY OF INTERNATIONAL CONCERN

On 18 July 2019, the World Health Organization (WHO) declared the outbreak of Ebola in Africa a Public Health Emergency of International Concern.
Since the outbreak in the Democratic Republic of the Congo in August 2018, more than 2000 cases of Ebola have been registered and more than 1500 people have died. The earliest outbreaks of the disease – described in 1976 –were limited to small communities in Central Africa, but between 2014 and 2016, several countries in West Africa were afflicted by an epidemic which cost the lives of 12,000 people, according to official estimates, and in reality probably many more. The disease occasionally rears its head outside Africa too, but so far these outbreaks have been contained thanks to immediate isolation of patients and the use of protective clothing.
The Congo has faced a new epidemic since August 2018. Ebola is high on the WHO list of diseases for which a vaccine is urgently needed. More than 160,000 people in the Congo have recently been inoculated with an experimental vaccine.
The WHO declares an international public health emergency if a disease threatens several countries and calls for coordinated international efforts. Previous occasions when an emergency was declared were the outbreak of Zika virus (2016), the outbreak of Ebola in West Africa (2014), the spreading of polio (2014) and the swine flu epidemic (2009).

One example is the mosquito-borne West Nile virus, which went all the way from Israel to America, while spreading in Europe at the same time. Greece reported 316 human cases last year, with 50 deaths, mostly from meningitis. The virus has not reached the Netherlands yet, but nine species of mosquito live here which could transmit it from migrating birds to humans. No vaccine for humans is available.
Kortekaas: 'North-west Europe has got off relatively lightly up to now, mainly because of the mild climate. Exotic insects have always been introduced from time to time, but now that our climate is becoming warmer and wetter, the conditions for mosquitoes are becoming more favourable.' Viral diseases are spreading to new tropical regions as well: in 2015, the originally African Zika virus caused serious brain damage in thousands of new-borns in Brazil.
Animals are often the victims of emerging viruses too. At the end of last year, African swine fever virus turned up in a wild boar population in the Belgian Ardennes. This disease had been spreading in Russia and Eastern Europe since 2012. There has been a massive outbreak in Asia that started in 2018: by the end of June 2019, 2.8 million pigs had been culled in Vietnam. The virus is not a threat to humans, but infections in pigs are nearly always fatal. By culling wild



CHIKUNGUNYA

Transmitted by Aedes mosquitoes
Hosts Humans

PHOTO ALAMY

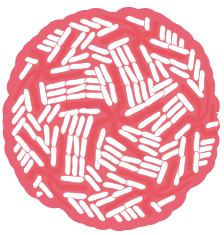
An experimental Ebola vaccine is administered in the Democratic Republic of Congo.

boar and putting up hundreds of kilometres of fencing in Denmark and France, it is hoped that the virus can be kept at bay in Western Europe. There is no prospect of a vaccine at present.

Actually, we are always one step behind in the battle against new viruses, notes Kortekaas. 'Industry only starts developing vaccines after a significant outbreak has occurred. Whereas there are a lot of viral diseases, some of them affecting people, for which we need to have vaccines on the shelf.'

Since the outbreak of Ebola in West Africa in 2013, and of Zika in Brazil in 2015, there is greater awareness internationally that preparation is half the battle when combatting diseases. In 2018, the World Health Organization (WHO) reviewed its 'R&D Blueprint' list of priority viral diseases for which a vaccine is urgently needed, such as SARS, Zika, Ebola and Rift Valley fever. But developing a vaccine is costly, and the countries with the biggest problem are usually poor, which puts a damper on investment in research by pharmaceutical companies. The WHO and charities are among the organizations trying to plug the gaps.

Kortekaas is closely involved in vaccine development. He designed a vaccine that protects sheep and other ruminants against Rift Valley fever, a mosquito-borne virus that occurs mainly in East and Southern Africa. It is at home amongst wild and domesticated ruminants and humans. The latter can also be infected through contact with the meat or blood of infected animals. The infection usually causes relatively mild symptoms in humans, but complications may result in death or serious brain abnormalities. Its widespread distribution and public health impact have put Rift Valley fever on the WHO's priority list.



DENGUE

Transmitted by Aedes mosquitoes
Hosts Humans

> 'Viruses are extremely flexible genetically'

EPIDEMIC PREPAREDNESS

In July, a consortium led by Kortekaas was allocated a budget of 12.5 million dollars by the Coalition for Epidemic Preparedness Innovations (CEPI) and the European Union to develop a human vaccine. 'At Wageningen Bioveterinary Research we have so far only developed veterinary vaccines. We will carry out a phase 1 clinical study in Europe, using volunteers, to show that the vaccine is safe to use. We are also looking at how immune cells and antibodies counteract the virus. In a follow-up study, we will vaccinate people in Africa in an area where there is Rift Valley fever,' says Kortekaas.

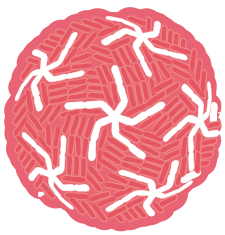
If you line up these developments, you get the feeling that we can hardly keep up with the whims of Mother Nature. What is the best strategy and what can science contribute? To start with, says Wim van der Poel, professor of Emerging and Zoonotic Viruses at Wageningen Bioveterinary Research, it is good to realize that a high standard of living in a country forms a key barrier to outbreaks of disease. 'Ebola could never wreak such havoc in the Netherlands >

PHOTO HOLLANDSE HOOGTE

African swine fever is on the move, threatening pigs and wild swans. A signboard with information about preventing infection on the side of the road in Groesbeek, the Netherlands.

because healthcare and hygiene are better here. Ebola goes on causing problems in Africa because disease control is so badly organized in countries like the Congo. You can reduce risks considerably by improving healthcare, sewage systems and drinking water quality.'

Secondly, Van der Poel sees a crucial role for experienced vets and doctors, who are always the first to encounter new infections. They are the first to notice unusual symptoms in humans or animals. This requires experience and an eye for detail, because the initial symptoms of most tropical viral infections are similar to flu symptoms. Van der Poel: 'That leading role was played by doctors in the SARS outbreak in 2002: the doctor who first reported the disease in Hong Kong, and who ended up dying of SARS himself, said: this is something new, I've never seen this in a patient before.' The same thing happened in veterinary medicine, says Van der Poel, in the cases of the sheep disease Bluetongue, the Schmallenberg virus and the avian flu H7N7. 'There were a couple of vets who said, something strange is going on, we need further diagnosis. So medical experience and the case descriptions are very important for getting outbreaks in our sights quickly. That can be underestimated.' Finally, Van der Poel says that virologists are developing better and better molecular techniques for tracking down viruses fast. 'When SARS broke out in 2002, they struggled for months to identify the virus. That would definitely go faster with the DNA techniques we use nowadays.'



ZIKA

Transmitted by Aedes mosquitoes
Hosts Apes, humans

FINANCIAL DAMAGE

The risk of infections could indeed increase in the near future, but we are better prepared technologically, says Van der Poel. 'In that sense, it is a bit of a gamble. If we stay alert, we can keep it under control, especially in a country like ours. But we shouldn't be complacent. Perhaps we've forgotten what it's like when a completely unknown virus like SARS rears its head. The financial damage caused by the panic and the grounding of air traffic during the SARS outbreaks was estimated at 40 billion dollars. There is no doubt at all that a new virus will turn up somewhere some time. We just don't know when.' To underline that danger, the WHO's priority list of dangerous viruses now includes Disease X: an unknown virus that might cause an epidemic in the future.

But scientists are not just waiting in the wings like the fire brigade, ready for the next report of a virus outbreak. Virologists want to improve their understanding now of where the main risks of an outbreak could arise. One branch of research focuses on what is known as vector competence. Researchers look into whether the species of mosquito or other insects found in the Netherlands are capable of transmitting tropical viruses. Kortekaas: 'For instance, we have established that Dutch mosquitoes can transmit Rift Valley virus from one sheep to another. That transmission was remarkably efficient.'

So what's going to happen when a person or a mosquito carrying the Rift Valley virus crosses national borders? Kortekaas: 'The crucial question is whether the virus feels at home in a new environment. And what determines that? Often, we have no idea why some tropical viral diseases have not reared their heads here yet. One important aspect is their interaction with local mosquito species, which may not be optimal for spreading the disease. On the other hand, viruses are extremely flexible and can evolve easily. If they get a chance, they eventually find a way to adapt to local hosts and conditions.'

EBOLA

Transmitted by direct contact
Hosts Apes, humans

Kortekaas's research data on the transmission of viruses by Dutch mosquitoes are very useful to quantitative veterinary epidemiologist Mart de Jong, another Wageningen professor. He has a lot of experience with building statistical and mathematical models that show the distribution of diseases such as avian flu and swine fever, or calculate the effect of a vaccination campaign. De Jong: 'You need models like that to interpret experiments and observations. To find answers to the question of when a vaccine is effective, for example.' De Jong was involved in an Irish study on the experimental vaccination of badgers against bovine tuberculosis (TB), a bacterium that can infect badgers, cattle and humans. An outbreak of the infection means culling cattle and badgers, while posing a danger to humans too. Calculations showed that if at least 30 per cent of the Irish badgers are vaccinated, bovine TB can be eradicated. Based on that result, the Irish government decided to start vaccinating badgers.

YELLOW FEVER

Transmitted by Aedes mosquitoes
Hosts Apes, humans

MOSQUITO-BORNE

Bovine TB is not spread by mosquitoes but through milk and droplets from coughing, and the bacterium infects far fewer animal species than tropical viruses. It is more of a challenge for a veterinary epidemiologist to make a model for mosquito-borne diseases. De Jong: 'For that you need a knowledge of the main insect species in our region for the transmission of a virus such as Rift Valley fever. We don't really know that. The question is whether transmission is determined by a few dominant insects, or whether several different species play a role at the same time. A big project aiming to answer questions like that has just started with funding from the Dutch National Science Agenda. My group is involved in that. It focuses on infectious diseases that are likely to spread towards the Netherlands, and especially those spread by mosquitoes, such as West Nile fever, Rift Valley fever and Chikungunya.' The reproductive success of mosquitoes provides an important key to understanding the risks, says De Jong. As far back as 1900, the Scottish doctor and Nobel Prize winner Ronald Ross showed that the distribution of the malaria parasite depends on the density of the mosquito population in an area. 'Based on that insight, people started draining swamps. Malaria was once present in Zeeland and Amsterdam. The disease gradually disappeared, but not by eliminating every last mosquito. Mosquito numbers went down, so transmission was no longer effective.'

Managing the density of mosquito populations is therefore a good strategy for controlling outbreaks of infections. De Jong wants to combine knowledge of mosquito population density and transmission between humans and farm animals. 'So we will be able to say: if a virus arrives here, does the model show that the infection can spread effectively? Can we do something about that? Where could an outbreak happen? And what is the best monitoring method to prevent that? This is all quite complicated, partly because it is not easy to predict mosquito population density. That depends on rainfall and local conditions. The challenge is to be creative with new research so you can say something sensible about it.' ■

www.wur.eu/virology

> **'The crucial question is: Will the virus feel at home in a new environment?'**

SARS

Transmitted by direct contact
Hosts Civet cats, bats, humans

COURSE GLOBAL ONE HEALTH

In autumn, Wageningen Centre for Development Innovation will run the course Global One Health: towards Human, Animal and Plant Heath. *www.wur.eu/cdi*

50 YEARS OF NUTRITION RESEARCH

‘There is so much more to nutrition than calories’

Two professors of Nutrition look ahead as Wageningen celebrates 50 years of nutrition research. One of them works at the DNA level; the other looks at the global picture.

TEXT ASTRID SMIT **PHOTOGRAPHY** BRAM BELLONI

EDITH FESKENS, PROFESSOR OF GLOBAL NUTRITION

‘We must change the food system radically’

‘In large areas of the world there is not just undernutrition, but a lot of overweight as well. With all the diseases that go with it, such as diabetes, cardiovascular disease and cancer’, says Edith Feskens. She was appointed to the new chair in Global Nutrition at the beginning of this year. For the last 10 years of her academic career, she will be focusing on both undernutrition and overnutrition in the world.

What is your dream? Where do you want to end up with the research?

‘How can we feed 10 billion people in 2050 with a healthy, sustainable diet? Which means no vitamin deficiencies, overweight or underweight. It is theoretically possible: worldwide there is enough food available to provide us all with sufficient calories, protein, vitamins and minerals. It is just the distribution that goes wrong. Our contribution is modest, but I am optimistic. Just look at the impact of the discussion about climate change. In the past five years, vegetarian food has become enormously popular in the West. We couldn’t have dreamt of that 10 years ago. Big changes are possible. To achieve them we must change the food system radically. Less emphasis on increasing production, for instance, and more emphasis on sustainability and health. We want to support that line with our research. To start with, we are focusing on the continents of Asia and Africa. How can we ensure that the people living there get a healthy diet? What does it take? That is our core theme.’

To some extent, the new chair group is building on the work of the former professor Clive West, who died in 2004. He had set up a successful research line on micronutrients. Schoolchildren in Kenya were given a cassava variety that is rich in beta carotene, the precursor of vitamin A. As a result, fewer children went blind. Now there is a comparable project running in Nigeria. Feskens: ‘In the past, the topic of Global Nutrition was covered by another chair group; now it has been given more prominence. Wageningen has a lot of knowledge to offer in this field, both in the area of nutrition and those of plant and livestock breeding.’

How are you going to approach it?

‘A large international research programme on Food Systems for Sustainable Diet is already up and running, led by Inge Brouwer. And we are setting up new projects as well. Our focus: what is a healthy diet in these countries, how sustainable is it to produce, and how does it reach the consumer? We also focus on a child’s first 1000 days and on adolescence. In those two periods, people are very vulnerable to deficiencies and overweight.’

What kinds of new projects do you have in mind?

‘In the Netherlands there is a project run by the Nutrition Centre called ‘The Healthy School Canteen’. Other countries would like to implement something like this with our help. The national public health institute in Ethiopia is interested, for example. There we research what schoolchildren consider healthy and why. A study by a PhD student showed that they don’t buy fresh fruit on their way to school because they are afraid it has suffered from air pollution. They eat a packet of crisps instead. They think that is healthier and of course, it has higher status. That is an interesting finding, and one you can use. Another example is our work in Vietnam, where a PhD student is doing research on which foods people eat, how much water they use, and what the options are for reducing water consumption.’ >

Until recently, you held the chair in Nutrition and Health in the Life Cycle. How have you ended up at Global Nutrition?

'I have actually finished most of my earlier research now. For years I have been working on the prevention of diabetes and overweight. I had started on that at the National Institute for Public Health and the Environment, and I carried on with it here as associate professor and later as full professor. The research resulted in a successful method called SLIMMER, for preventing diabetes and overweight with an adapted diet and exercise. People who take this programme achieve permanent weight loss, as one of our PhD students proved. The method is even covered by the basic health insurance now, so what more could a scientist want? I began to think about the last 10 years of my academic career. Since 2005, I have also led quite a few projects on diabetes and overweight in developing countries. Now I am going to expand that research line, precisely because the problem of overnutrition is growing in those countries.'

50 YEARS OF HUMAN NUTRITION AND HEALTH

Research on the link between nutrition and health started in the Netherlands in 1969, when the Human Nutrition department was opened in Wageningen. In the past 50 years, the department has grown into an internationally renowned chair group with relevant research results on topics including the relationship between diet and cardiovascular diseases, cholesterol or cancer.
The 50th anniversary will be celebrated on 18 October with a scientific symposium with international speakers, and on 19 October with an alumni day on the campus in Wageningen.

www.wur.eu/humannutrition50

SANDER KERSTEN, PROFESSOR OF NUTRITION, METABOLISM AND GENOMICS

'The way the body works is so wildly complex'

'There is more to nutrition than calories. Nutrition regulates our genes too,' says Sander Kersten, professor of Nutrition, Metabolism and Genomics. 'Nutrients continuously determine which genes become active or inactive. We are trying to find out how that works and why.'

How does nutrition activate our genes?

'Imagine you eat a meal that is rich in fatty acids. They get absorbed by cells in our bodies. The fatty acids serve as fuel, but they also bind to certain proteins in the cells, known as transcription factors. These ensure that parts of the DNA are transcribed, thus activating genes. We now know that there are transcription factors for fatty acids, glucose and amino acids. We wonder why it works like that. What is the underlying logic?'

What kinds of information has that delivered so far?

'We have mainly focused on the fatty acids. Using a new technique called RNA sequencing, we can see at a glance which of all the 25,000 genes a human being has are switched on in cells of a particular tissue type. We concentrate on two genes that are active in the digestion of fatty acids. One of them ensures that the cell absorbs less fat. The other regulates the storage of the fats as fat droplets. So switching on that gene is part of the feedback so that not too much fat gets into the cell, or that at least it is safely stored.'

Have you found a link between nutrients and diseases?

'To be honest, I try to steer clear of that subject. I concentrate on physiology, on the body's normal functioning. I wonder whether we can ever demonstrate how any

nutrient protects against diseases or causes them. The way the body works is so wildly complex.'

But have you got a better idea of how the body normally works?
'Yes, we are making progress on that. A nice example is the work of my colleague Lydia Afman. She discovered that in people on a diet containing saturated fats, genes were switched on that are active in inflammation processes. This didn't happen at all in people who ate equal amounts of unsaturated fats. A very significant result. The hypothesis is that this kind of diet increases the risk of diseases such as diabetes or cancer. We are researching it now for diabetes.'

What do you hope to achieve in the next few years?
'We hope to obtain some rock-solid scientific findings. Things that will get into the textbooks and never be dropped from them again. Then you have really left a legacy, I think.'

Isn't that what everyone wants? Why do you emphasize that so much?
'Because I'm worried about developments in our field. A lot of research results that get published in leading journals like *Nature* and *Cell* turn out not to be replicable or even to be wrong. An article in *Nature* in 2006 claimed that glucose controlled cells through a particular receptor. Now everyone knows that is not how it works, but the paper has never been retracted. That is very confusing and undermines the authority of our discipline. That really bothers me a lot. There is too much pressure to publish in top journals.'

How can that development be stopped?
'By putting up resistance. That is relatively easy for me, I have a permanent post. Young people don't always have any choice. They won't get anywhere without impressive results. We must protect them and allow them the time to do thorough research. We must build solid houses rather than straw facades.'

Years ago, the impression was created that we would soon be getting personalized dietary recommendations based on genetic data. What's your view on that?
'We have never invested in that kind of research and in the end, nothing much came of it. I do think there is a future for portable techniques such as a plaster with a little needle on your upper arm, which continuously measures substances in your blood. They can keep consumers and patients informed about their physical health status. We are trying to work on that now. Perhaps we can benefit from the arrival of the Belgian research institute Imec in Wageningen. The scientists there are specialists in these techniques.' ■

Forest researchers go underground

Scientists are building a global database on forest soils. The first analyses show how closely trees, soil organisms and climate are connected. 'We can now predict developments influenced by the climate.'

TEXT NIENKE BEINTEMA **ILLUSTRATION** STEFFIE PADMOS

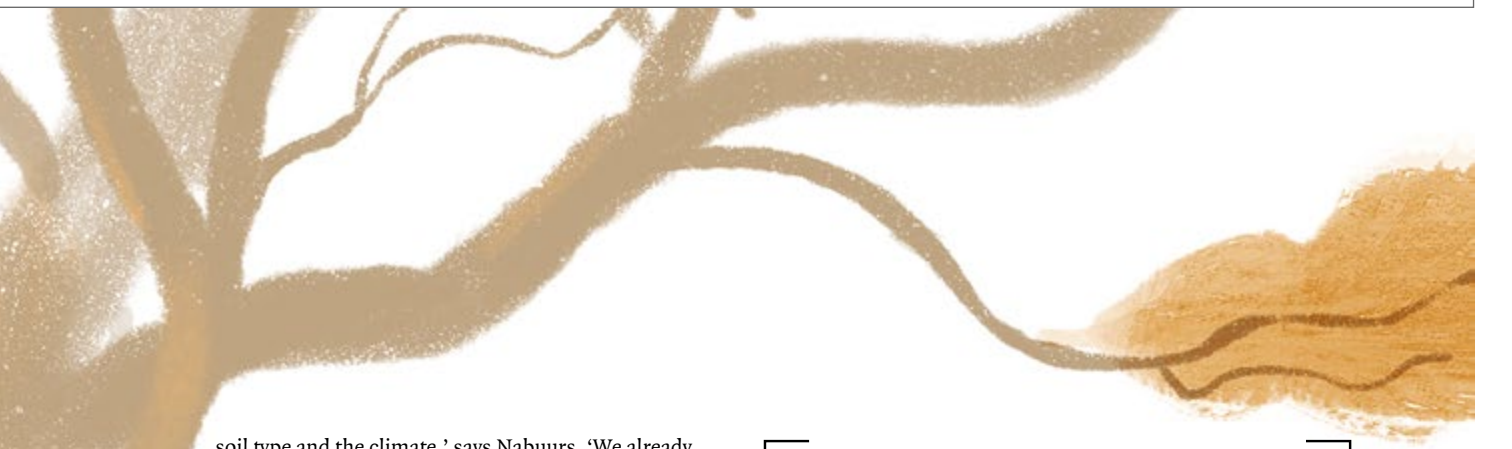
The soil below every forest harbours a jumble of fungi and bacteria which collaborate closely with the trees' roots. These fungi and bacteria free up nutrients in the soil for the roots, and in exchange the roots give the micro-organisms certain nutrients such as sugars. This collaboration goes on in every forest ecosystem, but the symbiosis looks very different in a tropical rainforest, in the northern taiga and on the Dutch Veluwe plateau. These differences around the world have now been documented for the first time. Wageningen researchers took part in the study, which was published in May in the top journal *Nature*.

'We have known how important the symbiosis between tree roots and micro-organisms is for a long time,' says Gert-Jan Nabuurs, professor of European Forests in Wageningen and co-author of the study. 'But we didn't know very much about it. That is partly because a lot of information was inaccessible, spread over databases in different countries.'

Nabuurs and his colleagues have been working for two decades to put together a European database. Five years ago they started gradually linking this database with data from countries all around the world. Nabuurs: 'It's unique: we now have access to data from 1.1 million measuring points around the world.'

The article in *Nature* came out of this Global Forest Biodiversity Initiative, started by Wageningen University & Research and partners.

'Researchers around the world collect data about forests, such as their density, the mix of species, the



soil type and the climate,' says Nabuurs. 'We already knew that you find different forms of symbiosis in the tropics, temperate and cold regions, and theoretical calculations had already been made to predict which forms are dominant and where. But now for the first time we can test those ideas against a whole lot of data.'

COMPUTER MODEL

The research showed that there are three main forms of symbiosis in forest soils: one variant in which tree roots collaborate with fungi in the soil (*ectomycorrhiza*), one in which the fungi live in the tree roots (arbuscular *mycorrhiza*), and collaboration between roots and nitrogen-fixing bacteria. 'We have made a computer model using the global measuring points,' says Nabuurs. 'It shows how factors such as soil chemistry, vegetation and climate determine which type of symbiosis predominates.'

Ectomycorrhiza turned out to be dominant in moderate and cold climates, where they play an important role in carbon storage in the soil. Arbuscular *mycorrhiza* are primarily found in the tropics, where they facilitate the fast recycling of carbon. Through climate change, the balance between these two types seems to be shifting in favour of the second. This negatively affects the soil's capacity to store carbon, and therefore itself becomes a contributing factor in climate change.

'Thanks to this model, we can now predict future developments in forests in great detail,' says Nabuurs. 'The differences, for example, under the influence of a warmer, drier or wetter climate.' That is where this research and the global map is of practical use, says Nabuurs. 'Once you know how forests react to changes, you can take that into account in your management of them.' The research shows that mixed forests are particularly rich in micro-organisms. 'It is our guess that this abundance makes a forest resilient,' says Nabuurs.

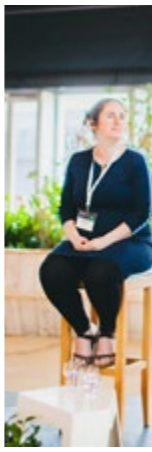
'We have data from 1.1 million measuring points around the world'

'The greater the diversity of micro-organisms, the more efficiently trees can use the available nutrients and water. In times of changes in particular, that could just be the difference between the survival and the disappearance of a given type of forest.'

However, adds Nabuurs, using this knowledge to adapt management strategies is easier said than done. 'We don't yet have a direct translation of this research into specific measures, but we have taken the first steps towards it. This research shows the existing relationships and patterns, and how they change. We can now use climate scenarios to predict what will happen to forests: which species we are going to lose, how far the boundaries of forest types are going to shift, and so on.'

But its immediate applications are not the biggest benefit of the research, Nabuurs emphasizes. 'At this stage, it is the ecological work that matters most to me. In the past, modelling how forests function was mainly done at the local level, and focussing on relationships above ground. Now for the first time we can look at global patterns, and also go underground. That is what makes this study cutting-edge. The fact that we can do that upscaling for the first time.' ■

www.wur.eu/climate-forest

DISCUSSION AT THE INTERNATIONAL CONFERENCE CRISPRCON

Talking about CRISPR-Cas

DNA can be changed with great precision using CRISPR-Cas. The introduction of the technology was discussed at the international conference CRISPRcon in Wageningen at the end of June. The emphasis lay on how to enable the general public to arrive at an informed assessment of its uses.

TEXT RIK NIJLAND **PHOTOGRAPHY** JONNE SEIJDEL

'An exchange of ideas: that is something we sorely need,' says the Wageningen microbiologist John van der Oost as he casts a satisfied eye over the full lecture theatre on the Wageningen campus. Hundreds of participants at the international conference CRISPRcon are thronging around 30 discussion tables to talk about the uses of gene technologies. There are members of religious communities, farmers and students, but the majority are researchers, social scientists and representatives of large seed companies. Van der Oost is one of the pioneers of

The two-day CRISPRcon conference brought a diverse group of people together to discuss the future of CRISPR-Cas and related gene technologies. Hosted this year by Wageningen University & Research, the conference was an initiative of the Keystone Policy Center, which aims to stimulate an open dialogue on gene technology.

CRISPR-Cas, a technique for making precise changes to DNA. In just a couple of years, it has spread to labs around the world. 'It is a marvellous instrument which deserves to be widely used. Of course we must act with the utmost caution but there is no reason for distrust.'

The possibilities are indeed endless, and range from removing a single gene in order to study exactly what its function is in an organism, to treating hereditary conditions in people, arming crops against drought stress or diseases, or adapting plants, bacteria and yeasts so they can produce more or different chemicals and drugs. But a few of the speakers emphasized that none of this makes the new technology an indispensable miracle cure. To tackle hunger in the world, let's start by doing something about the 40 per cent of food that ends up in the bin, suggested one organic farmer.

CRITICAL VOICES

Another critical note came from Alejandro Argumedo of the non-profit organization ANDES. 'We have no need for more genetic diversity through CRISPR. Four hundred varieties of potato are grown in Peru. They are part of life for us. Sustainability means respecting nature and the way people live with it. Western science is not the only way of looking at the world.'

> 'We have no need for more genetic diversity through CRISPR'

But such critical voices did not set the tone of the conference. Instead, the emphasis lay on how to enable the general public to arrive at an informed assessment of the uses of modern DNA technology. Discussion about this has become unavoidable. Last year the European Court of Justice handed down a ruling on the technology (see inset). There is no ban on changing genetic material with CRISPR, but the safety rules for marketing food products are strict. So strict that companies are put off by them or cannot afford the admissions procedure. The rules are far more relaxed in Asia and the US. It is high time the legislation was changed, say CRISPR fans. The EU commissioner for Health and Food Safety Vytenis Andriukaitis made a start on that during CRISPRcon by calling for a Europe-wide debate. But that idea sets off alarm bells for a lot of people. Around the turn of the century, discussion of genetic modification – using less precise precursors of CRISPR – led to 10 years of trench warfare between the two sides. The wish to avoid the same thing happening with CRISPR was palpable at CRISPRcon.

ALL THE WRONG FEELINGS

Wageningen president Louise Fresco took a historical perspective too. 'Imagine if the first use of genetic modification in agriculture had been a variety of wheat with a built-in carbon gene that provided protection against cancer of the stomach. The discussion about the use of GMOs in the food chain would undoubtedly have taken a very different course.' In that scenario, the public would have seen advantages to a new and perhaps rather scary technology, and not just the disadvantages. As it was, any advantages were not very clear to the general public, said Fresco. The technology was applied in the production of modified maize and soya, livestock feed crops grown in large-scale monocultures. So it mainly benefitted a handful of large agrochemical companies. 'That triggered all the wrong >

feelings,' said Fresco. 'It would be good for acceptance of CRISPR-Cas to look for a few applications that make a real difference to people.'
This was a frequently voiced view at the two-day conference in Wageningen. You don't win people over with impressive techniques but with convincing applications. What will this genetic change do for your health, how will it benefit the environment, will it improve life for farmers in developing countries? The emphasis on safety is a pitfall: there is no such thing as 100 per cent certainty, there is always room for doubt.

> **'Past experience shows you should conduct an open dialogue about gene editing'**

GENE EDITING, NO WAY

According to Anita van Mil of the London social research firm Hopkins Van Mil, interaction with the public should never be brief and superficial. 'If you ask people at a festival a few questions about a topic they don't know much about, they go on the defensive. Gene editing, what? No way. But what if you ask them what they would think of an intervention using this technology if a member of their family had a hereditary disease? Or whether they would want the technology used for plant breeding in a country suffering from famine due to climate change? Then they start thinking.'
The firm did a study for the Royal Society on gene editing's public image in the United Kingdom. With Brexit in the offing, the British are going to need their own legislation. So the scientific academy wanted to know what ideas people have on the subject and how they form their opinions.
'In several parts of the country, groups of 20 to 30 people took part in discussions, with experts available to answer questions,' explains Van Mil. 'Then the participants were given homework and we encouraged them to talk about gene technology with their families and friends before coming together again three weeks later. People's ideas had often changed. Cut through the one-liner lunacy of the media, especially in the UK, offer balanced information and give people time to think about it. As researchers we are neither for nor against gene-editing; we are neutral partners who want to conduct a constructive public dialogue. Your aim should be to establish openness.'

TESTING USEFULNESS

During CRISPRcon, Michelle Habets of the Rathenau Institute led a discussion entitled 'Let's avoid a trench war on CRISPR food' – a reference to the shadow of the past. The institute argues for making usefulness a factor in approving new food products, and not just safety. The proposal is based on a Norwegian approach to assessing biotechnological innovations. 'Is it just a small "point mutation" or is DNA from another organism introduced? The social implications should play a role in approval procedures too. Will the product increase sustainability, for example, and is it good for



small farmers in the South? If not, do we really want that product?' According to Habets, these are the conditions for responsibly integrating gene technology into agriculture and society. A general exemption, argued for by some proponents, offers no guarantee that the fabulous promised applications of the technique will ever be realized. When push comes to shove, the plant-breeding industry might prioritize upscaling production and increasing profit margins over a drought-resistant crop that benefits poor farmers. In the Norwegian model there is an incentive. 'Besides, countries can make their own decisions as to whether they accept a product, taking cultural differences and their own ethical choices into account.'

LOGISTICAL NIGHTMARE

For Europe to become a patchwork of different accepted food products strikes Hinse Boonstra, agricultural affairs manager at Bayer, as far from ideal. 'For the industry and for transportation that will be a logistical nightmare,' he says. He came to Wageningen with seven of his colleagues. 'Gene editing is important to us as a plant-breeding company. Past experience shows the need for a good, open dialogue about the subject. If you fail to do that, the chances are that you won't be able to use a sustainable technology that can be extremely beneficial to farmers and consumers.'

And this hampers innovation, says Boonstra. A multinational like Bayer works all around the world, but smaller European companies and farmers can't get experience of new products and varieties that are allowed in Asia and in the US. Or those new varieties are never even introduced. For many crops, a new variety is only viable if it can be marketed worldwide.

He didn't find any readymade answers in Wageningen. 'There are so many different parties, each with their own ideas about what agriculture and food production should look like. That makes it very complicated,' says Boonstra. 'It became obvious at CRISPRcon that an open dialogue is needed. It would be great if that at least generated an appreciation for everybody's position. That would hopefully create space for letting different visions co-exist: farmers who do use gene editing and farmers who don't, consumers who do or do not wish to buy those products. There simply isn't just one truth.' ■

www.wur.eu/crispr-cas

GMO LEGISLATION

The discussion about genetic modification that flared up in Europe in the 1990s was mainly about applications in agriculture and the food industry. The environmental and organic agriculture movements strongly opposed 'Frankenstein foods' produced from plants that had been enhanced with a gene from another species. In the end, the EU developed strict GMO legislation 15 years ago, with a strong emphasis on safety for humans and the environment. Wageningen hoped the European Court of Justice would make an exception for certain applications of the new CRISPR-Cas technique, as had happened in the US. There the technique is not seen as genetic modification if it is used for point mutations that are indistinguishable from natural changes in the DNA. But the European Court of Justice ruled last year that European legislation leaves no scope for that, so CRISPR falls under the severe GMO legislation.

Sustainable farmers

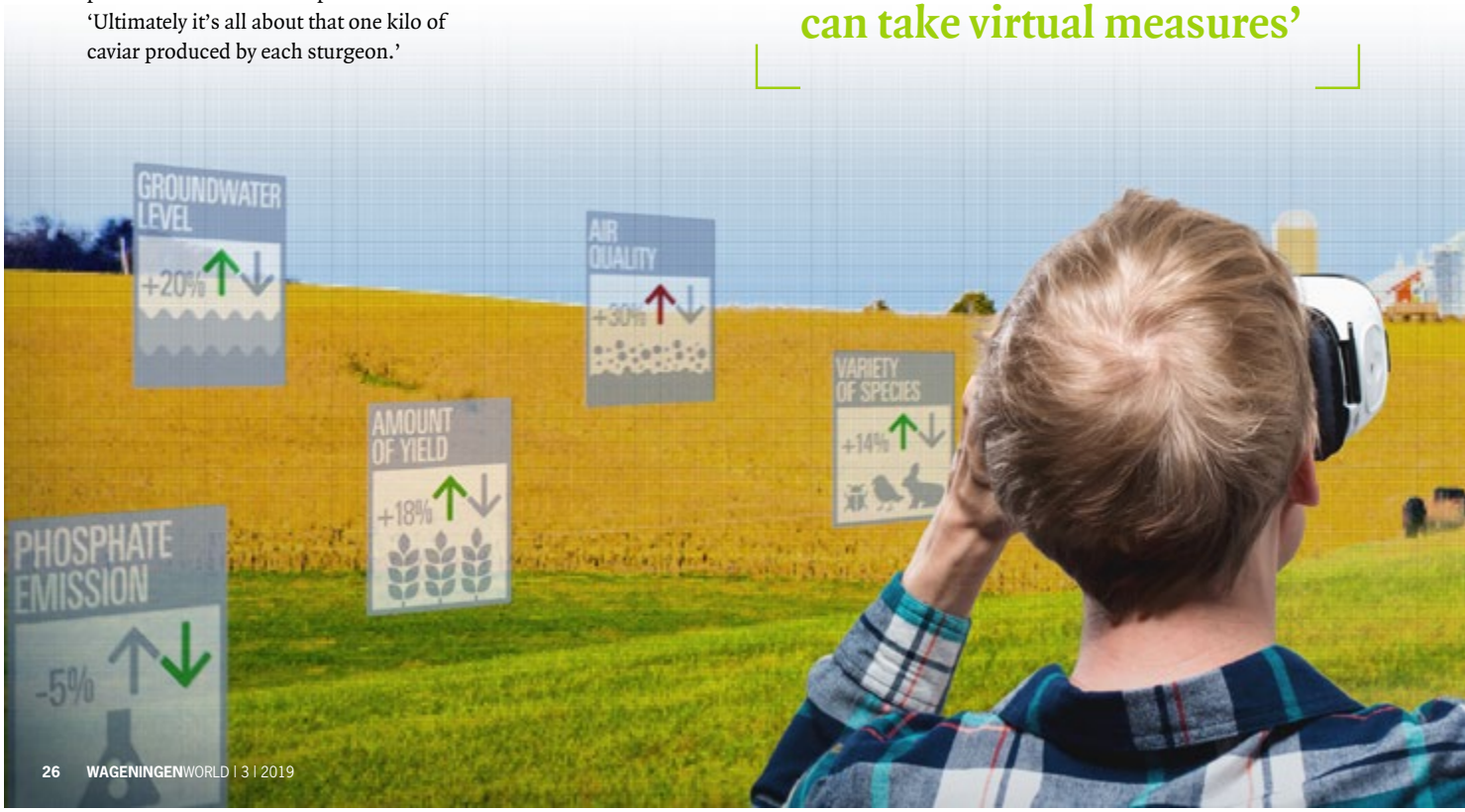
Together, model farmers from various parts of the world form an online school for sustainable farming systems. Others can explore their approach through distance learning methods including a hologram.

TEXT RENÉ DIDDE **ILLUSTRATION** PASCAL TIEMAN

It must sound strange to the Dutch, but there is a 4000-hectare dairy farm in Latvia where milk is not the main product. 'What the farmers are interested in is manure,' says Rogier Schulte, professor of Farming Systems Ecology in Wageningen. 'They put the cow dung and other organic waste into digesters and use generators to convert it into enough electricity for 2000 households.' But even the electricity generated is not the main product: that is the heat produced in the digesting process, which heats an eel and sturgeon farm, boosting production of fish and in particular caviar. 'Ultimately it's all about that one kilo of caviar produced by each sturgeon.'

The Latvian farm is just one of the seven farms Schulte selected in 2018 for the 'lighthouse farm' project. The project includes existing farms on different continents that have developed a sustainable and cost-effective farming system by adopting a radical approach. A beef farm in Ireland produces climate-neutral beef enriched with omega-3 fatty acids. A community of farmers in northern Ethiopia has created a green valley in a totally eroded desert area using a mix of careful water harvesting, dam and terrace construction and rotational grazing. In Brazil, farmers are trying to restore forest and biodiversity on a degraded nature reserve of one million

> 'Students or policymakers can take virtual measures'



light the way

hectares, in combination with organic arable farming. A Finnish organic farming cooperative is working on circular food and energy production for the regional market. In Indonesia, farmers are combining rice farming with fish farming.

'These farms were selected because they are all developing farming systems that excel in one or more of the sustainability criteria for the future. The idea of the network is that, together, they show the diversity of solutions available to address the challenges of the future,' says Schulte. As lighthouse farms, they are a light on the horizon guiding others on their way.

HOLOGRAM

Schulte describes the network as a 'global classroom or laboratory for sustainable farming systems'. Farmers all around the world can be inspired to apply the innovations on their own farms, or to develop their own variations on them. The classroom is diverse, with large industrial farms, small individual farmers and cooperatives, and both livestock and arable farms. Schulte is thinking of adding three Dutch farms at the end of the summer, from the livestock and arable sectors.

One of the means of international communication used is an interactive technique with which it will soon be possible to visit the projects using a hologram lens.

The Irish beef project has already been completed. Researcher Annemiek Pas Schrijver clicks on different maps on her laptop to see information about the acidity of the soil, the archaeology of the landscape and livestock farming's current phosphate emissions into the river. 'Participants, including students or policymakers, can take virtual measures during a session, such as planting trees, installing drains, increasing biodiversity or improving water purification. The model shows the effects on production and on the farmers' income,' she says. In June, King Willem-Alexander and Queen Máxima had a look at the activities in Ireland.

Schulte thinks that about 200 different farming systems can be improved through 12 to perhaps 20 model projects. 'Through the diversity in climate conditions, soil types, cultures, diets, livestock species and crop varieties, farmers all around the world will be in a position to improve their farms in terms of efficiency, sustainability and income.'

EXPERIMENTAL FARMS

With their collaboration with scientists and the welcome they extend to students, PhD and post-doc researchers, the lighthouse farms are like international experimental farms. A series of institutions is involved in funding the project, says Schulte. The EU supports the research in Ireland to the tune of 1.4 million euros. That enables five PhD students to do research on topics including farm system analysis, ecology, economics and health. Thanks to a Swiss charity, a PhD researcher and a post-doc will be doing research in Brazil too.

Schulte's chair group will organize a workshop in Wageningen in December, with contributions by all 12 lighthouse farm projects. ■

www.wur.eu/lighthouse-farm

Ending hunger with silkworms

Students Anjani Nayak and Fabiola Neitzel want to use protein-rich silkworms to make hypoallergenic pet food and eventually to help undernourished children in India. They won a Wageningen student challenge with their business plan. 'We saw the final round as the finishing line but we've only got busier since then.'

TEXT TESSA LOUWERENS **PHOTO** ANP

'Every year the silk industry in India is left with about 250 million kilos of silkworm pupae,' says student Anjani Nayak. 'The farmers want to get rid of them before they rot, and they often sell them off at a low price for fish feed,' she adds. 'That is not allowed because it causes pollution and there are health risks when the fresh pupae sink to the bottom of fish-ponds and rot there.' Together with German student Fabiola Neitzel, Anjani came up with an alternative: processing silkworms into food for undernourished children in Anjani's home country, India. With this idea they entered the WUR Student Challenge ReThink Protein with this idea. And they won, though not before adjusting their plans in the face of hard realities.

Students Fabiola Neitzel from Germany (left) and Anjani Nayak from India dry, crush and mill the silkworm pupae into powder.

Anjani learned a lot about the silk industry as a Bachelor's student of Agricultural Sciences in India. She learned how silkworms flourish on mulberry leaves, how they spin cocoons of silk, and how to rear them. It was then that she developed a fascination with insects. 'On Google I came across a video in which Marcel Dicke, the Wageningen professor of Entomology, talked about edible insects. That is not customary in India and my first thought was: yuck! Then I started to read more about it and within a few weeks I was sure I wanted to specialize in edible insects.'

GERMAN INSECT FARM

After watching that video, what Anjani wanted most was to do a Master's degree in Wageningen, but that was too expensive. In the end she managed to arrange an internship at a German insect farm, where she met Fabiola. Thanks in part to a shared passion for insects, they got on well from the start and became firm friends. After their internship they both embarked on Master's programmes in Germany: Fabiola in Insect Biotechnology and Bioresources at the Justus Liebig University in Giessen, and Anjani in Plant Protection and Nutrition at the University of Hohenheim.

And then last year, Anjani did get to Wageningen for the Insects as Food and Feed summer school, after which she took several courses here as an exchange student. 'Then I even found an opportunity to do my thesis here, under Dennis Oonincx and Joop van Loon.' It was here that she heard about the WUR Student Challenge, ReThink Protein. In this international competition, students are challenged to come up with new ideas for feeding the growing world population (see inset). >

FOTO GETTY

'I thought of silkworms straightaway, but I wasn't sure if it was a good idea.' She got in touch with Fabiola, who was in China at the time, and she was enthusiastic. The deadline for submitting ideas was only a month away. Fabiola: 'Communication was a bit difficult at times because of the restricted access to the internet in China.' They worked on their proposal throughout December and in January their two-person team SWAP (Silkworm as Protein) was born.

'Insects are a healthy and sustainable source of protein,' says Anjani. 'They are expensive to farm because production is often small-scale and labour-intensive. But the silk industry already has thousands of years of experience in this area. The pupae are a by-product, so they are affordable, and by using them as food we help combat pollution.'

'Dried pupae contain up to 70 per cent protein'

They submitted their proposal after Christmas. 'We thought we had got quite far at that point,' says Anjani. But taking part in the challenge turned out to be pretty labour-intensive and the months that followed brought a series of deadlines, presentations and meetings. Anjani: 'Every now and then I wondered whether it wouldn't have been a better idea to focus on my Master's thesis.' The collaboration went smoothly in spite of their being more than 300 kilometres apart, Anjani in Wageningen and Fabiola in Giessen. And they were not without support. Fabiola: 'You have access to a platform on which you can get help from the participating companies. One of the coaches who helped us enormously is Derick Jiwan, manager at Hazel Technologies, a Chicago-based company that develops products for reducing food waste.' The team was also coached by organizations including Rabobank, Topstart, Nutreco and Nature 2.0. Fabiola: 'And we took part in seminars, on writing a business plan, for instance, and on finding funding.'

The students also had the chance to pitch their ideas to different companies and brainstorm with them. Anjani: 'We learned an awful lot from that, but we also found out that it's impossible to follow all the advice. In the end you have to make decisions yourself.'

The pair succeeded in creating their first prototype, a kind of protein powder. It turned out to be quite a job to get hold of the silkworm pupae. Anjani: 'Eventually we discovered that you could buy dried pupae as a snack on eBay in China.' Fabiola processed these pupae in the lab. 'The dried, defatted pupae powder contains up to 70 per cent protein. It is also rich in iron and essential amino acids, and it is a source of healthy omega-3 fatty acids.'

DEVASTATED

Everything went swimmingly until the team had to radically change their idea in the middle of the competition. Anjani: 'We discovered that selling insects for human consumption is prohibited in India.' They were devastated. 'We thought, well, we might as well pack our bags.' But in consultation with their coaches they decided to adapt the idea and focus in the first instance on the animal feed industry. 'Ultimately, it's all part of the competition that you learn as you go along and develop your idea,' says Fabiola. Anjani: 'In Europe alone, there are 360 million pets and with increasing prosperity in India, the number of pets there is growing too. Animal feeds based on insects are also a solution for pets that are allergic to beef or chicken, and for pet-owners who want sustainable pet food.' Fabiola: 'Pet food is more lucrative than livestock feed too, and you can produce it in smaller quantities.' They hope to scale up production later on, and to develop products for the livestock feed industry as well. Anjani: 'In the end, once we are established, the law has changed in India and eating insects is more widely accepted, we want to make

> ‘Several investors have shown an interest’

the shift towards products for human consumption.’ After an extensive quest, the pair have now found a local silk producer in India who is willing to sell them his pupae. Anjani: ‘On condition that we give him the same price for them as the fish farmers.’ Because the pupae rot quickly, they really need to be processed the same day. The businessman has offered them a room where they can set up their first production line. The students want to dry, crush and grind the pupae and sell the powder worldwide. This would make them the first producers of silkworm protein powder in India.

TESTING FOR SAFETY

The jury was impressed by the team’s thorough preparations and the fact that they had already given careful thought to how they wanted to market their product. They did ask a few critical questions, however, including about safety issues, given the large amounts of pesticide used in the silk industry. Fabiola: ‘We are aware of that and we want to use the next 12 months to further validate the processing method and to test the pupae from India in the lab for safety.’ They then want to start a small-scale pilot production project in India in 2020. If that goes well, they hope to process 100,000 kilos of pupae per year from 2021.

Winning the competition is by no means the end of the road, they realize. ‘All the time we saw the final round as the finishing line, but we’ve been even busier since then. Several investors, such as Rabobank and Nutreco, have already shown an interest,’ they say proudly. They want to use the 5000 euros prize money to fly to India together at the end of this year, partly so as to meet the local silk farmer for the first time. But first they’ve got Master’s theses to finish off. ■

www.wur.eu/studentchallenges

INTERNATIONAL STUDENT COMPETITIONS

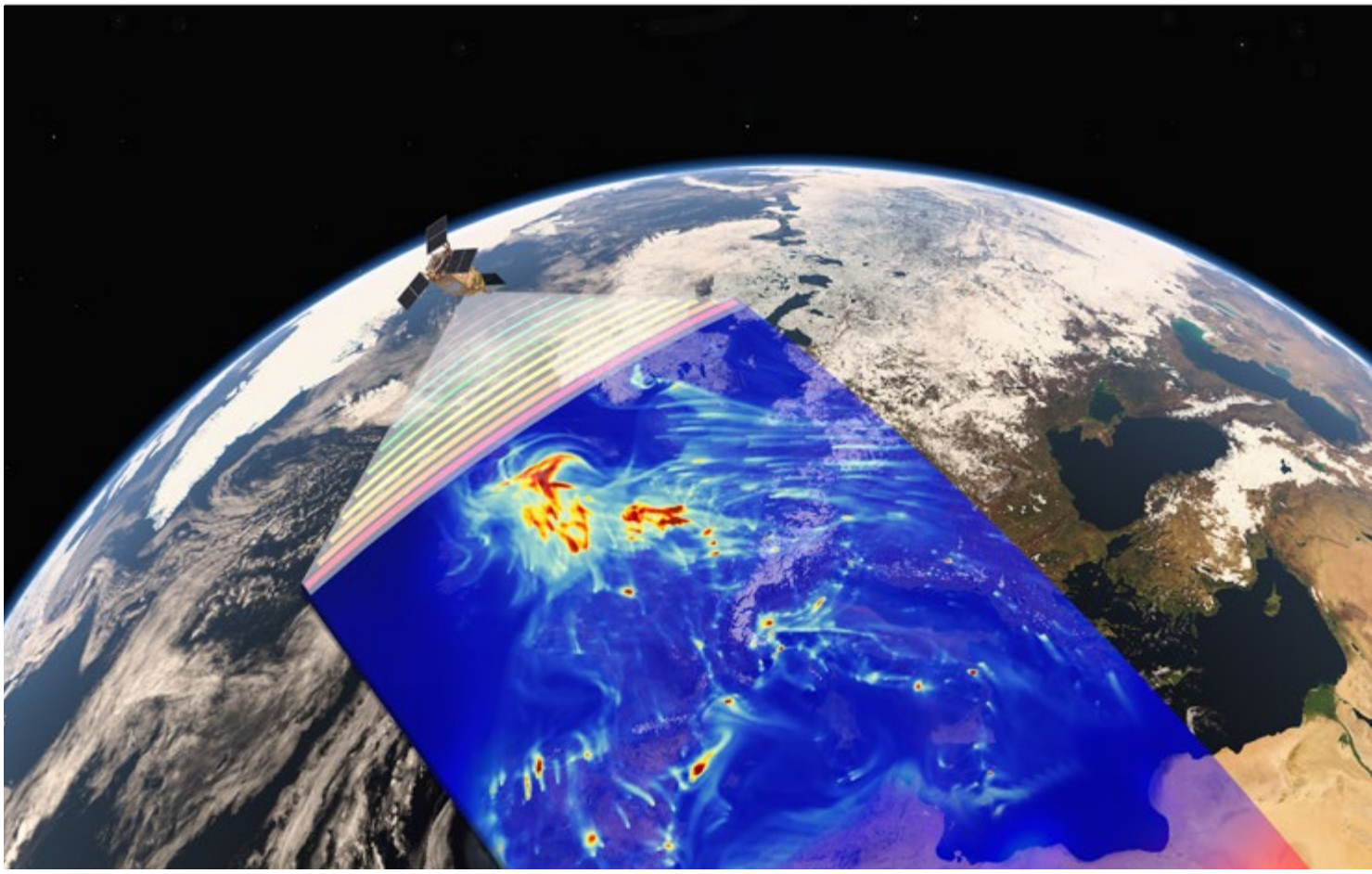
The WUR Student Challenge: ReThink Protein is an international competition in which students are challenged to submit an idea or a prototype for providing the growing world population with protein that is sustainable, healthy and affordable. ‘Our aim is to stimulate enterprising students to further develop their ideas and talents,’ says coordinator Rio Pals.

58 teams submitted a first draft and 40 of them were given six months to hone their idea or prototype with the help of coaches from the business world and universities. The jury, made up of people from The Protein Cluster (TPC), Cosun, Nutreco, the ministry of Agriculture, Nature and Food Quality, DSM and Nature 2.0, selected the best teams on the basis of criteria such as innovativeness, sustainability and feasibility.

Team SWAP (Silkworm as Protein) won the final round on 27 June in the ideation category. The GrainGain team won in the Prototype category with their idea for processing waste streams from beer breweries into products such as energy bars. The winning teams receive 5000 euros and support from StartHub to continue developing their idea. The best WUR teams will compete with teams from other Dutch science universities at the 4TU innovation finals on 7 November.

The next Wageningen student challenge is the Urban Greenhouse Challenge, which starts in October this year in China.

PHOTO GUY ACKERMANS



It takes an ESA satellite with a spectrometer one day to give a complete picture of air pollution all around the world.

Space watchdog for Earth's atmosphere

Tropomi, a Dutch-built measuring instrument that was mounted onto a satellite at the end of 2017, measures air quality better than has ever been done before. This reveals new sources of nitrogen dioxide. Authorities can use these data to check whether a sector is sticking to emission reduction agreements.

TEXT RENÉ DIDDE **PHOTO'S** ESA/ATG MEDIALAB

Since the end of 2017, a satellite with the Tropomi measuring instrument has been orbiting the earth on a different path every 100 minutes. In one day with 14 orbits, it gives a complete picture of all the air pollution in the world. 'Our Tropomi spectrometer measures sunlight reflected by Earth, from which we can deduce the type and the concentration of gases such as nitrogen dioxide,' says Folkert Boersma, associate professor of Meteorology and Air Quality in Wageningen, who works for the Royal Dutch Meteorological Institute (KNMI) as well. The images of the concentrations the instrument sends to Earth are not only light-

ning fast but also crystal clear. 'We have millions of images at our fingertips within three hours, of cities from Jakarta to Paris, and from Vancouver to Sydney. They enable us to see the concentration of polluting nitrogen dioxide at the urban district level.'

BOULEVARD PERIPHERIQUE

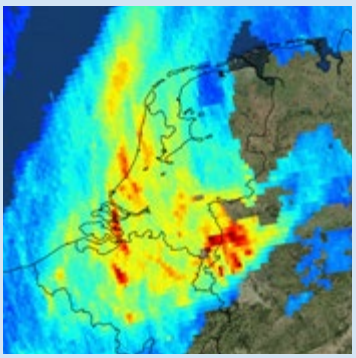
Nitrogen dioxide contributes to smog, especially in the summer months. It can sometimes be seen with the naked eye as a reddish-brown haze over cities. With Tropomi's predecessors, researchers could already see patches of air pollution above areas such as Rijnmond, the Ruhr and the Po valley. Nowadays the spectrometer measures with an improved pixel resolution of 5 by 3.5 kilometres. 'Now we can see the *Boulevard Peripherique* around Paris, the *Autoroute du Soleil* and the main shipping lanes,' says Boersma.

By factoring in the impact of the wind and chemical reactions, he explains, emissions from the source can be deduced from the concentrations indicated by the spectrometer. This brings to light hitherto undiscovered sources of nitrogen dioxide. On satellite images above China, Boersma discovered patches of pollution that turned out to come from new coal-fired power stations that the authorities had not yet registered for emissions reporting. He also saw the opposite. 'In north-west Spain less nitrogen dioxide was picked up because, it turned out later, air filtering techniques had been introduced in the power stations.'

DETECTIVE WORK

The basis for the environmental detective work is that the spectrometer measures sunlight reflected by Earth's atmosphere in many different colours of the spectrum. Take the nitrogen dioxide in smog. 'The NO_2 molecule absorbs sunlight of one colour a little bit more than that of another colour, so NO_2 leaves a unique barcode behind in the spectrum measured. The more NO_2 there is in the atmosphere, the more clearly it is recorded,' explains Boersma. And it is not just nitrogen dioxide that Tropomi can detect, but also other pollutants such as carbon monoxide, ozone, fine particles and methane. Methane contributes significantly to climate change.

The research using Tropomi makes it possible to monitor the emissions of a city from day to day. Boersma: 'We see that there is less nitrogen dioxide on Sundays because there is less traffic and industrial activity, and we see the smoke from ships in busy shipping lanes.' The Wageningen analysis also revealed that last year in a cold week in February in Paris, much more fuel was burned than had been assumed on the basis of existing databases on fuel use and consumption patterns in power stations and urban heating systems.



TROPOMI

The Tropomi spectrometer was launched with the ESA satellite Sentinel-5 Precursor in 2017. It took six years to develop and cost 80 million euros. Besides WUR, other Dutch institutes that are involved are the Royal Netherlands Meteorological Institute (KNMI), the Netherlands Institute for Space Research (SRON), research organization TNO and the Technical University of Delft. The Belgian Institute for Space Aeronomy BIRA is involved, and from Germany, the University of Bremen, the aerospace centre DLR and the Max Planck Institute.

www.tropomi.eu

WATCHDOG

With this information, Tropomi, which has been worked on by several European research institutions and universities (see inset) alongside Wageningen University & Research, can be an important watchdog for Planet Earth, says Boersma. 'We provide data with which the authorities can ascertain whether a sector such as road transport is keeping its word on emissions reductions. In future we can also see whether such measures as car-free inner cities really work, or whether there is much point in systems like letting cars with even and odd registration numbers be on the road on different days.'

A genuine Sherlock Holmes case is the mystery of the stagnating reduction in nitrogen dioxide emissions in the European Union. 'In the period 2004-2010, the concentration plummeted due to the introduction of the European emissions norms for road traffic, but after that nitrogen dioxide emissions did not go down any further. Economic growth is not an adequate explanation for that. We are currently researching whether "dieselgate" could explain it.' Car manufacturers manipulated the statistics on nitrogen oxide emissions from cars using software fixed to falsify emissions figures; the real emissions were much higher. 'We are also looking at the impact of natural sources such as lightning.'

TYPICAL OF WAGENINGEN

A typical example of Wageningen research that Folkert Boersma is doing with Tropomi is a study of fluorescence in plants, as a contribution to solving the climate puzzle. 'Plants emit a bit of light when they absorb CO_2 for their photosynthesis. From the satellite images, we can see where the amount of photosynthesis is going down, due to drought or felling in the Amazon, for example. We can also find out whether reforestation projects are working.' ■

www.wur.eu/maq

Fermentation's great promise

Much of our food, including sauerkraut, chocolate and yoghurt, is the product of fermentation: it has already been digested by bacteria, fungi or yeasts. But these micro-organisms can do a lot more than that. Researchers are working in specialized labs on new tempeh, chemicals and biofuel.

TEXT HANS WOLKERS
PHOTO VERSE BEELDWAREN

‘The possibilities fermentation offers are endless,’ says Professor Eddy Smid of the Wageningen Laboratory for Food Microbiology. He works with fermentation to develop new, healthy foods with a unique taste, better nutritional value or a longer shelf life. Micro-organisms are key to this process. The principle is not new: people have been making use of bacteria, fungi and yeasts to process foods for thousands of years (see inset). But scientists are still finding new applications.
Smid, for example, is always looking for the best match between various micro-organisms. ‘So we came up with Tinder for Microbes. That is a resource for predicting which micro-organisms combine well together, using the microbe’s profile, such as its preferred substrate feed and the substances the organism forms.’ >

PHOTO ALAMY

PHOTO SHUTTERSTOCK

Fermenting lupin to make tempeh and then making propionic acid bacteria form vitamin B12 produces a sustainable meat substitute.

> **‘Lupin tempeh is rich in protein *and* vitamin B12’**

A well-known match is the one between lactic acid and propionic acid bacteria, which combine to make the famous Emmenthaler cheese. The lactic acid formed by lactic acid bacteria is the perfect diet for the propionic acid bacteria, which in turn form flavour and aroma components that give the cheese a sweet flavour. ‘Those propionic acid bacteria also produce vitamins, including vitamin B12,’ says Smid. ‘We’ve been using that characteristic to develop a new tempeh with this essential vitamin. Normally, only animal products contain vitamin B12.’

Tempeh, a meat substitute made of fermented soya beans, is made by the *Rhizopus* fungus, which produces lactic acid. Researchers from Smid’s team added propionic acid bacteria, which enriched the tempeh with vitamin B12. This new meat substitute is of interest to vegans, who don’t eat animal products and therefore don’t get any B12.

LUPIN TEMPEH

Because the production of soya often goes hand in hand with large-scale deforestation, Smid sought a sustainable alternative to soya beans. He found one a few years ago in the form of lupin, a European crop with a nutritional value comparable to that of soya. He could ferment lupin to get lupin tempeh using the same fungus that is used with soya, after which fermentation with propionic acid bacteria formed vitamin B12. Smid: ‘That gave us a sustainable product that was rich in protein and vitamin B12.’

One of the interested companies, and one which also participates in Smid’s research, is the Dutch ‘Vegetarian Butcher’. ‘Fermented products may well be even more interesting as meat substitutes than the plant-based ingredients currently being used,’ says Niko Koffeman, co-founder of the company. ‘Fermentation leads to natural, unprocessed products. If they also contain a natural source of vitamin B12, we’ve got hold of something unique.’ Using regionally grown lupin makes the product even more sustainable. Koffeman hopes to have the new product on the supermarket shelves within a few years.

Filip Oosterlinck, product manager at De Hobbit, a Belgian producer of natural, organic meat substitutes, is collaborating in Smid’s research too. The vast majority of the conventional meat substitutes produced by the company, among them tempeh and natto, are fermented and inspired by Far Eastern cuisine. ‘Those fermentation

processes are thousands of years old. They provide complete, safe and natural foods without additives,' says Oosterlinck. 'Given fermentation's potential for so many new products, I expect we are going to be marketing more and more fermented meat substitutes based on new ingredients such as chickpeas or black beans.'

MAKING CHEMICALS

Applications of fermentation outside the food sector are relatively new. Jeroen Hugenholtz, a researcher at Wageningen Food and Biobased Research, focuses on making chemicals out of waste streams. He studied how processes can be steered and optimized through the choice of micro-organisms, ingredients and fermentation conditions, such as temperature and acidity (pH). 'We want our research on the efficient fermentation of waste streams to give companies new opportunities and a greater understanding of cost-effective chemical production,' says Hugenholtz. 'By using waste streams such as organic waste, it is theoretically possible to cut costs by at least 50 per cent because the raw material is cheap.' One example of successful conversion of a waste stream into chemicals is the production of bioplastic from organic waste through a process in which various bacteria produce fatty acids under anaerobic conditions. Subsequently the *Pseudomonas* bacterium converts the fatty acids into polyhydroxyalkanoate (PHA), one of the building blocks for bioplastic.

Different species of microbe produce different materials from organic waste: lactic acid bacteria ferment sugars into lactic acid, the basis for poly-lactic acid (PLA), another type of bioplastic. 'We monitor and steer these kinds of conversions by making use of one or two bacteria and then manipulating the pH and the oxygen supply,' explains Hugenholtz.

A big advantage of microbes, in Hugenholtz's view, is their capacity to convert contaminated waste streams, which is not possible using chemical methods, for which the raw materials need to be very pure. Fermentation is also more sustainable and cleaner: no solvents, acids, leaching or high temperatures are required, as they are for chemical processes. But micro-organisms alone will not suffice, thinks Hugenholtz, who sees fermentation and traditional chemical methods as complementary. 'It is often efficient to finish off >

EDDY SMID
professor of
Food Technology

PHOTO GUY ACKERMANS

JEROEN HUGENHOLTZ
researcher at Wageningen
Food & Biobased Research

FERMENTATION FOR MORE THAN JUST FOOD

Every day we eat products on which fungi, yeasts and bacteria have left their mark. Sauerkraut, beer, wine, yoghurt and cheese are obvious fermented foodstuffs, but so are coffee, cocoa and Parma ham. In all these products, bacteria, yeasts and fungi have converted substances into aromas or antibacterial components such as bacteriocins, which counteract specific pathogens. Manufacturers of raw-milk cheeses add bacteriocin-forming microbes to their products during fermentation, to halt the growth of pathogenic Listeria bacteria. Fermentation is important outside the food industry too. Yeasts and bacteria can produce antibiotics, insulin and other medicines, as well as chemicals and fuels. This becomes especially interesting if it is done using waste streams.

Waste streams can also be a source of products that are useful in foodstuffs. Through fermentation, a waste stream that contains relatively large numbers of proteins can provide the food industry with many useful amino acids and flavour components derived from them.

‘Companies are interested in sustainable alternatives to palm oil’

PHOTO GUY ACKERMANS

JACCO VAN HAVEREN
programme manager
Biobased Chemicals
& Fuels

the processing of fermented products made by fermentation using chemical processes. For example, we convert lactic acids formed by fermentation into polylactic acids, PLA, chemically.’

There are millions of species of bacteria and fungi which are capable of making countless food ingredients, chemicals or the building blocks for them out of waste streams. The yeast *Pichia pastoris* makes polypeptides – short protein chains of just a dozen or so amino acids – out of sugars. Some of these small proteins could replace certain ingredients in cosmetics. It will take a few years, however, before the first applications appear on the market. Jacco van Haveren, programme manager at Biobased Chemicals & Fuels in Wageningen: ‘The development could take years, but if it works well, it could go quickly.’

Clostridium is another example. This bacterium produces alcohols, aldehydes and fatty acids, substances that can be used to produce biofuels, solvents, cosmetics and pharmaceuticals. Some fatty acids are also suitable for use as preservatives. Both the food and the cosmetic industries currently use the preservative benzoate, a substance that has been linked to hyperactivity in children, and which sometimes gets converted into toxic benzene. The Wageningen study focuses on developing safe alternatives using biobased fatty acids.

‘One thing producers are very interested in, for both cosmetics and food products, is sustainable alternatives to palm oil,’ says Van Haveren. ‘Fatty acids formed by fermentation provide the basis for several oils that could replace palm oil.’

AVIATION FUEL

The research on applications for biofuel is very promising too. ‘The *Clostridium* bacterium makes a mix of acetone, ethanol and most of all, butanol out of potato peel,’ says Van Haveren. ‘Butanol is a building block for biofuel and the most interesting option, commercially. We are now trying to steer the process so that even more butanol is formed.’ If you use traditional chemistry to link three butanol molecules, you get dodecane, which has potential as aviation fuel. ‘Our goal is to make the production of aviation fuel out of waste streams consisting

REDUCING CLIMATE EMISSIONS IN THE CHEMICAL INDUSTRY

Fermentation is one of the technologies used to produce biobased chemicals. By producing these chemicals and using milder processes, the chemical industry is helping reduce its climate emissions. Wageningen makes a contribution as a knowledge partner.

Biobased alternatives are possible for all basic chemicals currently produced from oil. These might be substances with the same structure as petrochemicals (known as drop-in substances), or new chemicals with new and unique characteristics such as biodegradability or non-toxicity, which can be used in packaging or cosmetics. Wageningen Food & Biobased Research is doing research in collaboration with the industry on developing biobased chemicals which are produced sustainably and have improved characteristics. That is good for the environment as well as for the competitiveness of companies.

‘Biobased drop-in products will make a significant contribution to reducing CO_2 emissions,’ says Jacco van Haveren, programme manager for Biobased Chemicals and Fuels. But creating new substances can also resolve the undesirable aspects of currently available chemicals.

of potato peel and other wet biomass economically viable within 10 years,' states Van Haveren. 'But we do need financiers and funds for that, to invest in a factory.'
Misha Valk, head of Future Fuels at the Dutch company SkyNRG, a global leader in sustainable aviation fuel, sees an important role for fermentation of waste streams in making air travel more sustainable. 'At present, the commercial production of biokerosene from used vegetable oil or animal fats is possible,' he says. 'A new factory in Delfzijl will start producing 100,000 tons of sustainable kerosene a year from 2022. But there is nowhere near enough used oil and fats to meet the demand. So in the near future fermentation will definitely be an important technology for making kerosene out of waste streams commercially.'

BOTTLENECKS

Chemicals and materials obtained through fermentation currently cover only a fraction of the total demand. 'Only five to seven per cent of all chemicals are biobased,' states Van Haveren. 'And only five to ten per cent of those are obtained using fermentation.' One of the bottlenecks for large-scale production is that many processes are still in the development phase. Research on upscaling of processes developed in the laboratory is also expensive.
One positive exception is the production of bioplastic based on PLA (polylactic acid), almost all of which is obtained by fermenting sugars in agricultural products and waste streams. But in spite of the large-scale commercial production of 150,000 to 200,000 tons a year, PLA makes up only a tiny proportion of the 300 million tons of plastics produced globally every year. There is growth, though, says Van Haveren. As the supply of cheap oil slowly but surely runs out, biobased chemicals can compete better with petrochemicals. 'At the moment, PLA plastic is still a little more expensive than conventional plastic, but if we start producing it on an even larger scale, it will compete with oil-based plastics pricewise.'
Van Haveren sees concern about the climate, dwindling oil supplies and the toxicity of some traditional chemicals, such as the preservative benzoate, as an additional incentive to focus on manufacturing chemical building blocks, with a key role for fermentation. This will produce safer and more sustainable products, thanks to a tradition going back thousands of years of making micro-organisms work for us. ■

www.wur.eu/fermentationtechnology

PHOTO ALAMY

Clostridium bacteria make butanol out of potato peel. Linking three butanol molecules using traditional chemistry produces dodecane, which has potential as aviation fuel.

'Producing aviation fuel from biomass waste will be economically viable within 10 years'

ARTHUR VAN DER LINDEN, FOUNDER OF THE OASEBOS FOUNDATION

‘I always felt the world wasn’t green enough’

Arthur van der Linden’s passion for international nature conservation was ignited in Wageningen. He and some of his friends founded the Oasebos Foundation to save the rainforest in Costa Rica. The crux of good nature conservation is that you need space. ‘It’s the hectares that matter!’

TEXT MARION DE BOO **PHOTOGRAPHY** ALDO ALLESSI

Wisps of mist rise slowly from the tropical rainforest in the north-east of Costa Rica. Crickets chirp away and the howler monkeys can be heard loud and clear. From high up in the wild almond trees, the giants of the rainforest, come the screeches of the green-winged macaw, the largest parrot in the world. The camera zooms in on three chicks in a nesting hole at least three metres wide.

‘The green-winged macaw is iconic for the rainforest,’ says the Wageningen forestry expert Arthur van der Linden (47), showing a film on his laptop. ‘It is now in danger of extinction due to deforestation and the trade in exotic animals. By buying up forest to protect it, we are hoping to turn the tide.’

To do this, Van der Linden and two Wageningen classmates took the initiative to establish a foundation 15 years ago. Since then, the Oasebos Foundation has been buying up primeval forest in the Maquenque region in order to protect it as a nature reserve. ‘You can buy a tract of primeval forest in Costa Rica for 14 to 20 cents per square metre and protect that incredibly rich biodiversity for ever.’

A group of 10 friends bought the first tract of 18 hectares in 2001 from an elderly farmer with money problems. The ministry of Nature Conservation, which Van der Linden had worked with for three years, had tipped him off that the forest was for sale and was in danger of being bought by a hotel business. ‘I went there and closed the deal with my own credit card. Only afterwards did we look into the legal side of it. A larger purchase of 111 hectares followed in 2003, and the Oasebos Foundation was established in 2004.’

OAKS AND BEECHES

‘I always felt the world wasn’t green enough,’ says Van der Linden. ‘As a young lad of six or seven years old, I grew oak, beech and bird cherry saplings and planted them out along ditches and roads around my home village of Sevenum in Limburg.’

A Wageningen degree in Forestry was an obvious choice. Here he met Forestry professor Roelof Oldeman. ‘As soon as that man opened his mouth, he widened my horizons. After Limburg, suddenly the whole world was my playground.’ >

‘Forests are the planet’s natural air-conditioning’

In his student years, from 1989 to 1995, Van der Linden sang as a countertenor in an a cappella choir that sang everything from the Beatles to classical music. ‘But I was mainly busy studying. What I learned in Wageningen about how to design landscapes and what makes people tick has powered my whole career. I picked up both my enterprising attitude and my interest in sustainability in Wageningen.’

ARTHUR VAN DER LINDEN

Age: 47
Studied: Forestry 1996
Work: Project leader for recreation and tourism at the Provincial Authority of Gelderland. Founder of the Oasebos Foundation, www.oasebos.nl

On holiday in Senegal and Indonesia, the Wageningen student soon realized that a job as a development worker would not suit him. ‘It seemed like a road to nowhere to me, to aim to teach people a specific lesson. I preferred to connect with what the people in the country were doing themselves. A country like Costa Rica has a strong nature conservation movement. If you link up with that, your efforts will be more fruitful and what you achieve will last longer. Costa Rica has the highest biodiversity per square kilometre on Earth. It is a very complex world that you are protecting there.’

PARADISE

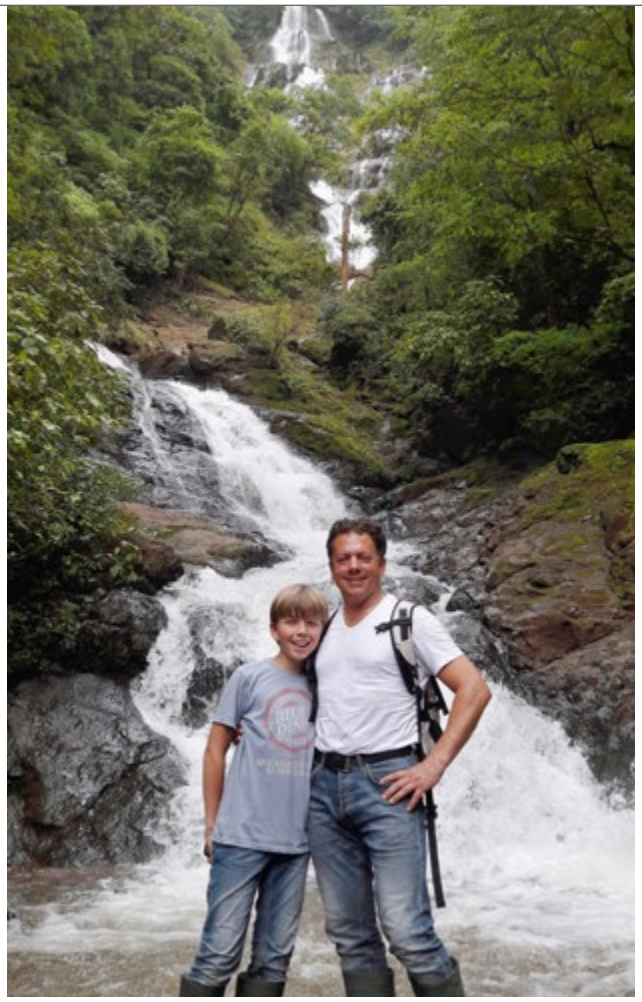
After he graduated, Van der Linden worked for two Limburg municipalities and then for three years for a forestry company in Costa Rica. During that period he developed good contacts in the Costa Rican government. ‘I had been there before. The first time was in 1993, when I did an internship at Curu National Park, on the Pacific coast. I thought it was magical. There was a turtle sanctuary there. Just imagine: a divine beach with bright white sand, blue water, palm trees, rocks at both ends and then at night a glorious starry sky in which you can see so much depth. Nature is so overwhelming there, and that touched me.’

About 90 per cent of the wild almond trees in which the macaws nest have been cut down since the 1960s to make way for cattle for hamburgers, pineapple and banana plantations, teak and oil palms. To save the rare parrots from extinction, Maquenque National Park is now being established, and the Oasebos Foundation is doing its bit towards that. Since it was founded in 2004, four tracts of virgin primeval forest in the Maquenque area, 215 hectares in total, have been bought up in order to protect the forest, not just for the macaws but also for other plant and animal life. The first purchase was made in 2004 and the last a few months ago. It is the most beautiful part of Costa Rica, Van der Linden thinks: a 15,000 hectare park with huge almond and kapok trees of up to 60 metres in height in the north-east near the border with Nicaragua. ‘You can drive along a dirt road there and see a five-metre-long boa constrictor crossing the road, or you go running and suddenly a caiman splashes into the water.’

AIR MILES

Much as he loved it, Van der Linden and his wife left Costa Rica in 2001 after three years and went back to Europe, because they wanted to start a family and be near their relatives and friends. They had two sons. ‘Costa Rica is in my heart but because I don’t want to clock up too many air miles, I only go there every four years now,’ says the entrepreneur. After a year with WWF Spain, promoting the FSC label for wood from sustainably managed forests, he started work in the Netherlands with the Foundation for Nature Management and Rural Areas, an initiative of the Royal Dutch Hunters Association. Three years later, he moved to the Rural Areas Service in Utrecht, where he designed recreation areas. In 2006, he got a job in the recreation and tourism department of the Province of Gelderland. ‘My ambition is now to develop a complete network of walks along the same lines as the cycle path network.’

On the side, Van der Linden is still an active ambassador for the Oasebos Foundation, after eight years as a member of the board. ‘Right now I am phoning around to try and get companies to buy half a hectare of forest in Costa Rica for 750 euros. You get a



Arthur van der Linden with his youngest son at the El Salto waterfalls in an area of Costa Rican forest protected by Oasebos.

‘After Limburg the whole world was suddenly my playground’

certificate of ownership. According to our statutes, the forest you buy will always be protected, and can never be sold. Costa Rica is a reliable country where you can do serious business. We have now handed out about 150 shares to both companies and individuals. We also have donors who support us with small amounts, whether monthly or on a one-off basis.’

The foundation gets maintenance funding from the Costa Rican ministry of Nature Conservation, with which it pays biologists as supervisors, who visit the reserves once a month. They also make use of local forest rangers. Van der Linden: ‘If there are problems, the supervisors visit more frequently. Because if the deer are being poached, the jaguar will have nothing to eat. When the local farmers harvest the sugar cane, they burn the stubble, and dry grasslands get burned as well. You don’t want those fires spreading into the forest reserves.’

The forests that are protected by the foundation must be left in peace. These are tracts of primeval rainforest adjoining existing nature areas. ‘We don’t engage in ecotourism. There are other organizations for that. If you don’t cut paths, you don’t get as many poachers going in. We only buy uninhabited land. Actually there is depopulation going on in this region: people are leaving for the big cities.’

The crux of nature conservation, says Van der Linden, is that you need space. ‘It’s the hectares that matter! If people want to set up a similar foundation to Oasebos, I help them free of charge. We now have a good business model, which we can scale up more and more. Already, four more foundations have been set up along the same lines as ours. Oasebos is the first nature conservation club in the world to make use of blockchain technology. In a few clicks you can become the owner of a piece of nature, which has been defined and checked and can only be allocated once. Our Dutch professionals work on a voluntary basis. If I fly, I pay for my ticket myself. We don’t advertise. That is why we have very low overhead costs.’

Van der Linden is very positive about Dutch nature policy. ‘The beaver, the otter and even the wolf are back.’ From his own wild garden on the edge of the Veluwe plateau, he hears owls and ravens. ‘Those ravens weren’t here 20 years ago, but now they are.’ Squirrels, hedgehogs and numerous species of birds visit his garden. ‘Of course it’s not going well on all fronts. We’ve got a blanket of air pollution over us, which does a lot of damage. And nature needs space in the Netherlands, the same as anywhere else. It’s the hectares that matter. Reforestation is a very good thing too, of course. Forests keep the planet cool and extract CO_2 from the air. They attract rain. Forests are the planet’s natural air-conditioning.’ ■

PHOTO ALAMY

GREEK ALUMNUS NIKOS MYLONAS:

‘I want to bring knowledge and technology to farmers’

Nikos Mylonas is developing agricultural applications for artificial intelligence in Athens. He got his inspiration in Wageningen, where he took the MSc in Biosystems Engineering with support from the Pavlos Condellis Fund. ‘I want farmers to benefit from it.’

TEXT ANJA JANSSEN

Nikos Mylonas grew up in Patras as the-son of an amateur olive farmer and winegrower. After a Bachelor’s degree in Mechanical Engineering in Athens, he was eager to pursue agricultural applications. ‘I have helped on the farm since I was a child, from sowing to harvesting. After that I initially opted for aeronautical engineering, but I always wanted to combine my technical know-how with agriculture.’

Wageningen was Nikos’s first choice for a Master’s. ‘I was attracted by both the theoretical side of the Master’s programme here and the practical experience it offered, with its thesis and internship options. And of course, Wageningen is number one in the field of agriculture.’

The grant from the Pavlos Condellis Fund covered his accommodation and living costs. The fund was established in 2016 by the Greek farm mechanization entrepreneur Pavlos Condellis, in order to give scholarships to outstanding Greek students want-

ing to do an MSc in Biosystems Engineering in Wageningen. 'Without that money, it would have been very difficult to study in Wageningen. The scholarship made it a lot easier.'

Mylonas was not disappointed by the hands-on experience he was looking for. 'The programme gives you realistic cases from actual practice. We worked in groups on projects for farmers and companies. Exactly what I wanted. We tested mobile robots and robotic arms, for instance.' For his thesis, Mylonas studied the use of drone footage for detecting weeds in sugar beet fields. 'And I went out to the farms for as well, to take measurements and fly the drones.'

In Wageningen, Nikos explored the potential applications of artificial intelligence, such as detecting weeds or diseased plants using camera footage. That inspired him to go on to a PhD at the Agricultural University in Athens, delving into image-processing techniques and deep learning – a computer technique for recognizing patterns, based on the way human neurones work. 'I want to bring this knowledge and technology to practitioners so they can benefit from them.'

NEW KNOWLEDGE IS NEEDED

This endeavour is a perfect fit with Pavlos Condellis's motives for setting up a fund for talented Greek students wanting to take the Master's in Biosystems Engineering – preferably specializing in precision agriculture. 'As well as new machines, what our agriculture sector needs most is new knowledge. I want to prepare young Greeks for the future of the world and of our country, and to give them the chance to develop to a high level,' said Condellis when he set up his named fund.

Mylonas graduated in September 2018 and started his PhD research in Athens this spring. There are currently three Greeks studying in Wageningen on a Pavlos Condellis Fund scholarship. Last year the scholarship students, including Mylonas, met Pavlov's widow Ariane Condellis in Wageningen. She has kept the fund going since her husband's death in 2017.

Ariane Condellis found her visit to Wageningen a very positive experience, she tells us in an email. 'I was impressed by the many different sides to the degree courses, by the atmosphere, by the professors' enthusiasm and by the obvious orientation towards sustainable development. And I also appreciate the practical approach in the degree programmes, focusing on the business world and not just on careers in the academic world. If I were younger I would have liked to do something like this too. That is a reason for me to carry on supporting students.'

> **'I enjoyed the intensity of the MSc programme'**

MORE COMPETITIVE

The approach to university studies in the Netherlands took a bit of getting used to, says Mylonas. 'It is more competitive than at Greek universities. To me the Dutch system is more inspiring because it challenges you to perform in a top university environment. The teachers expect more of you. I have enjoyed that intensity. On the other hand, teachers are open to feedback from students. That makes the learning process more interactive.'

He found the contact he had with students from other countries interesting too. 'In Wageningen I made friends from all around the world. My best friend comes from India but I also got to know South American and Chinese people. It was a unique experience to work with them and spend leisure time with them.' Cycling around Wageningen and the outstanding infrastructure for cycling was another unforgettable experience for Mylonas. 'I thought it was highly unusual to have the bike as the only means of transport, but I enjoyed it – although not on rainy or wintry days.' ■

PAVLOS CONDELLIS FUND FOR EXCELLENT GREEK STUDENTS

The Pavlov Condellis Fund is the first named fund under the University Fund Wageningen umbrella to be established by an international donor. Condellis set up the fund in 2016 to provide excellent Greek students with scholarships for the MSc programme in Biosystems Engineering at Wageningen University. The fund expects beneficiaries to contribute to the development of the agriculture sector in Greece after they graduate.

www.universityfundwageningen.eu/pavlosfund

If you are interested in setting up your own fund, please contact Arianne van Ballegooij at University Fund Wageningen: ufw@wur.nl

REUNIONS

Annual open day for alumni from now on

The worldwide alumni reunion as part of the university's centennial celebrations last year was such a success that it is getting a follow-up in the form of an annual alumni open day. The first such event will take place on Saturday afternoon, 5 October 2019, during National Science Week.

There were numerous compliments from alumni for the Worldwide Wageningen Alumni Day in 2018. This prompted the university to decide to organize a reunion every year, says Denise Spiekerman of the alumni office. 'We wanted to maintain the momentum.' The annual alumni day will offer graduates the opportunity to meet up and network. It will also give the university an opportunity to update alumni on developments at Wageningen and to strengthen their ties with WUR. 'Finding answers together is one of the objectives in the strategic plan. Alumni, who hold various positions in society, can help us achieve that objective,' says Spiekerman.
That is why this first alumni reunion will include a member of the Executive Board informing the visitors about what has been going on at the university. There will also be guided tours of the campus and a large networking drinks do. The main attraction of the plenary programme is the World Lecture by Marcel Dicke. The professor of Entomology received the Spinoza prize in 2007, becoming the first Wageningen scientist to get the 'highest distinction in Dutch science'. On 5 October, Dicke will tell the audience what he was able to do with the prize and how his research has developed since then.
The talks will be in Dutch. The World Lectures are organized by KLV and Wageningen Academy and sponsored by the Wageningen Ambassadors.
Info: www.wur.nl/alumniopendag



PHOTO'S GUY ACKERMANS

4TU

Dutch Engineers in Paris

The meeting of the Dutch Engineers Alumni Network (DEAN) in Paris on 10 July 2019 had Wageningen alumna Julie Vermooten as a speaker. And two bioprocess technology graduates were surprised to bump into one another after 16 years.

The Dutch Engineers Alumni Network is the alumni network for the four Dutch science universities (4TU), including WUR. The DEAN gathering was held in the residence of the Dutch ambassador Pieter de Gooijer. It was therefore not that surprising that his wife, Wageningen alumna Julie Vermooten (WUR Zootechnics 1993), gave a presentation. She talked to the 40 or so alumni who attended about her international career in Belgium and France. She is currently director of Public Policy at MSD Animal Health in Brussels.
The event was deemed a great success by Clara Hengeveld (WUR Bioprocess Technology 2003) and Daan Noordermeer (WUR Bioprocess Technology 2004) as they bumped into each other for the first time in 16 years. 'We recognized one another at once. It seems we haven't changed much in all that time,' says Noordermeer, who heads a research group at the Institute for Integrative Biology of the Cell. 'I loved seeing Daan again after all those years and chatting to him,' says Hengeveld, who works for Premier Research helping companies to develop and market medicines. 'It was also nice meeting other interesting people in a relaxed setting and finding out about their links to France and their experiences here.'
Info: www.wur.eu/deanparis2019

ALUMNI SOCIETY

Big changes for KLV

In the annual general meeting of KLV Wageningen Alumni Network in early July 2019, it was decided to wind up the alumni society. The capital will be used to set up a named alumni fund or a foundation instead.

It had already been concluded in a meeting in December 2018 that KLV has no future as a society of members. The board is now drawing up a plan for the dissolution of the society, says the chair Han Swinkels. 'KLV was founded to keep alumni involved with their alma mater. But in the past 15 years, the university has been doing more on that front. We are seeing hardly any young alumni or international alumni joining,' says Swinkels.
The 14 independent study groups and networks that are affiliated to KLV are flourishing, however. They will continue to exist and will get administrative support from University Fund Wageningen. The society's capital will be used to set up a KLV alumni fund or a foundation to finance that administrative support and alumni activities not covered by the university's alumni policy. KLV has built up capital of around one million euros, largely thanks to participation in KLV Professional Match from 2002 to 2019.
Of course members are sad that the society will be wound up, says Swinkels. 'There is also a small group who see prospects for KLV as a professional association. We are letting them work that idea out but we suspect the domains that Wageningen alumni work in are too diverse for that option to work.'
KLV will be wound up on 1 September 2020 at the earliest. No subscription fees will be charged for 2020. All the regular KLV activities, such as regional meetings, World Lectures and Science Cafes, will carry on up until the dissolution.
www.klv.nl

REUNIONS

Years of 1969 and 1994 meet again

The reunion on Wageningen Campus for the people who started 25 years ago (the year of 1994) will be on Saturday 26 October 2019. The 50-year reunion for the people who started in 1969 will be on Saturday 16 November. The programme consists of a presentation about Wageningen University & Research by rector magnificus Arthur Mol, reflections by two alumni on their careers (year of 1994) and thematic talks (year of 1969), a group photo and excursions on campus or in the town of Wageningen. The day will end with a drinks reception and dinner.
Info: www.wur.eu/25yearreunion2019
www.wur.eu/50yearreunion2019

WUR CONNECT

Makeover for WUR Connect

WUR Connect, the platform for alumni, students and staff of Wageningen University & Research, has a new, fresh look and has been made more user-friendly.

Logging in

From now on, logging in takes you to your personal feed where you can post messages, photos and videos.

Mentor

It is now easier to look for a mentor, for example someone who can help check your CV or who can introduce you to their work circle. You can also offer to help others as a mentor yourself. The platform makes it easy to contact people wanting help.

Job vacancies

Looking to kick off your career or make a new move? WUR Connect has a wide range of job vacancies, internships and traineeships in the Wageningen domain.

Reactions

If WUR Connect has helped you find an internship, a job or a friend you lost touch with, let us know via alumni@wur.nl.

More at https://wurconnect.nl

Prof. Louise O. Fresco, WUR PhD 1986, has been awarded an honorary doctorate by the Hebrew University of Jerusalem in recognition of her pioneering work in coming up with sustainable solutions for the world's food problems. 17 June 2019.

Chiel van Heerwaarden PhD, WUR Meteorology and Air Quality 2006, has received a Vidi grant of 800,000 euros from the Dutch Organization for Scientific Research (NWO). The assistant professor of Meteorology will use it to study cloud shadows with the help of innovative measurements and cloud simulations, with the aim of improving predictions of fluctuations in sunlight. 24 May 2019.

Annemiek ter Heijne PhD, WUR Environmental Sciences 2006, assistant professor at Environmental Technology, has received a Vidi grant of 800,000 euros from the NWO for a project on improving the technology for recovering raw materials. 24 May 2019.

Prof. Thom Huppertz, WUR Food Technology 1999, has been made professor by special appointment in Dairy Science & Technology at Wageningen. Huppertz succeeds Tiny van Boekel, who has held the chair on an interim basis since September 2017. 1 May 2019.

Ernst Koningsveld MSc, WUR Farming Technology 1975, has been appointed Officer in the Order of Orange-Nassau. He received the honour for his work in national and international organizations in the field of ergonomics, for example Human Factors NL, the International Ergonomics Association and the Centre for Registration of European Ergonomists. 26 April 2019.

Carlo Leonardi MSc, WUR Landscape Architecture and Planning 2017, has won the Herta Macht Master Thesis Prize awarded by the University of Groningen. The prize was for his thesis 'Experiencing the Post-Mining Wonder: Reclaiming a New Purpose for Post-mining Landscapes in the Quadrilatero Ferrifero (MG), Brazil', which he produced in the Landscape Architecture group in Wageningen. 25 June 2019.

Carla Moonen MSc, WUR Agricultural and Environmental Economics 1993, has been sworn in as a member of the D66 party in the Upper House of the Dutch parliament. Moonen is chair of the board of the sector association Koninklijke NLingenieurs and was previously chair of the Brabantse Delta water board and a senior adviser at the ministry of General Affairs. 11 June 2019.

Vera Ros PhD, WUR Biology 2004, has received a Vidi grant of 800,000 euros from the NWO. The assistant professor in Wageningen will use the grant to study viruses that are latent in insects. Ros wants to understand how these viruses are passed on and what effect they have on their host. 24 May 2019.

PHOTO JEROEN BOUMAN

Annie de Veer MSc, WUR Agricultural and Environmental Economics 1989, has been appointed director of Strategy, Knowledge and Innovation at the ministry of Agriculture, Nature and Food Quality. Annie de Veer has been the director of Wageningen Livestock Research since 2013. 16 September 2019.

Jan van Vegchel MSc, WUR Tropical Land Development 1988, legal adviser at ABC Legal, has won the 2019 University of Amsterdam dissertation prize for his dissertation on the revival of the right of reply in the digital age. 15 June 2019.

Nicolaas Veraart MSc, WUR Landscape Architecture 1988, has been appointed senior vice president and national practice lead for planning at the American engineering consultancy Michael Baker International. 9 July 2019.

PHOTO GETTY

Annemiek van Vleuten MSc, WUR Animal Sciences 2007, a professional cyclist, has won the Giro Rosa, the women's version of the Giro d'Italia, for the second year in a row. 14 July 2019.

Emilie Wientjes PhD, WUR Molecular Life Sciences 2007, assistant professor of Biophysics and Photosynthesis at Wageningen, has received a Vidi grant of 800,000 euros from the NWO. She will use it to investigate how plants adapt to varying amounts and colours of light. 24 May 2019.

GRANTS

Veni grants for outstanding researchers

Nine WUR alumni and researchers have received a Veni grant of up to 250,000 euros from the NWO. The grants are for outstanding researchers who have recently obtained a PhD. Grants have been awarded to:
Nico Claassens PhD,
WUR Biotechnology 2012
Carla Araya-Cloutier PhD,
WUR Food Technology 2012
Annette Janssen PhD,
WUR Hydrology and Water Quality 2012
Lieke Melsen PhD,
WUR Hydrology and Water Quality 2012
Gert Salentijn PhD,
University of Groningen Pharmacy 2012
Masha van der Sande PhD,
WUR Biology 2012
Lysanne Snijders PhD, WUR Biology 2011
Mark Sterken PhD, WUR Biology 2011
Charles Underwood PhD,
University of Oxford Biochemistry 2011.
17 July 2019.

Producing proteins for vegan burgers

Corjan van den Berg MSc, WUR Biotechnology 2005, and **Edgar Suarez PhD,** WUR PhD 2019, have founded the start-up FUMI Ingredients to produce vegetable proteins for meat substitutes. The founders met one another in the Wageningen Bioprocess Technology group. Suarez, who is from Colombia, was studying proteins for his doctorate and Van den Berg was his co-supervisor. Suarez developed a technique for making vegetable proteins with the help of micro-organisms or algae. Those proteins can help bind the various ingredients in burgers. 'We want to focus on vegan meat substitutes in the Netherlands,' Van den Berg told the WUR magazine *Resource*. 'This expanding market has sales of several million euros a year.'

PHOTO GUY ACKERMANS

'We want to focus on vegan meat substitutes in the Netherlands'

Sports grant for heptathlete

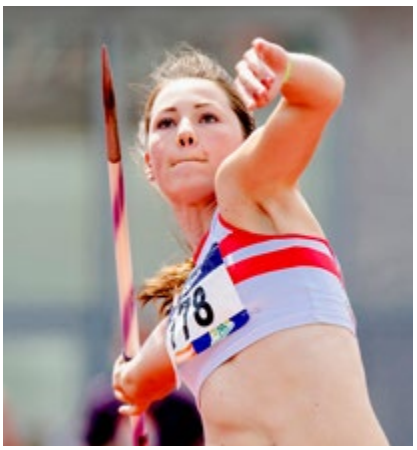


PHOTO ANP

Emma Oosterwegel, WUR student of Soil, Water and Atmosphere, received a grant on 15 May 2019 from the Niels Smith Fund, a named fund managed by University Fund Wageningen. The elite athlete takes part in heptathlons and the javelin. The grant of 1500 euros will help cover the costs of equipment and participation in competitions. Oosterwegel (20) won the Dutch indoor heptathlon this spring. On 12 July, she came fourth in the heptathlon in the European Athletics U23 Championships in Sweden. She wants eventually to compete in the main European Championships. The grant will help her make that dream come true.

Innovative researchers

Six young WUR researchers were awarded grants of 40,000 or 50,000 euros by the NWO for their innovative research ideas. **Corjan van den Berg MSc,** WUR Biotechnology 2005, and **Edgar Suarez PhD** WUR 2019, for New animal-free proteins; **Jurre Steens MSc,** WUR Biotechnology 2018, for CRISPR-Cas medical diagnosis; **Florian T Muijres PhD,** Delft 2006, for a mosquito trap for malaria prevention in Africa; **Lammert Kooistra,** WUR Soil, Water and Atmosphere 1997, for agriculture data from Consumer UAVs; **Julian W Bakker MSc,** WUR Biology 2017, for The transmission of tick-borne diseases; **Miguel Lurling PhD,** WUR Environmental Science 1994, for Vivianite for lake restoration and phosphate recovery.

IN MEMORIAM

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

Mr H. de Bakker,
honorary member of NBV.
5 December 2018.
Mr J.M.H. Bemelmans MSc,
WUR Food Technology 1968. 17 July 2018.
Mr F.C. Bubberman MSc,
WUR Tropical Land Development 1956.
15 May 2019.
Mr R. van Dijk PhD,
WUR Bioprocess Technology 1996.
21 May 2019.
Mr H.G. van der Flier MSc,
WUR Rural Sociology of the Non-Western Regions 1967. 4 July 2019.
Mr H.G. Fransz PhD,
WUR Forestry 1969. 27 May 2019.
Mr G.C. Gortzak MSc,
WUR Agricultural Plant Breeding 1994.
26 May 2019.
Mr P.H. Hamaker PhD,
WUR Soil and Fertilization Sciences 1967.
6 June 2019.
Mr G.P.L. van den Hazelkamp MSc,
WUR Food Technology 1980. 28 May 2019.
Ms F.J. Koornneef MSc, WUR Nutrition and Health 2018. 22 July 2019.
Mr N.M.T. Laudy MSc,
WUR Tropical Plant Breeding 1955.
10 June 2019.
Mr J.W. van Lieshout PhD,
WUR Agricultural Plant Breeding 1951.
28 July 2019.
Mr J. Mesdag MSc,
WUR Agricultural Plant Breeding 1958.
17 February 2019.
Ms L. Mevius MSc,
WUR Tropical Domestic Science 1975.
6 May 2019.
Mr P.H. Pels Rijcken MSc,
WUR Forestry 1964. 19 April 2019.
Mr J.J. Vonk MSc,
WUR Agricultural Plant Breeding 1957.
17 April 2019.
Mr W.E. Wittermans MSc,
WUR Rural Sociology of the Non-Western Regions 1969. 20 May 2019.

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

Sailing to the climate summit

Moon Weijens, MSc student of International Land and Water Management, and **Mara de Pater,** MSc student of Environmental Sciences, will sail off on 1 October 2019 in a three-master taking 26 young people to the climate summit in Chile. They will travel by bus for the last leg of the journey. At the summit, they plan to draw attention to the impact on the climate of flying. The climate summit is from 2 to 13 December 2019.
Info www.sailtothecop.com

BOOKS BY ALUMNI

Eric Denig MSc, WUR Land Development 1954, Jelle Landstra MSc, WUR Land Development 1975, and two other former agricultural attachés have written the book Diplomatie op klompen – 100 jaar landbouwattachés (Diplomacy in clogs — 100 years of agricultural attachés). The richly illustrated book gives a peep into the diplomatic world and the Netherlands' role on the world stage. It is based on their own experience and that of numerous former colleagues. Published by Matrijs, 19.95 euros.

Mirjam Smit-van Hal MSc, WUR Human Nutrition 2002, published Sunny Good Food in May. This 'cookery play book' for children aged two to eight combines recipes with play activities, tips, fun facts and a certificate. Van Hal is an independent consultant. The book (20.00 euros) can be ordered through www.sunnygoodfood.nl and bol.com.

Jos Schouwenaars PhD, WUR Land Development 1978, has written a collection of short stories, *Rumoer om moerassen* (Hubbub about marshland), which was published in July. Schouwenaars is an experienced international expert on water management in peatland areas and is currently an adviser at the Friesland water board. 'I wrote these stories to share my fascination with the magic of peatlands, how they were created and the unusual plants that formed them.' Published by Elikser, 14.50 euros.

KLV

KLV | WAGENINGEN ALUMNI NETWORK

KLV is for everyone at Wageningen. It aims to foster contacts with alumni, students and the university, for example through the study groups and networks.
KLV also offers career support services, such as a CV check and workshops. A selection of our activities is shown here. Go to www.klv.nl for a complete overview.

Young KLV - More success with LinkedIn
1 October 2019. Workshop in English for experienced LinkedIn users.

PSIMT – 64th thematic meeting
9 October 2019. Meeting of the study group for plant and systems innovations in global horticulture.

NZV members' day
7 November 2019. The Dutch Zootechnics Society members' day. nzvnet.nl

VWI meeting
9 November 2019. Meeting of the Network for Wageningen University Alumni Women. vwi-netwerk.nl

VTB anniversary party
22 November 2019. The tropical forests society celebrates 20 years. tropischebossen.nl

KLV Wageningen Alumni Network is Wageningen University & Research's alumni society with around 7000 members.

www.klv.nl

KLV

Huib Visser

Forestry, 1987

A PASSION FOR Vintage saxophones

Huib Visser (Forestry, majored in business administration, 1987) has been addicted to jazz music since he was 12. 'My father used to play it. I loved the rhythm, the high spirits and the swing.' Visser, an interim manager and HRM project manager, started by playing the clarinet. 'Later I got interested in saxophones. First I bought a new tenor sax, then an old one, then it got a bit out of hand. Out of curiosity, I started importing vintage saxophones made before 1960 from the US. That was a period when a lot of really fine instruments were made. I've imported about 125 such saxophones into this country. I'd then sell them as the opportunity arose. I kept 15 instruments for myself. My favourite is a bent soprano sax from 1919, a lovely little instrument with an amazing sound. I can really make it sing, as we saxophonists say, in my band, the Jazzperados.'

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PHOTO GUY ACKERMANS

PHOTO ALAMY

Improving fruit quality in India

'Apples are the mainstay of the economy of the northern Indian state of Himachal Pradesh,' says Bas Hetterscheid, a researcher at Wageningen Food & Biobased Research. 'Millions of people earn their living from apples. We want to work with local partners to combat post-harvest losses and improve the quality of the fruit.'

This is being done at the behest of the regional authorities which, with the support of the World Bank, want to see the sector grow. 'A programme has been set up for doing this by boosting yields, improving storage and opening up new markets, such as in the big cities.'

Hetterscheid and his colleagues in the post-harvest department are designing modern storage facilities for storing applies under controlled, cool conditions so that they keep longer and can be sold all year round. 'We also provide farmers and staff at the refrigeration facilities with training on quality control, storage and the physiology of different apple varieties.'

Improving the quality is key, stresses Hetterscheid. 'That is important so as to be able to sell the fruit all year round in Delhi and other big cities. At present a lot of apples are bruised when they arrive at the market.'

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