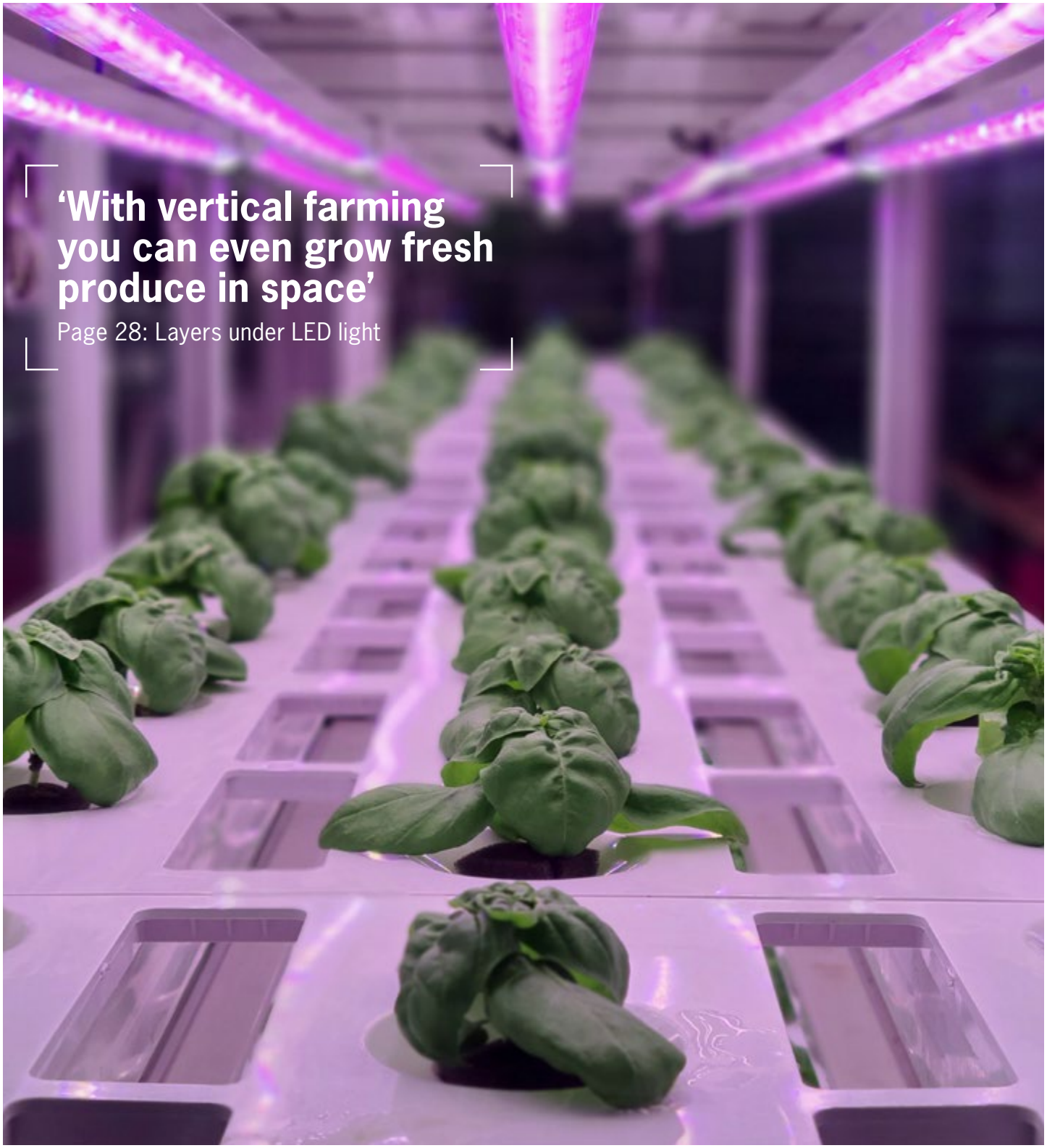
WAGENINGEN WORLD

MAGAZINE OF WAGENINGEN UNIVERSITY & RESEARCH ABOUT CONTRIBUTING TO THE QUALITY OF LIFE no.1 2022



‘With vertical farming you can even grow fresh produce in space’

Page 28: Layers under LED light

Cocoa farmers are still poor

The labels intended to support farmers have had little effect

Europe has a bird flu problem

The question arises again and again: why don’t we vaccinate our poultry?

Insects on the menu

‘The aversion comes largely from a fear of the unknown’

COLOPHON Wageningen World is the quarterly magazine for associates and alumni of Wageningen University & Research **Publisher** Wageningen University & Research **Editor-in-chief** Willem Andrée **Editorial Board** Jeroen Balemans, Channah Durlacher, Ben Geerlings, Ike de Haan, Marieke Reijneker, Antoinette Thijssen **Magazine editor** Miranda Bettonville **Copy editor** Rik Nijland **Translators** Clare McGregor, Clare Wilkinson **Art direction** Petra Siebelink **Design** Geert-Jan Bruins, Monique Chermin **Cover picture** Shutterstock **Overall design** Hemels Publishers **Printer** Tuijtel Hardinxveld-Giessendam ISSN 2212-9928 **Address** Wageningen Campus,Droevendaalsesteeg 4, 6708 PB Wageningen, telephone +31 317 48 40 20, wageningen.world@wur.nl **Change of address alumni** alumni@wur.nl **Change of address associates** wageningen.world@wur.nl, mentioning code on adress label **Change of career details** alumni@wur.nl

WAGENINGEN UNIVERSITY & RESEARCH

The mission of Wageningen University and Research is 'To explore the potential of nature to improve the quality of life'. Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 6,800 employees (6,000 fte) and 12,900 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.

WAGENINGEN WORLD ONLINE
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FEATURES

PHOTO RENÉ SCHOTANUS

The future of university education

'I think COVID-19 caused a seismic shift in the way we look at education, and how it should be offered. There will be a much stronger integration of digital and distance learning into regular education in future. This wouldn't have happened without COVID-19, because universities are inherently slow to change, and are cautious when it comes to innovation. This isn't meant as a criticism; I think it's good to consider decisions carefully. I do believe that COVID-19 has accelerated the process, and taken it further than it would otherwise have gone.

'The classic pattern, where you go to university at 18, study for four or five years and then get a job, has been changing for some time. You see more alternative pathways emerging, where people start working earlier, for example, or where they embark on a degree at a later age. But our education system is not geared to this – it's difficult to integrate adults into higher education, for example. The Netherlands and Belgium are lagging behind the rest of Europe in that respect. In other countries, you see more people of different ages at university.

'Another issue that's relevant to this is studying part-time. With the current tight labour market, this provides an opportunity for companies that are short-staffed to take on part-time students. Unfortunately, the higher education system is primarily geared to full-time study. Institutions are held accountable if they do not deliver enough students within a set time frame, and it is more difficult to finance part-time students adequately.

'You can also see that the labour market attaches less and less value to qualifications. In the United States and Australia, for example, many companies have their own certification systems. Research shows that job adverts nowadays are less likely to ask for a specific qualification, and more for generic competences.

'All in all, universities will have to move with the times and realize that some of their historical values are no longer self-evident today.'

Dirk van Damme, founder of DVD EduConsult and senior research fellow at the Centre for Curriculum Redesign in Boston, USA, was the keynote speaker at WUR's Dies Natalis on 9 March 2022.

EDUCATION

Best and greenest

Wageningen has been declared the best university in the Dutch higher education guide for the 17th year in a row. Degree results play a role, but 70 per cent of the score is determined by students' opinions about their degree programmes. Wageningen also came top again in the Universitas Indonesia GreenMetric ranking in December. This ranking compares the sustainability of 982 universities around the world, looking at how they deal with energy, climate, waste, transport, water, biodiversity and infrastructure. Sustainability in education and research is also taken into account.
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ORGANIZATION

FAO and WUR will be collaborating more

In December, Director-General Qu Dongyu of the UN Food and Agriculture Organization (FAO) and WUR President Louise Fresco signed a declaration of intent to collaborate more. Focus areas are research on zoonoses and sustainable fisheries and aquaculture.
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AGRIFOOD

Sustainability gaining ground

Sustainability is playing an ever-increasing role when people buy food, according to the Agrifood Monitor, which WUR carries out each year for the Agri & Food Top Sector. Fairness and being animal friendly and good for nature and the environment are increasingly important factors in the purchase of food products. But consumers still find taste, freshness, safety, affordability and health more important.
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INNOVATION

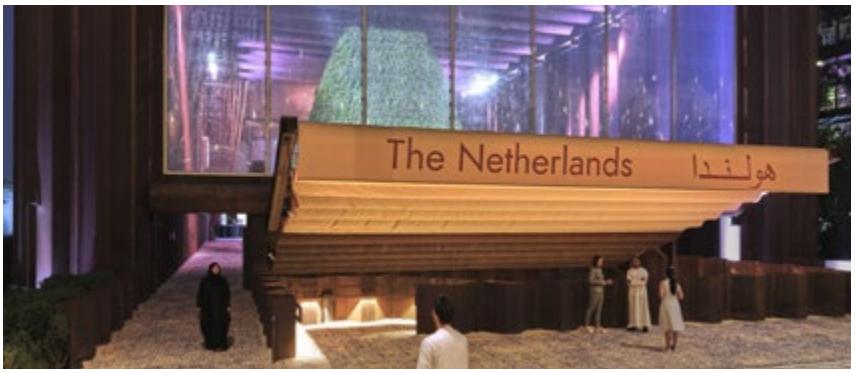

PHOTO V8 ARCHITECTS/JEROEN MUSCH

Wageningen knowledge at Dubai World Expo

In January and February, the contribution that Wageningen's knowledge and technology could make to hot, dry regions was showcased at the World Expo in Dubai.

The Dutch pavilion was all about water, circularity, energy, food and culture, with a vertical farm as an eye-catching feature. Wageningen presented innovations for challenging hot conditions.
An example is the greenhouse technology that Jouke Campen of Wageningen Plant Research developed for greenhouses in Abu Dhabi, where temperatures reach 45 degrees in the summer. Campen used efficient cooling to improve the greenhouse climate, increase production and reduce water consumption.
Middle Eastern countries want to grow more food themselves, explains the horticulture technologist. 'The food crisis in 2008 was a wake-up call for them. While these countries have enough money to import fresh products, they are still left empty-handed when there are worldwide shortages.' In Dubai, WUR also showcased its knowledge of supply chain management in the Gulf region and of desalination techniques that can cope with high salt concentrations.
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URBAN GREENHOUSE CHALLENGE

Healthy food for Washington

Thirty student teams from Europe, Asia and the US registered for the Urban Greenhouse Challenge, a design challenge organized by Wageningen. The assignment for this third edition of the challenge was to develop a centre for locally produced healthy food for a disadvantaged neighbourhood in Washington DC (USA). This urban farm also had to be efficient in its consumption of energy and water, and to create jobs.
The teams had assistance from WUR, the University of the District of Columbia and the participating companies.
After the first selection in January, the 20 teams with the best proposals went through to the next round, in which they work out the details of the production systems, the sustainable construction of the centre and the business model. The 10 best teams will present their designs in the final, on campus in Wageningen at the end of June. The winners will receive a prize of 10,000 euros.
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PHOTO WUR

MARINE ECOLOGY

Eel population declining again

The recovery of the eel population has stalled. Fewer adult eels made their way back to sea from the Netherlands during the period 2018-2020, due to the increase in commercial fishing. These conclusions were reached by Wageningen Marine Research in its evaluation of the Dutch eel management plan for the Ministry of Agriculture, Nature and Food Quality.

The eel policy is designed to reduce eel mortality due to human activities and facilitate the migration of silver eels, adult eels that return to the Sargasso Sea to mate.
This policy, with measures such as a reduction in catches and the removal of barriers in waterways, led to an improvement in eel stocks from 2005 and a steady increase in the number of silver eels reaching the sea. However, the evaluation for 2018-2020 reveals deterioration with a fall in silver eel numbers from 1460 tons to 970 tons. While the models have improved, these numbers are rough estimates based on limited catch and monitoring data.
Even so, the research team headed by Tessa van der Hammen calls the deterioration in the figures for the first time in 15 years 'worrying'. They blame it on 'an increase in commercial fishing in the IJsselmeer and Markermeer lakes.' The International Council for the Exploration of the Sea (ICES) has been calling for a European ban on eel fishing for 20 years. But that recommendation was disregarded once again last December by the EU ministers in the Fisheries Council.
Improvements in the population of eels in the Netherlands and the migration of silver eels take a long time because the eel is long-lived. It is thought to take glass eels (elvers) one to three years to travel from the Sargasso Sea to the Dutch coast and swim up the rivers. Another three to 20 years are required for them to develop into silver eels and swim back out to sea.
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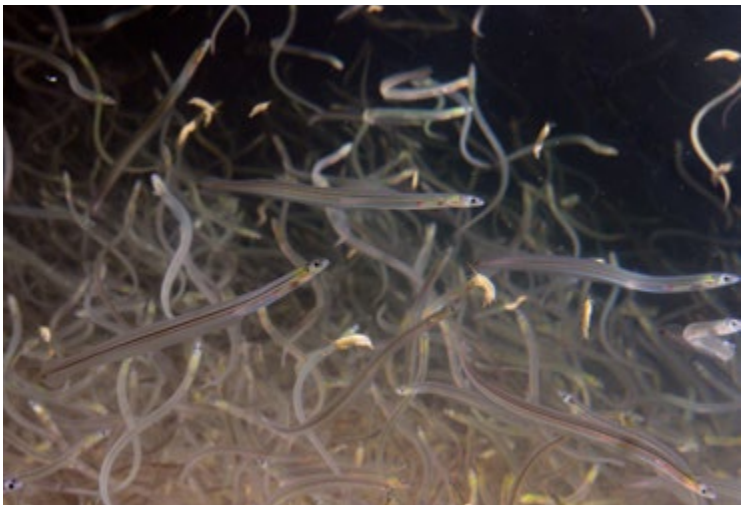

PHOTOS ALAMY

WAGENINGEN ACADEMY

Summer Schools online and on-site

Wageningen Academy organizes Summer Schools for professionals. In 2022 we offer both online and on-site programmes. The Greenhouse Horticulture and Insects as Food & Feed programmes are going to be run on-site again, enabling us to incorporate more social interaction, excursions, and group work. These are things that our participants value. One former participant told us, 'Guest lecturers provided us with useful information on insects and news. The programme offers great value in terms of establishing contacts with scientists, industry representatives and other course participants.' Online programmes are scheduled too, as they provide a good opportunity for those who cannot or do not want to travel. The Farm to Fork programme and the Biotechnology, Agriculture and Food programme are open to professionals with BSc, MSc and PhD degrees. *More information: www.wur.eu/academy*

CONSUMERS AND FOOD

PHOTO SHUTTERSTOCK

Less meat eaten during lockdown

The per capita consumption of meat and meat products in the Netherlands was two kilos less in 2020 than in 2019, according to calculations by Wageningen Economic Research for the animal rights organization Wakker Dier. That is the largest decrease since the annual study started in 2005.
The decline was due to the closure of restaurants during the Covid lockdowns rather than a shift in food preferences towards vegetarian products. Closing restaurants cut off a key sales channel for meat consumption.
Another notable development in the market is the growth in sales of vegetarian meat substitutes. The upward trend continued but the absolute size of this market is modest, at just 4 per cent.
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TROPICAL PLANT BREEDING

Dutch bananas can be used in beer and lingerie

Last November, Dutch bananas were harvested from the Neder Banaan greenhouse in Ede, where WUR is studying new banana varieties and more sustainable cultivation.

The 1600 bananas were used as an ingredient in banana cakes and in a specialty beer. The skins were put to good use too. Cooks marinated them and cooked 'pulled peel', a vegan meat substitute for salads or bread rolls.
The Ede greenhouse is the only banana greenhouse in the Netherlands. The plants are grown in pots filled with coconut fibre, rather than in soil, which protects them from soil fungi. These fungi are a threat to banana cultivation around the world, causing Panama disease for example. Gert Kema, professor by special appointment of Tropical Phytopathology and the man behind the Neder Banaan, has been studying cultivation methods and new banana varieties for years for that very reason.
The stalks of the banana plants in Ede also got recycled. On plantations, the stalks are burned after the harvest, but the Ede stalks were used to make transport pallets and even panties. Start-up Musa Intimates made banana lingerie from the fibres.
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PHOTO APA PHOTO

MARINE ECOLOGY

PHOTO ALAMY

Fish stocks sensitive to sea temperature

The growth of individual fish depends on the temperature of the seawater. A model study by an international research team now shows that fluctuations in temperature also have a big effect at the population level. A year with favourable conditions soon leads to a population boom in short-lived fish that eat plankton. Long-lived predatory fish respond much more slowly: fluctuations in seawater temperatures result in population changes over a period of decades.
The findings can give a better understanding of the effects of climate change on marine fish populations, says lead author Peter van der Sleen, a researcher at the Wildlife Ecology & Conservation chair group. That is why they performed model simulations with a range of climate scenarios. 'These are not hopeful results,' says Van der Sleen. 'Climate change will make fish stocks fluctuate more, which will have major implications for how marine ecosystems function and for the fishing industry.'
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NUTRITION AND HEALTH

PHOTO ALAMY

Less ADHD and more brain activity after diet

Increased activity is seen in the precuneus, part of the cerebrum, in boys who experience a dramatic reduction in ADHD symptoms after going on a diet. The greater the behavioural improvement, the more activity in this brain area.

Wageningen researchers made this finding in a study of 53 boys with ADHD aged between eight and ten. An fMRI brain scan to determine brain activity was made at the start and after five weeks of the diet. The study results were published mid-November in the journal *Scientific Reports*.
'This is an important step in the research on nutrition and ADHD,' says Saartje Hontelez of the Host-Microbe Interactomics chair group. 'We showed that the subjective observation by the parents of an improvement in behaviour after the diet was confirmed by the brain scans.'
Around 6 per cent of children in the Netherlands have ADHD, an attention deficit disorder with hyperactivity. The symptoms can be reduced considerably if the children adopt the strict Few Foods diet, also known as the RED diet.
An earlier study, in which Wageningen researchers were also involved, showed that about 60 per cent of the children no longer met the criteria for ADHD after being on the diet. They then underwent a follow-up process of one to two years to determine exactly which foodstuffs triggered the disorder.
It is known that the activity in the precuneus increases in children with ADHD after treatment with the drug Ritalin. 'Our findings tie in nicely with what is already known about this brain area,' says Hontelez.
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CLIMATE

Dry is good during a heatwave

The dry conditions during a heatwave are a positive aspect as they mean fewer fatalities. Previously it was assumed that dehydrated soil would make a heatwave even more deadly as it makes temperatures rise yet further. But an analysis by an international team of researchers, using a Wageningen model that can process millions of data points from weather balloons, has led to a different conclusion. In dry conditions, the air is less humid and so people can transpire more easily, which reduces the risk of overheating. The research results were published in *Science Advances*.
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PLANT SCIENCES

Cannabis labels are unreliable

The traditional division of cannabis into the *sativa* and *indica* variants is misleading, argue Biosystematics lecturer Robin van Velzen and Canadian colleagues in *Nature Plants*. Many users claim they get different highs from the two variants, which have their origins in two varieties of the cannabis plant. But after examining hundreds of cannabis samples taken from Dutch cannabis cafés and other sources, the researchers concluded that they could not tell whether a sample was a *sativa* or *indica* variant based on the genetic and chemical profile.
'Cannabis labelling is unreliable, in contrast to the situation for other valuable plant species,' says Van Velzen. 'That is unfortunate, especially for patients who use cannabis as a medicine. They need a consistent quality.'
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BIOMECHANICS

Swatting helps mosquito escape

If you try to swat a mosquito, you are actually helping it to escape. This finding comes from PhD research by Antoine Cribellier of Experimental Zoology. He studied the role of air flows in the flight behaviour of malaria mosquitoes. For his research, Cribellier developed a fly swatter that hits out at flying mosquitoes. Images of the escaping insects recorded by high-speed cameras show that they make use of the airflow that is set in motion. Not only does it push the mosquitoes away, it also triggers an active flight response.
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AERODYNAMICS

Morpho butterflies float in the canopy

Morpho butterflies have adapted to a life floating in the canopy of the Amazon rainforest in various ways. This finding comes from research in Peru by the Experimental Zoology chair group, which was published in *Science*.
Most *Morpho* butterflies flutter about in the undergrowth but a few species live in the canopy. Images recorded by high-speed cameras show that they spend much more time floating. With the help of engineers specializing in fluid dynamics from the maritime research institute MARIN, the zoologists were able to create computer simulations of the butterflies' aerodynamic performance. In the course of evolution, the species that moved to live in the canopy adapted their flight and the shape of their wings to the new environment, each species in its own way. Some have narrower wings while others have triangular wings. But the increased efficiency in their flight is the same.
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GENETICS

PHOTO ANP

Gene found that produces unfertilized seeds

Researchers have found a gene that allows the ova of plants to grow into seeds without fertilization. This could make it possible in the future for seeds to be produced that are genetically identical to the parent plant for various crops.

Some plants, such as the dandelion and hawkweed, occasionally produce seeds without fertilization. The plants that grow from those seeds all have the same properties as the parent plant. Researchers from the Wageningen company KeyGene and the Biosystematics chair group, working with colleagues from Japan and New Zealand, discovered the PAR gene, which deceives the egg cells in the ovary, making them divide without being fertilized.

The researchers say that this discovery, which was published in *Nature Genetics* in January, will make it possible to speed up plant breeding and will reduce the cost of seed production. For example, it may be possible in future to make a direct copy of the desirable traits of parent plants in the seed. KeyGene and the Japanese plant breeding company Takii have already managed to switch on PAR genes in lettuce and sunflowers.
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ORGANIC CHEMISTRY

New crystals for solar cells

In collaboration with British researchers, the Wageningen Organic Chemistry chair group has developed a chelating treatment to stabilize halide perovskites, substances seen as a cheap successor to silicon in solar cells. However, the perovskite crystals are currently too unstable to withstand weathering. Using infrared nanospectroscopy, Francesco Simone Ruggeri was able to work out how the distribution of certain ions leads to this instability. Researchers in Oxford were then able to give perovskite crystals a boost using EDTA (ethylenediaminetetraacetic acid).
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AGRICULTURAL ECONOMICS

Green Deal means lower farm yields

The implementation of the EU's Green Deal will lead to a reduction in agricultural production in Europe, higher imports and higher prices, according to scenario calculations by agricultural economists at Wageningen.

PHOTO SHUTTERSTOCK

The European Commission's aim with the Green Deal is to combat climate change and environmental harm caused by agriculture. To assess what becoming greener will mean for crop production, the Wageningen economists studied 25 farms across Europe to see what changes the farmers would need to make to satisfy the sustainability requirements. They focused in particular on the reduction of crop protection agents – usage of which must be halved by 2030 – and the more restricted use of fertilizer.

The researchers entered the results in economic models to calculate the effects on the production of various scenarios, for example in the share of organic farming. If all the measures studied were implemented, it would lead to an average fall in production of 10 to 20 per cent. But there are big differences: sugar beet cultivation would hardly be affected whereas apple production would decline by 30 per cent.

All in all, the measures would lead to rising prices for farm products. The researchers also expect quality problems, for example grain becoming unfit for consumption due to fungi or smaller apples with damaged skin.

'If demand remains the same, Europe will have to make up the difference by increasing imports,' says author Johan Bremmer of Wageningen Economic Research. 'That will have negative effects on the European trade balance as exports will fall and imports will rise.'

The study was commissioned by CropLife, an organization representing the interests of crop protection product manufacturers.

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BIOLOGY

Conifers at risk of shrinkage

The oak withstood the heatwave in 2018 better than the Norway spruce and Scots pine. Beech trees were somewhere in between. These findings are from a European study led by the Forest Ecology & Forest Management chair group.

The researchers based their conclusions on measurements of 377 trees of 21 different species. They used dendrometers to accurately determine the width of the tree trunks. The results were published in January in *Nature Communications*.

The width of a trunk varies over the course of the day: during daylight hours it shrinks as water is transported to the leaves, and at night it expands as water is taken from the soil and fills the trunk and bark. This is also when the tree grows. When the water reserves in the soil are depleted during long, hot, dry periods, the trunks are no longer able to refill with water and the trees become stressed. That can have an effect on growth for years to come. The study showed that conifer species were more prone to shrinkage than deciduous trees. Ute Sass-Klaassen of Forest Ecology & Forest Management says tree monitoring with dendrometers can be used as an early warning system for detecting drought stress in trees.

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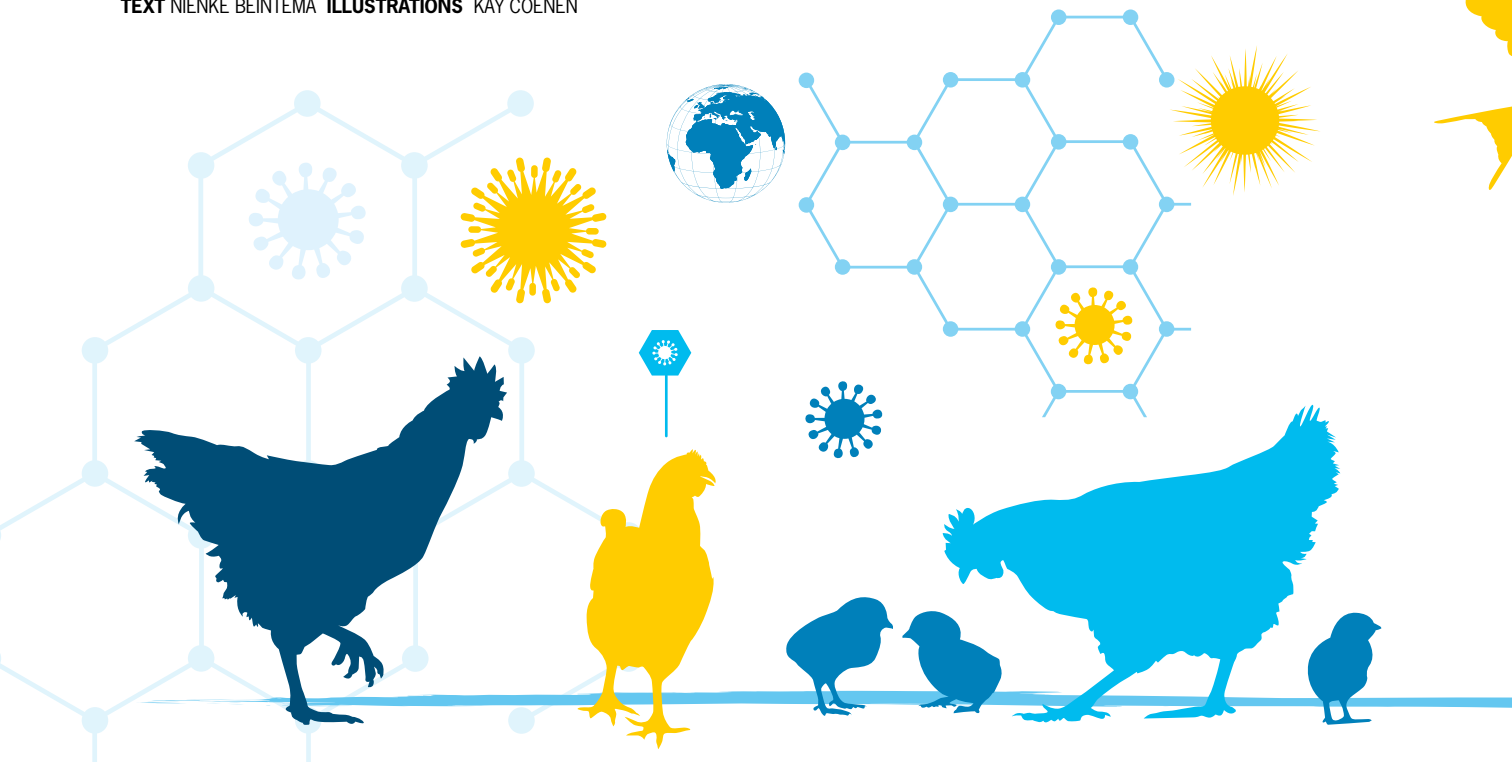
Should we vaccinate against bird flu?

Never before have there been so many outbreaks of bird flu in Europe. With hundreds of farms affected and millions of birds culled, the question arises: why don't we vaccinate poultry?

TEXT NIENKE BEINTEMA **ILLUSTRATIONS** KAY COENEN



The numbers are alarming. Between September and December 2021 there were over 300 outbreaks of bird flu on poultry farms in 27 European countries. More than eight million birds were culled. As for wild birds, more than 500 outbreaks were discovered among them in the same period, sometimes involving thousands of animals, such as barnacle geese in the United Kingdom and cranes in Israel.
The Netherlands, too, was hard hit by the virus – and the end is not yet in sight. In January 2022 alone, hundreds of thousands of birds were culled and bird flu was detected in red knots and seals. What is going on? And more importantly, what can be done about it?
Vaccinating poultry would be a logical solution. Several vaccines against bird flu have been developed around the world, but none of them are perfect. In the Netherlands, only a vaccine based on a 'low pathogenic strain' from 1986 has been registered. 'That doesn't work against this highly pathogenic variant of bird flu in the field,' says Mart de Jong, professor of Quantitative Veterinary Epidemiology at Wageningen. 'And the question is whether the new modern vaccines against highly pathogenic bird flu are effective enough, whether they provide sufficient protection against transmission.'

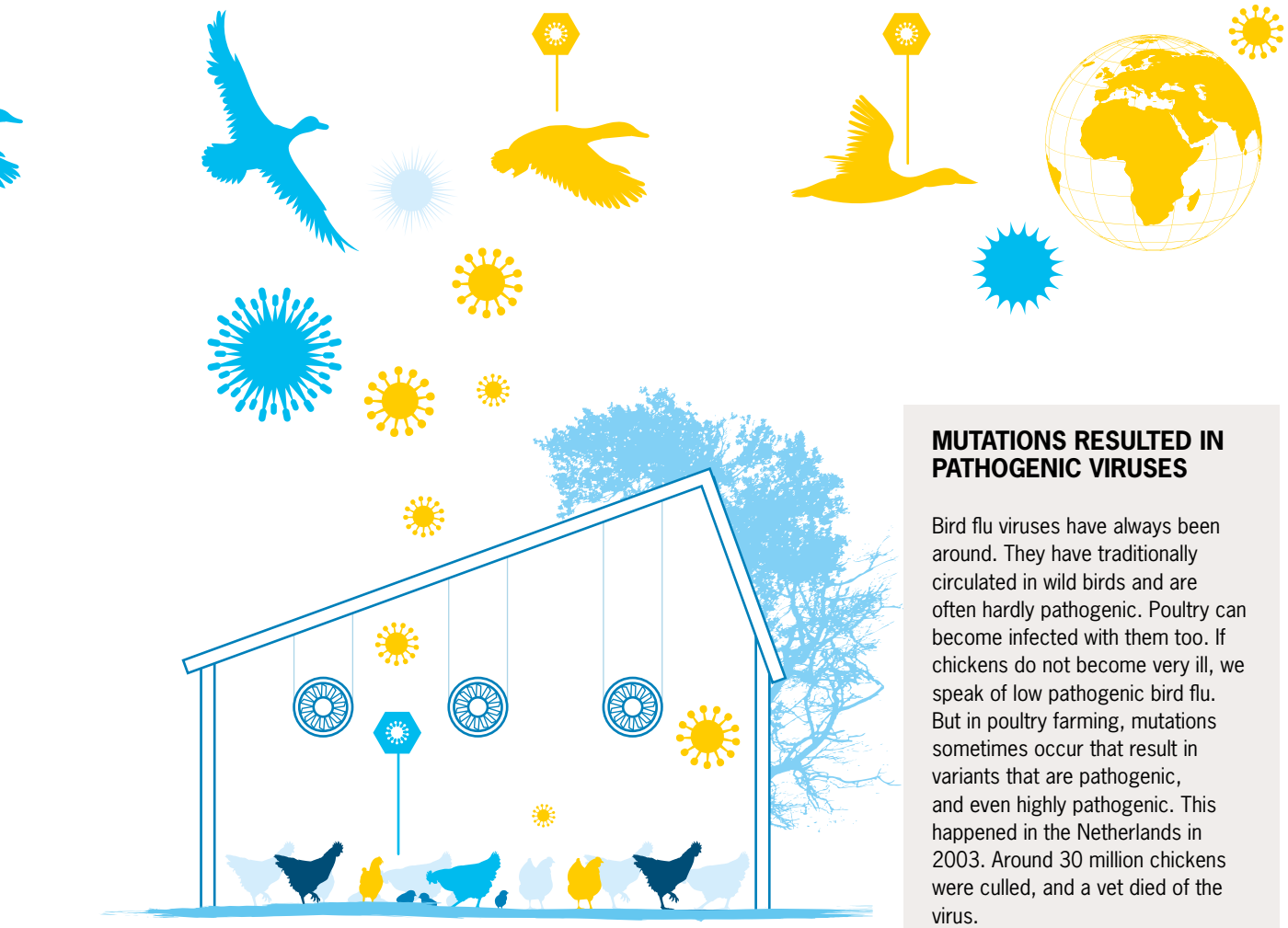
'Vaccinated animals are hard to distinguish from infected animals'

CHICKEN-AND-EGG SITUATION

New variants are constantly emerging through genetic mixing with low pathogenic bird flu viruses. But why aren't pharmaceutical companies working flat out on improving vaccines? According to De Jong, it is a chicken-and-egg situation. 'Within Europe, countries only trade in non-vaccinated poultry and meat,' he says, 'because vaccinated birds are diagnostically difficult to distinguish from infected ones.' For this reason, there is no international market for vaccinated birds, so poultry farmers do not want to vaccinate, and pharmaceutical companies therefore do not invest in making really good bird flu vaccines.
In any case, vaccines would have to be continually adapted to the prevailing avian flu strain, just as already happens with human flu vaccines. But there is something else going on as well, according to De Jong. 'Many of the existing vaccines work well in the lab, but their effectiveness in the field is very disappointing,' says De Jong. 'This is especially true of the traditional vaccines, which consist of an inactivated virus. With them, we see much lower quantities of antibodies in the field. The question now is whether this is also the case with newer types of vaccine.'

LOSING CONTROL

If the antibody level is too low, a vaccine does not provide adequate protection against virus transmission, so vaccinated animals can still pass on the virus to each other. 'You don't want that,' says De Jong, 'because then you lose control of transmission. Newer vaccines, such as those against SARS-CoV-2, are more complex. They not only activate the B cells, the white blood cells that produce antibodies, but also ensure T-cell immunity.' T cells are white blood cells too. They stimulate many facets of our immune system, including the B cells. And both types of cells can live in the body for a long time, thus providing immune memory. De Jong: 'But it is not clear whether this helps to protect birds from transmission at low levels of antibodies, and if so, how it does it.'
At the end of 2021, Agriculture Minister Carola Schouten announced that she was releasing funds for research into better vaccines. 'We are involved in that,' says De Jong. 'One of the things we will be researching is how you can stimulate immunity better with newer types of vaccine so that you do actually prevent transmission.'
But even if vaccines become more effective, there is another problem: international trade. Countries only want healthy animals



to cross their borders, and this is strictly controlled in the supply chain. But how do you distinguish infected animals from vaccinated ones? This concept, also known as DIVA (differentiating infected from vaccinated animals), is one of Nancy Beerens' specializations. Beerens is head of the bird flu reference laboratory at Wageningen Bioveterinary Research. This lab is to bird flu what RIVM (the National Institute for Public Health) is to Covid-19. It analyses all the Dutch specimens from poultry and wild birds suspected of carrying bird flu and advises the government on risk control.

'Many older types of vaccine consist of an inactivated virus,' explains Beerens. 'The immune system makes antibodies against all the proteins in that virus. As a result, you cannot tell the difference between vaccinated and infected birds from their blood. New types of vaccines are often based solely on the haemagglutinin (HA) protein, a protein that is characteristic of the virus variant in question and is found on the outside of the virus particle. In animals vaccinated with these vaccines, antibodies will only be present against this HA protein. Beerens: 'If you find antibodies against other viral proteins in a blood test, then you know that an infection is present.'

TESTING VACCINES

Wageningen will soon be testing various types of vaccine for effectiveness. Also on the research agenda is the ability to differentiate between infected and vaccinated animals. The highest hopes are pinned on newer types of vaccine such as a >

MUTATIONS RESULTED IN PATHOGENIC VIRUSES

Bird flu viruses have always been around. They have traditionally circulated in wild birds and are often hardly pathogenic. Poultry can become infected with them too. If chickens do not become very ill, we speak of low pathogenic bird flu. But in poultry farming, mutations sometimes occur that result in variants that are pathogenic, and even highly pathogenic. This happened in the Netherlands in 2003. Around 30 million chickens were culled, and a vet died of the virus.

Initially, highly pathogenic variants tended to cause problems only locally. They were so deadly that wild birds that caught them never got very far. But around the turn of the century, a highly pathogenic variant that was able to hitch a ride with migratory birds emerged on poultry farms in Asia. Genetic mixing occurred with low pathogenic bird flu viruses, as a result of which dozens of new pathogenic variants have since emerged. As Asian migratory birds share their breeding grounds in Siberia with migratory birds from Europe and Africa, these variants have been able to spread around the world. And birds that deviated from their usual migratory route even brought the virus to North America.

> **‘Vaccinating tens of thousands of birds is very intensive’**

DNA vaccine, which works in a similar way to the mRNA vaccines we are currently being given against Covid-19: the body makes a specific piece of virus protein itself. In the case of Covid-19, this is the spike protein on the coronavirus; in the case of bird flu, it is a piece of the HA protein. Another option is a vector vaccine, in which a harmless virus is introduced that will make a piece of the HA protein from the bird flu virus. In both cases, screening will show the difference between vaccinated and infected animals as vaccinated animals will only have antibodies against the HA protein. In the same way, in the case of the coronavirus the public health service can differentiate between vaccinated people and infected people: vaccinated people will only have antibodies against the spike protein.

Clear differentiation between infected and vaccinated animals can help overcome the resistance in Europe to vaccinating against bird flu, Beerens thinks. ‘Bird flu is not going to go away,’ she says. ‘We will have to make the disease controllable. To do that, we have to explore several avenues at the same time: better diagnosis, risk reduction, monitoring and control. And in my opinion, vaccination really is part and parcel of it.’

Another obstacle is the practicalities of a vaccination campaign. The vaccine is administered by injection, just like our own flu and Covid vaccines. ‘That is manual labour and very intensive, especially for a farmer with tens of thousands of birds,’ says Henk Hogeveen, professor of Animal Health Management. ‘What is more, it takes several weeks before an animal is optimally protected. So it’s of little use for broilers: they are sent for slaughter after six or seven weeks. Theoretically, you could also administer the vaccine in a different way, Hogeveen notes, by putting it in the water, for instance. But there are no such vaccines yet - once again because the European pharmaceutical companies do not see much future in them.

MARKET FOR DISEASED CHICKENS

Hogeveen himself is researching practices related to bird flu in Indonesia, where the disease is endemic: the virus brews under the radar in many places and re-emerges here or there on a regular basis. ‘Culling is a rare occurrence there,’ he says. ‘A farmer who discovers that his chickens have bird flu

often rushes them to market – even though they are not yet fully grown. A small profit is better than none.'

There is a market for diseased chickens in many parts of Indonesia, continues Hogeveen. 'People prefer to buy live chickens,' he explains, 'not packaged chicken fillets like we do. Interestingly, lean chickens are also in demand. If a chicken is fat, people are afraid it has been given hormones.'

For individual farmers, the existence of this market for diseased chickens reduces the damage caused by the bird flu virus, and thus also the incentive to do something about it, according to Hogeveen. And they are not very inclined to take measures against the virus in the first place, because they cost money. So there is little in the way of strict hygiene throughout the supply chain, from poultry farm to market. 'It is not standard practice to disinfect crates, for example'. On the other hand, in many places in Asia, as well as in Egypt, poultry is vaccinated, because overall, that benefits farmers: their chickens are healthier, and the mortality rate is lower. A bird flu vaccine is used that was developed in Southeast Asia and is cheap. And the vaccination itself, using injections and therefore manual labour, is affordable In Asia as labour costs are low. 'It is not a fantastic vaccine, but it does reduce the severity of the disease,' says Hogeveen.

SPREADING TO HUMANS

'The fact that bird flu is rife in Southeast Asia is cause for concern for us too. After all, new variants can be brought in by migratory birds. And there is always the risk of a variant spreading to humans. So it is in our own interests to limit the spread of the virus in Asia as much as possible,' emphasizes Hogeveen. He is involved in a number of projects investigating possible measures. 'Education about hygiene is an important strategy,' he says, 'as is vaccination. In Indonesia, farmers decide on that for themselves. There is no central control, which is something that could help.' That is his message to the Netherlands too: he sees a role for the Dutch government when it comes to vaccination policy. First of all, the government can push for changes to European trade agreements, so that vaccination does get accepted and progress can be made on developing better vaccines, improving their administration, and differentiating between infected and vaccinated animals. 'Sometimes the market fails, and then it's OK for the government to intervene,' says Hogeveen. 'As far as I'm concerned, they can make vaccination compulsory in Europe, or subsidize it, or both. Make sure that vaccination becomes part of the cost structure. Then manufacturers will take the initiative to develop better vaccines.'

ANIMAL WELFARE

But the driving forces here should not be economic interests or human health risks alone, Hogeveen comments. Animal welfare is a factor that should not be ignored. There is increasing public resistance to mass culls and the confinement of all poultry every winter. 'Ultimately, our country must work towards a socially acceptable poultry sector,' emphasizes Hogeveen. 'We must then aim for a One Health approach, in which we consider the health of humans, animals and the environment more in conjunction with each other.'

This is only possible if you get the wider public on board. Once people see the advantages, public opinion will start to shift, he predicts. 'Just as we are now seeing in relation to the overuse of antibiotics in livestock farming. People don't want that anymore. And livestock farmers are quite willing to go along with that, as long as they can maintain a profitable business model.' ■

www.wur.eu/birdflu

DANGER TO HUMANS

In Asia, bird flu virus strains have emerged that can also infect humans through intensive contact with poultry. There is no precise data on exactly how many people become infected, and how pathogenic the virus is: many infections remain under the radar. But half of the people who end up in hospital with this type of bird flu die. For unknown reasons, there seems to have been an acceleration in the number of human infections in the last two years. The virus strains in question are not present in Europe. But the more infections there are, the greater the chance that a variant will emerge that is easily transmissible from person to person. Only five mutations are needed for this, discovered the Rotterdam virologist Ron Fouchier in 2011. In the past, bird flu and human flu have sometimes been genetically linked, causing pandemics. The Asian flu of 1957 and the Hong Kong flu of 1968, which killed between one and four million people each, could certainly be traced back to bird flu viruses, and the Spanish flu of 1918 probably also had bird flu links.

Breeding coral larvae in the lab

Something hopeful is happening in the aquaria on the Wageningen campus: for the first time, a coral from the waters off Curacao is producing larvae. 'Now we can find out what makes corals tick and use that information to lure them to artificial reefs.'

TEXT ROELOF KLEIS **PHOTOGRAPHY** TIM WIJGERDE

It is hot in the climate chamber at the Marine Ecology Group. There is an aquarium along the wall of the narrow room. A yellow tang fish catches the eye, but the star role in this tank is reserved for the coral on the floor. Centre-stage is F11, the first generation of home-grown Favia fragum, a coral from the waters off Curaçao.

'F11 is our first coral that was born and bred here and has already produced its own babies,' says marine biologist Robbert-Jan Geertsma proudly. He personally picked the parent coral off the reef and brought it to Wageningen. 'Just in a couple of coolers in my hand luggage', he says. It was all perfectly legal, though. 'Ploughing through all the paperwork resulted in a five-hour delay.'

DIVING FOR CORAL EGGS

Corals consist of polyps that reproduce sexually by releasing millions of sperm and egg cells. These float to the surface and look for gametes from other coral colonies.

> 'You don't see any as lovely as these in the wild nowadays'

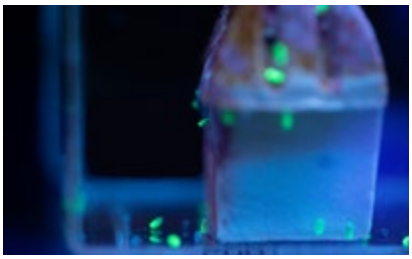
Geertsma: 'Normally, you had to dive for coral eggs for months in order to then fertilize and grow them in the lab. This is no longer necessary; in the Covid period we managed to complete the entire life cycle in the lab.'

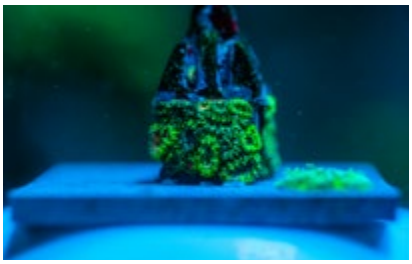
According to Geertsma, this breeding line is the only one in the Netherlands and one of the few in Europe. Alongside F11, there are dozens more of these tiny 'golf balls' lying on the aquarium floor. 'We now have a steady production line, which allows us to experiment all year round.'

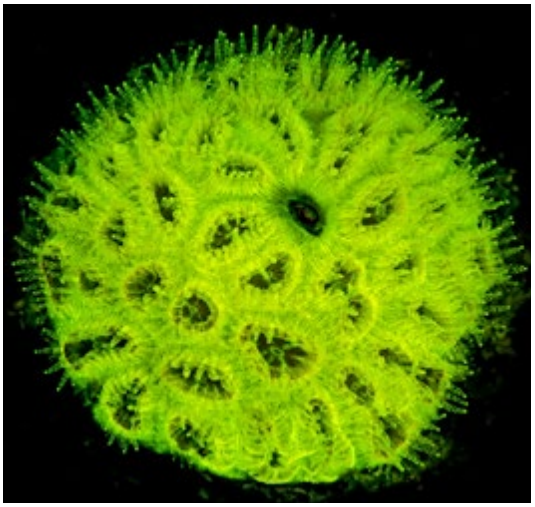
So the Wageningen offspring are doing their bit to expand our understanding of the life of corals. With the exception of a few locations, the world's coral reefs are in a bad way. Research might be able to offer tools for recovery.

COLOUR RETURNS

'Our corals are much healthier than those in the wild,' says Geertsema. 'When you pick them off the reef, they are very white and sometimes have large holes in them. Once here in the lab, their colour returns and their wounds heal. In the wild, they are very stressed. You won't find lovely ones like these out there anymore. It is frustrating to swim over a coral reef and see that corals you saw last time are gone. But when you succeed in breeding the first larvae in the lab and you see that they are thriving and that there is already a second generation, it gives you hope.'







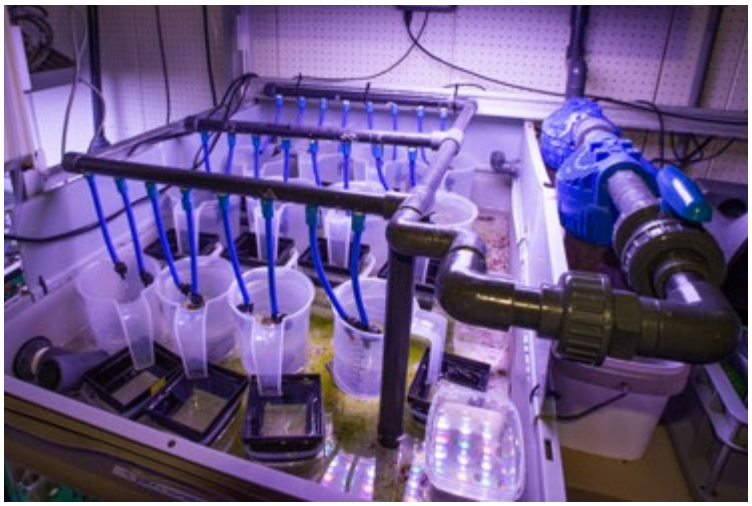


PHOTO ANP

Researchers in the coral lab in Wageningen have succeeded in getting a golf ball coral to produce larvae. Below right: the larvae are collected. Top right: the larvae establish themselves. The fluorescent pigments in the coral light up in green under blue light.

The larvae are choosy about where they live, says Geertsema. They see colours, smell odours and feel the ground. They are about one millimetre in size and are hard to see with the naked eye. The research group is therefore working on an optical system to track individual coral larvae for hours or even days. The system, Favia Vision, makes good use of the fact that the larvae contain a protein that lights up. 'This allows us to chart the selection process of the larvae. In a short time, we can test for a lot of substances to see whether they attract or repel larvae.'

This knowledge is useful for coral restoration, says Professor Tinka Murk. 'In the lab, we can now find out what makes larvae tick, and use that knowledge to lure them to artificial reefs. That gives reef recovery a kind of kick-start.' There will soon be another lab, in which research will be done on climate adaptation in coral. The researchers also have the mechanism behind coral bleaching in their sights. In some parts of the world, warming seawater is causing coral to bleach and eventually die. But in the warm Persian Gulf, for example, that is not happening. Murk suspects that some symbiotic combinations of corals and algae are more robust than others. 'Cultivating them in the lab will enable us to figure out why that is so. Which is hopeful, because it potentially opens the door to boosting native corals by offering them the right algae.' ■

www.wur.eu/coral-lab

‘We don't yet crave our portion of grasshoppers’

Insects are an efficient and sustainable source of protein, but they rarely feature on a Western menu. Sociologist of consumption Hans Dagevos is investigating why this is and how it can be changed. ‘As long as consumers don’t come into contact with them, they will not start eating insect products en masse.’

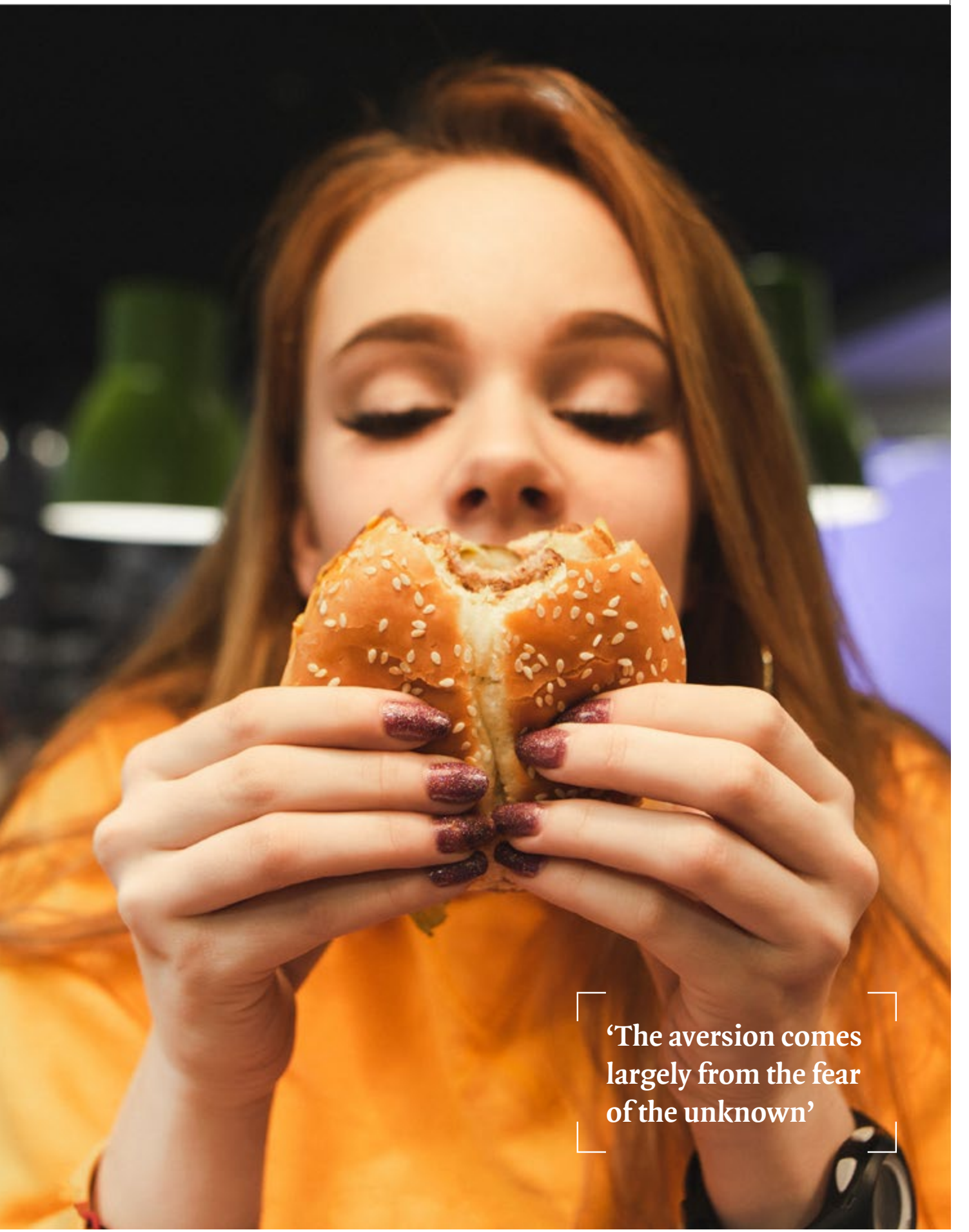
TEXT ANNE VAN KESSEL **PHOTO** SHUTTERSTOCK

We still eat a lot of meat; the average Dutch person gets through about 38 kilos a year. And thanks to the growing world population and increasing prosperity, global meat consumption is expected to increase significantly in the next few decades.

Insects are seen as a sustainable alternative to traditional livestock. Livestock farming takes up a lot of agricultural land and produces greenhouse gas emissions. Producing one kilo of beef requires many times that amount of feed and thousands of litres of water. Insects require much less space and grow efficiently. Being cold-blooded, they do not need energy to maintain their body temperature, so they use most of their food to grow. Moreover, they can live off waste products and can be eaten almost in their entirety.

RICH IN PROTEIN

Millions of people eat insects, which are an important part of the diet in tropical countries in particular. Insects are rich in proteins, fats, vitamins and minerals. But in the West, there is still little appetite for them, according to research done in 2020 by Hans Dagevos, a consumption sociologist and senior researcher at Wageningen Economic Research. Dagevos and his colleagues compared the acceptance of alternative protein sources in 2019 and 2015. They found an increase in the intention to eat alternatives such as plant-based meat substitutes, grains or seaweed, but that people didn’t necessarily choose them once they were in the shop. The participants were asked whether their attitude towards certain protein alternatives was positive or negative, on a scale of one to seven. Insects proved to be the least accepted alternative protein source: they did not >



‘The aversion comes largely from the fear of the unknown’

> ‘Don't forget that this kind of transition takes a long time’

elicit positive emotions. In fact, they aroused the most disgust. But there was an increase in the influence of social norms relating to eating insects, the unwritten codes of conduct. These play an important role when it comes to eating: people want to know, for example, whether others have tried something and whether it is considered normal to do so.

In another study, Dagevos specifically looked at literature on consumer research done since 2019 on the consumption of insects (known as entomophagy) in the Western world. What the study shows could be summed up as: we don’t like what we don’t understand. ‘The hesitance and aversion can largely be explained by the fear of the unknown,’ says Dagevos. ‘Insect products are few and far between in supermarkets and restaurants. As long as consumers don’t come into contact with them, they cannot get to know them so they won’t start eating them en masse.’

PHOTO GUY ACKERMANS

Hans Dagevos, a consumption sociologist and senior researcher at Wageningen Economic Research

GROUND UP IN BISCUITS

There are three approaches you can take to getting consumers to eat more insects, Dagevos explains. There is the indirect route, where pigs and chickens are fed insects and people then eat the meat or eggs. And there is a direct route, where people are served either the whole insect as a dish or biscuits, pasta and soups containing ground-up insects. 'At the moment, most eyes are on the latter route.'

A striking finding from the literature review, says Dagevos, is that hardly anyone has explored whether people are more drawn to entomophagy if they know about ways of making insect farming circular, such as feeding insects on restaurant waste. 'I wondered whether that circularity could help make people overcome their fear and disgust.'

Through the involvement of McDonald’s in the project on the 'Role of insects in new production cycles', which Dagevos's research is part of, he came up with a design for a study in which test subjects read an online story about a fictitious owner of a fast-food restaurant who wants to make his business operations more sustainable and decides to start taking his food waste to an insect farmer.

The farmed insects then come to the restaurant as an ingredient in various products, from insect burgers to ice cream containing insect protein, and from wraps made with insect flour to chicken nuggets from insect-fed chickens. In total, the more than 1000 participants saw 18 dishes with insects on an illustrated menu. In some products, the insects were clearly visible; in others, like the ice cream, they were present in the form of meal. There were no insect-free dishes.

What did you want the participants to tell you?

‘The study consisted of two rounds. In the first round, we confronted the participants with the products and asked them if they were inclined to order them. Round two came two weeks later, and then we presented the participants with a bunch of statements about sustainable behaviour and how important it was to them. After that, they were asked about eating insects and whether they found it scary. Then they read the information about circularity in the fast-food restaurant and could once again answer the question as to whether they would choose the products.’

So does the information on circularity change people’s minds?

‘We haven't analysed all the results yet, but

it seems that the idea of circularity doesn't have much impact. If people are very committed to sustainability, the information does affect their willingness to eat insects, but not very much. Another hypothesis was that if people have a very strong aversion to the idea of eating insects, hearing about circularity will not do much to change it. And that proved to be the case. It seems an aversion doesn't just disappear if you give people information about circularity'.

Not too surprising in itself. You had already concluded from your literature study that information alone will not be enough to change behaviour.

'That's right. And even if the information aligns with the values of the target group, such as people who already live very sustainably, it does not change their intentions very much, we now see. If people were to choose any of the products, they would go for the dishes in which the insects are least visible. This confirms the idea that it is best to market food containing ground insects, in addition to the indirect route of using insects as animal feed'.

If insects are only present in a product in processed form, to what extent are people aware of that? And can that then be a prelude to eating unprocessed insects?

'That will depend on how visible you make the insects on the packaging. If they are mentioned somewhere on the back in the ingredients list, it will not make much difference. Not many people look at the back of the packaging. It's a different story if it becomes part of the marketing and insects are clearly visible on the front of the packaging. Something like what OERei does. That egg producer shows on the box that the chickens are fed on insects. Whether this makes people more or less inclined to eat whole insects themselves, we don't know yet.'

The last time Wageningen World published an article on eating insects was in 2010. At the time, professor of entomology Arnold van Huis said: 'We are often not taken seriously, but I would like to speak to those critics again in five years' time. Even the conservative Dutch will be tucking into insect burgers.' Fellow professor of entomology Marcel Dicke added: 'Within 10 years the shops will be full of insects.' Well, 12 years have gone by now and not much has come of it. Why is that?

'Twenty years ago, the idea was that we would start eating whole insects. From recent research we now know that that is still three bridges too far for most people. We don't yet crave our portion of grasshoppers. We will have to focus on the other two routes, I think. Don't forget that transitions like this take a long time. You can see this in the case of the protein transition too. How long has it taken for people to begin to cut down on meat and for the transition to a more flexitarian diet to gain a serious foothold? People would like to eat less meat, but in reality, it happens slowly. Now that the supply of plant-based meat substitutes is increasing, more people are buying these products. So there's a big role for supply.'

Will insects ever be prominent in the Western diet?

'I'm going to be a lot more cautious than Van Huis and Dicke now. I don't see it happening in the short term. And if it does happen, I expect it will take decades rather than years. As to what form it will take, that's anyone's guess. But prioritizing the circular economy may help to get insect farming off the ground and of course, it is also important to develop a highly attractive product range.' ■

www.wur.eu/insects

Insects that the EU currently allows to be bred and sold for human consumption:

House cricket (*Acheta domesticus*)

Banded cricket (*Gryllodes sigillatus*)

Migratory locust (*Locusta migratoria*)

Mealworm (*Tenebrio molitor*)

Buffalo worm, also known as the lesser mealworm (*Alphitobius diaperinus*)


Lipton
Original
SPARKLING
ICE TEA

BAN ON DISPOSABLE PLASTICS

What are the alternatives?

The European Union has banned the use of plastics for single-use products such as bowls and drinking straws. The ban includes biodegradable plastics. 'But we think some of these materials should be exempt', says Christiaan Bolck, programme manager for renewable materials in Wageningen.

TEXT KARST OOSTERHUIS **PHOTO** ANP

WOUTER POST,
Sustainable Plastics Technology researcher

‘Biodegradable plastics are also banned, which I find very strange’

The phenomenon of plastic soup will not have escaped anyone's attention. Images of a sea turtle entangled in plastic are etched into many people's retinas. And the plastic objects found in the oceans are just the tip of the iceberg. The majority of plastics never make it to the sea but end up in the soil and river sludge, sometimes in the form of tiny microplastic particles. These plastics are less visible, and we know little about their impact.

How can we tackle these problems? Can we stop using fossil-based plastics that accumulate in the environment, and what are the alternatives? Researcher Wouter Post of Wageningen Food & Biobased Research is involved in developing new materials for various applications: 'You want plastics to be endlessly recyclable and to biodegrade when they do end up in the wider environment. My utopian dream is that a plastic that is at risk of ending up in the sea, for example, will trigger a mechanism on contact with seawater that causes the material to biodegrade quickly and fully. That is still a long way off, but it is what we are striving for in our projects.'

Post is working in the Sustainable Plastic Technology expert group on a project that has outlined a future scenario for plastic use in 2050. This resulted in a roadmap of alternatives to fossil plastics. Most products and packaging can already be replaced by bio-based materials with good biodegradability, but this is still difficult for food films with strongly protective properties for preventing spoilage.

'Technically speaking, there are lots of possibilities,' says Post. 'But you also have to deal with an existing infrastructure of waste collection and recycling, and with political considerations. For that reason, our future scenario still seems unrealistic.'

The European Union has chosen a different path. The Single-Use Plastic Directive, which came into force in July 2021, bans the use of all plastics for a number of common products made for single use, such as food containers, drinking cups and straws. Alternatives made of plant-based materials such as cardboard are allowed. Post's colleague Christiaan Bolck, programme manager for renewable materials, is glad the EU is taking a stricter stance, but he still sees room for improvement. 'The current dogma is: all plastics are bad and materials made by nature are good. There is no room for truly biodegradable manmade plastics, which we think it's all right to use too. The guiding principle should be to ban materials that accumulate in the environment.'

HOLY GRAIL

This is exactly where the European legislation fails, according to the researchers. Alternatives are now often made of cardboard, but that is not water repellent, so coatings are added, some of which are based on substances containing PFAS. These coatings are not yet regulated by law, despite their potentially harmful effects on the environment. There is also a risk that users are more likely to leave a cardboard straw lying around because they think it is harmless. 'Paper straws quickly become mushy and then they're not nice to drink through, as I know from experience,' says Bolck. 'We should focus on products that do what they are made to do, and fully break down after their functional life. That is the holy grail for us.'

Post even fears that the ban on plastics could be counterproductive. 'There's been a lot of fanfare around the ban on single-use plastics, but it is going to hold back technological developments that could bring positive change.' In a project financed by the Dutch government's sustainable investment scheme Invest-NL, he is looking at the possible applications of PHA (polyhydroxyalkanoate), a material that he believes to have a lot of potential. PHA is a polymer made by microorganisms and it can be made from organic waste streams. You can use it to make, for example, a straw that feels like traditional plastic, but which breaks down '100 to 1000 times' faster than traditional plastic when it enters the environment. ´Conventional plastics take several hundred years to do that, so this is a real gain. Yet all biodegradable plastics are banned for specific applications and to me, that's really strange.'

DEMO FACTORY

PHAs are being embraced in the United States and Asia, however. There, they are already being produced on a larger scale, but hardly at all in Europe. But a demonstration plant is being built in the Netherlands in collaboration with five water boards, research centre STOWA, the Dordrecht waste processor HVC, and Paques Biomaterials. The Dordrecht plant will produce PHBV, a bioplastic from the PHA family. Bacteria make the polymer from organic waste streams such as industrial wastewater. By controlling the supply of food in a reactor, the bacteria can make up to 80 per cent of their weight in PHA, which is then extracted as a powder.

PHOTO GETTY IMAGES

'PHA is made by bacteria themselves and acts as their energy reserve, so it makes sense that it is highly biodegradable,' explains René Rozendal, director of Paques Biomaterials.
Post and his colleagues are now in possession of several kilos of the material for research purposes. The possible applications of PHBV are being investigated in Wageningen, and Post thinks the company is onto something really special. 'The material has a number of properties that are fundamentally different from other PHAs currently being produced and that makes it a promising material for making thin films. This has been very difficult to do with PHAs, but with this material it seems possible.'
Post sees opportunities for agriculture in particular. The accumulation of plastic in the soil, through things like fertilizer coatings or agricultural mulch films, is a major problem. In Europe, only 63 per cent of all agricultural plastics are collected. What happens to the rest is unknown, but it is likely that a large proportion remains in the soil. Yet there is no European legislation for controlling this. According to the European Chemicals Agency (ECHA), the biggest source of microplastics is artificial fertilizer coatings that enable the delayed release of nutrients. 'It is incomprehensible to me that non-degradable plastics are still deliberately being buried in the ground and stay there,' says Rozendal of Paques Biomaterials. 'That is why we invented a coating based on PHBV that you can put in the soil with a clear conscience.'

INNOVATION ON THE FOOTBALL PITCH

Another innovation came out of the collaboration between Post's group and a turf producer. Turf grows better on nets, making it easier to harvest and transport to the customer. Normally, these nets are made of polypropylene, which does not break down in the soil. But nets based on PHA would break down too quickly, so the researchers opted for PBS (polybutylene succinate). Post: 'This is a polymer that lasts longer in the soil. The trick was to develop a material that is still strong enough after 12 months, when the turf is harvested, but that breaks down within a year of being put in place. The manufacturer wants to start selling the mats soon and there is a good chance that they'll be used on football pitches one day.'
Violette Geissen, professor of Soil Degradation and Land Management, researches the effects of plastics in the soil. She is critical of the use of plastics in agriculture, even bio-degradable plastics. Various additives are added to agricultural films made from bioplastics to give them the desired properties. 'It is not clear what the effects of these chemicals are and there is no testing before these plastics are allowed on the market. Moreover, degradability is often standardized for >

FOTO AREND-JAN DER GLIND

CHRISTIAAN BOLCK,
Renewable Materials programme manager

'Ban materials that can accumulate in the environment'

favourable conditions with sufficient soil moisture and a certain temperature. No measurements are made in field conditions, and in the dry south of Spain, for example, many of these plastics do not break down at all.'

PLANT GROWTH DELAYED

Recent studies by one of her PhD students also show that plant growth is negatively affected by the presence of biodegradable plastics in the soil, such as polybutyrate adipate terephthalate (PBAT), polylactic acid (PLA) and a starch-based plastic. Some plastics even absorbed pesticides, making them decompose more slowly. The mechanisms behind this are not yet clear. Geissen therefore argues that it should be compulsory for biodegradable plastics to be tested in the field before they are approved for use. Yet Post, and Rozendal of Paques Biomaterials, are optimistic about PHAs in agriculture. 'If any material can decompose almost anywhere, it is this one,' says the company director. 'But it is a justified criticism that you must also look at the chemical additives in degradable plastics. Ultimately, you want to find biodegradable alternatives to those as well. Fortunately, this is coming in for more and more attention.'

PHOTO SHUTTERSTOCK

Of all the agricultural plastics in Europe, only 63 per cent are collected after use. A lot of the rest probably stays in the soil.

Post and Bolck are investigating which materials break down in which environments, because where a plastic ends up ultimately determines the rate of decomposition. Every soil has a different microbial population, for example, and weather conditions play a role too. Several projects are therefore investigating how quickly materials break down in the soil and in the sea. 'We have tanks with seawater from which samples are regularly taken,' says Post. 'We look at both the mechanical and chemical decomposition. The next step is to measure CO_2 as well. That way you can prove that biodegradation is really going on, and that the plastics are not just disintegrating into microplastics.'

Laudable as it may be to look for more sustainable and biodegradable alternatives, Bolck thinks it is even better to first critically examine the need for plastic for a specific application. That is why he was a member of the jury for the NL Packaging Awards in the sustainability category. The aim of this award is to stimulate the reduction of the ecological footprint of packaging. 'There are a lot of products that don't need to be packaged at all. In 2019 the winner was a form of print that can be stamped directly on fruit. I think that's a wonderful solution. Protecting products to prevent spoilage is a good thing, but nowadays packaging is sometimes no more than a marketing tool.'

SACRIFICE CONVENIENCE

In Bolck's view, it is inevitable that we will sacrifice a bit of convenience. According to the scientist, it would be a good thing to ban some products completely, which has already been done with free plastic bags, for example. But it is hard to know where to draw the line, because there's a fine

RENÉ ROZENDAL,
director of Paques Biomaterials

'If any material can decompose almost anywhere, it is PHA'

PHOTO RAPHAEL DRENT

VIOLETTE GEISSEN,
professor of Soil Degradation and Land Management

'It is unclear what effects plastic additives have on soil life'

line between convenience and nonsense, he observes. 'A prepared salad could be considered a luxury, but the same applies to a packet of tomato soup. You could just buy tomatoes and grow your own herbs. But do we want to return to a time when you have to spend half your day in the kitchen? That may be sustainable, but it is not realistic.'

Nor is plastic always necessary in agriculture, according to Professor Geissen. On asparagus farms, for example, mulch films are used so that the farmer can harvest in March and get a higher price from consumers who are eager for the seasonal vegetable. Some organic farmers are also switching to plastic for weed control, she notes. 'There is no regulation of the use of plastic in organic farming. Some of the plastics remain in the soil, while there are many other methods that every farmer is familiar with, such as mechanical weeding.'

European legislation is now being drafted that will restrict the use of plastics in agriculture: a development warmly welcomed by the scientists, although Post and Bolck are hoping that an exception will be made for plastics that truly biodegrade on and around farmland.

FIVE TIMES MORE EXPENSIVE

Apart from the possible legal and practical obstacles, the price of biodegradable plastics is still a major dealbreaker too. The biodegradable options can be up to five times more expensive than current fossil-based plastics. But there is another complicating factor: the current infrastructure for waste collection and recycling is not equipped to deal with many different materials. Separating plastics is a costly process, and the more different plastics you collect, the more complicated the logistics become.

The previous Dutch cabinet decided to put a lot of effort into recycling and wants to have half of all plastic packaging being recycled by 2025. The trend is therefore to create as few new plastics as possible. Bolck and Post, however, are convinced that we will not solve the plastic problem with the existing materials. One of the main shortcomings of the current system is that most plastics, even if they can be recycled, still end up in the environment. 'I fully subscribe to the circular idea,' says Bolck. 'But everything we make can also end up in the biological cycle and cause damage there. Even if only a fraction ends up in nature, as long as the material cannot break down, it will accumulate.'

SYSTEM CHANGE NEEDED

Post sees PHAs as a 'major piece of the puzzle' in reducing plastic accumulation in the environment, but he realizes that the system needs to change radically before biodegradable plastics can stage a breakthrough. 'The transition to new materials requires existing plastics to be phased out. As a society, you will first have to agree on the way forward. For the past hundred years, plastics have been optimized for their function. I think we now need to start designing materials giving priority to what happens after their functional life.' ■

www.wur.eu/renewablematerials

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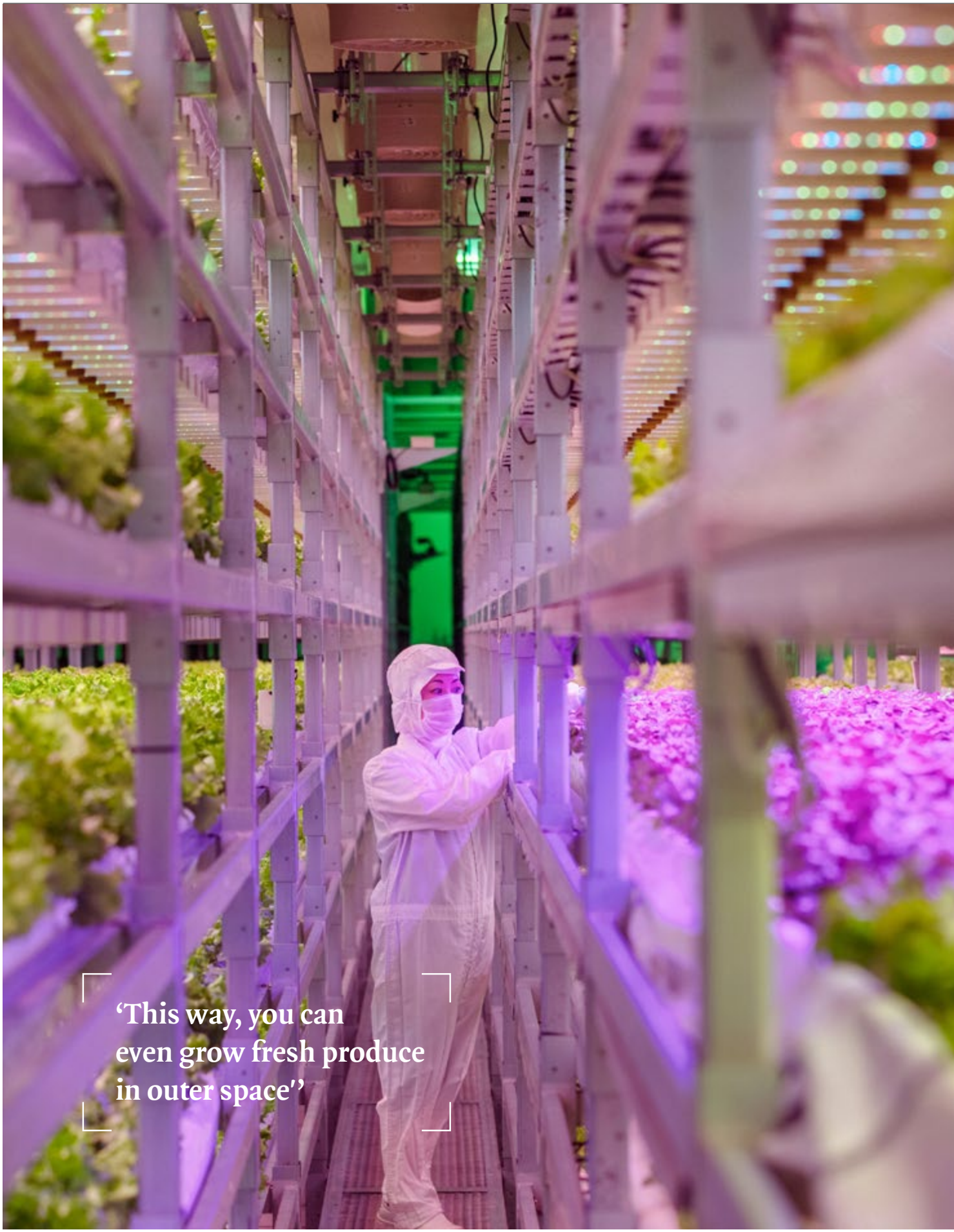


‘This way, you can even grow fresh produce in outer space’’

Layers under LED light

There is a new global trend: growing vegetables stacked in multiple layers without daylight. This vertical horticulture takes up little space, saves water and can be done in places like disused factories. At present, its main use is for herbs and lettuce seedlings, but in Wageningen its future is being explored.

TEXT MARION DE BOO **PHOTO** JONAS GRATZER/GETTY IMAGES

'As soon as you step inside here, you can almost smell the pesto,' says Leo Marcelis. We are standing in one of the climate chambers on the Wageningen campus. This is where Marcelis, a professor of Horticulture and Product Physiology, experiments with 'vertical gardening'. Basil plants and lettuce grow one above the other in layers. The plants do not get any daylight, but are lit with brightly coloured, energy-efficient LED lights. Each nursery has its own LED strip lights in alternating patterns of red and blue. 'We want to find out how much light these plants need for optimal production,' says Marcelis. 'We can vary both the intensity and the colour of the light, and we can hang the lights both above and in between the plants. We are studying the plants' growth and production as well as aspects of quality such as taste, nutritional value and shelf life.'

Vertical horticulture, or vertical farming, is on the rise worldwide. In December 2021 Marcelis and his colleagues published a review article on vertical horticulture in *Nature Food*, outlining the numerous advantages of the method. Stacking containers full of lettuces, radishes or strawberry plants enables you to grow much more food in the same space than you could in a greenhouse. Carefully controlled growing conditions guarantee production and quality all year round. No soil is needed, because the plants grow in pots full of artificial substrate.

ON THE TUNDRA

By this method, fresh fruit and vegetables can also be grown close to the consumer in densely populated urban areas, at locations such as disused factories or office buildings, empty basements, and shipping containers. Marcelis: 'This is a great way to grow fresh produce on the outskirts of cities and near large supermarket distribution centres, for example. But also on the tundra, in the desert and even in a spaceship, on the way to Mars.' >

PHOTO GUY ACKERMANS

Leo Marcelis, professor of Horticulture and Product Physiology

In vertical horticulture, the water evaporated by the plants is recycled. 'Our tomatoes only need two to four litres of water per harvested kilo of produce,' says Marcelis. 'In outdoor crops in hot countries, they need at least 60 litres; in a Dutch greenhouse, about 16 litres.' Moreover, if the nurseries are hermetically sealed, few if any pests or diseases get in, so pesticides are hardly ever needed, as long as the grower observes strict hygiene and monitors the crops carefully. Nor is there any loss of nutrients to the environment in a closed system.

SUBSTANTIAL INVESTMENTS

The downsides of stacked cultivation without daylight, however, are its high energy consumption and the substantial investments required. 'You need more lamps, more racks and a more expensive climate system than in greenhouses,' says Marcelis. 'But LED lighting is revolutionizing greenhouse horticulture. LED lamps are getting more and more efficient at converting electricity into light and they are also getting cheaper. And they are available in a wide range of colours that you can play with to optimize the growth and production of your plants.'

Red light is very efficient for photosynthesis, the process by which the plant produces sugars under the influence of light. But a plant won't grow well on red light alone; it needs at least a little blue light as well. And besides photosynthesis, certain other processes in the plant are strongly influenced by light too. A plant has a number of receptors with which it perceives different colours of light, and which influence a large number of physiological processes.

Important research questions in Wageningen are whether plants' need for light stays the same all day, and to what extent the needs of young plants differ from those of fully-grown plants. Light requirements are closely related to other growth factors such as temperature and CO_2 levels, humidity, and air currents. Marcelis: 'There is still a lot that can be optimized. For instance, we know that plants are naturally very sensitive to the ratio of red to far-red light, especially at sunset. With smart lighting, the grower can encourage the plants to grow faster and over a longer stretch of time.'

WORKING WITH INFARM

In January, WUR announced a new collaboration with Infarm. This international company with its headquarters in Berlin has already set up 1400 vertical farms in supermarkets and large-scale horticultural centres in 11 countries in North America, Europe and Asia. Worldwide, Infarm is experimenting with 75 different crops. Computers control the cultivation remotely, monitor it via sensors and cameras, and continuously share data via a cloud network. Data scientists analyse the measurement data to adjust production in real time. 'This has enabled us to cut the cost of our nurseries by 82 per cent since 2018, and to increase production by 240 per cent,' claims an Infarm spokesperson. 'Another important thing is that our cultivation systems are modular. Our customers can start small and gradually expand the system, which means lower investment costs at the start.' Some XL branches of Albert Heijn in the Netherlands already have Infarm vertical farming pods in which fresh herbs are grown on-site in the supermarket.

‘Our tomatoes only need four litres of water per harvested kilo’

Over the next four years, Infarm will be financing research by two Wageningen PhD students and one postdoc on the stacked cultivation of tomatoes. Marcelis: 'We are going to work with dwarf tomato plants, no taller than about 20 to 50 centimetres. We want to know how you can grow tomatoes that are optimally healthy and nutritious without daylight and using as little energy as possible. We shall evaluate their growth rate, health and nutritional value, using sensors and 3D scanners.'

ATTRACTING CAPITAL

Investors believe in vertical horticulture. In December 2021, Infarm raised 200 million dollars in capital, earmarked for the expansion of its global operations. In 2023, the company will open a research centre in the desert state of Qatar. A competitor from San Francisco, Plenty, raised 400 million dollars from investor SoftBank and supermarket chain Walmart in January 2022. Plenty sells vertical farming systems to supermarkets. The company claims that its system can produce as much food on one hectare as a conventional farm on 360 hectares, while using 95 per cent less water. In Amsterdam, the vertical-farming company GROWY is already growing 50 varieties of lettuce, herbs and microgreens for restaurants and delicatessens. And in Poeldijk, Future Crops is pioneering the vertical cultivation of herbs.

Marcelis: 'Until about 10 years ago, I was sceptical about vertical horticulture. Dutch greenhouse horticulture has a strong competitive position. Although we often grumble about our climate, viewed year-round, a temperate climate is actually very favourable for greenhouse horticulture.' Further north it is too dark, further east it is too cold in winter, and further south it is too hot and dry in summer.

Dutch greenhouse horticulture is also highly developed, and the horticulturalist has everything under control. When it gets too cold, the heating is switched on. When it gets too hot, the windows are opened. And when it is too dark, there is additional lighting. Marcelis: 'Vertical horticulture is a logical next step. Both growing systems will exist side by side and will partially overlap. There are already growers who use vertical horticulture to grow young plants, only putting them in the greenhouse in the final phase, when the need for light is greatest.'

BOOMING

Vertical horticulture is rapidly gaining ground in America and Asia. According to Marcelis, Dutch growers work very efficiently and keep a close eye on costs. ‘That is why they can produce fairly cheaply. Vertical horticulture will have to compete with that. But increasingly, it will not just be about the cost price. Vertical horticulture is more likely to take off in other countries where horticulture is less developed and the climate is often less favourable,' he expects. ‘Water-saving growing systems with climate control are especially welcome in hot desert countries.’

Marcelis cannot make categorical statements about the costs of vertical farming. But he doesn’t believe vertical farming will be viable for bulk crops such as cereals because of the investments involved. ‘The system is still so new that everything is changing all the time. That is why we do not have good objective figures yet. Of course, it is nice for consumers to see mint and coriander growing in cabinets in the supermarket, but that will only be a small section of the market. The entire horticultural industry, vertical or otherwise, is working on systems for farming autonomously and on an ever-larger scale.' ■

www.wur.eu/verticalfarming

IDEAL PLANT SHAPE

The ideal plant has its leaves neatly spread out, without overlap, so that all the light is caught and is evenly distributed over them. In practice, a lot of light still falls on the ground and goes unused. In Wageningen, researchers are going to use a 3D scanner to depict the structure of the plant. How compact can or should a plant be? How is the light intercepted and distributed by the various layers of leaves? Another important question is how the sugars produced by photosynthesis are distributed between the leaves and the fruit. The researchers also make simulation models of the light interception, photosynthesis, plant shape and nutritional supply for every conceivable combination of varieties. The shape of the plant can be influenced by directing the light onto particular parts of it. Plant breeders may also be able to further optimize the position of the leaves.

Resilience of tropical forest gives hope

Much of the tropical forest cleared for farmland that is later abandoned grows back within a few decades. Almost total recovery is possible within 120 years. A surprisingly positive message, say the researchers.

TEXT ROELOF KLEIS **PHOTOS** ALAMY

A lot of tropical forest is still being destroyed for the sake of crop and livestock farming. Much of that land ends up lying fallow: the soil becomes exhausted, and farmers stop or move elsewhere. The forest then grows back on the abandoned land. And that process is going encouragingly fast, according to a large international study led by Wageningen forest ecologist Lourens Poorter.

Poorter and his colleagues charted the growth of what is known as secondary forest in the tropical rainforests of South and Central America and parts of West Africa. Not by monitoring the development of forest plots over time, but by comparing forest plots of varying ages, i.e. the number of years since the fields or cattle pastures were abandoned. This approach was pretty much born out of necessity. 'There is not much longitudinal research available on these kinds of plots,' Poorter explains. 'Very few of these small woodland areas are monitored over time, and if they are it is often for no more than 20 years. And yet it is precisely the longer-term recovery that is interesting. When you compare secondary forests that vary in age and are at different stages of recovery, a kind of timeline of forest recovery emerges'.

2275 PLOTS

In the study, which was published in *Science* in mid-December, more than 2275 plots of secondary forest were compared across 77 landscapes. These were small sample plots, on average only 0.1 hectares in size, once used for shifting cultivation or as cattle pasture by small farmers. The study recorded the speed and completeness of the recovery of many forest characteristics, such as forest structure, species diversity and composition, soil carbon content and its functioning as an ecosystem.

The results are encouraging. Nature picks up where it left off surprisingly quickly. Within 20 years, many of the characteristics of the former forest are back at nearly 80 per cent of normal levels. An almost complete recovery is possible within 120 years. That is, if the forest is left alone. Some characteristics recover faster than

> ‘Recovery is going much faster than expected'

others, however. In the case of the soil, recovery usually takes no more than a decade, and the wood and leaf properties recover in less than 25 years. Biodiversity, on the other hand, needs more time to return to its former level: between 20 and 60 years. Not that everything will be as it once was after 60 years. The number of species does recover, but they are not always the same species. Moreover, it can take a long time before tropical trees are really mature. So full recovery takes at least 120 years.

NEIGHBOURING TREES

The researchers conclude that secondary tropical forest is highly resilient, as long as the land was not used for agriculture for longer than three to ten years. Poorter: 'The longer and the more intensively you use the land, the more you deplete it and the slower the recovery.' Moreover, the soil must still contain sufficient seed to provide for new growth. It is essential that there is older forest nearby. Seeds from neighbouring trees can then colonize the terrain.

A large area of land is now covered by secondary forest. More than a quarter of the neotropical region – the tropical forests of South and Central America – is host to secondary forest that grew back after the land was used for agriculture. Poorter says the study shows how important these forest plots are for restoring biodiversity and achieving climate targets. ‘Tropical forest is not lost forever after being cut down. The recovery goes much faster than expected. That is the surprisingly positive message of this study. I am an optimist by nature. For me, the glass is always half full. But now, after 20 years, it turns out to be 80 per cent full!'

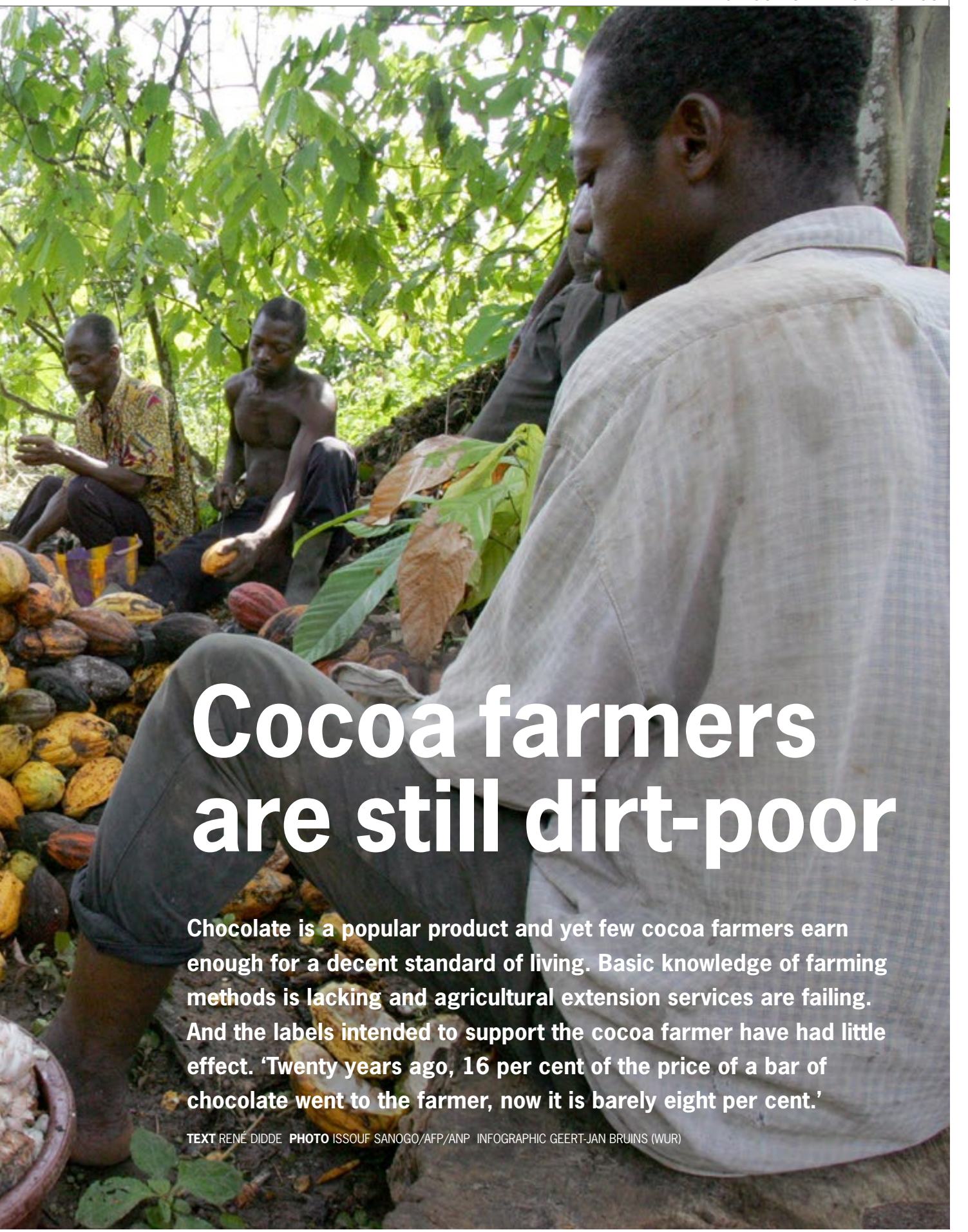
This positive message comes with a hefty disclaimer, however. ‘This is not a “licence to kill', in the sense of: just go ahead and do your thing. There is very little old tropical forest left. So let's do our best to preserve what we have.'

HELPING HAND

That recovery does not have to cost much. Nature does most of the work, assisted here and there by active management, depending on local conditions. These local conditions are important. On average, secondary forest recovers rapidly, but there are big differences between locations. Recovery takes much longer in places where there is not much seed or where an invasive species is dominant. In those places, a helping hand is needed in the form of replanting, weeding or creating ecological corridors to the area. ‘Use natural forest restoration where possible and plant where necessary. And another good option could be agroforestry: a combination of agriculture and forestry.' ■

www.wur.eu/forest-recovery

Tropical forest that is felled for agriculture is not lost for ever; 80 per cent of it has recovered within 20 years.



Cocoa farmers are still dirt-poor

Chocolate is a popular product and yet few cocoa farmers earn enough for a decent standard of living. Basic knowledge of farming methods is lacking and agricultural extension services are failing. And the labels intended to support the cocoa farmer have had little effect. 'Twenty years ago, 16 per cent of the price of a bar of chocolate went to the farmer, now it is barely eight per cent.'

TEXT RENÉ DIDDE **PHOTO** ISSOUF SANOGO/AFP/ANP INFOGRAPHIC GEERT-JAN BRUINS (WUR)

NIELS ANTEN,
professor of Crop and Weed Ecology in Wageningen

‘Agricultural extension services are inadequate’

In the West, we’ve been eating more and more chocolate, and consumption shot up during the Covid pandemic. Meanwhile, in Africa, the producers of the raw cocoa are not benefitting from the rising sales. The approximately three million mostly small farmers have been struggling for decades. Especially in the West African countries Ghana and Ivory Coast, where 70 per cent of the cocoa comes from, three quarters of the cocoa farmers earn less than a living income. ‘Their meagre income goes on primary needs such as food, medicine and school fees. There is little left over to invest in the much-needed improvements to farming methods,’ notes economist Yuca Waarts of Wageningen Economic Research.

So the cocoa farmers go on farming with old cocoa trees, which they should really replace after 20 years. The soil also becomes exhausted because they have no money for fertilizer. They often take new land into production by cutting down a piece of rainforest. Since 1970, according to estimates by the Dutch Ministry of Foreign Affairs, 80 per cent of the land of the world’s largest cocoa producing country, Ivory Coast, has been cleared of tropical forest for cocoa farming. In addition, rising temperatures and changing precipitation patterns due to climate change could have a negative impact on cocoa cultivation. Longer periods of drought are particularly disastrous for cocoa trees, which thrive best in the humid climate of the tropical rainforest.

TWO-THIRDS CERTIFIED

Quality labels such as Fairtrade and Rainforest Alliance were created with a view to improving the positions of small cocoa farmers. The Dutch cocoa sector agreed back in 2010 that all chocolate in the Netherlands had to carry one of these labels by 2025. According to Statistics Netherlands, 66 per cent of the chocolate was certified in 2018.

Consumers also seem willing to pay for ethically sound chocolate. The Tony’s Chocolonely brand was developed in 2012 by the Dutch consumer television programme *Keuringsdienst van Waarde* with the aim of improving the position of cocoa farmers. The distinctive bars are not only selling well in supermarkets but have also become trendy corporate gifts. In 2020 the brand accounted for 16 per cent of the Dutch market of chocolate bars.

It is expected that large, fast-growing economies such as China and India will increase the world demand for cocoa from four to five million tons per year. According to the laws of economics, this should lead to a price increase, but Yuca Waarts concludes that this is not the case. ‘In fact, there seems to be an oversupply of cocoa, because more small farmers are producing cocoa. We have been talking about a decent income for farmers for years.’ She is not seeing that reflected in hard figures, however.

How do you explain how a globally sought-after product like cocoa remains at a low ebb both agriculturally and economically? ‘The cocoa price fluctuates constantly and shows a downward trend. Yet in spite of falling prices, farmers still plant a few trees if they can. Cocoa farming is a tradition that at least offers some security. And anyway, there are hardly any alternatives,’ explains Waarts. In her November 2021 report *Balancing the Living Income Challenge*, she calculated that even if we paid twice as much for chocolate, the income of all the smallholders in Ghana and Ivory Coast would increase, but that many farmers would still not earn a living income. This is because about 70 per cent of the farmers produce only 30 per cent of the cocoa. ‘It would only increase the income per farmer a little bit. The price increase mainly goes to the larger-scale farmers, who grow bigger volumes of cocoa. And the higher prices can also lead to overproduction.’

PRUNING DOESN’T HAPPEN

Larger-scale farmers work more professionally and can more often make the leap to better propagation material and soil preparation. ‘They can also spend time and money on pruning the cocoa trees and they can buy artificial fertilizer,’ says Niels Anten, professor of Crop and Weed Ecology in Wageningen. Anten has done a lot of research on cocoa cultivation and has been involved in field experiments in West Africa for years.

According to him, the small cocoa farmers are difficult to reach. ‘A farmer thinks: I am not going to prune, because those branches will bear my cocoa beans next season, so I am not going to remove them.’ Anten sees a parallel with the way the Netherlands worked immediately after the Second World War. ‘Fruit growers then had enormous apple trees, which took up more and more space and produced fewer and fewer apples. Pruning cocoa trees back to a smaller size makes a higher density and a higher yield possible. The agricultural extension services

PHOTO AFP/ANP

A labourer harvests cocoa beans on an organic plantation in Ivory Coast.

are failing to get this message across.' Anten also notes a remarkable lack of basic knowledge. At the research stations of the Cocoa Research Institute in Ghana, he saw cocoa yields easily increase fivefold from 550 kilos to 3000 kilos per hectare. 'In reality, though, the yield on the larger farms was only 1200 kilos. That is less than in the trials, but it's still more than double the national average. Mould and plant density are among the issues in farming practice.' The researchers do not yet have a clear picture of the precise factors determining success and failure. 'Together with the research institutes, we still have to answer some fundamental questions, such as which fertilizers make a difference for which type of soil,' says Anten.

SMALL FARMS

A few doors down the corridor in Wageningen, Ken Giller, professor of Plant Production Systems, has made the problems of small farmers in Africa his life's work. 'We can see the poverty trap at work among nearly all farmers in Africa, including those growing coffee or maize. It is the poverty of a growing population, 90 per cent of whom work in agriculture and on ever smaller farms,' says Giller. This is a consequence of the African inheritance system in which four children might each inherit a quarter of the land.

In addition to the inadequate agricultural extension services, Giller points out that governments invest too little in knowledge and the development of infrastructure. 'There are subsidies and price guarantees for cocoa, but fertilizer, for example, is 10 times more expensive in Africa than in Asia, because it isn't subsidized.' He also blames the poverty on the neo-liberal trend in the world food economy. 'Twenty years ago, 16 per cent of the price of a bar of chocolate went to the farmer, but now it is barely eight per cent. Nearly half the profits go to traders, the chocolate manufacturers and the supermarkets.'

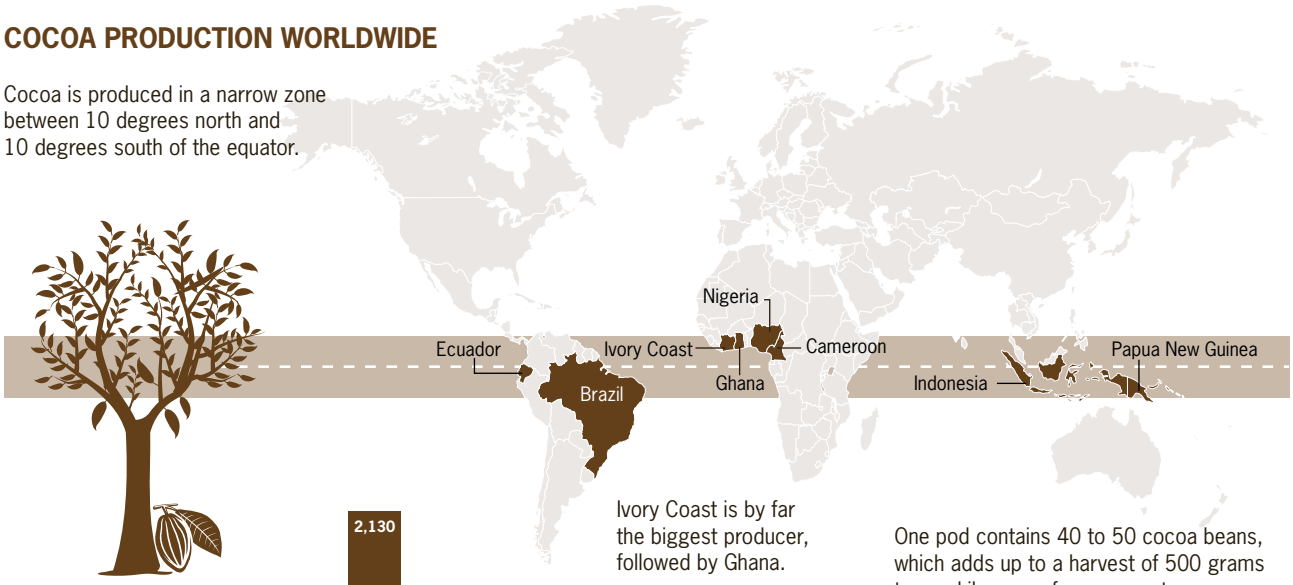
Giller agrees with Niels Anten that it doesn't help that cocoa farming is not easy. 'The lifespan of a cocoa tree is 20 years, so you get results from improving varieties much more slowly than you do with annual crops. And we have only recently learned that potassium is a much more important element in cocoa fertilizers than nitrogen and phosphorus. The research has virtually been at a standstill since the 1970s.' According to the agricultural researchers, this is mainly because until a decade ago, cocoa processing companies in Europe focused primarily on shareholder >

YUCA WAARTS,
economist at Wageningen Economic Research

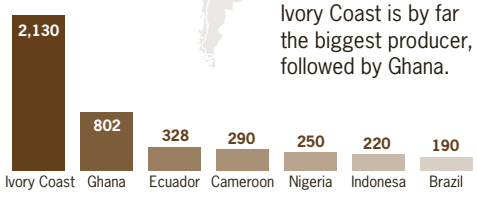
'Cocoa farming is a tradition and there are hardly any alternatives'

COCOA PRODUCTION WORLDWIDE

Cocoa is produced in a narrow zone between 10 degrees north and 10 degrees south of the equator.



The cocoa tree bears maximum fruit for about 20 years; 30 to 40 cacao pods per year.



Cocoa production in 2019 (x1000 tons)

Ivory Coast is by far the biggest producer, followed by Ghana.

One pod contains 40 to 50 cocoa beans, which adds up to a harvest of 500 grams to one kilogram of cocoa per tree per year.

Theoretically, one tree can yield five kilo of cocoa, according to Wageningen research.

returns. 'It's slowly changing now, under the influence of sustainable investment,' says Anten.

But Ken Giller is not pessimistic. There are opportunities for farmers, he says. 'In Ghana and Ivory Coast, there is increasing diversification in the cocoa sector and agriculture is being combined with forestry – agroforestry, in the jargon.' This could mean planting cocoa trees in amongst the giant trees of the tropical forest. 'The cocoa trees benefit from the shade of the tropical trees. And the leaves that fall from the trees provide compost that benefits the soil after one season,' explains Giller. A PhD student is investigating the possibility of composting the husks from the harvested cocoa beans together with the leaves from the taller trees. Agroforestry may also offer opportunities for combatting climate change, planting new trees in the tropical rainforest, and restoring biodiversity. 'I think agroforestry in combination with cocoa farming on well-chosen locations can create ecological corridors between nature reserves,' says Giller. Yet some have doubts about this form of agroforestry since, although the tropical trees keep the cocoa trees cool, they also compete with them for scarce water in times of drought.

Another option is to plant banana trees when planting young cocoa plants and new tropical trees. 'With their enormous leaves, the bananas provide enough shade during the cocoa trees' vulnerable first few years. Later, the tropical trees take over the provision of shade,' says Giller. 'And the bananas give the farmers an interesting second crop.' A further source of additional income could come from paying farmers for nature conservation and 'carbon credits' for the storage of CO_2 by trees, suggest the researchers.

PHOTO GUY ACKERMANS

KEN GILLER,
professor of Plant Production Systems at Wageningen

'Much more of the processing of cocoa beans could be done in Ivory Coast and Ghana'

A RAFT OF MEASURES

Tackling this issue calls for a raft of measures, according to IDH, the Sustainable Trade Initiative. This NGO's operational field includes the cocoa sector, and it helps to form new partnerships and co-finances sustainability projects. 'Intensifying farming methods, raising the price of cocoa or certifying chocolate will not work on their own if the aim is for the majority of cocoa farmers to earn a living income,' says acting director for the cocoa markets and Wageningen alumnus Frank Joosten. 'To improve the position of cocoa farmers, we need to move quickly towards a more segmented approach in which farmers and their options are central. Decisive factors are the size of the farm – whether one to four hectares or more, the region – whether it's getting drier, or still gets enough rain, and the presence of labour, infrastructure and sales markets for other products,' says Joosten.

PHOTO GUY ACKERMANS

FRANK JOOSTEN,
interim director of Cocoa Markets at IDH

‘Intensification, price increases or certification don't work on their own’

The problem is that governments, credit providers and multinationals are still not working together enough. ‘We've got to get away from all working on our own little islands,’ says Joosten. ‘For example, micro-credit organizations and banks in Ivory Coast lend to cocoa cooperatives and their members, but often do not coordinate this with the government extension services or the multinationals’ sustainability programmes.’

SPEED UP

According to Niels Anten, it's time to speed things up. ‘Cocoa consumption is going to go on increasing. If production remains at the same level, it will be at the expense of rainforest, or of agricultural land where essential food crops are currently grown.’
Ken Giller can see one improvement that is already under way. 'There is more added value if the harvested cocoa beans are processed in the country where they are grown.’ Every year, between 750,000 and 800,000 tons of cocoa go to the world's largest cocoa-importing port, Amsterdam, where the cocoa beans are stored and then shipped on. Without the country producing a single bean, this transit makes the Netherlands the world's second largest cocoa exporter after Ivory Coast. Some of the cocoa is processed in the Netherlands into cocoa mass, cocoa butter and cocoa powder. ‘Much more of this processing could be done in Ivory Coast and Ghana,’ thinks Giller. ‘For chocolate exports to China, at any rate, this could boost economic development in the country, which the small cocoa farmers could benefit from.’
Economist Yuca Waarts sees the diversification of cocoa farming as more promising. ‘Besides cocoa beans, farmers can also earn an income from cashew nuts, coffee and palm oil trees. Subsidies from the government and corporations could also help ensure a living income,’ she says.
According to Frank Joosten of IDH, a plan announced in January by the Swiss multinational Nestlé may be able to reverse the trend. The company pays farmers a sum of money if they grow other crops besides cocoa or keep livestock. ‘They also get money if they prune their cocoa trees, plant other trees than cocoa trees and send their children to school. If they implement all the measures, they get about 475 euros per family per year for two years, and half that sum after that. It's a substantial addition to their income.’ ■

www.wur.eu/cocoa

PHOTO ALAMY

CHILD LABOUR

Despite all the efforts over the years, 1.6 million children in Ghana and Ivory Coast still work on their parents' farms. About 55 per cent of Ghanaian farmers and 40 per cent of Ivory Coast cocoa farmers employ their children.
We look at these figures through a Western lens, says Anna Laven, a political scientist at the Dutch Royal Tropical Institute. ‘Many children do certain tasks on the farm, such as helping with the harvest. But this mainly happens after school and in the holidays. Cocoa is not the problem with child labour. In fact, the sale of the beans pays the school fees,' says Laven.
Yet some children will undoubtedly do dangerous or excessively heavy work, using machetes without protective clothing. ‘Even at the household level, children often do heavy work, such as gathering firewood in the forest or carrying water from the well,' says the researcher. 'What would help to prevent child labour is for these countries to invest in rural development and employment opportunities for the young.'

GARDENER ELSKE HAGERAATS:

‘It can be done, a fair wage for farmers’

While supermarkets compete with bargain prices, some farmers earn no more than a pittance. Gardener Elske Hageraats devised a solidarity payment system that enables a farmer to earn a fair wage. ‘Instead of money for the vegetables, I want to be paid an hourly wage.’

TEXT MARIANNE WILSCHUT **PHOTO** DIEUWERTJE BRAVENBOER

Wild cabbage, oca, woodland sunflowers, paracress: there are lots of unusual vegetable names on the labels in the beds of the Ommuurde Tuin (walled garden) in Renkum, near Wageningen. But more familiar vegetables like Brussels sprouts, pumpkin, mangetout, and green asparagus feature on the labels as well. A lot of the beds are still empty. ‘We are busy getting ready for the new season,’ Elske Hageraats explains. She points to a strip of land: ‘We have just tilled the soil there so the compost gets thoroughly mixed into it. And see that white stuff there? That is used straw and grain spawn from a mushroom grower friend of mine, which we use as a mulch layer on the rhubarb.

Hageraats is a self-employed gardener at this centuries-old market garden where pesticides and artificial fertilizers are banned. The agro-ecological business owes its name to the remains of a wall around the plot, constructed back when the kitchen garden was owned by King William III and his wife Queen Emma in the 19th century. >

‘Our members were astonished that we earn so little’

PHOTO SJOERD SCHIMMEL

From left: Elske Hageraats, Esther Kuiler (owner of the Ommuurde Tuin) and Marieke van Leersum (a freelance colleague) celebrate the Ommuurde Tuin's 20th anniversary in 2019.

'Emma grew herbs here in her tea garden', says Hageraats. Also dating back to those days is an old pear tree at the edge of the plot. 'We still pick its pears for stewing.'

EDIBLE FLOWERS

The vegetables, herbs, fruit and edible flowers that are grown in the Ommuurde Tuin from May to October - some 450 varieties in total - are sold to restaurants in Nijmegen and Wageningen and in the Ommuurde Tuin's own shop. They also go into the 90 vegetable boxes that customers collect every week. These boxes are no longer sold one at a time. As of last year, the customers, the 200 members of the garden, pay a sum of money to the growers at the beginning of the season. 'We use that to pay the lease on the land and for compost and seeds, and it also has to cover our labour costs,' explains Hageraats. 'Instead of asking for money for the vegetables, I want to see my costs covered and receive an average hourly wage. In this Community Supported Agriculture system (CSA), the customer is a harvest shareholder. That is fair because that way we share the risk. If part of the harvest should fail due to a hot summer, members will get slightly smaller quantities of vegetables in their boxes. In a good harvest year, the boxes will be fuller.'

The members pay according to their means. 'Our target price for a single box is 16 euros, the minimum hourly wage for a self-employed person, because we reckon that about one hour's work has gone into it, in total. But ideally customers pay the hourly wage they earn themselves. So a financial advisor who earns 80 euros per hour should pay us that for a vegetable box. Not everyone is doing that yet, but at least we are now at the minimum wage.'

With the 'solidarity payment' she devised, Hageraats wants not only a fair remuneration for her work, but also to raise awareness. 'We are as transparent as possible with our members about the hours we spend and the costs we incur. Many of our members were really surprised that we earn so little.'

TWO MSC DEGREES

The fact that it doesn't pay well did not put Hageraats off going into farming after graduating from Wageningen. 'I have always had a great love of nature. That is why I studied biology. As a student I organized the Farm Experience Internship, a kind of mini-internship at a farm. This course came out of a student initiative. That's how I got to know the Ommuurde Tuin and started doing voluntary work there myself. It made me so happy to work with the soil and to be outdoors that I never wanted to leave.'

Hageraats took two Master's degrees: 'I was doing biology, but I missed the bigger picture there, so I switched to sociology. But by then I had got so far with the biology degree that I finished that too. I really like the combination of natural and social sciences. It enables you to talk to people from both disciplines. In the case of GMOs, genetically modified organisms, for example, I know exactly how they are created *and* what their social impact could be.'

The best thing about her student days was Wageningen's international atmosphere. 'Eating together, making music and starting lovely projects with the Farmers'

‘Large-scale arable farmers are interested in my idea of solidarity payments’

Group. Among other things, I organized a Rural Development symposium in Colombia with a Colombian PhD student. We had invited the government, farmers’ organizations and the FARC to speak online. WUR wasn’t keen on that, because they didn’t want to be associated with the FARC, a terrorist organization, but these were talks on rural development. And one of the lecturers said: ‘just do it’. So we persevered and it was a fantastic thing to have organized.’

After her studies in Wageningen, Hageraats took a vocational training course at Warmonderhof, a Dutch biodynamic agricultural college, and then started working at the Ommuurde Tuin on a freelance basis. She also teaches courses on agroecology for people who want to start their own garden. And she wrote the book *Eerlijk loon!* (Fair wage!), which contains inspiring examples of farmers’ campaigns for a better income, including those of the activist group Farmers Defence Force. She was helped with the research by Rural Sociology students from Wageningen. ‘They did an investigative study and came up with examples such as the ‘price scale’ in Amsterdam and the *Bieterrunde* (bidding round) system in Germany, where members cover all the costs, including the farmer’s salary. All these examples from home and abroad gave me the confidence that it *can* be done, a fair wage for farmers. It’s not for nothing that community farming is on the rise. Large-scale arable farmers who sell their products through wholesalers or a supermarket have also shown interest in CSA and in my idea for solidarity payments.’

SUPERMARKETS

This is a way for farmers to bypass the supermarkets. The latter ‘are so powerful that they can negotiate low prices. This morning I heard an Aldi advert on the radio: “You pay less, but you get more”. That is only possible through exploitation, in my opinion. It is shameless that they have the nerve to advertise that! The Court of Audit calculated in 2019 that a third of all farmers in the Netherlands earn less than the minimum wage. Without subsidies it would be half the farmers.’

Hageraats believes that the low remuneration of farmers is not just an issue for consumers and supermarkets. The government should act too, and not just by reducing the VAT on fruit and vegetables. In France, supermarkets are obliged to buy products that are available locally at a cost-covering price. This prevents supermarkets from buying up a cheaper, foreign batch instead. The Dutch government should do the same.’

SOLIDARITY LOAN

Hageraats is still pondering the possibilities for a fair wage for farmers. ‘I am now looking at how these ideas can be applied in other countries too. My book has already been translated into English, Spanish and Portuguese, but perhaps there are students who can translate it into another language. I am also in touch with a WUR PhD student in Colombia who has started a similar project there. The underpayment of farmers is an even bigger problem there. I gave him a solidarity loan so he could start the agricultural project. He has to repay that loan. But not to me, to the next person who wants to start an agro-ecological CSA, and so on. But even with a loan, it is still very difficult to get a solidarity wage project off the ground in rural Colombia, because poverty is a big problem there. So I want to suggest to our members that in addition to subscribing to our vegetable box, they also subscribe to a box in Colombia, which then goes to poor Colombians. That way we expand the community around the Ommuurde Tuin even more.’ ■

PHOTO DE OMMUURDE TUIN

ELSKE HAGERAATS

Elske Hageraats (33) is a gardener, teacher and writer. She works at the Ommuurde Tuin in Renkum and teaches the course 'Agroecology in Practice'. She co-founded the Future Farmers Foundation and wrote: *Eerlijk loon!, solidaire betaling en andere boereninitiatieven* (*Fair wage! Solidarity payment and other peasant initiatives*).

Qualifications: WUR MSc in Biology and MSc in Development and Rural Innovation 2017; diploma in biodynamic agriculture, Aeres Warmonderhof college

FOODSHOT GLOBAL GROUNDBREAKER PRIZE

Producing food and saving the earth

What would a healthy diet look like that does the least possible harm to the climate and the environment? Hannah van Zanten is figuring it out in the Circular Food System model, with which she won the Groundbreaker Prize. 'If livestock are fed on waste streams, there is no need to import soya from Brazil'.

TEXT ALEXANDRA BRANDERHORST **ILLUSTRATION** WUR

PHOTO BART VAN OVERBEEKE

Hannah van Zanten

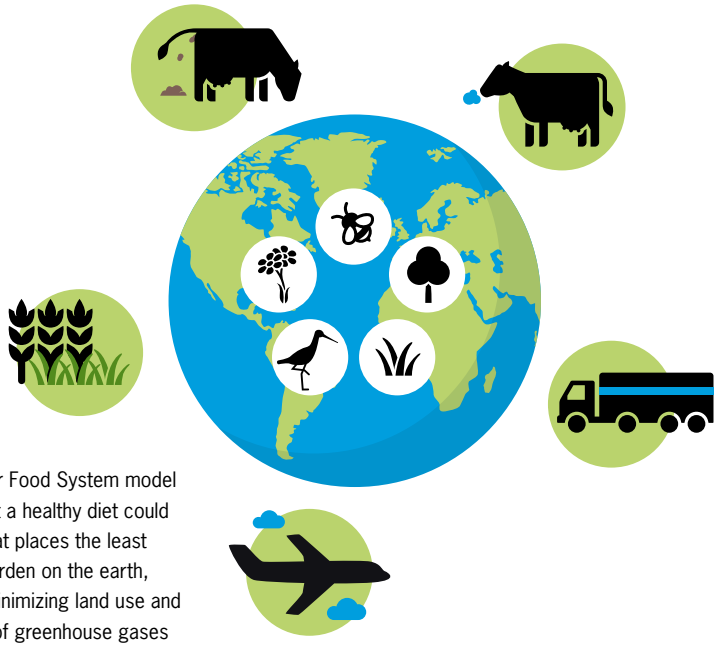
'The livestock industry has a big impact on the environment. I pondered what we could do differently,' says Hannah van Zanten, associate professor in the Farming Systems Ecology chair group in Wageningen and visiting professor at Cornell University.

With her team and other colleagues from Wageningen and elsewhere, Van Zanten developed the Circular Food System model, which maps out what a healthy diet of plant and animal proteins looks like when it also respects the Earth's carrying capacity. For every continent, the model takes into account greenhouse gas emissions from food production, land use, fertilizer inputs, the impact on biodiversity, and how to make such a system financially viable. The European model is very nearly ready and the global model is in the making. It also incorporates the impact of food transportation between continents. In January, Foodshot Global awarded Van Zanten the Groundbreaker Prize for her work: 150,000 dollars to be spent on research.

EATING RESIDUAL STREAMS

'The food system that colleagues and I have developed is circular and targets an optimal combination of plant and animal proteins,' says Van Zanten, who obtained her PhD cum laude in 2016 for her thesis on the role of livestock farming in a circular food system. She found there was a valuable role for livestock if you feed the animals on food scraps and waste from the food industry, and graze them on grasslands that are unsuitable for arable farming. 'If livestock are fed on these waste streams, we can grow crops for human consumption on the land where we now grow livestock feed. That way there is much more food for human consumption and the livestock feed, such as soya from Brazil, does not have to be transported halfway around the world,' explains Van Zanten. It also means that we can continue to eat meat and milk, but about 60 to 80 per cent

> ‘The food system is very complex, with conflicting interests involved’



The Circular Food System model shows what a healthy diet could look like that places the least possible burden on the earth, partly by minimizing land use and emissions of greenhouse gases and environmental pollutants.

less than our current rate of consumption. After obtaining her doctorate, Van Zanten was awarded a Veni grant by the Dutch Research Council for follow-up research into the international circular food system that she envisages, and work started on developing the model. ‘We *can* use this to study how our ideas play out in practice. After all, the food system is very complex and there are many conflicting interests involved in it.’

PORK OR CHICKEN

Protein from insects is frequently proposed as an alternative to animal protein. But breeding insects requires a lot of electricity, Van Zanten notes. Moreover, the insects eat food leftovers that are currently used for biofuels. ‘Our model maps the relations between these different chains, generating broad analyses and enabling us to see how we can manage the trade-offs.’ So for instance, are we primarily aiming at a healthy diet or at minimizing the environmental impact? To give an example: in an environmentally optimal circular system, it is better to keep dairy livestock (which produces both milk and meat) and pigs, because these animals are best suited to eating grass and residual streams respectively. But for our own health, it is better to avoid red meat and eat chicken. Van Zanten, PhD student Ben van Selm and their colleagues published figures in *Nature Food* earlier this year showing that in an optimal circular system, greenhouse gas emissions would be reduced by up to 31 per cent and the use of agricultural land by up to 42 per cent, compared to the situation with a healthy diet according to the international standard. ‘We are now looking at what happens if we in Europe take a diet that meets all the health requirements as our starting point. How can we reduce greenhouse gas emissions and land use in that scenario?’

GAME

A model with a thousand rules and formulas is not very appealing, so Van Zanten and her research team are developing a game that helps players get to grips with it. The players can adjust the preconditions and goals, changing livestock numbers or growing different crops and then seeing the effects on things like greenhouse gas emissions straightaway. ‘Once stakeholders see for themselves how they can be part of sustainability, things will really change. That is where I want to get to.’
Van Zanten wants to use the Groundbreaker Prize money, to bring her model to the attention of companies, consumers and governments in various countries. ‘FoodShot Global has a huge international network and specializes in campaigns that make people think about certain themes.’ ■

www.universityfundwageningen.eu/research

WAGENINGEN AND FOODSHOT GLOBAL

FoodShot Global is a US-led collaboration between venture funds, banks, corporations, universities and philanthropic foundations that seek to contribute to a sustainable food system. Wageningen is involved in the network as a knowledge partner. FoodShot Global focuses on scientifically sound concepts and supports their application in practice, by providing credit to start-ups and organizing competitions such as the annual FoodShot Challenges, in which scientists and entrepreneurs can compete for a cash prize for pioneering work.
The University Fund Wageningen (UFW) organized internal nominations and a selection procedure for the challenge, and supported Hannah Van Zanten in preparing her entry. 'We have experience with philanthropic organizations and understand their motives and goals,' says Fanny Castel of UFW. *www.foodshot.org*

UNIVERSITY FUNDING

Funding for biodiversity recovery in Limburg

Dutch universities are jointly raising funds for research this spring. Wageningen focuses on biodiversity, with a project of nature restoration in the South Limburg hills, where many unique species are on the brink of collapse.

'Unfortunately, public funds are limited and pioneering research is becoming increasingly difficult to get funding for,' says Arianne van Ballegooij, fundraiser at the University Fund Wageningen (UFW). 'This campaign is how Wageningen is putting the theme of biodiversity in the spotlight. Private individuals can donate to the South Limburg Hills Biodiversity Rescue Plan.'

The project is about new forms of nature restoration, says Philippine Vergeer, assistant professor in Plant Ecology and Nature Management. Many unique species, such as mezereum and white helleborine, have been reduced to isolated patches of nature. 'Saving them needs you to look not only at the species itself, but more broadly at the landscape as a whole.' Scattered across the hills of South Limburg are remnants of chalk grasslands, old woodlands and stream valleys. 'Insects such as bumblebees and honeybees migrate along linear structures such as hedges, copses and footpaths. We're going to restore these cultural and historical elements locally in order to reconnect the populations.'

Some species in the hills have a unique genetic makeup, acquired over millennia of evolution. 'They're unique in the South Limburg hills,' says Vergeer, 'and many of them are on the brink of going under.' Funds from the campaign will be used to strengthen local populations. 'We collect seeds from local plants, for instance, and cross-breed them in the greenhouse in Wageningen to make the best possible use of the available genetic potential. Thank you all very much in advance! When we plant the seeds, we choose not only the ideal spots but also places with just a bit more light, or just a bit drier or wetter.' The researchers are monitoring the recovery. 'Deliberately utilizing all the variation in the landscape will let us encourage genetic diversity. That's hugely important if the populations are to be viable.'

Info: www.wur.nl/supportjouwuniversiteit

PHOTOS SHUTTERSTOCK

Mezerium, white helleborine and the baneberry are unique to the hills of South Limburg.

SUPPORT

There are already 1200 Friends of UFW

The Friends of UFW support activities that prepare students and young alumni for the labour market, such as thesis prizes, networking meetings and workshops. There are now about 1200 Friends of UFW. If you would also like to be a Friend of UFW, you can join for just 5 euros a month.

www.wur.eu/vriendsofufw

JOB MARKET

Employers meet students and alumni

On 1 February, 664 students, alumni and PhD students met over 50 employers online for the WUR Career Day. As well as an opportunity to connect with each other, participants could listen to presentations, take part in Q&A sessions and have an exploratory chat with potential employers. Although the event could not be live this year, the employers were enthusiastic, says Hanneke van Keulen of Student Career Services. 'They see Wageningen students as a very interesting target group.' The students were also highly motivated, as this online comment shows: 'I thought the presentations and Q&A sessions were very interesting and I'm looking forward to future events.'

The next WUR Career Day is on 12 October 2022.

www.wur.eu/careerday

CROWDFUNDING

Van Uven's Bechstein grand restored to its former glory

Professor Van Uven's Bechstein grand can be restored thanks to donations from more than 80 donors.

For decades, Wageningen students and staff have played on this grand piano, which came from the legendary Van Uven. He was a great driving force behind musical life in Wageningen in the 20th century and was the founder of the Wageningen Student Choral and Orchestral Society (WSKOV). The valuable grand piano is a century old and in need of a major overhaul. After donations from WUR, the Rabobank Cooperative Fund and WSKOV, there was still a shortfall of 3000 euros. Thanks to crowdfunding, that sum has now been raised. The donors included former members of WSKOV. 'I loved playing with the WSKOV choir and orchestra, and also regularly enjoyed the Bechstein grand,' says Jaap, one of the donors. 'Hopefully, many more Wageningen students will get that opportunity!' The piano specialist Leendert van der Waal is renovating the mechanism. The instrument should then be good for another century.
https://crowdfunding.wur.nl

HERITAGE

Heirs donate a special wooden table

Willem G.J. Zwart

The Gaia building on Wageningen Campus has recently acquired a special table made from a 400-year-old Indonesian teak tree that was felled in Cepu, Central Java, in 1934. The chief forester there was Willem G.J. Zwart, Tropical Forestry 1919. He had a thin slice sawn off to make a table. Zwart died in a Japanese concentration camp in 1942. His wife eventually got the table back and his children recently donated it to WUR, 'for a space that is accessible to as large and as varied an audience as possible'.

WUR CONNECT

Why Wageningen?

Making a well-considered choice for a suitable degree course is not easy. Wageningen University & Research parental adviser Hermien van Miltenburg is on WUR Connect looking for personal stories from alumni about their choices and their time at the university. How do you look back on it? Did your degree fit your career? Your story can help new students and their parents pick the right course.

A Wageningen EMBA

On WUR Connect you will find an interview with the Brazilian MBA alumna Raquel Paiva Serôa da Motta about what the Executive Master of Business Administration in Food & Agribusiness in Wageningen brought her. Da Motta is impassioned about sustainability: 'Agriculture and food are where sustainability becomes tangible. Thanks to my MBA, I can now present sustainability as a business case at companies.'

Raquel Paiva Serôa da Motta

10,000 alumni

WUR Connect, the online WUR community for alumni, now has almost 10,000 members. If you would like to contact a former fellow student or if you are, for example, looking for a new job or have a place for an internship, go to WUR Connect.

For activities, career opportunities and fellow students or alumni all around the world, go to: www.wurconnect.nl

PERSONALIA

Dominique Crijns MSc,
Land Development 1994, has been appointed as an senior adviser on physical matters at the Ministry of General Affairs. Crijns had been working for the Climate directorate at the Ministry of Economic Affairs and Climate Policy.
1 December 2021.

Martijn Diender PhD,
Biotechnology 2014, received a Dutch Research Council (NWO) Veni grant for talented postdoc researchers for his research into microorganisms that use carbon monoxide and can thereby extract valuable metals from waste flows.
16 December 2021.

Clark Halpern MSc,
Organic Agriculture 2021, won the Unilever Research Prize for the best Master's theses in the scope of the UN's Sustainable Development Goals. His thesis was about the impact of climate change on the circular food system in Ethiopia.
25 November 2021.

PHOTO BERBER HANJA

Ernst van den Ende PhD,
Phytopathology 1988, has been appointed general director of the Animal Sciences Group at WUR. He was previously the general director of the Plant Science Group.
1 January 2022.

Rik Huisman PhD, Biology 2010, received an NWO Veni grant for talented postdoc researchers for his studies into how plants cooperate with bacteria and fungi.
16 December 2021.

PHOTO CHEESEWORKS.NL

Gerrit Hiemstra MSc,
Farming Technology 1986, meteorologist, NOS weather man and entrepreneur, has been awarded the 2021 Machiavelli Prize for his exceptional contribution to communication between politics, government bodies and the public. Hiemstra received the prize because he 'provides insights into climate change and its consequences engagingly for a broad audience'.
9 February 2022.

Prof. Evert Jacobsen,
Plant Breeding 1974, received a medal for his extraordinary contribution to the People's Republic of China at the commemoration of the PRC's 70th anniversary.
3 November 2021.

Amber Laan BSc,
Economics and Policy 2019, dairy farmer and agricultural adviser, is the new chair of Hollands Agrarisch Jongeren Kontakt.
15 December 2021.

Berend van der Meer PhD,
Molecular Life Sciences 2014, has received an NWO Veni grant for talented postdoc researchers for his research into the role of friction between particles in flowing and deformable materials.
16 December 2021.

Elly Morriën PhD,
WUR PhD 2011, now an assistant professor at the University of Amsterdam, received the gold medal from the Teylers Foundation's Second Society along with Emilia Hannula for a critical study on optimizing the sustainable multi-functionality of soils.
5 November 2021.

Prof. Simon Oosting,
Zootechnics 1985, has been appointed professor of Animal Production Systems at WUR.
1 December 2021.

'This will be the adventure of a lifetime'

In April, **Michelle Kloosterman** (BSc Nutrition and Health, 2021) will start the Pacific Crest Trail – a monster six-month trek of 4300 kilometres, hiking along the coast from Mexico to Canada. 'I love immersing myself in the wilderness,' she writes, 'so this will be the adventure of a lifetime.' She is getting sponsored for a good cause during the trip: training rescue teams in Costa Rica to release humpbacks from the old fishing nets that these whales sometimes get caught in. During their annual migration, humpbacks make a similar journey along the coast to the one Michelle intends making. She is hoping to raise 70,000 dollars.
www.jointhemigration.org

Do lobsters or crabs pinch harder?

PHOTO ZAPP

Last summer, Biology Master's student **Hilmar Derksen** (BSc Biology 2020) was given the opportunity by public broadcaster NTR to make five pilot episodes about Dutch nature underwater. 'And I'm hoping it won't stop there – we're in discussions about a new concept.' For the children's television programme Zapp your Planet, he made a series called *Koppie Onder*: he talks with infectious enthusiasm about sea creatures and goes out to investigate – do lobsters or crabs pinch harder? 'Once you see all the things that live in the water, you automatically look after them better,' says Derksen, quoting the legendary Jacques Cousteau.
www.zapp.nl

Lidwien Smit PhD, Environmental Protection (water purification) 2001, has been appointed professor of One Health and Environmental Epidemiology at the Faculty of Veterinary Medicine, Utrecht University.
1 November 2021.

Prof. Frank Sterck, Biology 1989, has been appointed personal professor of Forest Ecology and Forest Management in Wageningen. He works on forest models for creating 'climate-smart' forests with increased productivity, resilience, biodiversity or carbon sequestration.
1 January 2022

Prof. Julius van der Werf, Zootechnics 1984, Professor of Animal Genetics at the University of New England in Australia, has been awarded the Helen Newton Turner Medal for his 'Outstanding Contributions to Australian Animal Genetics'.
9 November 2021.

Iziah Sama PhD,
Bioinformatics 2005, Medical Center Groningen, has been awarded the first annual Desmond Julian Award for his paper in the *European Heart Journal*.
28 October 2021.

IN MEMORIAM

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

Ms H.C.S. Backus MSc, Domestic Science 1969. 12 November 2021.
Mr J.A. Bakker MSc, Biology 1985. 26 October 2021.
Mr H. van Blitterswijk MSc, Forestry since 1998. 9 December 2021
Mr W. de Boer MSc, Zootechnics 1951. 28 December 2021.
Mr H.W.J. Boerwinkel PhD, WUR PhD 1986. 7 October 2021.
Mr. C.J. Bos PhD, Plant Sciences 1964. 4 January 2022
Mr L. Braakenburg MSc, Tropical Rural Economics 1969. 12 January 2022.
Mr J. van Bruchem PhD, Zootechnics 1972. 11 November 2021.
Mr M. Dieleman MSc, Agricultural Plant Breeding 1964, 21 November 2021.
Mr W.C.H. van Hoof PhD, Tropical Plant Breeding 1972. 10 December 2021.
Mr A. van Ittersum MSc, Tropical Plant Breeding 1969. 8 January 2022.
Ms A.E. Jager MSc, Food Technology 1988. 28 September 2021.
Mr C.P. de Jager PhD, Horticulture 1968. 5 January 2022.
Mr J.J. Jansen MSc, Forestry 1973. 8 February 2022.
Mr J.P. de Kraker MSc, Tropical Rural Economics 1967. 24 September 2021.
Mr R.E.F. Leakey PhD, WUR honorary doctorate 2003. 2 January 2022.
Ms A. Louët Feisser MSc, Tropical Domestic Sciences 1970. 28 January 2022.
Ms M.A. Luten MSc, Domestic Sciences 1983. 3 September 2021.
Mr H. de Nood MSc, Rural Economics 1963. 24 January 2021.
Mr F. Prins MSc, Rural Sociology of the Non-Western Regions 1979. 6 October 2021.
Mr L.W.R.B. de Regt MSc, Farming Technology 1985. 20 September 2021.
Mr J.H. Ruiter MSc, Tropical Agriculture 1951. 19 November 2021.
Ms F.C. Sieders MSc, Human Nutrition 1987. 19 November 2021.
Mr C.J.A. Schmalhausen MSc, Landscape Architecture 1985. 13 August 2021.
Mr J.T. Smeding MSc, Agricultural Plant Breeding 1949, 23 November 2021.
Mr H. Stormink MSc, Zootechnics 1988, 20 November 2021.

Continued on page 50

IN MEMORIAM

Continued from page 49

Prof. S. Tamminga, Zootechnics 1970. 4 January 2022.
C.P. Veerman PhD, WUR PhD 2018. 30 October 2021
Mr K. de Vries MSc, Zootechnics 1969. 11 November 2021.
Prof. P.R. Wiepkema, emeritus professor of Ethology, 13 December 2021
Mr C.M. de Wijs MSc, Forestry 1964. 4 December 2021.
Mr A.P.W. de Wit MSc, Rural Economics 1966. 29 January 2022.
Mr P. van Woerden MSc, Agricultural Plant Breeding 1979, 17 December 2021.

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

PHOTO GUY ACKERMANS

The Silver Medal of Honour for Jan Karel Mak

Jan Karel Mak (WUR Environmental Hygiene 1983) was presented with the silver medal during the Dies Natalis at Wageningen University & Research, by Executive Board chair Prof.Louise Fresco. Mak received the medal in recognition of his many years of service to the Wageningen University Fund (UFW). Fresco lauded him for his whole-hearted commitment to students and the various fund-raising campaigns he has set up in recent years. After 12 years, Mak has now stepped down as chair of UFW. He is succeeded by **Jacqueline Pieters** (WUR Agricultural Economics 1992).

BOOKS BY ALUMNI

The education family

Together with his mother, **Jeroen Dijsselbloem** (Economics of Agriculture and the Environment, 1991) interviewed the many teachers in their family. What were their experiences of the Secondary Education Act, primary school or the creation of the Regional Training Centres, for example? Based on 40 interviews, Dijsselbloem gives a picture of the Dutch education system, the big changes in a relatively short period of time and the ideals and disappointments of the people in front of the class.
Prometheus, €21.99 (e-book €12.99)

Taste! The flavours of the valley

Max Elbers, a Master's student in Animal Sciences has made a book together with the photographer Mirian Hendriks about eighteen regional products from the area around Wageningen, from asparagus to lupin falafel. As well as recipes, there are details of the producer, a restaurant that has the product on its menu, and the relationship with WUR. The recipes and the insets about WUR are in English; the main body text is in Dutch. A QR code takes you to a site with translations of the Dutch texts too.
www.proefdesmakenvandevallei.nl, €45

Perspective without a horizon

In 2019, the renowned nature photographer and filmmaker Ruben Smit (Forestry 1996) contracted Lyme disease. He suffers from migraine attacks and tinnitus, can hardly stand light and sound and has difficulty speaking. After six months at home, he decided to go for an hour's walk every day; taking his simple, analogue Pentax camera. In *Perspectief zonder horizon* (Perspective without a horizon, available in hardcover), he sketches his slow recovery in pictures and in words. Alongside the beautiful, subdued photos that the recovery produced, Smit writes about his feelings at the time.
Ruben Smit Productions, €45

Roos van Doorn, pastoral worker

Forest and Nature Management, 1998

'My mission as a pastor and pastoral worker at De Ontmoeting in Bennekom is to stimulate curiosity and give people a sense of how amazing and interesting life is – in good times and bad.

'After graduating in Forestry and Nature Management, I worked for six years in nature education on the Schovenhorst Estate and I taught Forestry and Nature Management at the Van Hall Larenstein University of Applied Sciences for 14 years. That work too was all about wonder, connectedness and curiosity, although then I focused mainly on living organisms in nature. There you see, for example, how life and death are inextricably linked.

'Now that I focus on a daily basis on how people find meaning, I still like to work in and with nature, which provides us with an uplifting environment where we find peace and inspiration. We organized a retreat in nature, where participants could step out of their routine and wind down. They were inspired by nature in winter, when animals take shelter, and the seeds in the soil wait quietly for spring to come.

'Wonder, connectedness, love, meaning in life, the feeling that "this matters": these are things you can't see, but you *can* feel. Making room for that is now my work, during a retreat, for example, or a one-to-one chat. 'I lead gatherings with music, stories and rituals and I have conversations with people who are going through a difficult period, or who are dying. Life - or what some people call God - is at the heart of this.'

'Making room for wonder, connectedness, curiosity'

PHOTO GUY ACKERMANS

PHOTO JURATEBUIVIENE / SHUTTERSTOCK.COM

Oman's frankincense trees are documented

Professor of Tropical Forest Ecology Frans Bongers has been working on frankincense since the late 1990s. He has sounded the alarm about the decline of the frankincense tree *Boswellia Papyrifera* in African countries such as Eritrea, Sudan and Ethiopia. This tree is pretty much doomed there, due to overproduction and a lack of new growth. But a different species grows in Oman: *Boswellia sacra*. '*Boswellia sacra* is the holy frankincense tree that is mentioned in the Bible', says Bongers. 'It is used for applications in perfumes and oils.' The study he is now leading is documenting the state of this species in Oman. 'We are looking at the distribution of the trees, its health status and how sustainably the frankincense is tapped.'

The frankincense trees are found in the southern coastal region of Dhofar. Bongers: 'An extremely rugged desert area of 30 by 150 kilometres. So we drive around a lot and map the trees using a system with which you can enter data on your mobile phone.'

Probably the greatest threat to the frankincense tree is grazing by camels, says Bongers. 'There are more than a quarter of a million camels in Oman and they eat everything, including all the frankincense trees. We hope to be able to present a solid report on the current. Then it's up to the politicians, ministries and organizations to tackle the issue.' The aim is to make the exploitation of the frankincense tree more sustainable. Bongers is doing this work on behalf of the Environmental Society of Oman.

Info: frans.bongers@wur.nl