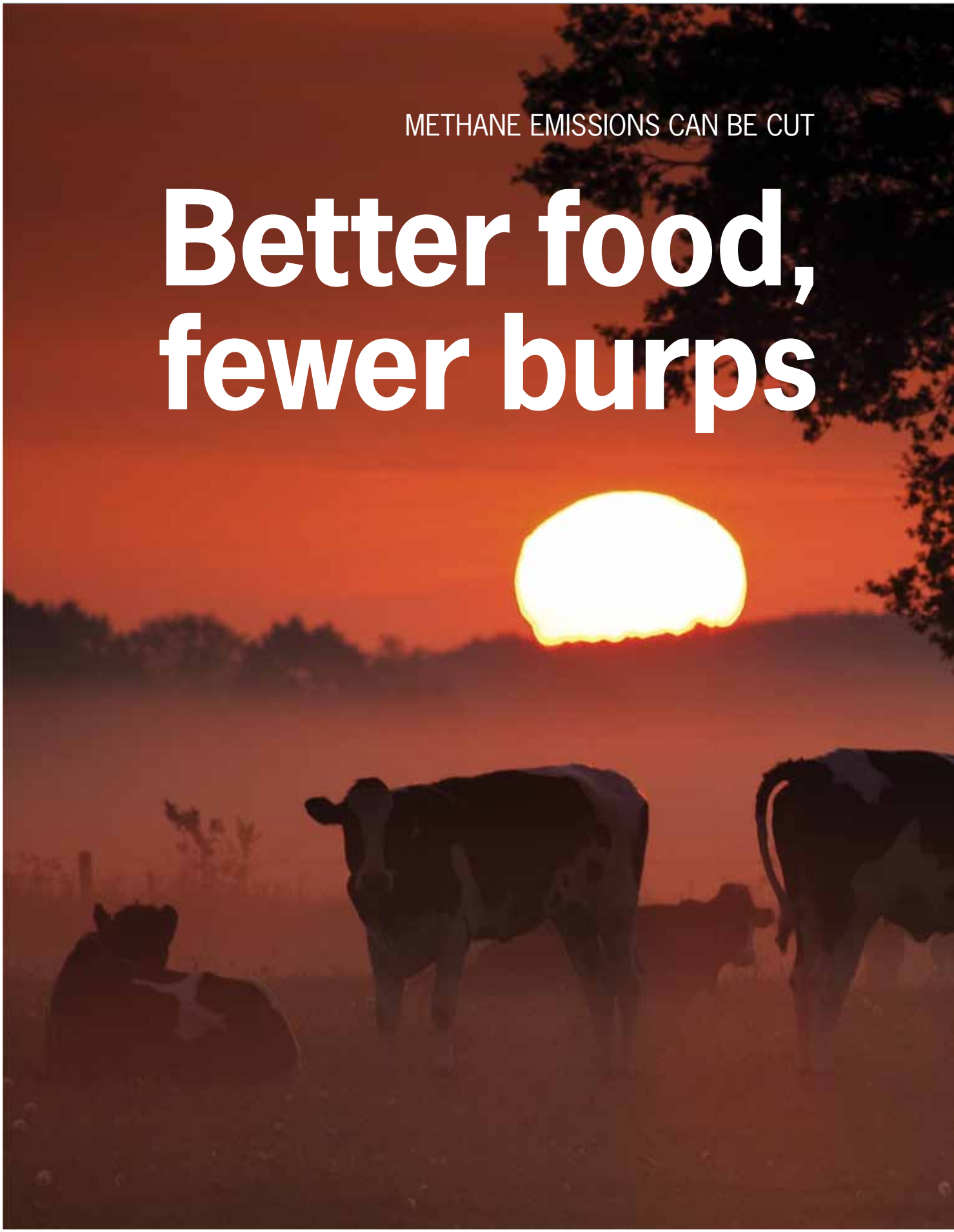
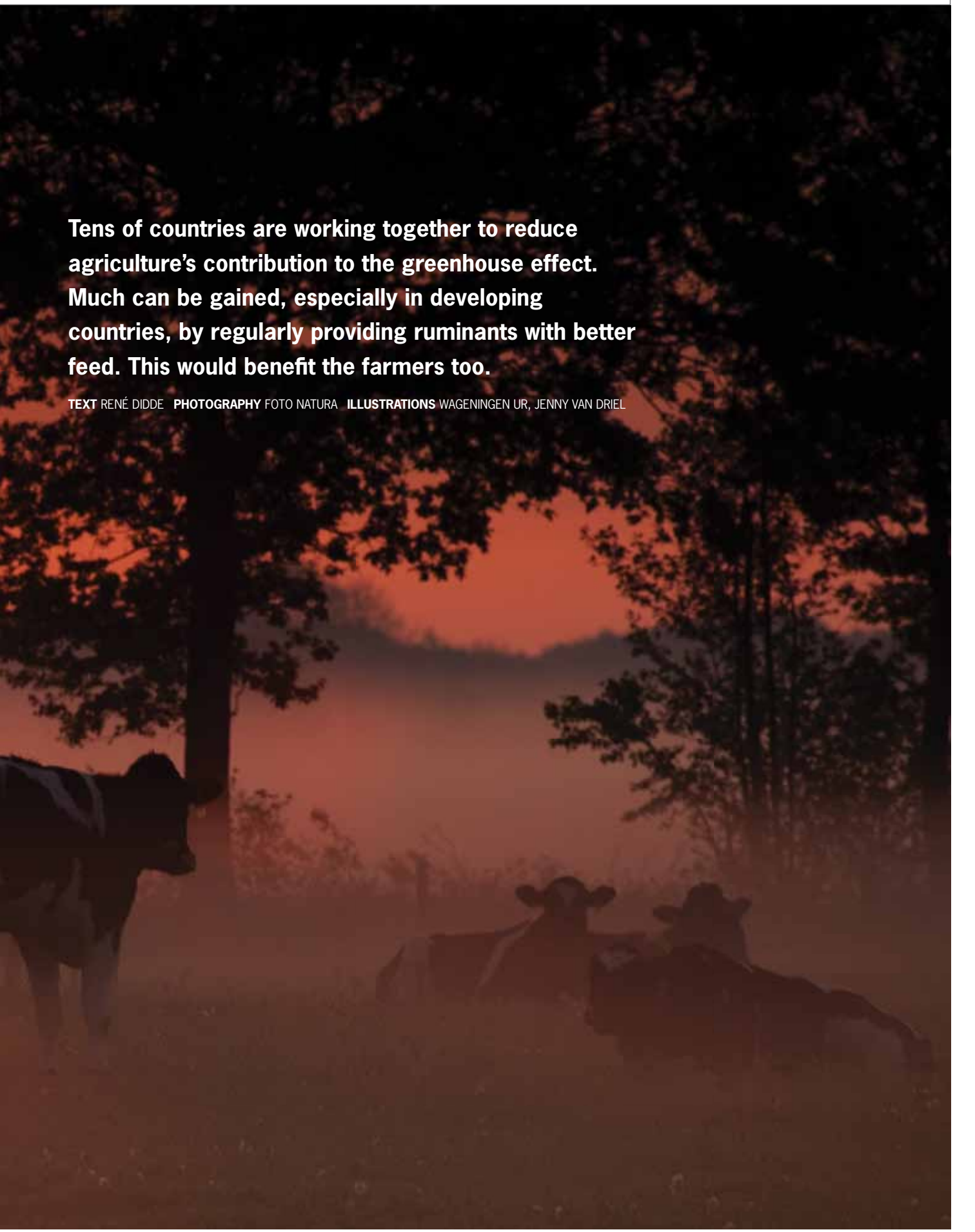
METHANE EMISSIONS CAN BE CUT

Better food, fewer burps





Tens of countries are working together to reduce agriculture's contribution to the greenhouse effect. Much can be gained, especially in developing countries, by regularly providing ruminants with better feed. This would benefit the farmers too.

TEXT RENÉ DIDDE **PHOTOGRAPHY** FOTO NATURA **ILLUSTRATIONS** WAGENINGEN UR, JENNY VAN DRIEL

Aeroplanes, cars, the chemical industry and energy companies are not the only ones contributing to climate change. Ruminants, particularly cows, also play a major role. Partly through the release of methane from their complex digestive system, these good-natured animals are responsible for almost three percent of the world's total greenhouse gas emissions. This is roughly equivalent to total air traffic emissions.

In other words, producing one litre of milk in western countries releases one kilogram of CO_2-equivalent greenhouse gases into the atmosphere. Half of this is methane (CH_4) from the animal's stomach; and 20 percent is carbon dioxide (CO_2) in part from the production of fertilizer for grassland. Another 30 percent comes from the emission of nitrous oxide (N_2O), which is released among other ways through the storage of manure and the fertilization of land used for producing livestock feed. Methane and nitrous oxide are particularly strong greenhouse gases. They have, respectively, a 21 and 300 times greater impact on global warming than the familiar carbon dioxide.

Especially striking is the poor climate score of livestock farming in Africa, South Asia and the Middle East. The free-roaming and generally poorly fed cows in these regions produce little milk, but emit a relatively large amount of methane. Consequently, livestock farming worldwide is, according to the FAO, responsible for a whopping 18 percent of the greenhouse gas emissions produced through human activities, and thus for a significant share of the current climate change.

JAC MEIJS,
Wageningen UR Livestock Research

'The Netherlands is doing a lot of research that will help reduce greenhouse gas emissions.'

LIVESTOCK NUMBERS SOARING

If nothing is done, this contribution will continue to grow. Countries such as China, India and Brazil are experiencing enormous economic growth, accompanied by changes in consumption patterns from a traditional almost vegetarian diet to one containing more animal proteins. Add to this the expected growth of the world population from six billion today to nearly nine billion by 2050, and the inevitable conclusion is that the livestock population will also dramatically increase.

The relatively large contribution of livestock farming to climate change, especially caused by ruminants, came to light in 2006 through the publication *Livestock's long shadow.* This study conducted by the UN's Food and Agriculture Organization (FAO) was an eye opener. 'The one ray of hope to come out of the failed climate conference of 2009 in Copenhagen was that 21 countries, including the Netherlands, joined forces to further research into agricultural emissions', says Jac Meijs of Wageningen UR Livestock Research. The resulting Global Research Alliance (GRA) was officially launched in June of this year in Rome.

Meijs, whose background is in cow research, serves in the secretariat of GRA on behalf of Wageningen UR. He is enthusiastic in describing the many research projects planned for the coming years, focused for example on feed adjustment, breeding, manure storage, manure application, influence of soil use on carbon fixation in the soil, and establishment of standardized methodologies for measuring emissions. 'We also want to strengthen researcher networks and work together more effectively by making more coordinated use of national research funds and contributions from Brussels', says Meijs. Already 36 countries are participating, including China and Brazil with their emerging economies. Aside from the research group dedicated to livestock farming, there is a research team looking into the contribution of rice production, as well as a third group looking at possibilities to reduce greenhouse gas emissions from arable farming, horticulture and fruit production.

'A lot of research is being conducted in the Netherlands that will eventually contribute to the reduction of greenhouse gases. More than 50 projects are already underway related to the livestock sector alone; and another thirty will follow for other sectors', explains Meijs. He points out that the livestock sector in the Netherlands voluntarily pledged to reduce greenhouse gas emissions by 30 percent in 2020 compared to the 1990 level. 'The sector is maintaining this commitment, despite the lower environmental ambitions of the current cabinet', says Meijs. Almost 20 percent – or two-thirds of the aimed reduction – had already been achieved in 2008. The agricultural sector was thus responsible for nearly half of the Netherlands' total reduction in greenhouse gas emissions.

POLITE BURP

One of the most obvious measures is to improve the efficiency of feed for ruminants. Reducing the emission of methane by these animals would already make a significant difference. 'Methane emissions account for one third of livestock's contribution to the climate problem', says Jan Dijkstra, associate professor in the Animal Nutrition group of Wageningen University, part of Wageningen UR. Using a life-size model of the digestive system of a cow, he explains how this colossal portion of the emissions produced by human activity takes place. 'The first fermentation of a cow's food takes place in the gut and the rumen. In this oxygen-free environment, micro-organisms break down rough fibres, sugar and starch into volatile fatty acids, for example, which are the main components of the cow's energy supply. In the process a surplus of hydrogen gas is produced', instructs Dijkstra.

Too much built-up pressure from the hydrogen gas would disrupt the digestion process, but cows have a solution for this: they burp. 'Methanogenic micro-organisms take care >

GREENHOUSE GAS EMISSIONS FROM LIVESTOCK

Greenhouse gas emissions

Emissions in CO_2 equivalents* per year

World

45,000 Mtons

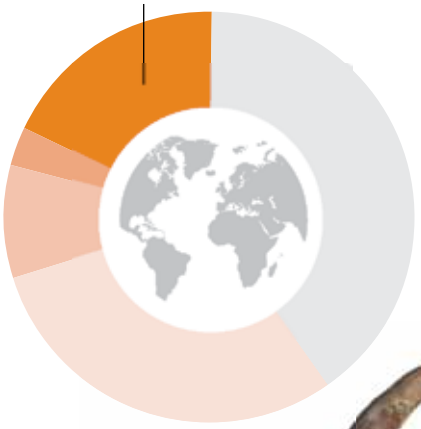
Netherlands

200 Mtons

Contribution of livestock to greenhouse gas emissions

- Livestock
- Road transport
- Air traffic
- Industry
- Other

18%



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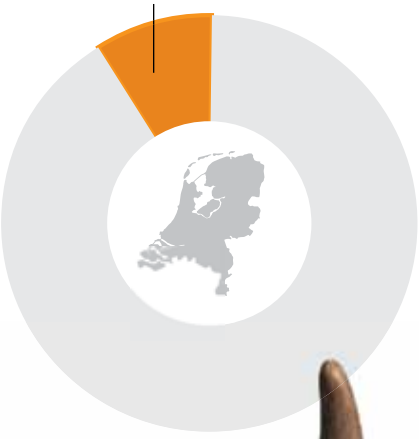
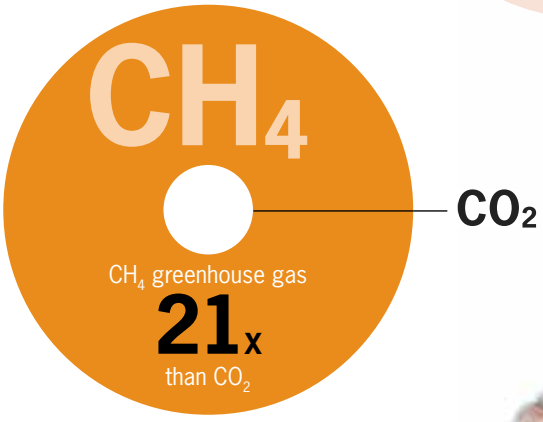


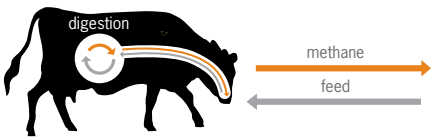
*CO_2 equivalents

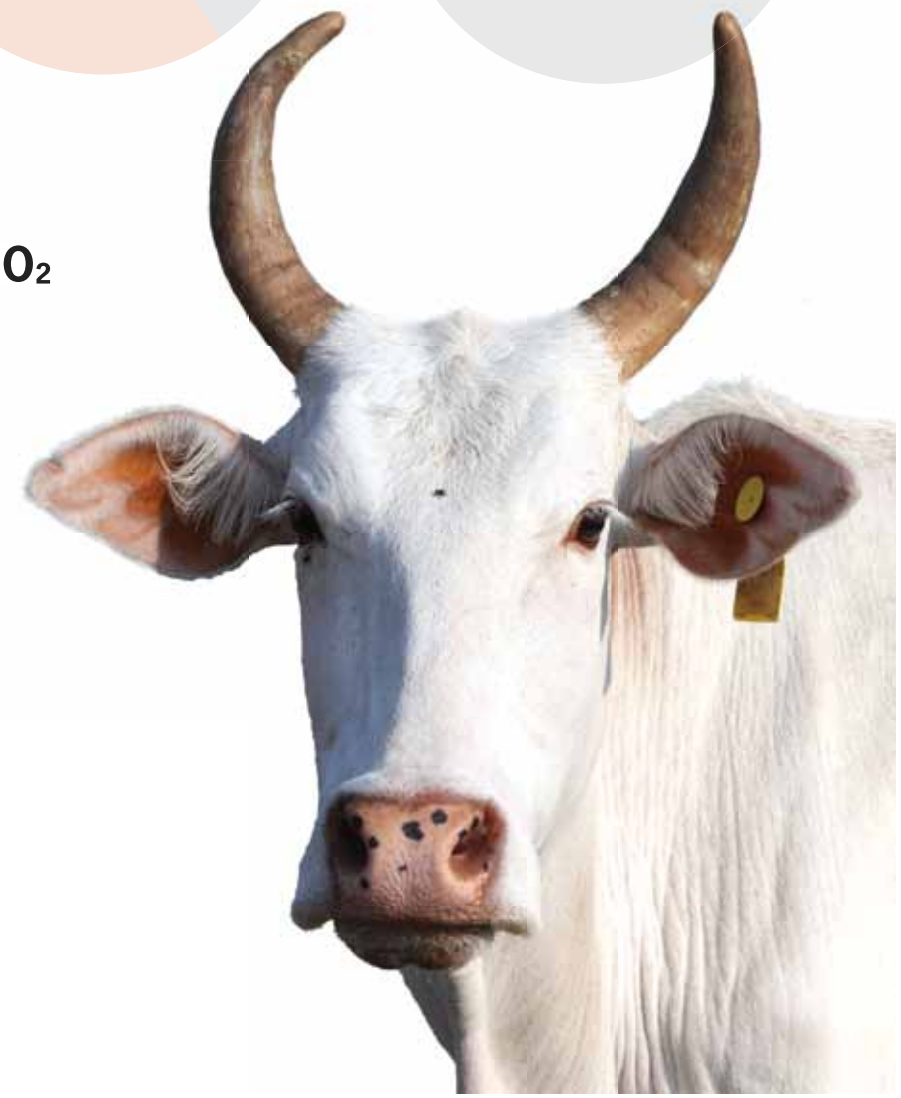


Emissions of non-CO_2 greenhouse gases are usually expressed in CO_2 equivalents. Methane contributes 21 times more to the greenhouse effect than the same amount of CO_2.

Methane emissions per cow

20 grams CH_4 per kilo feed





of the hydrogen gas by combining it with carbon dioxide, which creates methane. This gas is released by the cow as a burp. Quite inoffensively, by the way', adds Dijkstra. 'The animal keeps its mouth politely closed, and the gas escapes through its nostrils.'
Dijkstra has calculated the exact contribution made by the methane-burping cows in 'respiration chambers'. 'We measure the methane content of the incoming air and determine the methane concentration also in the outgoing air', explains Dijkstra. This revealed that cows that eat a relatively large amount of young grass emit less methane than animals that are fed primarily silage made of older grass.

GRASS GROWS SLOWLY

Feeding animals more young grass would in itself lead to a 15 percent reduction in methane emissions. But there is also a factor working against this. 'In recent years grassland in the Netherlands has been treated with less fertilizer, which means that the grass grows more slowly. When less artificial fertilizer is used the production of nitrous oxide declines, but the emission of methane increases due to the application of animal manure. In practice we still think we can achieve a net reduction of at least 10 percent', says Dijkstra.
There are plenty of other measures that are also in some way counterproductive. A cow on feed containing more maize instead of grass emits less methane. 'This is because the starchy maize produces propionic acid in the stomach', explains Dijkstra. 'That acid bonds with hydrogen, which is then not available to produce methane. But farmers cannot do this indefinitely. In the first place, maize is more expensive than grass. And secondly, it absorbs less nitrogen as it grows than grass does. To satisfy EU requirements for nitrate in groundwater, most livestock farmers cannot dedicate more than 30 percent of their land to the production of maize.'
Tests have shown that a more fatty diet also reduces methane emissions. 'Sunflower seeds, rapeseed and linseed all have a hydrogen-bonding effect that is comparable to that of propionic acid, but they also inhibit digestion. Here too, it is a question of fine-tuning', says Dijkstra. He nevertheless estimates that an additional 10 percent reduction can be achieved through the addition of more maize and fat in livestock feed.
All of the changes to cattle feed combined could lead in theory to a 50 percent reduction in emissions of methane. 'There is indeed great potential, but in practice I think for the time being we should be content with a 25 percent drop in methane emissions', says Dijkstra. This would already amount to a 1.5 percent reduction in global greenhouse gas emissions.
The fact that there is a big difference in methane emissions produced after eating young, leafy grass compared to old, longer-stemmed grass is not only of interest to the Netherlands, emphasizes Dijkstra. 'Application of this knowledge is especially important for developing countries, where fodder is often of a lower quality. It could make a world of difference there by reducing methane emissions.'
Theun Vellinga agrees that the greatest potential lies in Third World countries. A researcher at Wageningen UR Livestock Research, he believes this would also improve the farmers' income. Improving the production per animal through better nutrition, improved breeding methods and better disease control are all important in this regard, explains Vellinga. 'This shows that improving food security in Africa and Asia, improving the income level of farmers and achieving a drastic reduction in emissions can go hand in hand.' And it's not rocket science, adds Vellinga. 'In fact, the knowledge required is already readily available. In the Netherlands, consistent improvements in efficiency over the past forty years have led to a doubling of the milk produced per cow, while over the same period methane emissions dropped by half.'

SERIOUS OVERGRAZING

Vellinga supports Jan Dijkstra's conclusion that improving the quality of cattle feed tops the list of needed measures. 'In many extensive agricultural systems cows graze on com-

Global livestock emissions of greenhouse gases

Per type of livestock

Beef and dairy cattle **44%**
Other livestock **56%**

Per type of greenhouse gas

CH_4 **33%**
Laughing gas **33%**
Carbon dioxide **33%**

Per type of system

Extensive systems **67%**
Intensive systems **33%**

mon ground. No one feels responsible, and this results in serious overgrazing, weight loss among the animals, fewer calves and a low production level of five hundred kilograms of milk per cow per year.' Joint management of the grassland would have a direct impact, according to Vellinga, who spent a year and a half at the FAO in Rome calculating the effects of such measures.
Offering the animals more digestible feed would also lead to an increase in milk production and a decrease in methane burps per cow. 'Now they are often fed poorly digestible straw from rice, wheat or sorghum. We normally optimize the protein content and kernel size of such grains for human consumption. But the International Livestock Research Institute (ILRI) in Nairobi is currently working on improving both the grains and the straw.'

WALKING BANK ACCOUNTS

Socio-economic factors also play a role in developing countries. Cows often represent a farmer's capital – they are walking bank accounts in a way. 'At the FAO we could see when school fees were due in a particular country, because the farmers would sell a cow', recalls Vellinga. 'If farmers had access to a better infrastructure of banks and microcredit, they wouldn't have to save in the form of cows. These are often old, non-productive cows anyway, so this would tackle two problems at once.
In countries with more intensive cattle breeding it is actually desirable to keep dairy cows longer. Cows in the Netherlands currently live for only six years, with a productive lifespan of approximately 3.6 years. So far the policy has been to always have a ready supply of newly and better-bred heifers. This is not only expensive, but also requires a greater number of young animals, which produce nothing but greenhouse gasses in their first years. Cows' milk production does not go down until they are 10 years old. If the farmers kept their dairy cows for 10 rather than 3.6 years, they would save on young animals, feed and environmental emissions. One measure that is already having a global impact, both in terms of the farmers' wallets and the environment, is fermentation of cow manure. Theun Vellinga: 'Manure fermentation is producing energy-rich biogas both in the west and in developing countries. In the west this energy can be used to supply electricity, heat or fuel for cars. In southern countries biogas can be used as a relatively clean cooking fuel that does not require a day-long search for kindling. This spares the forests and leads to less air pollution. The nice thing is that the residue from the fermentation process contains nutrients such as nitrogen and phosphate. This by-product can be used without any problem as a fertilizer.'
Wiebren van Stralen, a member of the Dutch Federation of Agriculture and Horticulture (LTO) working group on livestock farming, sees additional challenges closer to home. Milk quotas will cease to exist in the Netherlands in 2015, but this must not lead to more cows. The sector aims to produce 'climate neutral' milk by 2020. 'This means that we will produce all the energy required to run the whole milk production chain ourselves', says Van Stralen. 'Moreover, the dairy industry has laid down that emissions from livestock farming must not increase; so the answer is not more cows but even greater efficiency.'
After one hundred years of improvements in both the production and efficiency of cows, we are slowly approaching the limits of what can be achieved in these areas. 'This is why we will have to start directing our attention to environmental efficiency', says Van Stralen. 'This includes both large-scale manure fermentation operations and small-scale manure refineries that break up the manure and extract proteins, energy and phosphate. We will also be tapping energy from the relatively warm milk produced by the cows.' ■

JAN DIJKSTRA,
Animal Feeds chair group at Wageningen University

'I think for now we should be content with a 25 percent drop in methane emissions'

THEUN VELLINGA
Wageningen UR Livestock Research

'Improving the income level of farmers and reducing emissions can go hand in hand.'

KNOWLEDGE EXCHANGE

Global Research Alliance partners will have the opportunity to meet three times this autumn in the Netherlands, starting at the end of October with a congress on climate-friendly agriculture. The Sixth International Symposium on Non-CO_2 Greenhouse Gas (NCGG6) will take place in Amsterdam in early November, followed directly by a separate meeting of the lLivestock Research Group of the Global Research Alliance.