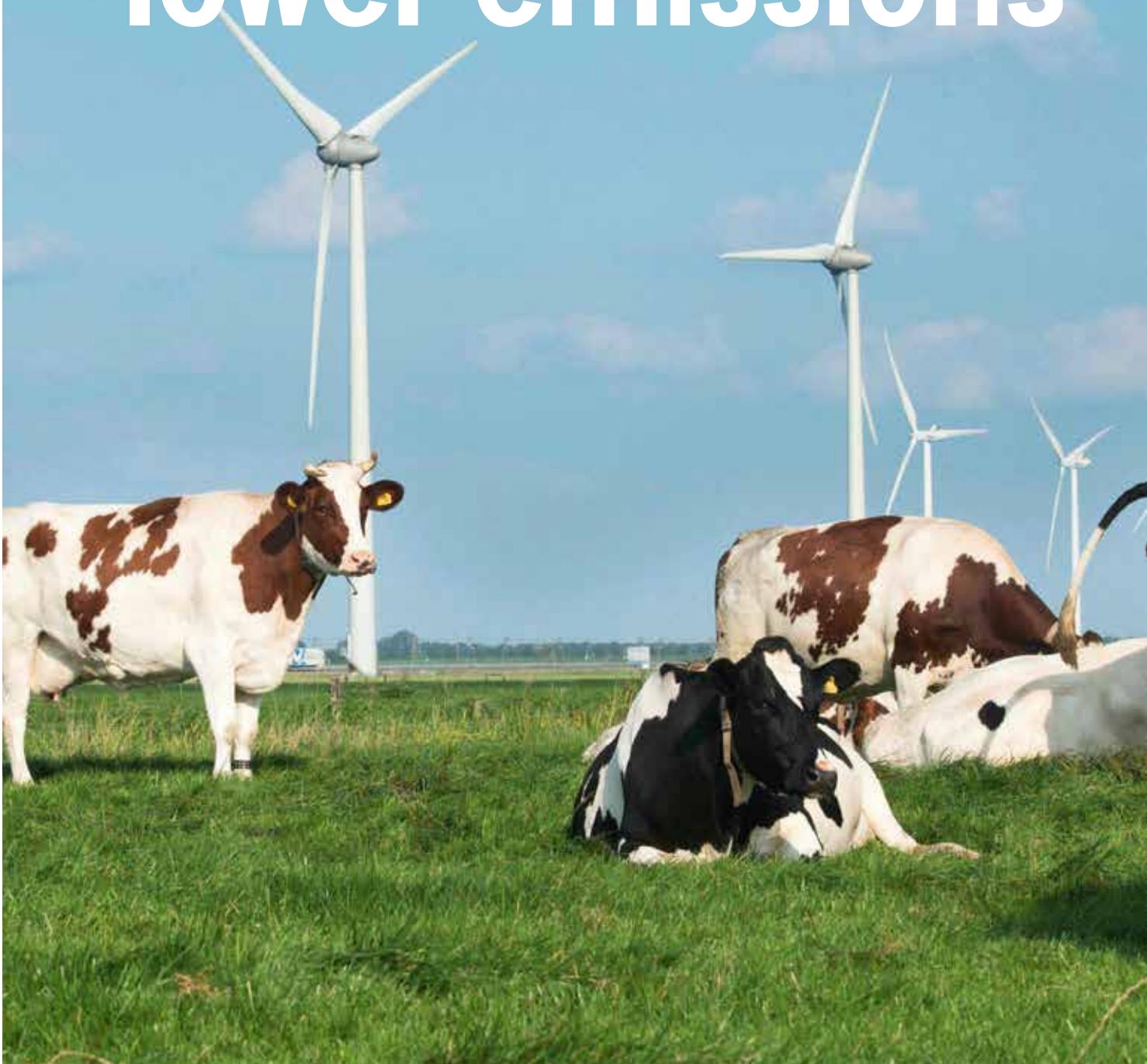


AGRICULTURE AND FOOD PRODUCTION AFTER PARIS

# More food, lower emissions



## The climate conference in Paris spelled the end of fossil fuels, says departing professor Pier Vellinga. He hopes that greenhouse gas emissions from agriculture will now be brought down too. Wageningen scientists are already working on this, as well as trying to tackle the effects of climate change. How can we produce enough food in the face of drought, heat and salinization?

TEXT RIK NIJLAND PHOTO HOLLANDSE HOOGTE INFOGRAPHICS PETRA SIEBELINK

There are two prints of Venice hanging on the wall. They still have to be fitted into the overflowing supermarket bag Pier Vellinga has brought to tidy up his office at Alterra with. He visited the Italian city a couple of times a year as a water advisor. The collapsible floodgates being built partly on his advice are due for completion this year.

Vellinga (65), professor and project director of Climate at Alterra, is leaving Wageningen UR just as his work appears to be bearing fruit, and not only in Venice. On the home front, the Grebbedijk between Wageningen and Rhenen will most probably be transformed in the years to come into a climate dyke, a design also known as the unbreachable or multifunctional dyke. This is one of the concepts developed by Vellinga – who trained as a water engineer in Delft – which is gradually gaining ground. The idea is to build dykes which fulfil multiple functions and are not prone to suddenly bursting but at worst overflow slowly.

For eight years Vellinga was one of the leading lights in Wageningen climate research. He devoted himself to scientific research for the IPCC climate panel and for studies on adaptations to climate change in agriculture and water management. He often spoke on these issues in the media, sometimes coming under heavy fire from climate sceptics.

Vellinga sees the climate treaty in Paris as the culmination of these efforts, as he made clear in his valedictory speech – which

coincided with the conference – and in the many lectures which followed it. ‘Things are moving in the right direction,’ he says now in the office he is vacating. ‘The conference in Paris marks the breakthrough for sustainable energy. In Africa it is already cheaper to build wind and solar energy stations than coal- or oil-fired power stations. Okay, it will still take another 30 years before the old power stations are written off but from a technical-economic point of view that problem is solved. In roughly five years’ time no one will be buying petrol-fueled cars.’

### GREENHOUSE GAS EMISSIONS

Now that fossil fuels are on the way out, it is high time we tackled the second biggest source of greenhouse gases: agriculture. Agriculture accounts for 20 to 30 percent of the emissions, says Vellinga. This is through its energy consumption, deforestation, the production of artificial fertilizer, the transportation of raw materials, and the emission of methane from cows and irrigated rice cultivation. ‘I hope the climate will now be a source of inspiration for fundamental changes in our agriculture and food system,’ says Vellinga.

Wageningen has traditionally focused on increasing efficiency in agriculture, says the emeritus professor: bigger harvests per hectare with less input, and more animals per square metre. ‘But that is not the way to get greenhouse gases from agriculture under control. What is more, biodiversity is >



**PIER VELLINGA**

Emeritus professor of Climate change, water and safety

**‘We’ve got to move towards a more vegetarian lifestyle’**



**JAN VERHAGEN**

Agronomist at Wageningen UR

**‘I think food security and production come first’**

declining fast because of monocultures, even though that intensification does mean you need less land. The problem lies in eating habits based on too much animal protein,' says Vellinga. 'From the problems faced by coal and oil companies, which have lost half their value in a few years, we can learn that only improving efficiency is not enough if the basis is unsound.'

The solution is clear to Vellinga. 'The question must be: how can we produce as much food as possible with a minimum of greenhouse gases. To do this we've got to move towards a more vegetarian lifestyle. The first thing to go is beef, then milk and cheese, then other kinds of meat. For a scientific institution whose mission is healthy people on a healthy planet, there is now a unique opportunity to develop the agriculture and the nutrition of the future. There are plenty of alternatives to animal protein available, and they require less energy, water and space. They are also, if chosen well, healthier for people and planet.'

### LOW IN PROTEIN

Agronomist Jan Verhagen of Wageningen UR largely agrees with Vellinga's message. 'Eating less meat and dairy is fine, and good for our health as well,' he says. But to exclude it rigorously would be going too far for him. 'Meat is an important source of protein. In Africa, for instance, the diet is so low in protein that people there can use a bit of meat. In marginal areas, too, cattle are like vacuum cleaners, mopping up nutrients which would otherwise go to waste.' But Verhagen fully supports the idea of Wageningen experts putting their heads together. 'How do we get hold of enough protein in the world? Where are we going to get it from, from plants or from animals – and if so what kinds of animals? Insects, maybe? Or more from the sea? I am all for this kind of exploratory thinking. In Wageningen we are strongly focused on the problems of the present, preoccupied with the status quo. Wageningen needs to be more daring and look further ahead to help shape the future.'



### THEUN VELLINGA

Researcher at Wageningen UR Livestock Research

**'Even if we become flexitarians, animal production will continue to grow globally'**



### GERARD VAN DER LINDEN

Abiotic Stress Research group leader at Wageningen UR

**'We are breeding for an acceptable yield in less optimal growing conditions'**

His colleague Theun Vellinga, a livestock expert at Wageningen UR Livestock Research, sees cutting down on meat as only a partial solution. 'Halving our consumption is fine but even if we in Europe, the US and Australia become flexitarians, animal production will continue to grow globally. The population growth rate in Africa and Asia is massive. Billions of people live there who think: I want to eat meat sometimes too.'

I don't think it's morally justifiable to deny them that. We should focus on food security and making production as sustainable as possible.'

There is much to be gained on both scores, thinks Theun Vellinga. It is ironic, he says, that the more intensive the farming system, the lower the greenhouse gas emissions per kilo of product. This applies to pigs and poultry but especially to cattle, thanks to the production of the greenhouse gas methane in the cow's stomach. 'Our cows eat a lot but they grow fast so you can divide their methane emissions over many litres of milk and kilos of meat. There is a lot of room for improvement in Africa and Asia. With better feed and better management, production there could be doubled without a significant rise in greenhouse gas emissions. I think we should aim for this "sustainable intensification".'

### SALINIZATION AND DROUGHT

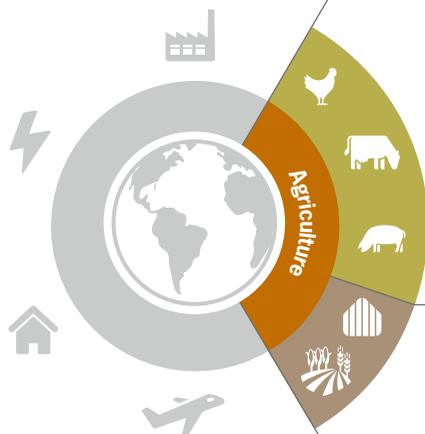
Jan Verhagen would agree that it is not agriculture's chief role to pursue climate mitigation by restricting emissions of greenhouse gases. 'I think food security and production come first. Producing more on the same surface area, and in the process it goes without saying that we must give careful thought to energy consumption and sustainability. Our main role in Wageningen should be on the adaptation side of things: how to deal with the consequences of climate change such as salinization, drought, heat, new diseases and pests, and so on. I think the conference in Paris has clarified the urgency of this in the minds of a broader public and of companies, but much of that research got started in Wageningen ages ago.'

As an example, plant breeder Gerard van der Linden established a research group on Abiotic Stress eight years ago. 'Our crops have been pampered for a long time. It was inexpensive to provide extra nitrogen, for instance, so why would you spend a lot of money on a plant that can cope with less nitrogen? That's a thing of the past now. For environmental reasons you are no longer allowed to use unlimited fertilizer. What is more, the production of artificial fertilizer takes a lot of energy, therefore causing heavy CO<sub>2</sub> emissions. So nowadays were are >

## AGRICULTURE AND GREENHOUSE GASES

Various gases are released in agricultural and horticultural processes, especially CO<sub>2</sub> and methane from greenhouse horticulture and livestock farming. Wageningen UR is researching and developing methods of cutting back these emissions.

**20-30%** of the total global emissions of greenhouse gases come from agriculture



### Bringing methane emissions down

In the agriculture sector, cows are by far the biggest source of methane (78%), due to fermentation of feed in the rumen. This could be reduced in various ways:



Adaptations to the feed can bring down methane production by cows. Better manure management can help cut back agricultural emissions too.



In developing countries milk and meat production from cattle could be increased considerably without emissions of greenhouse gas going up significantly.



Alternative protein sources such as algae and insects could help meet the growing demand for protein without the problematic methane emissions from cows. These protein sources also require less energy (therefore causing lower CO<sub>2</sub> emissions), water and space.

### Bringing CO<sub>2</sub> emissions down

Most of the CO<sub>2</sub> emissions in Dutch agriculture and horticulture come from the use of fossil fuels in greenhouse horticulture. But there are other areas where savings can be made:



Cutting energy consumption in greenhouses by using sustainable energy and energy-saving measures. Other areas in which savings can be made are: rationalizing transport and logistics in food production, reducing food waste and producing less artificial fertilizer.



2010-2014



Developing new, renewable resources for energy and material as an alternative to fossil fuels. Bio-refinery, for instance, produces chemicals, biofuels and biomaterials, and waste products can fuel power stations.



Preventing CO<sub>2</sub> emissions caused by deforestation for agriculture, and increasing CO<sub>2</sub> absorption by forests through management measures.

## MORE CO<sub>2</sub> SEQUESTRATION BY FORESTS

European forests can play an important role in reducing the amount of carbon dioxide in the air. This was the message extraordinary professor of European Forests Gert-Jan Nabuurs drew attention to at the climate conference in Paris last December. His arguments were based on a report he wrote together with colleagues last year. 'Already now European forests absorb 13 percent of the CO<sub>2</sub> emissions from the use of fossil fuels in the EU. This could grow to 20 percent by 2030.'

This would require a very diverse palette of measures, varying per region. The forests of central Europe, for instance, are in need of rejuvenation. In southern Europe,

on the other hand, the focus needs to be on using wood as the basis for bio-products such as viscose and vanilla. 'That gives forests an economic role which prompts people to invest in them and do more to protect the forest against fire, for example,' predicts Nabuurs. By contrast, in northern Europe it would be better to stop exploiting forests for paper production on peat soils. The oxidation of the drained soils releases large amounts of CO<sub>2</sub> into the air. 'I think our report led to the term 'sustainable forest management' being used in the treaty text, but we'll have to wait and see whether that will be followed by substantial measures.'

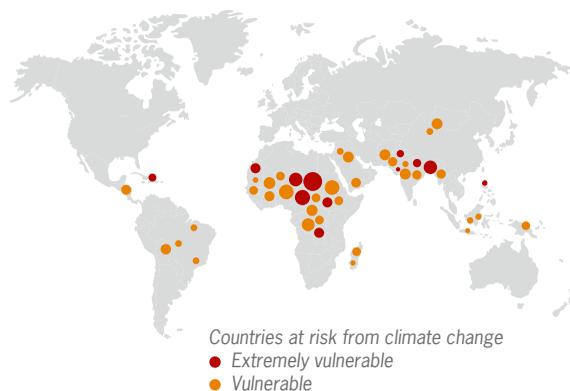
## CLIMATE AND FOOD PRODUCTION

breeding plants with other purposes in mind: we don't aim for the highest possible yield but for an acceptable yield in less optimal growing conditions.' Van der Linden focuses on crops affected by climate change through drought, salinization and excessively high temperatures. 'The plant-breeding companies are becoming more and more interested in this, partly because they seek to promote their varieties in countries such as India and China where the growing conditions are often not ideal.'

Work is going on in collaboration with companies to develop a potato for the Dutch market which can survive on less water, says Van der Linden. 'We are also doing research on barley, a model plant that is more resistant to salt than wheat. Unfortunately barley is not an interesting grain for the Netherlands, which makes it difficult to get funding for the research.' He is also focusing on an alternative crop, quinoa. 'That plant even goes on being productive if it is flooded with seawater. I know there is interest in introducing this crop in Vietnam, China and the coastal zones of Saudi Arabia. We are studying the feasibility of this, and what improvements can be made to the quinoa varieties we have developed.'

But the ambitions go further than this. Climate change means not just that plants will have to be more stress-resistant but also

All around the world agriculture is suffering from the effects of climate change. Wageningen UR is working on production methods which can keep food production up under changing conditions such as heat, drought and salinization.



### Adapting crops to climate change

Plant breeders are working on crops that can produce adequate harvests under sub-optimal growing conditions.



**Potato** - which can cope with less water



**Quinoa** - which can withstand low and high temperatures, drought and salt



**Barley** - which copes better than wheat under saline conditions

that they will be exposed to pathogens that adapt. 'We are more susceptible to illness when we are under stress, and it is no different for plants. The question is: can we develop resistant varieties that are robust in the face of various different conditions?'

Eddy Moors, extraordinary professor at VU University Amsterdam and head of the Climate Change and Adaptive Land and Water Management department at Alterra, has a dream too. He is very keen to get better input for crop growth models which give an

## MONITORING EMISSIONS

'Experience teaches us that states which voluntarily commit themselves to an international agreement do not always do their best to comply,' says Sylvia Karlsson-Vinkhuyzen of the Public Administration and Policy Group at Wageningen University. She is studying the way states are held to account for the implementation of international environmental legislation. The agreements made in Paris for checking whether countries really do take action were vague, she says, and lack sufficient mechanisms for ensuring transparency. 'This makes it very important for scientists and civil society to monitor what states do and hold them to account.'

Countries themselves report on whether their greenhouse gas emissions are really going down. It is difficult to check up on that. Eddy Moors' group at Alterra and the Meteorology and Air Quality chair group are involved in the Integrated Carbon Observation System (ICOS) which monitors emissions and absorption of greenhouse gases in Europe. 'Using measurements and flow models we can establish whether the data countries submit are correct,' says Moors. 'We have an advisory role for national governments and the European Commission. ICOS is the only body in Europe that can do this, but every year it is a challenge to get funding.'

impression of how climate change affects crop farming on a global scale. ‘These are often still based on data and models created by De Wit and Goudriaan in the 1970s. Their research on the potential of crops was done when there were much lower concentrations of CO<sub>2</sub> in the air, and with a smaller temperature range. Although there is already work going on in Wageningen, we still have a lot of catching up to do in that area.’

Moors did not hang out the flag when the negotiators in Paris reached an agreement. ‘Let’s wait and see how many countries really do sign the agreement next spring. And remember that it will take 50 years before the effects are visible.’ So climate adaptation will remain a hot item, he predicts. ‘It would be good,’ he says, ‘if we paid more attention to food security in increasingly dry conditions, to rising sea levels, especially in urbanized deltas, and to the problems of heat in urban areas.’ He himself is involved in making San Francisco ‘climate-proof’, and his department is also doing research in the Netherlands on adaptations in urban areas to enable them to cope with heat and torrential rain. ‘I would like to shift towards evaluating the effectiveness of various measures, such as applying heat-reflective paint or planting vegetation that provides cooling through evaporation and shade.’

### FROM VILLAGE TO CATCHMENT AREA

There is global demand for Dutch expertise in the field of climate adaptation, notes Moors. He believes this to be related to the long Dutch tradition of dealing with water safety issues, as well as to the knowledge that has been acquired in the fields of water supply, drought and salinization in large-scale research projects such as Knowledge for Climate, which was led by Pier Vellinga. ‘Thanks to all the expertise we can show what kind of impact climate change has at village level, as well as integrating those local problems and the measures to address them in a comprehensive policy – for an entire catchment are for instance.’

As an example, Alterra is working on revealing what climate change is doing in south



#### EDDY MOORS

Head of Climate Change and Adaptive Land and Water Management at Alterra, extraordinary professor of Water and Climate at VU University Amsterdam

**‘In Africa it is difficult to switch to climate-smart agriculture’**



#### ERIK VAN SEVENTER

Manager at Wageningen UR Food & Biobased Research

**‘Actually we should clean up the greenhouse gases too’**

Asia, from the Himalaya to the Ganges delta, a region in which hundreds of millions of people are dependent on agriculture and access to water, while also facing frequent flooding. The institute is involved too in drawing up a delta plan for Bangladesh. According to Moors, all development plans should be drawn up with climate change in mind. ‘In Africa for instance it proves difficult to switch to climate-smart agriculture. It is still hard work to convince aid organizations and governments, but, to give an example, there is not much point in making plans for

agriculture only to discover later that due to climate change there is not enough water available.’

Alongside adaptation to climate change, the approach of mitigation – or preventing emissions – is another growing field in Wageningen UR which should receive a boost from ‘Paris’, expects Erik van Seventer, manager at Wageningen UR Food & Biobased Research. ‘It is a good signal that China and the US support this agreement,’ he says. ‘Companies have been pushing for uniform legislation for a long time.’ ‘Paris is positive for our research on a biobased economy, too: use renewable resources instead of fossil fuels, which will bring emissions of CO<sub>2</sub> right down. We want to manufacture biobased chemicals, biofuels and materials from biomass – whether that is verge grass, beet leaves, used cooking fat or wood. By using biorefinery we get everything out that we can convert into valuable products. What is left over can fuel a power station.’

Van Seventer would like to see Wageningen taking the lead in the development of a yardstick for assessing the sustainability of manufacturing processes and the use of waste products. ‘I think we should lay down as solid a scientific basis as possible for a reliable yardstick. The result of a life cycle analysis, in which you assess the environmental impact of a product from the cradle to the grave, is currently still too dependent on the weightings you use. People just fill those in as they see fit, and they should be standardized.’

Cutting greenhouse gas emissions is too small a step really, in Seventer’s opinion. ‘Politically speaking, the closed agreement is a marvelous feat. Paris is a good start. But now people are acting as if we ought to be very pleased with less deterioration. It’s as though a company that makes less of a loss next year is suddenly declared healthy. Actually we should clean up our atmospheric pollution, the greenhouse gases, as well. That could be the next step.’ ■

[www.wageningenur.nl/climatechange](http://www.wageningenur.nl/climatechange)