

# MEAT ATLAS

Facts and figures about the animals we eat

2021



# IMPRINT

The **MEAT ATLAS 2021** is jointly published by  
Heinrich Böll Stiftung, Berlin, Germany  
Friends of the Earth Europe, Brussels, Belgium  
Bund für Umwelt und Naturschutz, Berlin, Germany

Chief executive editors:  
Christine Chemnitz, Heinrich Böll Foundation (project management)  
Stanka Becheva, Friends of the Earth Europe

Managing editor, graphics research: Dietmar Bartz  
Art director, graphic development: Ellen Stockmar

Atlas  Manufaktur  
52° 31' N, 13° 24' O

English edition  
Editor: Paul Mundy  
Proofreader: Rachel Glassberg

German edition  
Chief sub-editor: Elisabeth Schmidt-Landenberger

Documentation and final editing: Andreas Kaizik, Sandra Thiele (Infotext GbR)

Contributors: Francesco Ajena, Isis Alvarez, Stanka Becheva, Reinhild Benning, Milena Bernal Rubio, Peter Birke, Christine Chemnitz, Inka Dewitz, Thomas Fatheuer, Lukas Paul Fesenfeld, Harald Grethe, Carla Hoinkes, Heike Holdinghausen, Philip Howard, Kristin Jürkenbeck, Kamal Kishore, Ilse Köhler-Rollefson, Silvie Lang, Jonas Luckmann, Bettina Müller, Lia Polotzek, Thorsten Reinsch, Hanni Rützler, Maureen Schulze, Shefali Sharma, Achim Spiller, Lisa Tostado, Mia Watanabe, Katrin Wenz, Sabine Wichmann, Stephanie Wunder, Anke Zühlsdorf

Cover image: Ellen Stockmar, image editing: Roland Koletzki

The views do not necessarily reflect those of all partner organizations.  
The maps show the areas where data are collected and do not make any statement about political affiliation.

Editorial responsibility (V. i. S. d. P.): Annette Maennel, Heinrich Böll Foundation  
1st edition, September 2021

This material – except the cover image, publication covers and logos – is licensed under the Creative Commons “Attribution 4.0 International” (CC BY 4.0). For the licence agreement, see <https://creativecommons.org/licenses/by/4.0/legalcode>, and a summary (not a substitute) at <https://creativecommons.org/licenses/by/4.0/deed.en>. Individual graphics from this atlas may be reproduced if the attribution “Bartz/Stockmar, CC BY 4.0” is placed next to the graphic.



Friends of the Earth Europe gratefully acknowledges financial assistance from the European Commission (LIFE Programme). The sole responsibility for the content of this document lies with Friends of the Earth Europe. It does not necessarily reflect the opinion of the funder mentioned above. The funder cannot be held responsible for any use that may be made of the information contained therein.



## FOR DOWNLOADS

Heinrich Böll Stiftung, [www.eu.boell.org/meatatlas](http://www.eu.boell.org/meatatlas)  
Friends of the Earth Europe, [www.friendsoftheearth.eu/meatatlas-2021](http://www.friendsoftheearth.eu/meatatlas-2021)



# MEAT ATLAS

Facts and figures about the animals we eat

2021

# TABLE OF CONTENTS

## 02 IMPRINT

## 08 INTRODUCTION

## 10 TWELVE BRIEF LESSONS ABOUT MEAT AND THE WORLD

## 12 CONSUMPTION EVERYDAY FOOD AND LUXURY GOOD

The global demand for meat continues to rise due to economic and population growth, but at a slower pace than 10 years ago. Poultry accounts for an increasingly large share of consumption. Large differences remain in consumption per capita between countries and among population groups.

## 14 WORLD TRADE IN LORRIES AND SHIPS

Trade in meat and live animals is relatively new and growing fast. Disease outbreaks, sanitary restrictions and trade policies can lead to big swings in trade flow. The big four players are China – which dominates import markets – as well as the USA, Brazil and the EU, which provide most exports.

## 16 MERCOSUR TRADING AWAY THE ENVIRONMENT

The Association Agreement between the European Union and the Mercosur countries raises concerns with regards to meat and feed, as well as the rainforest and the climate. Meanwhile, the EU is worried about cheap imports, and resistance is growing. Whether the deal will actually come into force is questionable.

## 18 PRODUCTION PROBLEM FOODS AND THEIR PRODUCERS

The world's meat production has grown rapidly, fed by rising demand and made possible by technological advances in livestock farming. But this has had serious consequences for animal welfare and small-scale producers.

## 20 ABATTOIRS CHOPPING BUT NOT CHANGING

Covid-19 outbreaks in abattoirs and processing plants are just the latest in a long list of problems in the meat industry. Low wages, hard work, and precarious employment are the price that workers pay to supply us with cheap meat. The industry is attempting to dodge its responsibility to provide decent conditions for its staff.

## 22 MEAT WASTE A LOT LESS THAN THE WHOLE HOG

The meat industry used to be famous for using “everything about the hog except the squeal”. But a large proportion of the livestock raised for food do not end up as food. Many die, or are killed, before they reach the slaughterhouse, and even more meat is wasted between the factory and the plate.

## **24 LAND CONFLICTS** **CUTTING DOWN FORESTS, CARVING UP PASTURES**

In South America, natural vegetation is being turned into pastureland and monocultures to support an unsustainable form of livestock production. In Africa and Asia, a sustainable form of livestock raising is losing ground to industrialized agriculture. Traditional local communities are on the losing end.

## **26 COMPANIES** **DOMINATING THE MARKET FROM FARM TO DISPLAY CASE**

Global meat companies play a major role in determining how meat and feed are produced, transported and traded. Food is big business: the 100 largest food and beverage firms around the world include 10 main meat producers and processors.

## **28 FINANCE** **BIG BUCKS FOR BIG FIRMS**

Big Meat attracts big money. Both private and public investors pour money into meat and dairy corporations, further boosting their market power and fuelling yet more consolidation in an already concentrated industry. The environmental and social damage caused by the industry is largely overlooked.

## **30 GENDER AND POVERTY** **YET MORE UNPAID WORK**

In many countries, women do most of the farm work, but they are not allowed to make most of the decisions. They have to balance caring for their children and elderly parents with looking after the chickens and goats. Livestock can be a welcome source

of extra money, but may also mean more work. And if selling eggs and milk becomes more profitable, men very often take charge.

## **32 FEED** **SOY, FOREST, AND SAVANNA**

More than one-third of all crops worldwide end up in the stomachs of livestock. That includes one billion tonnes a year of soybeans and maize alone. The feed and livestock industries want to increase that even further.

## **34 CLIMATE** **A LIGHTER HOOFPRIENT**

Livestock's share of global greenhouse gas emissions is understated. The climate footprint of the animals and the feed they need is significant. There are ways to change that.

## **36 PESTICIDES** **BANNED BY BRUSSELS, ALLOWED IN THE AMAZON**

Pesticide applications are on the rise across the globe. Some of the most dangerous substances have been banned in the European Union, but are still being used on a large scale in other parts of the world. Many are intended for the cultivation of soybean and maize, which are destined mainly for use as livestock feed.

## **38 WATER** **THIRSTY ANIMALS, THIRSTY CROPS**

All animal products have a water footprint: the amount of water needed to produce them. It is not just the total amount that is important, but the types of water that are needed. There is enough "green" water. But the volumes of "blue" and "grey" water should be kept low.

## 40 FERTILIZERS

### TOO MUCH OF A GOOD THING

Nitrogen pollution from livestock manure is an increasing problem in many parts of the world. Countries in the European Union have lots of ideas on how to reduce such contamination of their environments. One approach is through closer monitoring of industrial livestock producers and restricting the amount of manure slurry that crop farmers are allowed to apply.

## 42 REWETTING

### GIVE PEAT A CHANCE

Across the globe, peatlands are being drained for farming and raising livestock. But dried-out peat emits huge amounts of greenhouse gases. Agricultural policy should initiate the transition to the climate-friendly use of these areas.

## 44 ANTIBIOTICS

### USELESS MEDICINES

Antibiotics help to treat many diseases. The big problem: in both humans and animals, pathogens can develop antibiotic resistance – a fatal danger. And in industrial livestock production, these drugs are still not being used carefully enough.

## 46 PANDEMICS

### DANGEROUS CONTACTS

Livestock production and meat consumption stimulate outbreaks of diseases that can be transmitted from wild animals to humans. Such zoonoses can have catastrophic consequences – as Covid-19 has shown.

## 48 PASTORALISM

### BOUNTY FROM A BARREN LAND

Mobile herders move with their herds or flocks in the remotest of pastures. This form

of animal production, known as pastoralism, is economically important and climate-friendly, but it is under severe threat.

## 50 PASTORALISM IN INDIA

### RANGELAND, NOT WASTELAND

India is the world's largest exporter of buffalo, sheep and goat meat. Remarkably, the majority of this output is produced in traditional agropastoral systems.

## 52 ACTIVE STATE

### THE POLITICAL ECONOMY OF TRANSFORMING THE MEAT SYSTEM

Representative surveys in various countries have found a surprising amount of public support for reduced consumption of meat. Policymakers must find the right package and sequence of measures to stimulate the transition to a more sustainable future.

## 54 THE EUROPEAN UNION

### COMMON LIVESTOCK POLICY

Intensive livestock production creates environmental and animal welfare problems. Reforms currently being considered to the EU's Common Agricultural Policy do not go nearly far enough to resolve these. But improvements can be made even within the current system.

## 56 LABEL

### THREE STARS FOR A BETTER LIFE

Buy meat from a supermarket, and you can probably choose between organic and non-organic. But with the non-organic products, you have no way of telling whether the animal was treated well, or was stuck in a pen with little room to move. Calls are growing for meat labels that show the conditions under which the animals are raised.

## **58 EU STRATEGIES**

### **A GOOD START, BUT COULD TRY HARDER**

As part of its Green Deal, the European Commission has proposed a “Farm to Fork Strategy”. This is the EU’s most coherent attempt yet to respond to the fundamental challenges plaguing the food system. But much will depend on converting grand-sounding words into actual policies.

## **60 LAB MEAT**

### **CELLSTOCK VS LIVESTOCK**

Lab-grown meat is a disruptive innovation that could help resolve sustainability and health issues related to livestock, as well as reduce the numbers of animals farmed. But the sustainability gains do not yet match expectations.

## **62 INSECTS AS FOOD**

### **SNACKING ON SILKWORMS, LUNCHING ON LOCUSTS**

Adding insects to our menus could help overcome the world’s food supply problems. But the industrial production of insects is controversial: would it be useful or dangerous?

## **64 MEAT SUBSTITUTES**

### **A NEW SECTOR EMERGES**

Vegan and vegetarian alternatives to meat are gaining popularity fast – making them tastier for big firms, too. Competition is likely to flare up around in-vitro meat: start-ups developing lab-grown products are sprouting everywhere.

## **66 ACTIVISM**

### **PRESSURE FROM BELOW**

Civil society is a sometimes underestimated stakeholder in the food system. Supporting sustainable production and criticizing industrialized agriculture, it influences public opinion and habits and demands better policies and international solidarity. And it can hold governments and companies accountable for their actions, while offering solutions.

## **68 SURVEY ON YOUTH**

### **CHANGING HABITS**

Young people in Germany – the “Fridays for Future generation” – eat less meat than their elders. Their attitudes and habits are likely to steer food consumption and policy in the coming decades. Results of a representative survey.

## **72 AUTHORS AND SOURCES FOR DATA AND GRAPHICS**

## **74 ABOUT US**

# INTRODUCTION

One of the key demands of Fridays for Future, the youth climate movement, is “Listen to science!” In the age of Covid-19, governments frequently consult scientists and adapt policies to their advice. Scientists have also been stressing for over a decade that a climate- and biodiversity-friendly diet contains less than half the amount of meat consumed in industrialized countries today.

However, an ambitious and dedicated political shift in agriculture and food policy to tackle the climate crisis seems far away. The food and farming sector in industrialized countries, which accounts for about one-third of global greenhouse gas emissions, is far from doing its fair share to reduce them.

If the climate crisis failed to ring alarm bells, Covid-19 should have done so. The expansion of industrial agriculture at the expense of nature puts our global health at risk. The World Health Organization has been underlining the dire threat to global human health of zoonoses (infectious diseases transmitted via animals), which are closely linked to industrial meat and feed production around the globe. Furthermore, the terrible working conditions in

“ The expansion of industrial agriculture at the expense of nature puts our global health at risk.

slaughterhouses came to light during the first and second waves of the Covid-19 crisis, when meat factories turned into infection hotspots in many countries.

The fact that the meat industry keeps profiting throughout all crises while being subject to little regulation poses the question as to whom governments really listen to. While livestock corporations fuel the climate crisis, deforestation, pesticide use and biodiversity loss, and while they drive people off their land, they are still supported and financed by the world’s most powerful banks and investors, many of them from Europe. Policies, on the other hand – be they on animal welfare, trade or climate – include very few restrictions on this damaging industry. Strict, binding regulations for meat producers are often only achieved via citizens’ engagement – like the “End the Cage Age” campaign. This European Citizens’ Initiative for a ban on keeping animals in cages in the EU brought together over 170 organizations and was supported by 1.4 million people. Citizens have long grasped the problem.



The results of a survey commissioned for this report in Germany show that more than two-thirds of the younger generation reject today's meat industry. Considering meat production a threat to the climate, they choose vegetarian or vegan diets twice as often as the population as a whole. And they see a need for action on the part of the government.

**C**ontrarily to what politicians might claim, laws and regulations can steer our consumption decisions in favour of sustainability and health. There are numerous instruments for this: fiscal, informational and legal. European and national food strategies should contain such instruments, as well as those which support sustainable livestock breeding and a transition of the industry towards more locally embedded models in order to create fair and sustainable food environments. They should also reinforce environmental and social laws as well as animal welfare legislation in order to shift the focus of current industrial meat production to quality instead of quantity.

Eight years ago, we published the first Meat Atlas. Since then, a lot has changed in Europe and globally. Industrial meat has become a critical issue in society, the media and science. Consumers are increasingly turning to vegetarian products or to sustainably produced meat.

**“ Laws and regulations can steer our consumption decisions in favour of sustainability and health.**

It is clear that many (especially young) people no longer want to accept the profit-driven damage caused by the meat industry and are increasingly interested in and committed to climate, sustainability, animal welfare and food sovereignty causes. We consider this an encouraging step for our future and want to use this Atlas to strengthen their commitment with information.

**T**his Atlas is intended to support all those who seek climate justice and food sovereignty, and who want to protect nature. Revealing new data and facts, and providing links between various key issues, it is a crucial contribution to the work done by many to shed light on the problems arising from industrial meat production.

**Barbara Unmüßig**  
Heinrich-Böll-Stiftung

**Olaf Bandt**  
Bund für Umwelt und Naturschutz Deutschland

**Jagoda Munić**  
Friends of the Earth Europe

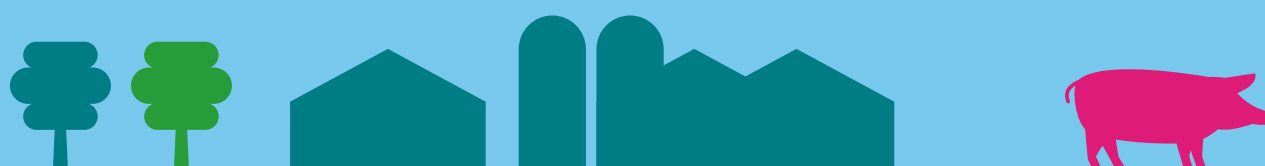
## 12 BRIEF LESSONS

# ABOUT MEAT AND THE WORLD

**1** Global meat production is increasing. But to protect **BIODIVERSITY AND THE CLIMATE**, the developed world **WILL HAVE TO HALVE ITS CONSUMPTION OF MEAT**.



**2** More than one billion people around the world earn their living by **KEEPING LIVESTOCK**. Traditional and nature-friendly animal husbandry is coming under pressure from **INDUSTRIALIZED AGRICULTURE**.



**3** Almost two-thirds of the world's 600 million poor livestock keepers are **WOMEN**. They face disadvantages because they have **LIMITED ACCESS** to land, services and farm ownership.

**4** **CONFLICTS** over land are on the rise, in part because of industrial meat production. More and more people are being killed for defending the **RIGHT TO LAND**.

**5** The use of **ANTIBIOTICS IN ANIMAL HUSBANDRY** is resulting in more and more **MICROBIAL RESISTANCE**. This threatens the effectiveness of antibiotics, one of the most important types of treatment in human medicine.



**6** The leading producers of fodder crops are among the largest users of **PESTICIDES** – which contaminate groundwater and harm **BIODIVERSITY**.



**7** The five biggest **MEAT AND MILK PRODUCERS** emit the same volume of **CLIMATE-DAMAGING GREENHOUSE GASES** as **Exxon, AN OIL GIANT**.



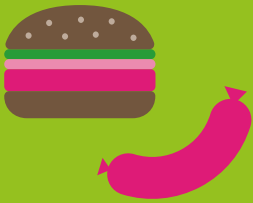
**8** **RE-WETTING THE PEATLANDS** that occupy 3 percent of EU farmland would avoid climate-damaging gas emissions by **UP TO ONE QUARTER**.



**9** In many countries, habits, role models and **ADVERTISING**, along with cultural traditions, combine to promote meat consumption. The food industry is **PROFITING** from the status quo.



**10** **FINANCIAL INSTITUTIONS** like public and private banks, pension, and investment funds, support industrial animal production with **HUNDREDS OF BILLIONS** of euros.



**11** **MEAT SUBSTITUTES** can reduce meat consumption. The market is growing fast. **PLANT-BASED** alternatives currently play a big role; **CELL-BASED** meat – not yet.

**12** Despite the global impact of meat, no country in the world has a **STRATEGY TO REDUCE CONSUMPTION** or **TRANSFORM PRODUCTION**. Governments can play a major role through **LAWS**.



## CONSUMPTION

# EVERYDAY FOOD AND LUXURY GOOD

The global demand for meat continues to rise due to economic and population growth, but at a slower pace than 10 years ago. Poultry accounts for an increasingly large share of consumption. Large differences remain in consumption per capita between countries and among population groups.

Worldwide consumption of meat has more than doubled in the past 20 years, reaching 320 million tonnes in 2018. The global population has risen, as have incomes; both factors contribute roughly equally to rising demand for meat. That's good news for the meat industry: consumption is forecast to rise by another 13 percent by 2028.

But for many people around the world, meat is still a luxury item whose consumption depends heavily on income. The global economic crisis caused by the Covid-19 pandemic has caused many people's incomes to plummet. The World Bank estimates that the current crisis will push 97 million people below the poverty line, and many millions more will suffer serious financial shortfalls.

This is also true for China, the world's biggest meat consumer. Along with another virus, African swine fever, Covid-19 is the main reason for the reduced consumption of pork in 2020. The fight against the pandemic caused the Chinese economy to grow by only 2.3 percent in 2020 – the weakest pace since 1976.

In most of the developed world, meat consumption has remained at a high and fairly constant level for decades.

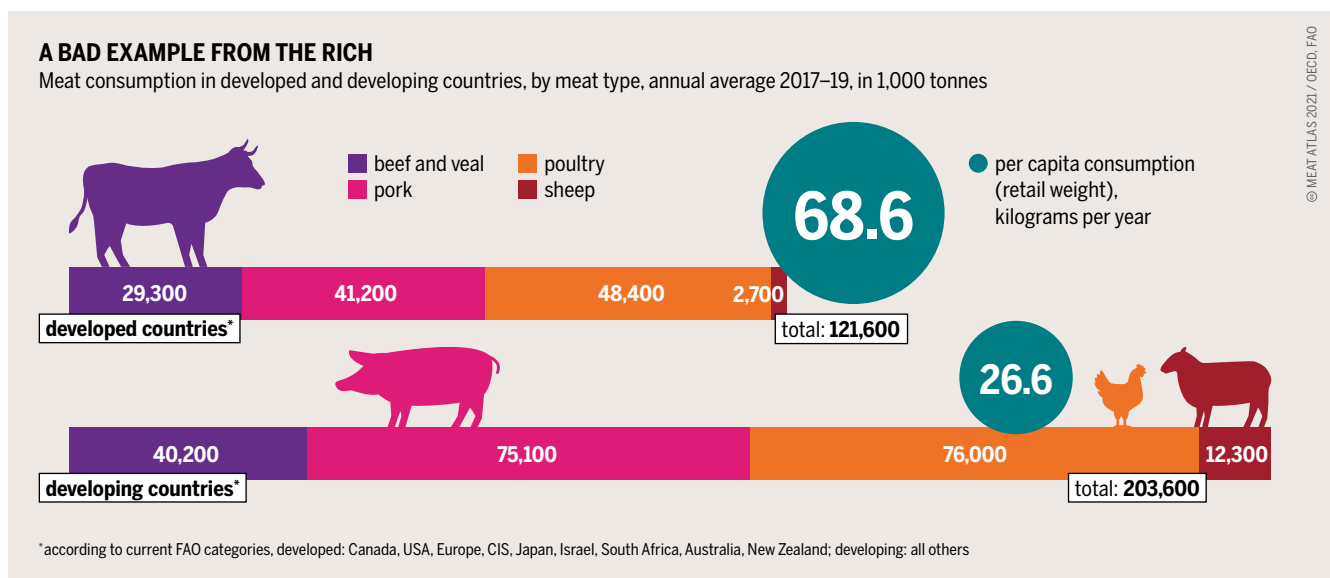
Each person in Germany consumes an average of 60 kg a year, while in the USA and Australia it is more than 100 kg. Over the past several years, demand in some developed countries has been declining slightly due to consumer concerns about health, animal welfare and the environment.

The biggest growth in meat consumption will take place in the developing world. According to the OECD, a club of mostly wealthy countries, demand in the developing world will rise by four times as much as in the developed world by 2028. Developing countries start from a much lower base than their developed counterparts but have faster-growing populations; nevertheless, their additional consumption will remain relatively low. This is especially clear in Africa, where overall demand is rising very quickly, but consumption per person is expected to rise only slightly in the next 10 years – from 17 to 17.5 kg per year.

The most populous country, China, consumes almost one-third of the world's meat and has accounted for one-third of the growth in consumption over the last 20 years, even though its per capita consumption is still less than half that of the USA. Demand in China is likely to continue to rise, though at a much slower rate due to rising concerns about obesity and a population that is set to shrink from 2030 onwards.

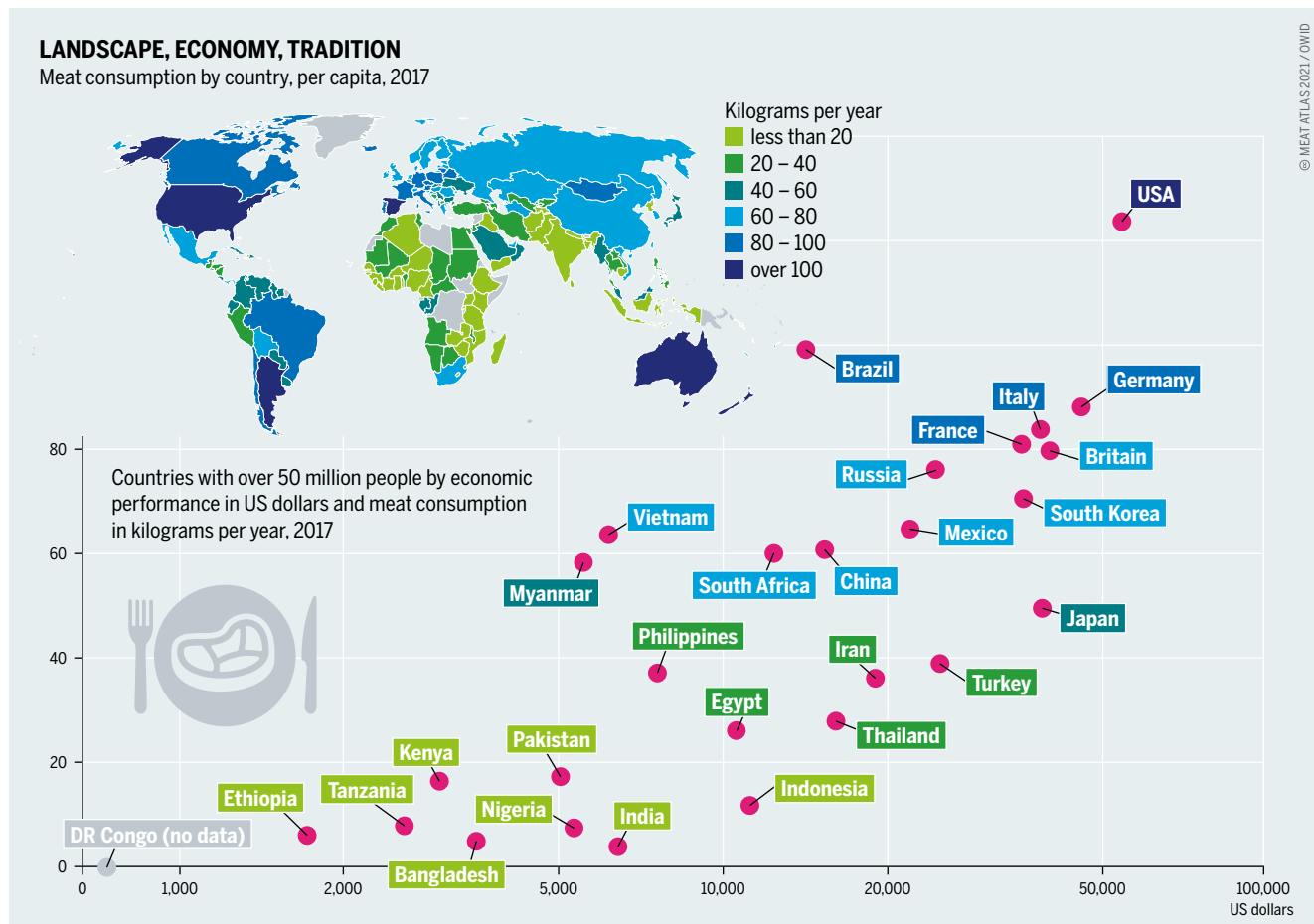
In Africa and Asia, meat consumption will overtake production. Imports will rise, especially in sub-Saharan Africa. But the global rise in meat imports will largely be driven by

*Although they have five times as many people, developing countries consume less than twice as much meat as developed ones*



## LANDSCAPE, ECONOMY, TRADITION

Meat consumption by country, per capita, 2017



Asia (outside of China). The region as a whole is expected to account for around 56 percent of world trade by 2029.

The major global trends do not apply equally to all types of meat. While the share of beef and lamb in total consumption is declining, humans are eating more and more pork and poultry. Poultry alone will account for around half of the global growth in consumption in the next decade. In the USA, for example, per capita consumption of beef has fallen by about one-third in the last 30 years, while that of poultry has more than doubled. This is due, among other things, to its price advantage and lower fat content. Pork will account for around 28 percent of the growth in the next decade, driven mainly by rising consumption in Asia. Many Asian and African countries, however, consume very little pork due to the religious beliefs of a significant part of their populations.

The country-level data on overall demand and average consumption tell only part of the story. Within each country, demand varies greatly according to socioeconomic factors. In industrialized regions, meat consumption per person tends to decrease with higher education and incomes. In addition, women and young people tend to eat less meat than their older, male counterparts. In Germany, for example, men on average eat around twice as much meat as women per day. In the USA – where diets tend to be meat-heavy – men still lead consumption by about 50 percent. In

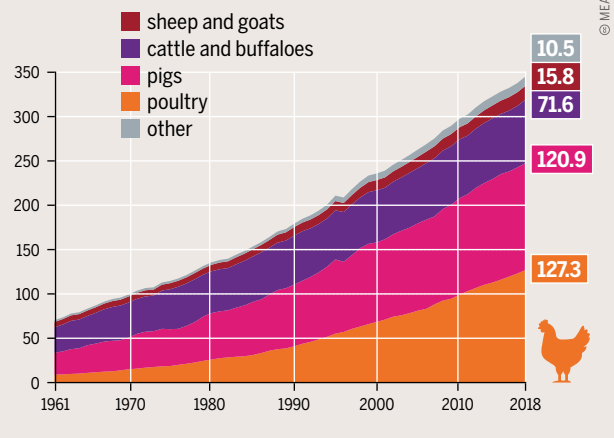
*A general rule: the richer a country is, the more meat its inhabitants consume. But other factors, like climate or religion, also influence per capita consumption*

poorer parts of the world, extreme income inequalities are reflected in per capita meat consumption. Among the elite, consumption levels are similar to those in the OECD countries, while meat is still a luxury for the much more numerous lower and lower-middle classes. That is another reason meat remains a status symbol for many. ●

*Meat consumption has increased markedly. Growing prosperity is almost as important a factor as population growth*

## TOP OF THE PECKING ORDER

Increase in global consumption by type of meat, with bone, in million tonnes



## WORLD TRADE

# IN LORRIES AND SHIPS

Trade in meat and live animals is relatively new and growing fast. Disease outbreaks, sanitary restrictions and trade policies can lead to big swings in trade flow. The big four players are China – which dominates import markets – as well as the USA, Brazil and the EU, which provide most exports.

Just under 38 million tonnes of meat, comprising around 11 percent of annual global production, are traded across national borders each year. Although the vast majority of meat stays in the country where it is produced, the share traded internationally is growing steadily. In the 1960s, less than 4 percent of worldwide beef production was traded across borders; now, it is almost 20 percent. For poultry the share is around 12 percent; for pork, 11 percent.

The reduction of customs tariffs and quotas through the World Trade Organization is one reason for the growing

trade in meat and meat products. But many countries still use tariffs to protect their meat sector, and strict rules to contain livestock diseases hinder many developing countries from exporting their meat products. This may be because they do indeed have problems with particular diseases, or because they lack the laboratory capacity and institutional structures to prove that they are disease-free.

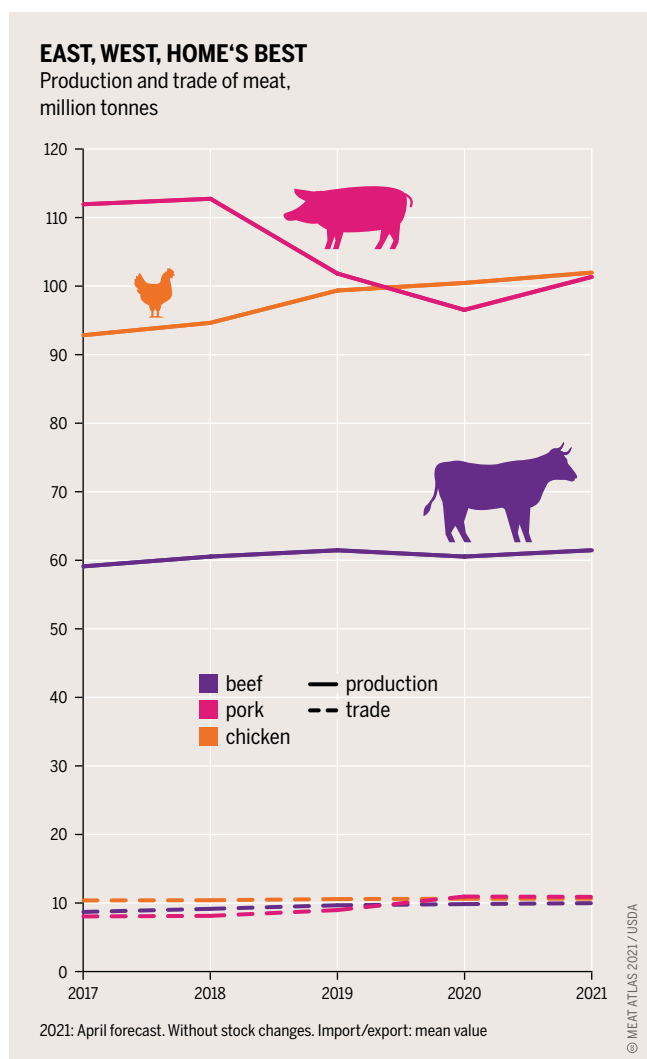
In any case, livestock diseases are the main reason for the fragility of international trade flows in meat. Trade may increase markedly over a very short period, or be cut off abruptly. The temporary collapse in the market for poultry in Southeast Asia with the emergence of bird flu in 1997, and the complete collapse of British beef exports in the 1990s after the spread of BSE in the United Kingdom, show how embargoes can dry up trade flows almost overnight. After the latter outbreak, the European Commission imposed a worldwide ban on exports of British beef and beef products.

In contrast, global trade actually profited from the outbreak of African swine fever. The disease caused Chinese pork production to drop by almost 20 percent. As a result, in 2019, China imported 2 million tonnes – 62 percent – more meat than in the previous year. World trade rose by around 6.9 percent. The biggest winners were Brazilian producers, which supplied record amounts of poultry and pork to China. The EU also expanded its exports: in the first half of 2020, its pork exports were 15 percent above the same period in the previous year, mainly because exports to China doubled. The situation was reversed in late summer 2020, when African swine fever reached Germany. Customers such as China, South Korea and Japan stopped imports from Germany. The European Commission revised its positive estimate for exports for 2020, and forecast a drop of 10 percent by the end of 2021.

The meat trade is also a favoured means of exerting political pressure. Russia banned the import of meat and cheese from Europe as a consequence of the EU sanctions following the Russian annexation of Crimea. China slowed beef imports from Australia after the government in Canberra accused China of being the source of the Covid-19 pandemic. And Saudi Arabia banned poultry imports from Brazil as a warning to that country not to move its embassy in Israel from Tel Aviv to Jerusalem.

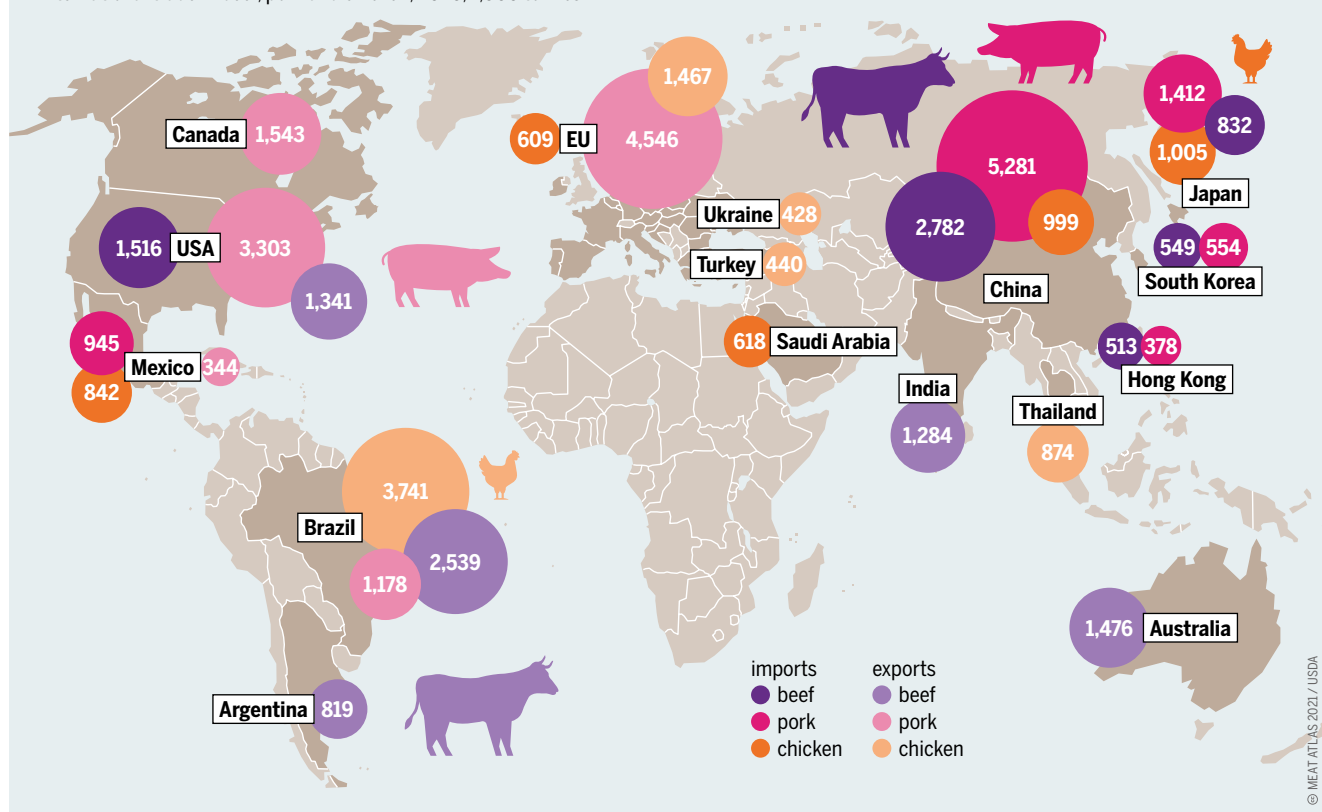
Overall, livestock disease, sanitary restrictions and trade policies are likely to remain the main factors driving or limiting the development of trade in meat. Things were different in the past. In the 1960s and 1970s, very little meat was traded internationally due to its perishability. The big shift occurred through technological advances that made frozen or refrigerated transport possible.

*Though public debate over trade has been intense, the share of global meat exports is relatively low and rising only slowly*



## TOP 5 IMPORTERS AND EXPORTERS

International trade in beef, pork and chicken, 2020, 1,000 tonnes



The number of live animals traded has also risen steadily. In 2017 – the year with the most recent data available – almost 2 billion live animals were traded, and since 2003 the global market has doubled to about 24 billion euros. Poultry make up by far the greatest amount of livestock traded, though other species are also shipped live. Pigs are destined mainly for the USA and Poland, while most sheep and cattle are sent to the Arab world. Overall, a large proportion of live animals are traded regionally. Some 70 percent of the animals traded by the EU are moved from one member country to another, with each country handling a different part of the value chain. Piglets born in Denmark, for example, are taken to Poland for fattening. Land transport is limited to a maximum of 8 hours a day. But there is no time limit for animals loaded onto ships: their journey may last for weeks.

Worldwide demand for meat is forecast to continue to grow over the next decade. The OECD and FAO predict that global meat production will rise by almost 13 percent between 2019 and 2029, and that international trade will grow by 12 percent. The most important market player is China, with its huge demand pulling in around one-third of world imports. Developing countries will also import more as their rapidly rising demand outstrips local supply, and as many small-scale local producers struggle to compete with cheap imports.

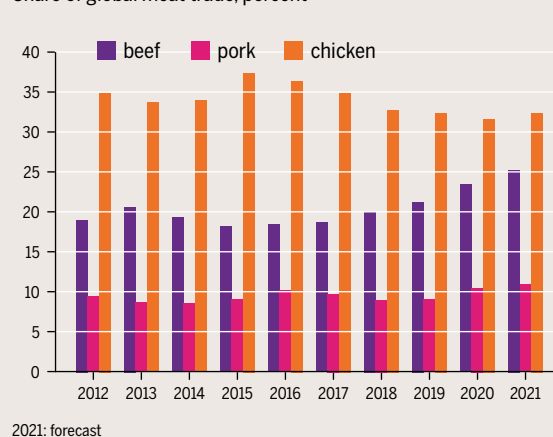
*A big portion of the meat that enters the international trade – either as living animals or after slaughter – comes from Brazil*

*Only a few countries are engaged strongly in the international meat trade. They include Brazil, China, the EU and the USA*

Exports are also concentrated in a small number of countries. The three biggest exporters, Brazil, the USA and the EU, will account for around 60 percent of all meat exports by the end of the decade, according to FAO. Demand for meat is already saturated in many developed countries and is likely to fall. Depending on how production conditions change, the EU and the US will increasingly focus their production on serving the export market. ●

## BRAZIL: WORLD EXPORT CHAMPION

Share of global meat trade, percent



2021: forecast



# MERCOSUR

# TRADING AWAY THE ENVIRONMENT

The Association Agreement between the European Union and the Mercosur countries raises concerns with regards to meat and feed, as well as the rainforest and the climate. Meanwhile, the EU is worried about cheap imports, and resistance is growing. Whether the deal will actually come into force is questionable.

It took more than 20 years for the European Union and the Mercosur countries – Argentina, Brazil, Uruguay and Paraguay – to negotiate an agreement for their two economic areas. The draft deal envisages eliminating customs duties, after a transitional period, on 92 percent of imports from Mercosur to the EU, and on 91 percent of the trade going in the opposite direction. That would greatly ease the export of agricultural products such as ethanol and beef from South America, and of items such as vehicles, machinery and chemicals from Europe to the Mercosur states. If the agreement is approved by the Council of the European Union, then the European Parliament and the parliaments of EU member states, as well as the governments of the Mercosur countries, will also have to give their consent before it can come into force.

Between 70 and 80 percent of all beef imports in the EU currently come from Mercosur. The agreement would expand this. On top of the 200,000 tonnes of beef that enter the European Union from the area every year, another 99,000 tonnes could be imported with zero or minimal customs duties. The Sustainability Impact Assessment, published by the

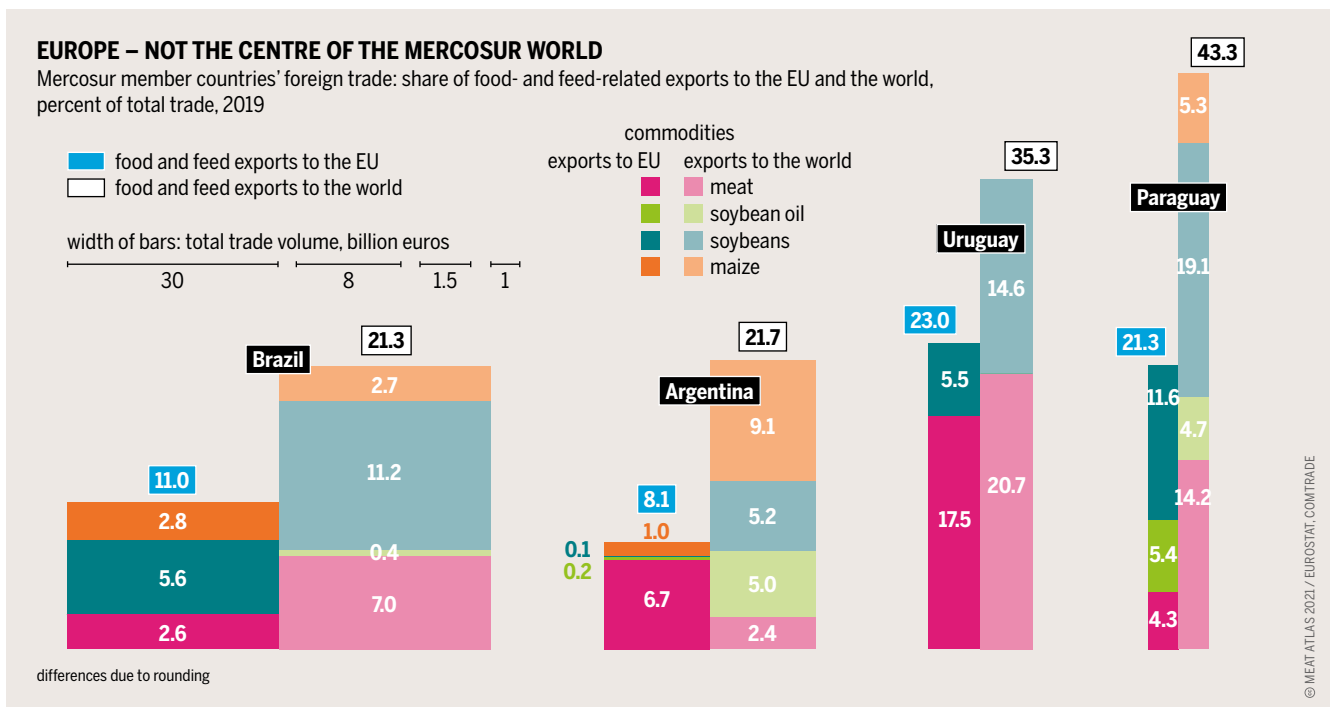
EU in July 2020, forecasts that beef imports will rise by 30 to 64 percent under the individual provisions. In a study of its own, the French government calculates that the facilitated market access for beef from Mercosur could increase deforestation there by at least 5 percent a year over a period of 6 years. Those are far-reaching consequences, even though beef exports to the EU are a relatively small part of total production in Mercosur – which exceed 11 million tonnes of live-weight and 7.8 million tonnes of carcass weight a year.

Beef is already one of the main drivers of deforestation today. It leads to the destruction of the livelihoods of indigenous and small-scale farming communities. In the Amazon, cattle graze on 63 percent of all deforested land. Half the agricultural products shipped from Brazil to the EU – mainly soybeans, beef and coffee – can be traced back to deforestation.

Exports of poultry and pork would also increase as a result of the agreement. Some 180,000 tonnes of poultry meat per year could be imported into Europe duty-free, on top of the 392,000 tonnes allowed today. Another 25,000 tonnes of pork would be added at a low-tariff rate. This would nearly double the EU’s pork imports from Mercosur, which currently total around 33,000 tonnes a year.

Similar predictions have been made for soybeans, which are used mainly as livestock feed in the European meat industry. Brazil is the world’s biggest soy exporter. The EU’s

*Mercosur does not depend too greatly on the EU as an export market. As long as China is a big customer, the EU will have limited influence on Mercosur’s forest protection policies*





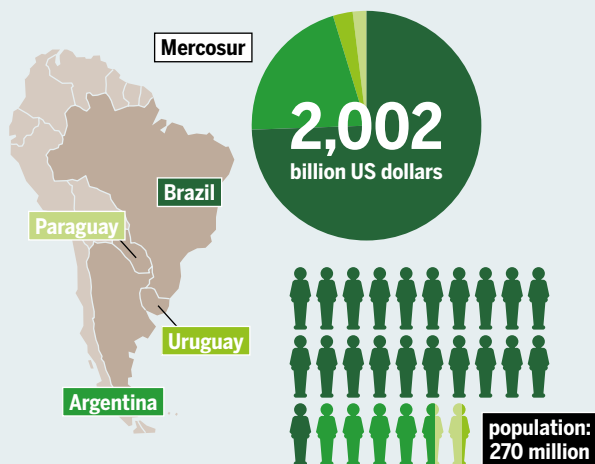
## UNEQUAL TRADERS

Mercosur and the European Union compared

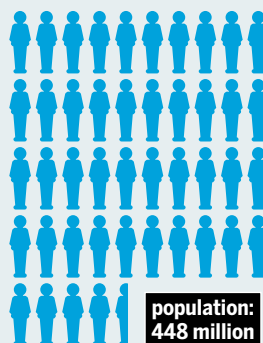


population 2021\*

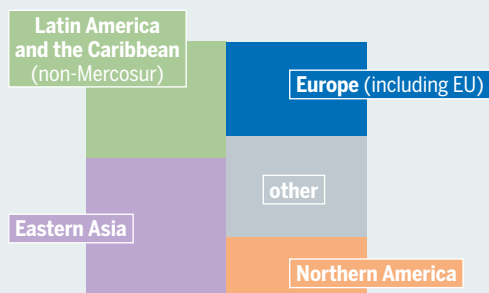
● gross domestic product 2021\*



**European Union**

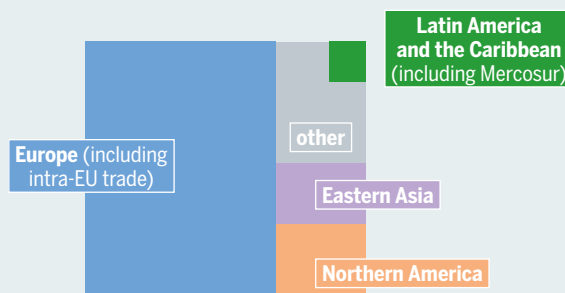


■ Europe's trade importance for Mercosur, 2019



\* estimate. EU: without UK

■ Latin America's trade importance for the EU, 2019



© MEATLAS 2021 / WIKIPEDIA, ITSY

Sustainability Impact Assessment predicts that imports of soybeans and other oilseeds from Mercosur could rise by up to 5.9 percent, with serious ecological consequences. According to a 2019 study, almost two-thirds of the pesticides sold in Brazil are applied in soybean and sugarcane cultivation. The deal with the EU would eliminate duties on pesticides imported into Mercosur, which may now be as high as 14 percent. Trade in pesticides would be strengthened, to the benefit of the European and especially the German chemical industry.

The EU–Mercosur agreement would not only have a negative impact on forests and biodiversity in parts of South America. It would also harm the climate. More carbon dioxide would be emitted because of further deforestation and increased production and transport. The French impact assessment even shows that under such conditions, the production of a kilogram of beef is responsible for four times the greenhouse-gas emissions as the equivalent in Europe.

It is not yet certain that the agreement will actually come into force. The amount of criticism is too great. Farmers in Europe fear that they will not be able to compete be-

*In theory, international trade talks take place between equal partners. In reality, the less dependent partner has most of the advantages on its side*

cause of falling prices. Non-governmental organizations criticize the preferential treatment given to pesticide exports, as well as the consequences for the climate. More and more EU member states are also expressing scepticism or even criticism. In France, the Netherlands, Belgium, Ireland and Austria, governments and parliaments agree that the agreement cannot be ratified in its current form. The German chancellor has also expressed concerns.

In a non-binding resolution, the EU Parliament voted for changes. The EU Trade Commissioner, Valdis Dombrovskis, has stated that the agreement would not be reopened and renegotiated. Amendments would be limited to protocol annexes, roadmaps and similar details. This has been the case for other EU agreements. The ratification process has already been put on hold until after 2021. But that does not mean it has been put on ice, as Bernd Lange, Chair of the EU Parliament's Trade Committee, has emphasized. ●

## PRODUCTION

# PROBLEM FOODS AND THEIR PRODUCERS

The world's meat production has grown rapidly, fed by rising demand and made possible by technological advances in livestock farming. But this has had serious consequences for animal welfare and small-scale producers.

For the first time since 1961, global meat production did not rise in 2019, but actually fell by 2 percent to 325 million tonnes. The main cause was not declining demand, but an outbreak of African swine fever. In China, this pig disease led to a 10 percent decrease in meat production, and over 20 percent less pork output.

Before the outbreak, China produced twice as much pork as the European Union and more than five times as much as the United States. Despite the slump in output, China remains the world's biggest meat producer, at over 88 million tonnes a year, way ahead of the USA, the EU, Brazil and Russia.

Looking back, global meat production has grown rapidly over the past few decades. In the 1970s, it totalled just one-third of current levels. At that time, the EU and USA led the list of producers; however, they were overtaken by China by 1990. This country has boosted output more than tenfold in the last 50 years. Production in Africa has also quadrupled since the 1970s, but from a relatively low start-

ing point. The continent now produces around 20 million tonnes of meat a year.

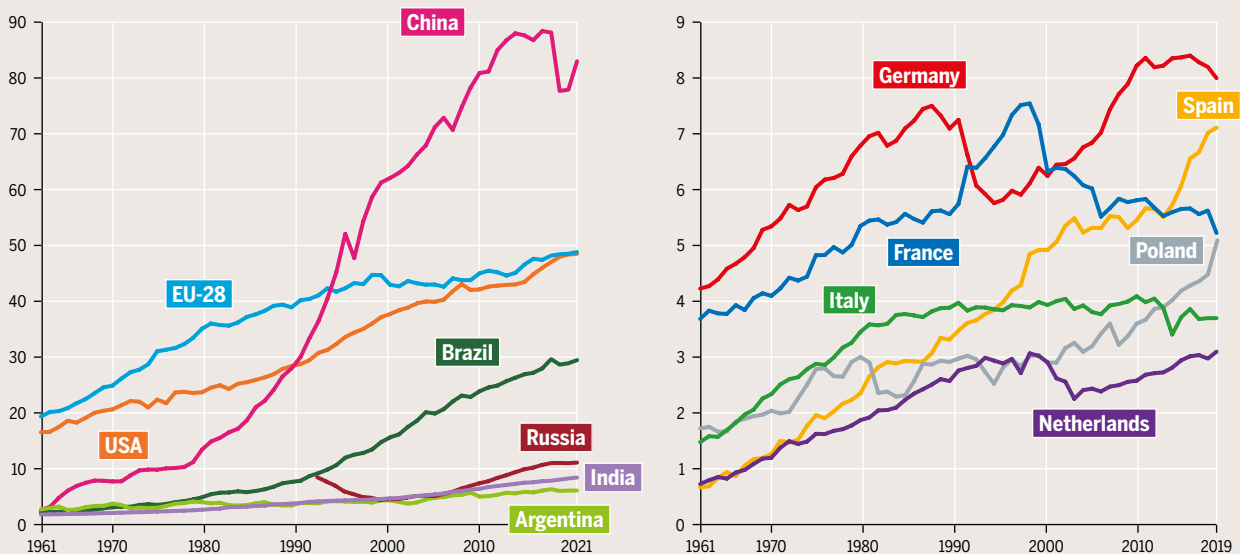
The increases in productivity over the last decades are mainly a result of technical innovations. Fewer and fewer animals are raised on pasture. A large proportion of meat comes from livestock kept indoors or on feedlots, where large numbers of animals are penned in a small outdoor area. Intensive and industrial management have increasingly replaced extensive production methods in many countries. Innovations in the fields of animal genetics, management and the use of antibiotics have permitted individual farms to raise more and more animals, and to increase the amount of meat each animal produces.

While production in most of the developed world is largely mechanized, two types of systems still exist in the global South: small-scale, extensive producers alongside capital-intensive industrialized enterprises. The International Livestock Research Institute estimates that about 600 million people earn their livelihoods from small-scale livestock production. They sell their animals to customers in local markets, or raise them for home consumption. They come into contact with the global value chains of industri-

*China drastically reduced its pig meat production in 2019 due to an African swine fever outbreak. But growth continues to rise in many parts of the world*

### BOOM BUSINESS

Trends in meat production in major production countries and selected individual EU member states,\* million tonnes

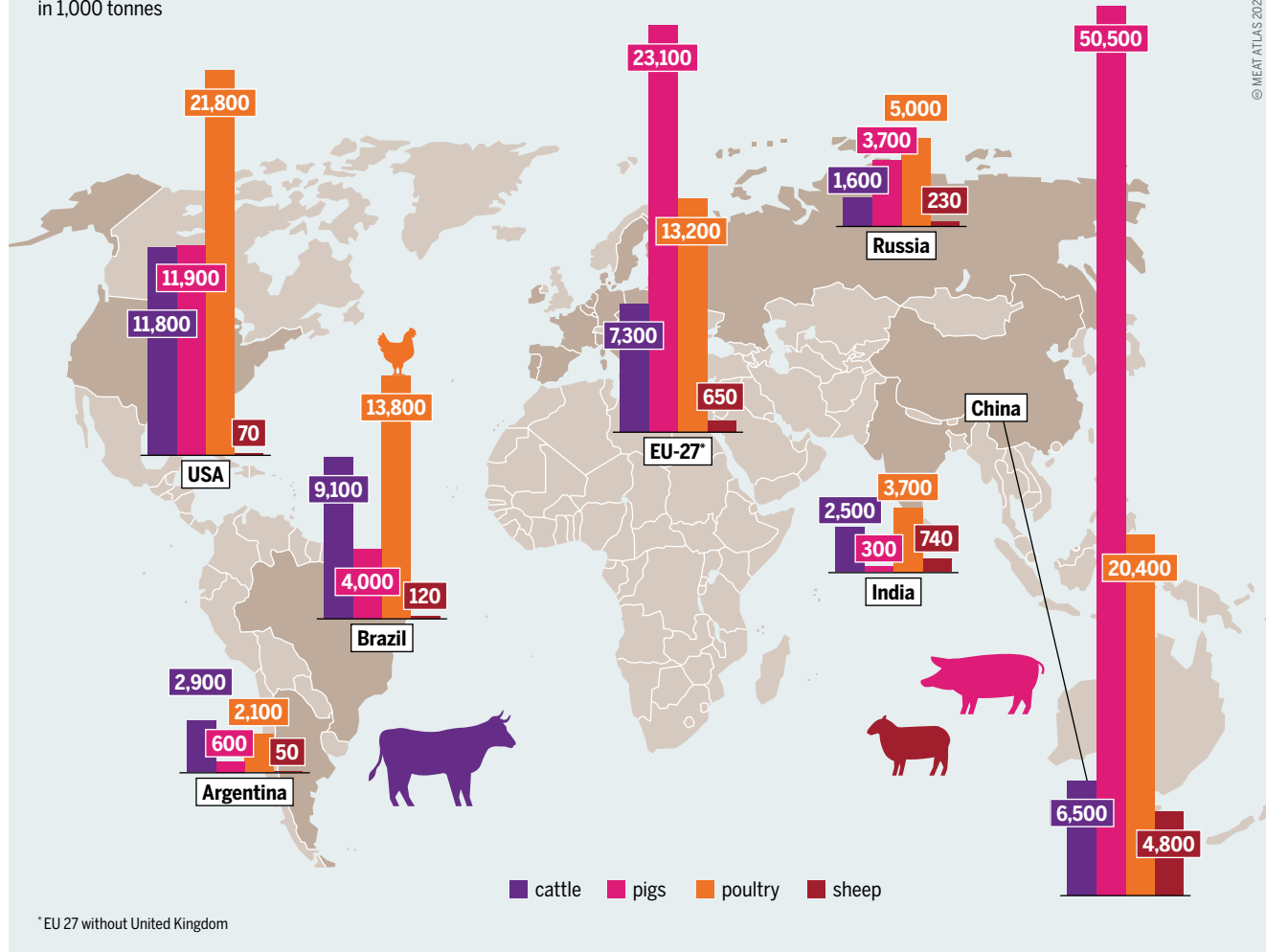


© MEAT ATLAS 2021 / OWID, FAO

\* including United Kingdom. 2020: estimate, 2021: forecast. Germany pre-1990: including East Germany. Reduction of East German meat production after unification with West Germany

## FOR ALL THE PORK IN CHINA

Largest producing countries of major animal products, annual average 2017–19, in 1,000 tonnes



© MEAT ATLAS 2021 / OECD, FAO

al meat production if they lose their local market share to –sometimes cheaper– industrial products.

Looking into the future, the Organisation for Economic Co-operation and Development (OECD) predicts that global meat production will continue to grow, though at a somewhat slower rate. It is expected to increase by another 40 million tonnes a year by 2029 – one year before the target year for the Sustainable Development Goals. That would take the total output to around 366 million tonnes a year, unless policy changes intervene. Although 80 percent of the growth is likely to take place in the global South, the biggest producers will remain China, Brazil, the USA and the members of the European Union. By 2029 these countries might still produce 60 percent of worldwide meat output. But India, a country that produces and consumes relatively little meat, has markedly increased its poultry production and is now one of the world’s 10 largest poultry producers.

While the three most important types of livestock are pigs, cattle and poultry birds, the distribution of livestock species varies considerably around the world. Countries with large Muslim and Hindu populations produce and consume very little pork, while pigs account for a large share of production in China, the EU and the USA.

Poultry remains the fastest-growing sector in the meat industry. Just 50 years ago, it accounted for only 12 percent

*The production of meat and milk results not only in food, but in problems for people and the environment*

of global meat production. Today, it is 35 percent. In the next 10 years, poultry is expected to make up almost half of the increase in total meat output. Low production and retail costs, as well as a short production cycle, have led to chicken being the meat of choice for producers and consumers alike. Moreover, the genetic changes that have been achieved in poultry breeding eclipse those in other livestock species. Comparisons with traditional breeds show that high-performance breeds grow four times faster but need only half as much feed. But precisely these breeding developments can have serious health consequences for the birds, and therefore attract criticism from animal welfare organizations. For example, rapid weight gain can lead to joint and foot problems and bone inflammation.

The industrialization of livestock farming and the rising numbers of farm animals require more and more feed made from cereals and oilseeds. This in turn makes it necessary to convert forests and pastures into arable land. Its negative effects on the climate and the environment have made meat one of the most problematic consumer goods in the world. ●

## ABATTOIRS

# CHOPPING BUT NOT CHANGING

**Covid-19 outbreaks in abattoirs and processing plants are just the latest in a long list of problems in the meat industry. Low wages, hard work, and precarious employment are the price that workers pay to supply us with cheap meat. The industry is attempting to dodge its responsibility to provide decent conditions for its staff.**

In early 2020, it emerged that over 200 of the 3,700 employees at Smithfield in Sioux Falls, one of the biggest pork processors in the US, had been infected with Covid-19. After an intervention by the federal government, the plant was classified as a “critical infrastructure industry” and was not closed immediately on the grounds that a shutdown would lead to supply shortages. It was only after 700 workers had contracted the virus that production was finally halted for three weeks.

Sioux Falls was no exceptional case. Mass infections of workers occurred in numerous slaughterhouses and meat processing plants around the world. Tens of thousands of

workers in the Brazilian meat industry were infected, and dozens died in the first wave of the pandemic. Poultry plants belonging to the world’s largest meat companies, JBS and BRF, were criticized for refusing to provide their workers with the necessary equipment to protect them against infection. The authorities in Rio Grande do Sul linked one-third of all Covid-19 cases to local cold-storage facilities. In Mato Grosso do Sul, one-quarter of the workers in a cattle abattoir owned by JBS tested positive for the virus. At the main factory of Tönnies, Germany’s biggest pork processor, more than 1,500 of its 6,100 staff were found to be infected.

The Covid crisis has shined a spotlight on the poor working conditions in the meat-processing industry around the world. A long list of factors has contributed to the spread of the virus in the industry, including a lack of social distancing, poor housing conditions for workers, a lack of inspections, cold temperatures, and insufficient ventilation. Management, on the other hand, likes to blame the workers for the disease outbreaks. Even when there were cases of tuberculosis in German plants in 2018 and 2019, managers denied responsibility. During the Covid-19 crisis, politicians and managers have used racist stereotypes of migrant workers to “explain” the infections: the “living conditions of certain cultures” are supposed to make workers want to live close together.

Criticism of the labour conditions in the meat industry is by no means new. In many countries, slaughterhouses employ people whose residence status forces them to accept low wages and poor working conditions. In many parts of Europe, labour turnover rates are correspondingly high. A large proportion of the staff in the meat sector are cross-border or migrant workers from both within and, increasingly, from outside the EU. The work is frequently physically demanding with repetitive hand movements, excessive working hours and exposure to health hazards.

A report by EFFAT, a European trade union federation, warns that many workers are employed through temporary work agencies or subcontractors that enable the meat plants to escape liability. In some countries, the subcontractors operate as bogus cooperatives, with the workers classified as self-employed. The practice of “posting” workers – employing workers in one country but having them perform the work in another – still occurs, though it is becoming less common. “Letterbox” companies are also frequent. These have a mailing address in one country but conduct their business in another. Such tricks enable employers to evade or circumvent stricter regulations concerning remuneration, social security and taxes in the host country.

The enormous expansion of meat production facilities and abattoirs in recent years has been accompanied by ris-

### LARGEST SLAUGHTERHOUSES AROUND THE WORLD

Selected abattoirs by capacity, area or year founded

The world’s largest abattoir by capacity is a plant in Tar Heel, North Carolina, USA. Built in 1992 and operated by the Chinese-owned Smithfield group, it can slaughter **36,000 pigs** daily.



In China’s decentralized industry structure, its largest hog slaughterhouse is set to open in late 2021. Techbank Food’s plant in Fuyang, Anhui province, will have a capacity of **14,000 pigs** per day.

In Europe, the Italian-owned Litera Meat plant in Binéfar near Huesca, Spain, opened in 2019 with a capacity of more than **22,000 pigs** per day, or 160,000 a week, surpassing what was previously the continent’s largest plant, operated by Danish Crown in Horsens, Denmark, by 60,000 animals per week.



One of the world’s largest **cattle** slaughterhouses is a plant in Dakota City, Nebraska, USA. Operated by Tyson Fresh Meats, it processes more than **7,000 cattle** a day.



India’s largest abattoir by capacity is said to be the municipal plant in Deonar near Mumbai, slaughtering **6,000 goats and sheep** per day. The largest plant by area is Al-Kabeer’s **400-hectare** buffalo slaughterhouse in Rudraram, Hyderabad.

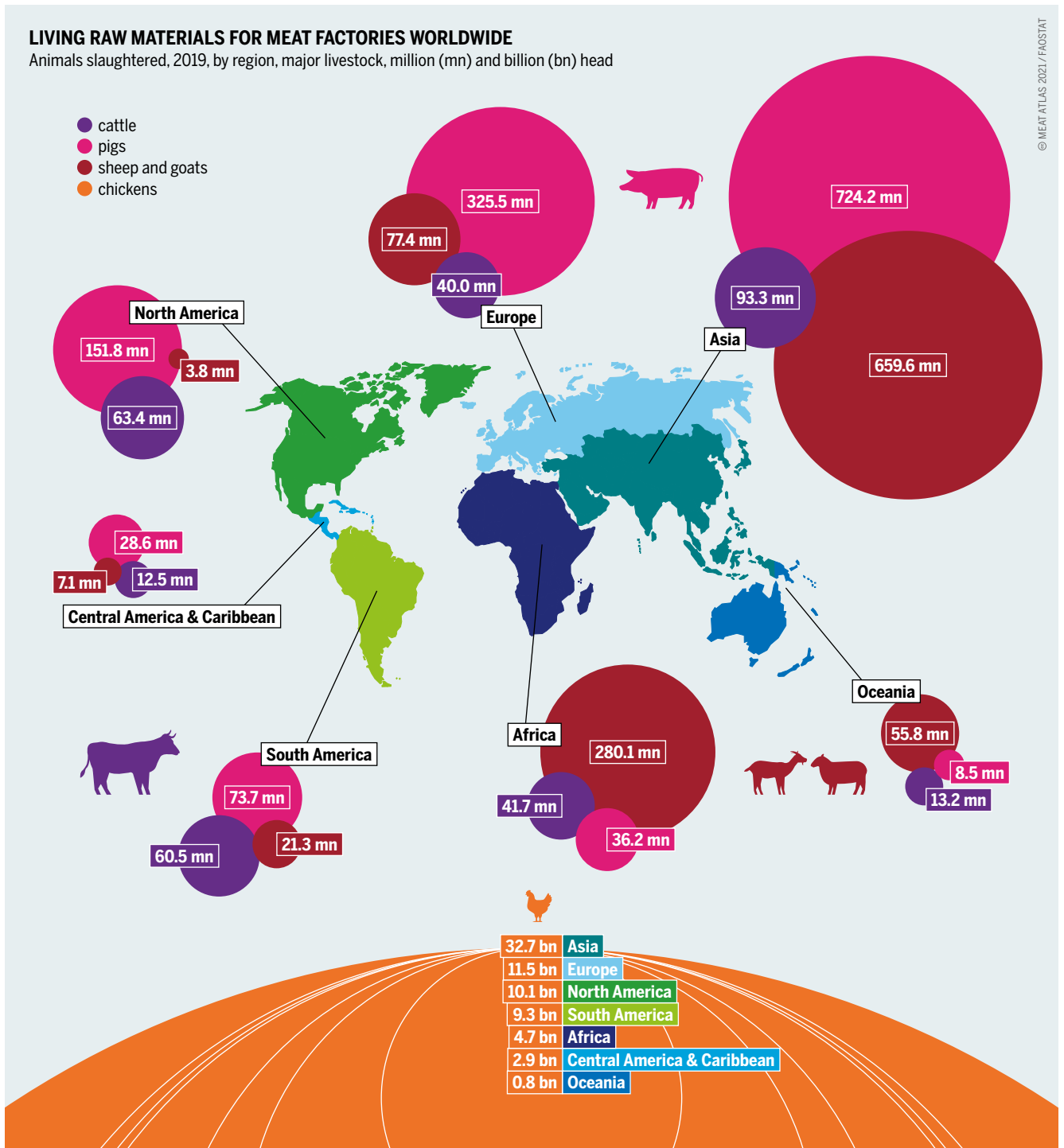
© MEAT ATLAS 2021 / MEDIA REPORTS

*The enormous economy of scale in slaughterhouses has resulted in huge units with a far-flung network of dependent animal suppliers*

## LIVING RAW MATERIALS FOR MEAT FACTORIES WORLDWIDE

Animals slaughtered, 2019, by region, major livestock, million (mn) and billion (bn) head

© MEAT ATLAS 2021/FAOSTAT



ing numbers of migrants working in the industry. It is also marked by the internationalization of corporate structures. For example, Smithfield, the largest pork producer in the Western world with over 100,000 employees, is now part of WH Group, which is headquartered in Hong Kong. JBS, a Brazilian beef producer firm with over 200,000 workers, has been active in the US market for years. In the USA, the deterioration in working conditions has been accompanied by fierce disputes. Between 1994 and 2008, Smithfield was the scene of a long-lasting battle over union rights and decent working conditions. Even though this struggle ended in defeat for the workers, demands for better labour rights, social rights and secure residence are still on the table.

To put an end to the poor working conditions in the meat

*75 billion animals – the vast majority of them poultry birds – are killed every year to satisfy humankind’s hunger for meat*

industry, European food trade unions are demanding that the EU create a legally binding instrument to ensure that employers are jointly liable throughout the whole subcontracting chain. This should provide for sanctions, back payments and compensation if the industry does not respect labour laws. A European solution is needed because the sector is mobile. The boom in the German meat industry is rooted in the shift in production from Denmark and the Netherlands, where wages are higher and collective agreements generally protect workers better. ●

## MEAT WASTE

# A LOT LESS THAN THE WHOLE HOG

The meat industry used to be famous for using “everything about the hog except the squeal”. But a large proportion of the livestock raised for food do not end up as food. Many die, or are killed, before they reach the slaughterhouse, and even more meat is wasted between the factory and the plate.

At the start of the 1990s, Europeans were shocked to see photos of hundreds of thousands of dead cattle. Yet BSE, or “mad cow” disease, was not the last disease outbreak to result in the culling and disposal of large numbers of animals that had been intended for human consumption. After BSE came bird flu, and after that, African swine fever. Experts estimate that this last disease, which is highly contagious in pigs, resulted in the deaths of up to 200 million pigs in China, either directly or culled as a precaution.

Even without such disease outbreaks, many animals die before they can be taken to the abattoir. In France alone, more than 200 million animals are killed every year without being used as meat. These include animals that die while they are being reared, or that are culled and disposed of for economic reasons. In Germany, up to 200,000 male dairy calves and 45 million male chicks of layer breeds die because they would produce too little meat, so are not worth keeping

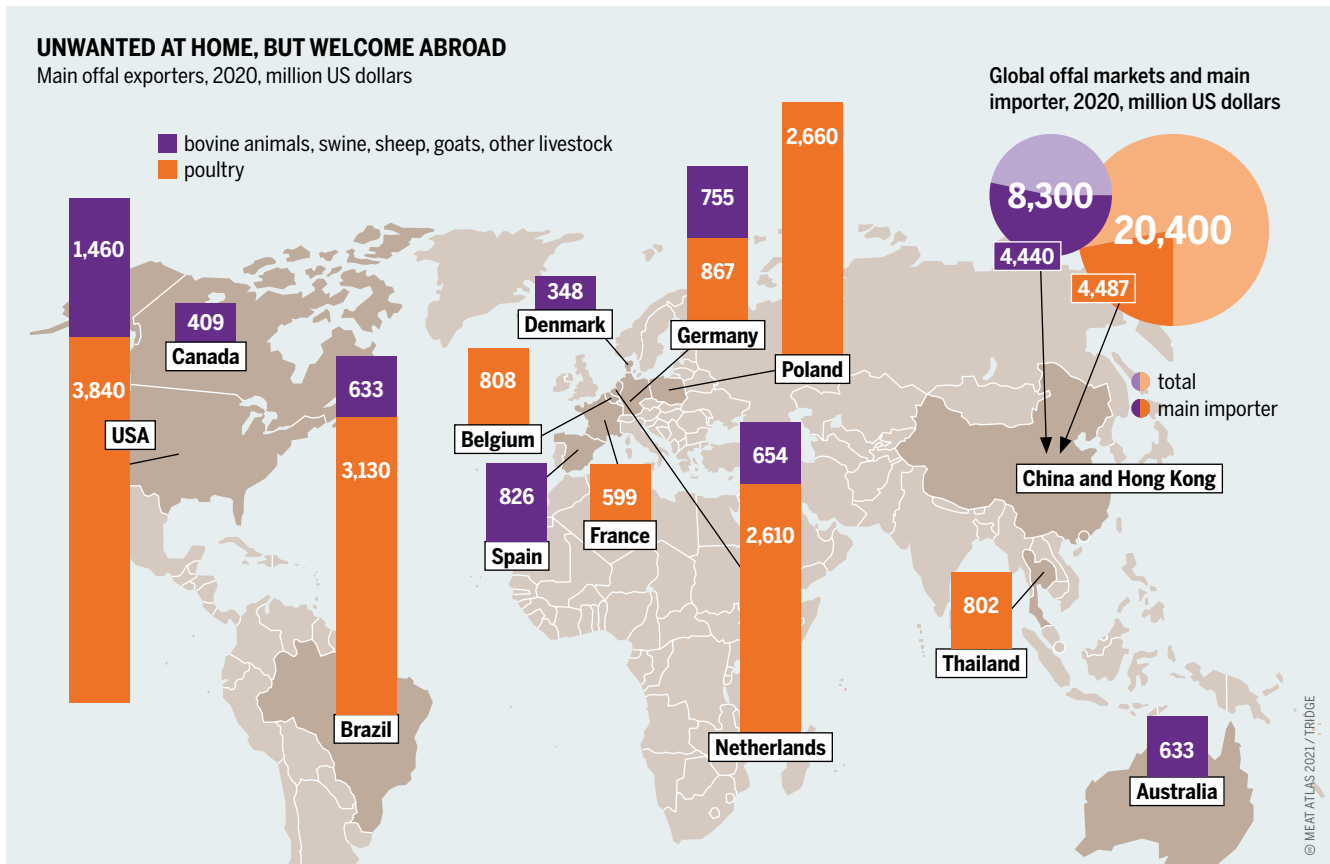
alive for fattening. In France, over 50 million male chicks are killed each year directly after they hatch.

On the other hand, performance-oriented breeding and poor husbandry conditions lead to animals dying during the rearing stage. Denmark, a much smaller country than Germany, Spain and France, has the fourth highest pig population in Europe. The average litter size for pigs has risen in recent years to 19.4 piglets per sow – five more within just one decade. The problem is that the average sow has only 14 or 15 functioning teats. As a result, the piglets are smaller and more delicate, and many die at birth or within the first few days of life. The mortality of suckling piglets in Denmark is around 15 percent, or about 3 million dead animals a year. In all, 28 percent of animals die at various stages of pregnancy, rearing and fattening.

In Germany, the average litter size is just above 15. Still, around 16 percent of all suckling piglets die. Because of Germany’s higher pig population, that adds up to 8.6 million dead piglets a year.

A lot of loss occurs after slaughter too, as by no means do all parts of the animal end up on dinner plates. Because meat

*Offal such as pig heads and chicken feet, worth nearly \$30 billion a year, is scorned in producing countries but finds a ready market elsewhere*





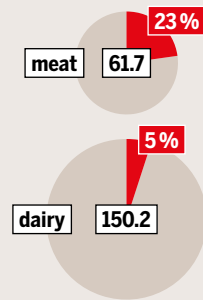
## LOSSES BETWEEN STALL AND STOMACH

Meat and dairy waste per food supply chain stage in the EU, 2011,\* million tonnes

■ primary production ■ processing, manufacturing ■ retail and distribution ■ consumption



Meat/dairy available in the EU, million tonnes, and percentage wasted



\*most recent data available, data still in use

© MEAT ATLAS 2021 / CALDEIRA ET AL.

has become relatively cheap, consumers in many countries have become choosy: they eat only certain cuts. Along with Romania, Poland has the lowest meat prices in the European Union. The average Polish consumer ate 77.1 kilograms of meat and offal in 2019, a rise of 9 percent over 2005. But the consumption of fat and offal fell by 9 percent in the same period. Even if these animal parts are not thrown away but are used in industry, they are no longer food.

Poultry is becoming more and more popular. Per capita Polish consumption in 2019 was 28.3 kilograms, some 21 percent higher than in 2005. Meanwhile, Poland has become the largest poultry producer in Europe. EU citizens prefer chicken breasts; other parts, such as wings and drumsticks, are often frozen and exported to Asia and Africa.

Only 60 percent of a slaughtered pig in Germany ends up as cutlets or sausage on a plate. The parts not suited for human consumption, such as bones, hooves and some internal organs, are rendered into food for pets or fish, used in the chemical or fertilizer industry, or turned into biofuel. Out of the 8.6 million tonnes of total slaughter weight in 2019, around 2.6 million tonnes of such “animal by-products” were used in these ways. Further losses occur during wholesale and retail trade, as well as at the consumption stage, as items pass their sell-by dates or food is prepared for consumption but not actually eaten. In 2016, the most recent data available, 11.9 percent of global meat production was lost between slaughter and retail.

That amounts to 39 million tonnes, or the equivalent of 115 million cattle or 413 million pigs. Such high losses represent an enormous waste of resources, as these animals had to be reared and fed, even though they never ended up as human food. While inadequate refrigeration is the main problem in the global South in the developed world the disposal of food that is fit for consumption is mainly to blame. Studies estimate that this accounts for between 4 and 11 percent of the quantity actually consumed in Europe. This is also because meat, with its comparatively cheap prices, is becoming less and less valued as a type of food.

Losses and waste can be reduced at each stage in the

*The numbers of animals that die prematurely show the ruthlessness of the meat industry. They represent wasted feed and land used to grow it, and a burden on the environment*

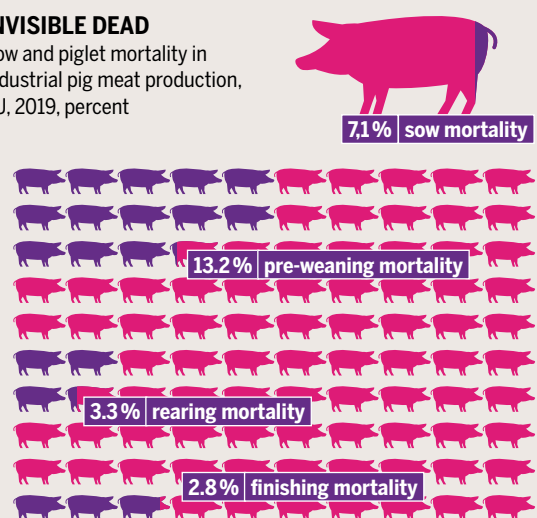
*Meat and dairy waste is highest among consumers in private households and restaurants. However, non-edible waste somewhat distorts the picture*

value chain. In the developing world, better veterinary care and refrigeration would help. In the developed world, livestock farmers can adopt husbandry methods that avoid high losses, along with more robust breeds and, in pigs, smaller litters. Multipurpose breeds of cattle and chickens would avoid the economic pressure to kill males. An increasing volume of somewhat dearer eggs from dual-purpose hens is now coming on the market. These breeds lay fewer eggs, but the males also produce meat. From 2022 on, shredding day-old chicks will be banned in France. Germany and Spain have gone a step further, deciding to ban the killing of day-old chicks.

The waste of food can be avoided primarily through a greater appreciation of its worth. Consumers could, for example, reflect on the need to use the whole animal, as used to be the case. Instead of always opting for steak or chicken breast on the menu, they might occasionally choose a less popular type of meat or offal. That would also be a gain for culinary diversity. ●

## INVISIBLE DEAD

Sow and piglet mortality in industrial pig meat production, EU, 2019, percent



including UK

© MEAT ATLAS 2021 / AHDB

## LAND CONFLICTS

# CUTTING DOWN FORESTS, CARVING UP PASTURES

**In South America, natural vegetation is being turned into pastureland and monocultures to support an unsustainable form of livestock production. In Africa and Asia, a sustainable form of livestock raising is losing ground to industrialized agriculture. Traditional local communities are on the losing end.**

**N**o other consumer products need as much land to produce as meat and milk. Globally, 77 percent of agricultural land is used to raise animals or the crops to feed them. That means that livestock production is inextricably linked with conflicts over land. According to the British environmental organization Global Witness, 212 campaigners for land rights were killed in 2019. The numbers of activists killed have been rising for years.

Conflicts over land can take very different forms. On the one hand, the expansion of pasture and fodder cropping threatens land use by indigenous people and smallholders. On the other, livestock raising is also a traditional production system often used by nomadic communities practicing pastoralism, which is based on co-existence with natural ecosystems. This is being threatened by the expansion of industrial agriculture.

Brazil is a prime example of export-oriented livestock farming leading to land conflicts. The expansion of animal agriculture at the expense of natural ecosystems is progressing relentlessly in the self-proclaimed agricultural powerhouse of the world. The exact numbers are controversial, but an estimated 150 to 200 million hectares of land are used for raising livestock. For comparison, “only” 35 million hectares are used to grow soybeans, and around 4.5 million

are used for maize. The area used to raise cattle in Brazil alone, 175 million hectares, is about the same as the entire agricultural area of the European Union.

Because of its sheer scope, cattle raising is the main driver of the destruction of ecosystems and the habitat they provide to indigenous peoples and traditional communities. The expansion of pastureland and large-scale monocultures constricts the living spaces of these communities. They are often driven off their land or find it impossible to continue their way of life. Since areas for hunting and gathering are not legally secured, agro-industrial interests find it easy to take them over. Conflicts over land are often accompanied by conflicts over water. Water is diverted for agricultural use, and springs are poisoned by pesticides and chemical fertilizers, making them unusable for local people.

The expansion of agribusiness in the Amazon region is well researched and documented. At least two-thirds of deforestation in the area occurs through the creation of pastures for cattle – not only to meet the growing demand for beef, but also as a strategy for securing title to the land. The ownership of many forested areas is not clearly regulated, and clearing the forest is in most cases illegal. But Brazilian law states that anyone who uses land can lay claim to it, and converting it to pasture is the easiest way to demonstrate that use. The situation in Pará, a state in the Amazon region, illustrates this process. Between 2000 and 2018 it lost 11.6 million hectares of natural vegetation, while in the same period cattle pastures grew by 8.3 million hectares – an area the size of Austria. Once it has become possible to con-

*In the perpetrators' view, only dead activists cannot ask uncomfortable questions. Governments often have little interest in investigating these killings*



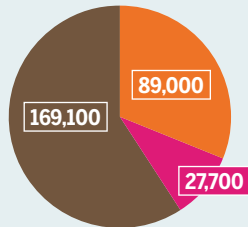


## WHERE MEAT AND FEED ARE MOST DESTRUCTIVE

Regions in Latin America most affected by deforestation; drivers and counteractive measures

- forests
- endangered or lost areas

Deforestation worldwide attributable to trade with the EU 2005–2017, average hectares/year



- soy industry (livestock feed)
- beef production (meat)
- other drivers



selected counteractive measures, hurdles and compensations



- present
- expanding
- small scale
- no data/ not in use

© MEAT ATLAS 2021 / WWF

solidate ownership claims through the creation of pasture, other investments often follow, such as growing soybeans.

While the production of beef and feed is the most significant cause of conflicts over land in South America, this is not always the case elsewhere. In much of the world, pastoralism is a traditional practice that relies on co-existence with natural ecosystems, not their elimination. The significance of pastoralism is often ignored, and as a production system and way of life it receives very little political support. More than 200 million people are estimated to practise pastoralism, and they manage 25 percent of the world's land surface. Entire countries have been shaped by pastoralism: some 76 percent of the area of Mongolia is used as pastureland.

That land is often a commons – land with a communal form of ownership. The lack of individual land-ownership

*The legal protection of forests and indigenous rights is the most common means used to resist drastic environmental destruction in Latin America*

rights is a widespread feature of pastoralist societies. This, and their apparently low productivity, have made them vulnerable to modernization attempts. In many countries, especially in Africa, “modern” forms of farming with individual land ownership rights have expanded at the expense of pastoralist societies.

The expansion of large-scale cattle raising in South America and the threats to pastoralist societies, especially in Africa and Asia, both share a common solution: securing the rights of traditional communities. These rights are fundamental for land use policies that take climate change and biodiversity loss seriously as a major global threat. ●

## COMPANIES

# DOMINATING THE MARKET FROM FARM TO DISPLAY CASE

**Global meat companies play a major role in determining how meat and feed are produced, transported and traded. Food is big business: the 100 largest food and beverage firms around the world include 10 main meat producers and processors.**

The 10 largest companies in the meat sector have their headquarters in just five countries: Brazil, the USA, China, Japan and the European Union. But they dominate markets around the world and have a presence in all the main meat-producing regions. These firms are responsible for the industrial production and slaughter of massive numbers of animals. The behemoth, Brazil's JBS, dwarfs all the others. It has more than 400 branches in 15 countries, and slaughters up to 75,000 cattle, 115,000 pigs, 14 million poultry birds and 16,000 lambs every day. Together, that adds up to over 210,000 tonnes of meat a month. Though the second biggest processor, the US giant Tyson Foods slaughters far less, it's still a staggering number of animals: 22,000 cattle, 70,000 pigs and 7.8 million chickens a day.

JBS, Tyson, Cargill and WH Group have branches throughout Europe. They generate their European profits by selling fresh and frozen meat produced in Europe or imported from countries such as Brazil and Thailand. Brazilian companies BRF and Marfrig distribute directly across Europe or through distribution centres. These meat producing giants use mergers and acquisitions to swallow up small and large firms to consolidate their market power.

Tyson boosted its European presence by buying up BRF's European operations. JBS acquired a UK-based pigmeat pro-

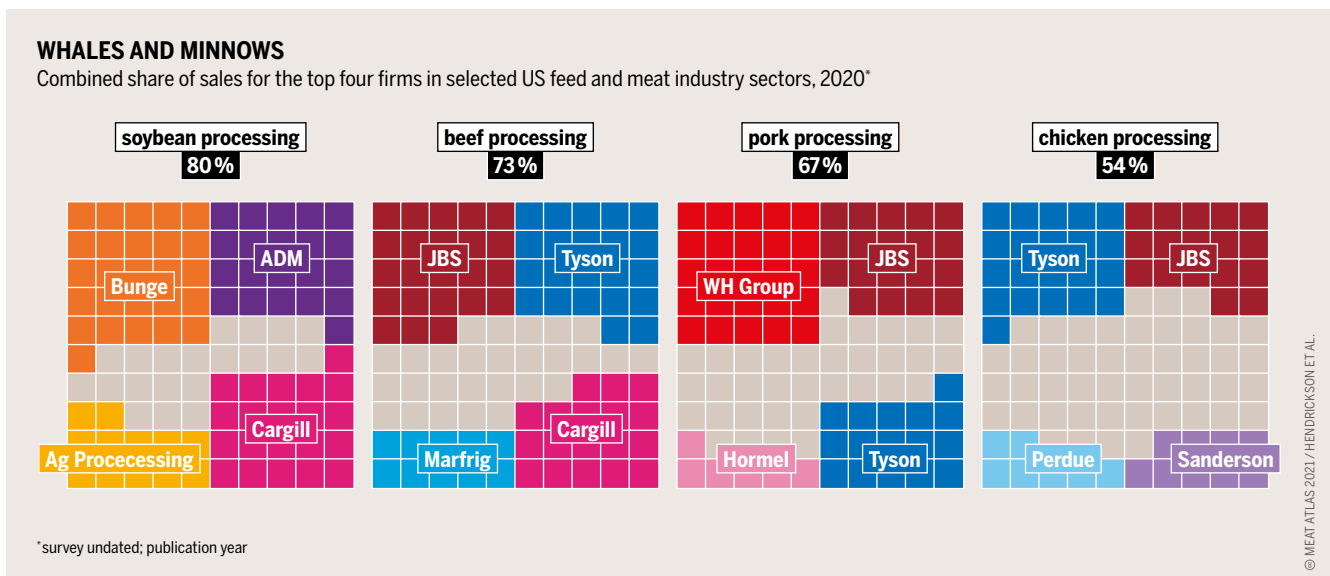
cessor to expand its marketshare and is preparing to buy German meat company Tönnies. European firms also have turnovers in the billions. Danish Crown (Denmark), Groupe Bigard (France), Tönnies (Germany), Coren (Spain) and Westfleisch (Germany) are among the biggest producers of beef and pork. Dawn Meats (Ireland) is the European leader in beef and lamb, while LDC (France), Plukon Food Group (Netherlands), Gruppo Veronesi (Italy) and PHW-Gruppe (Germany) are the biggest poultry processors.

Such market power enables these firms to impose low producer prices, and sometimes to force farmers to sell at below their cost of production. That has consequences: farmers have to raise large numbers of animals so they can keep the business of their mighty customers, often relying on public subsidies for support.

In Germany, five companies – Tönnies, Westfleisch, Vion, the Müller Group and Danish Crown – control two-thirds of all processed pork. In the US, meat processing is in the hands of a few corporations. For beef, it is JBS, Tyson, Cargill and Marfrig that together control 85 percent of the market. JBS, Tyson and Hormel account for 66 percent of the pork, while Tyson, JBS, Sanderson Farms and Purdue handle 51 percent of the chicken.

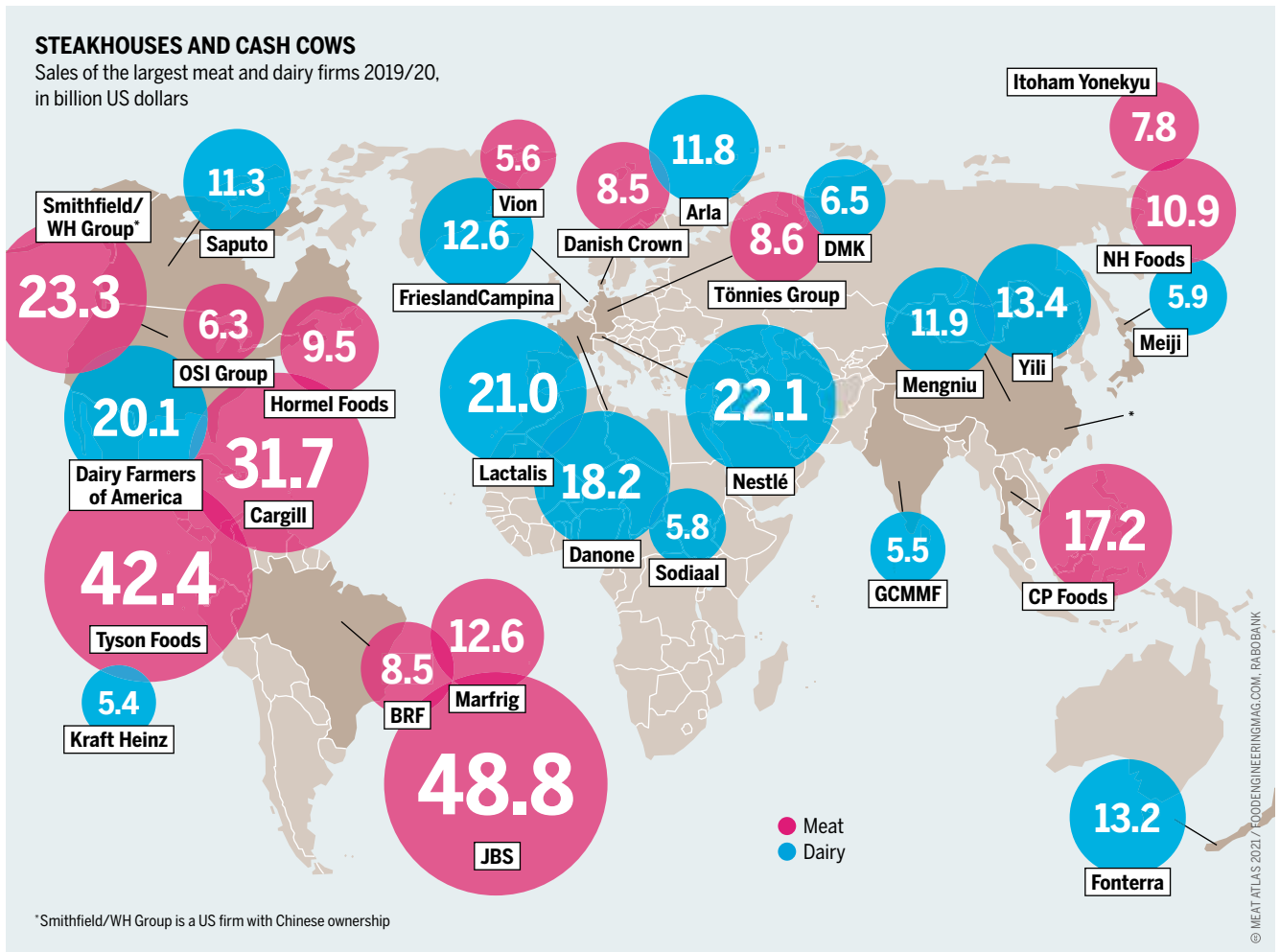
Agri Benchmark, an international non-profit network, reported in 2019 that EU farm subsidies enabled farms to turn an overall profit even though they suffered losses in their cow- and calf-rearing operations. Beef processing

*The US market for feed and meat has been researched in great depth. Many small companies are battling against giants*



## STEAKHOUSES AND CASH COWS

Sales of the largest meat and dairy firms 2019/20, in billion US dollars



© MEAT ATLAS 2021 / FOODENGINEERINGMAG.COM, RABOBANK

firms suffered even greater losses than the farmers who raised the cattle. But they benefited more from the subsidies because many of them are also active as producers of feed grain. In 2016, European pork prices averaged just 1.48 euros per kilogram. European pig raisers – except those in Belgium, Denmark and Spain – lost an average of 7 cents per kilogram of meat they produced.

Apart from the indirect subsidies, the global meat giants also benefit from special government assistance. JBS, for example, received 78 million US dollars in payments from the Trump administration’s farm bailout package during its trade war with China. Incidentally, 20 percent of JBS is owned by the Brazilian Development Bank, which is financed by the country’s tax revenues. In 2017, Brazilian prosecutors imposed one of the highest fines in corporate history for corruption after they discovered that JBS bosses had bribed almost 1,900 officials to advance their business interests.

Some meat giants, such as Cargill, are wholly privately owned. Others are at least partially listed on the stock exchanges. Financial firms are major investors, underwriters and lenders to the sector. Over 2,500 investment banks, private banks and pension funds from around the world

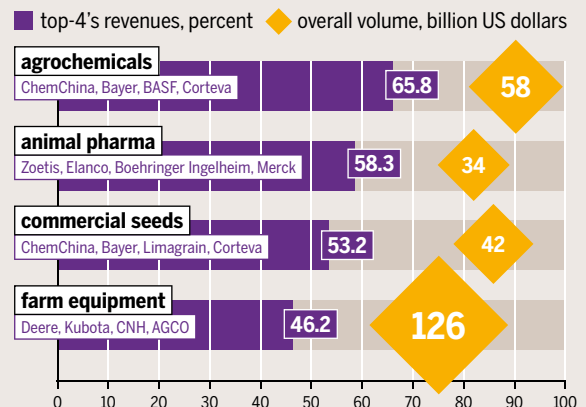
*Critical connections: one-third of the world’s arable land is used to grow feed. Crop firms are a key factor in meat production*

*Americas in the lead? Beware of first impressions. Chinese meat producers that are not listed on a stock exchange are a big unknown*

invested a total of 478 billion US dollars in meat and dairy companies from 2015–2020, according to Feedback, a non-governmental organization. The biggest investors include Black Rock, Capital Group, Vanguard and the Norwegian government pension fund. ●

## TRACTORS AND TRADERS

Concentration in global feed- and meat-related industries, 2018



© MEAT ATLAS 2021 / HOWARD, HENDRICKSON

## FINANCE

# BIG BUCKS FOR BIG FIRMS

**Big Meat attracts big money. Both private and public investors pour money into meat and dairy corporations, further boosting their market power and fuelling yet more consolidation in an already concentrated industry. The environmental and social damage caused by the industry is largely overlooked.**

**U**nlike small producers, industrial meat and dairy corporations operate a lucrative business model. Between 2015 and 2020, global meat and dairy companies received over 478 billion US dollars in backing from 2,500 investment firms, banks, and pension funds around the globe, in the form of loans, underwriting, investment or revolving credit. For comparison: this is more than the 365 billion euros the EU spends on its 7-year Common Agricultural Policy budget.

By buying up smaller companies, large meat and dairy corporations have reduced competition and fuelled their own growth. Yet, hidden behind retail brands, they are largely invisible to the public. In the USA, the four largest corporations – JBS, Tyson, WH Group and Cargill – offer 60 meat-focused brands between them, creating an illusion of choice in a very consolidated market. In the UK, companies such as Cargill and Moy Park supply products sold under brands such as “Willow Farms”, Tesco’s chicken range. Meanwhile, smaller and independent production continues to shrink: since 2007, one-third of small abattoirs in the UK have closed.

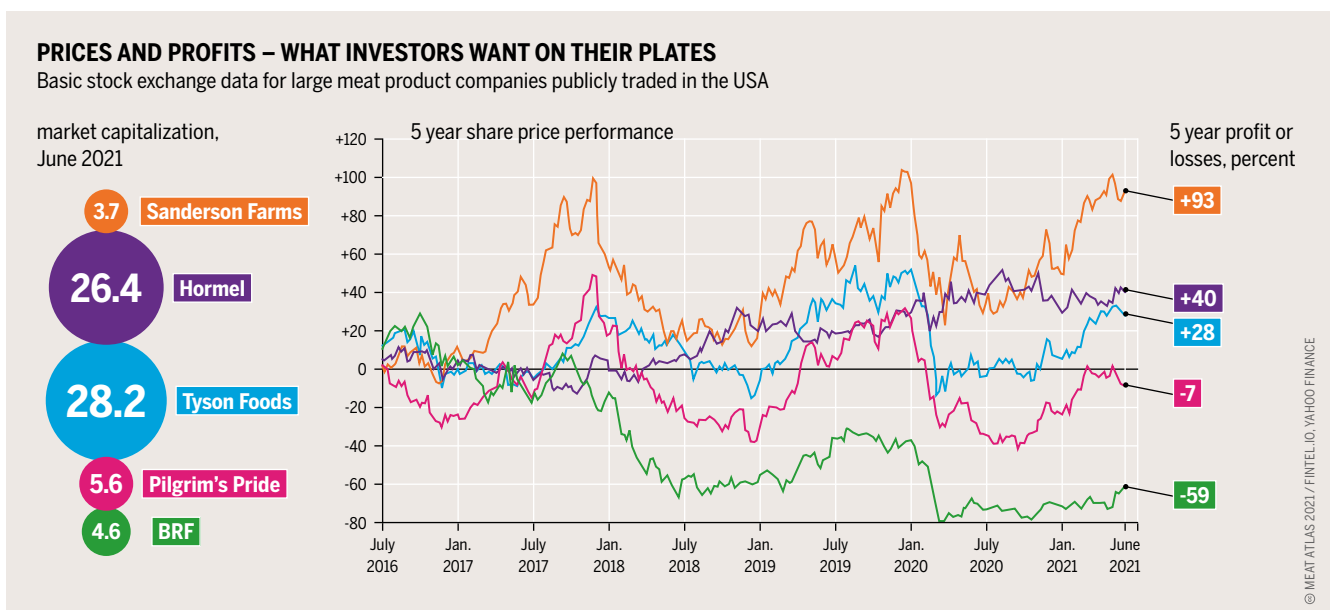
Who profits from this consolidation? It varies. For publicly listed companies, market expansion holds the promise of attractive shareholder dividends. But several major meat

and dairy companies are privately owned: the family that owns Cargill includes 14 billionaires, collectively receiving around 18 percent of the company’s profits each year. Cargill paid out 1.13 billion dollars to its family owners in July 2020 at the height of the Covid-19 pandemic – at the same time as many workers in meat-processing plants were falling ill from the disease.

The sector gets financial backing in the form of loans, investments, bonds, underwriting, and revolving credit facilities – optional credit that banks extend to companies should they need it. Research by Feedback, a campaign group, found that in April 2020, 3,000 investors provided 228 billion dollars in backing to the 35 largest meat and dairy corporations. In addition to investment, between 2015 and 2020, loans totalling 167 billion dollars flowed from over 200 banks to these companies, with banks based in the USA, France and the UK providing 51 percent of the total credit. These financial flows directly drive climate change: together, the 35 corporations emit more greenhouse gases than the economy of Germany. Thirteen of them also score weakly on the Farm Animal Risk and Return (FAIRR) Index, which analyses protein producers across risks, including human rights, climate impact and antimicrobial resistance.

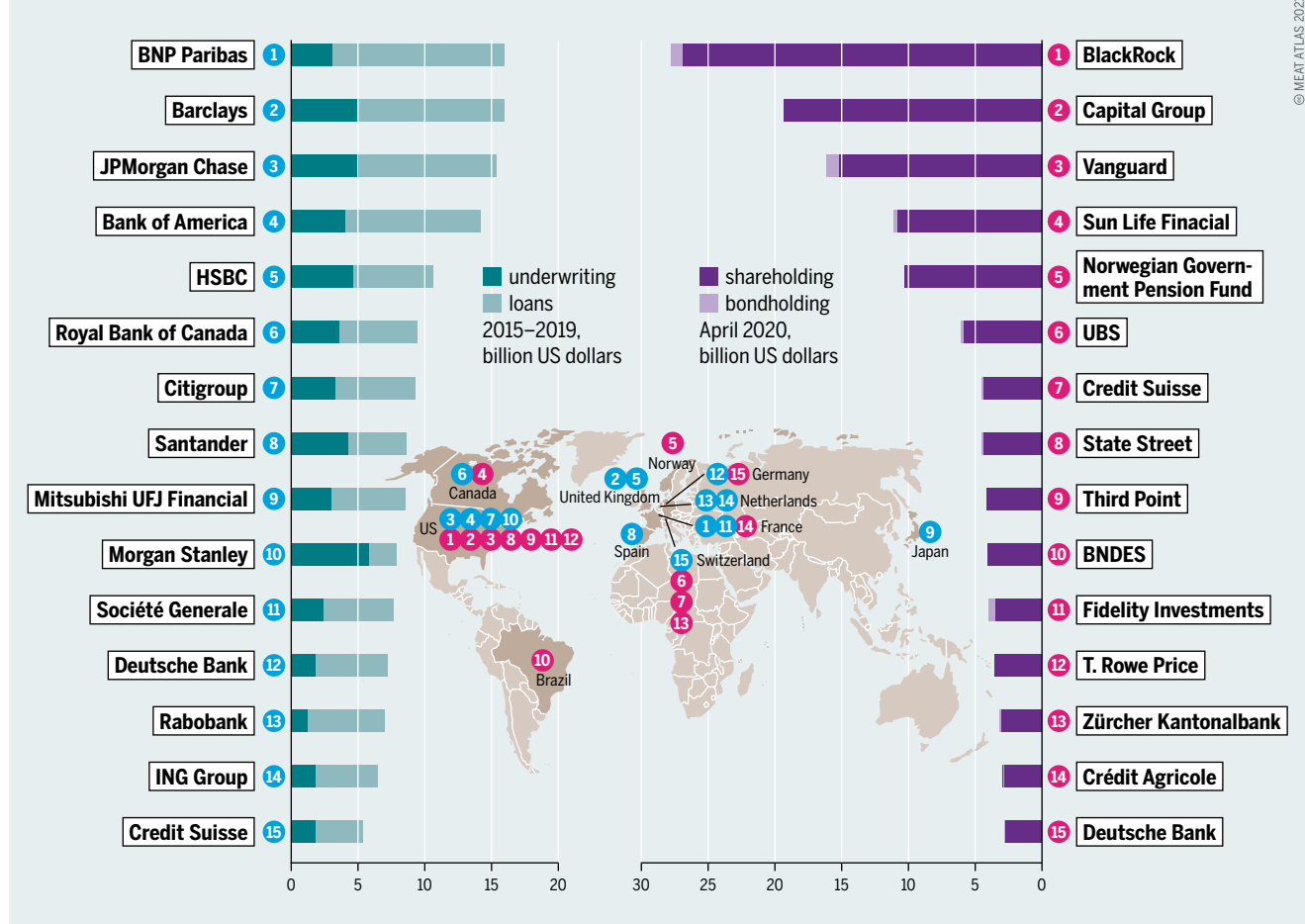
Assets in the industrial meat and dairy sector present a challenge to investors trying to come to terms with climate risks. The environmental, social, and governance risks associated with JBS, a Brazil based multinational, were enough to prompt Nordea, a Finnish asset manager, to pull its investments out of the company, citing “its ties to farms in-

*The meat processor BRF has been shaken by domestic crisis and the pandemic in Brazil. Sanderson Farms is rumoured to want to take it over*



## WHERE THE MONEY FOR THE MEAT INDUSTRY COMES FROM

Biggest financial institutions backing the meat and dairy sector



volved in Amazon deforestation”.

Big Meat and Dairy is not only propped up by vast swathes of private finance. It is also supported by public institutions, including public-sector pension funds and development banks. Local governments across the UK with net zero goals continue to invest in industrial meat and dairy through their pension funds – supporting companies that undermine local, small-scale farming. Despite stringent criteria for safeguarding investments and maintaining environmental and social accountability, multilateral development banks hold direct investments in industrial livestock companies, offer them loans, and provide them with other forms of financial backing.

The European Bank for Reconstruction and Development and the International Finance Corporation – the private-sector arm of the World Bank – have lent 2.6 billion dollars of public money to industrial livestock producers over the past decade. For regional development banks, this trend is even more pronounced. Take the Brazilian development bank BNDES, for example: it is the largest minority shareholder in JBS, which has been accused of trading with ranchers on illegally deforested land and displacing Brazil’s indigenous communities. While the livestock sector receives only 2.5 percent of official development assistance, the scale of public finance available makes these sums equivalent to creating whole megafarms across several continents. This is in direct conflict with these banks’ purpose of

*High-street banks, global investors and pension funds are bankrolling destructive livestock corporations*

promoting the public interest and their commitment to the UN’s Sustainable Development Goals.

While many financiers have made commitments to environmental policies and targets, the impacts of industrial-scale agriculture are yet to be regulated across financial and legal platforms. The Task Force on Climate-Related Financial Disclosures and the Carbon Disclosure Project provide guidelines for financial institutions and companies to disclose their impacts. But such disclosures are neither mandatory nor comprehensive, nor does disclosure necessarily lead to action.

Banks and asset managers continue to finance industrial meat and dairy corporations despite direct contradictions between this support and their alignment with the Sustainable Development Goals, as well as their other environmental, social, and governance commitments. NGOs and some financial institutions and agri-businesses are calling for financiers to be better regulated. In late 2020, EU parliamentarians also called for regulation to govern deforestation and other environmental harms in companies’ supply chains and finance organizations’ investments. The European Commission is now moving towards a strong legislative proposal for this. ●



## GENDER AND POVERTY

# YET MORE UNPAID WORK

**In many countries, women do most of the farm work, but they are not allowed to make most of the decisions. They have to balance caring for their children and elderly parents with looking after the chickens and goats. Livestock can be a welcome source of extra money, but may also mean more work. And if selling eggs and milk becomes more profitable, men very often take charge.**

**S**mall-scale livestock rearing is an important livelihood for many women in rural communities. The World Bank calculates that one in five people around the world rely on livestock as their main source of income. Almost two-thirds of the world's 600 million poor livestock keepers are women.

Women's roles in livestock keeping differ from region to region, and who owns livestock – men or women – is

strongly dependent on social, cultural and economic factors. The ownership also depends on the type of animal. Women make up the majority of poor livestock farmers who raise sheep, goats and Poultry. They have limited access to services, land and capital. But when rearing these animals becomes a more important source of family income, their ownership, management and control are often turned over to men.

A dairy intensification project in Tanzania shows the importance of considering gender in value chain development and reveals the complex interplay between intensification, empowerment and child nutrition. The project successfully increased milk production by smallholders. But as soon as higher yields made milk a marketable product, its control moved to men. Women's control over both milk and income decreased, and the nutrition of children did not improve.

Structural barriers, gender stereotypes and discrimination may exacerbate the position of women in livestock-related livelihoods. These barriers are maintained through social norms that deter women from making decisions, travelling to markets or turning to extension agencies for advice. They deny women access to using, owning or inheriting land and livestock, and prevent them from obtaining resources such as credit.

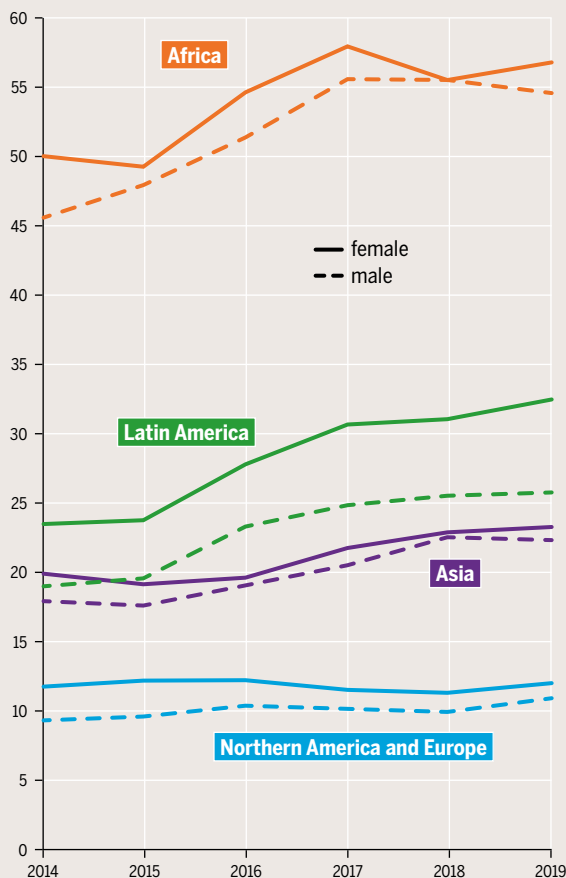
The problem is widespread. A survey by the International Livestock Research Institute found that in low- and middle-income countries, women made up the majority of the poor livestock farming workforce. But they accounted for under 19 percent of agricultural holders, and received only 10 percent of total agricultural development funds and 5 percent of all agricultural extension services. In Senegal, according to a study by the think tank IPAR, women own just 13 percent of the land and were granted only 1 percent of loans for agriculture because they lack titles to the land they farm. The Global Forest Coalition made similar findings in Latin America: in Colombia, only 8 percent of the women interviewed owned land, compared to 17 percent in Paraguay, 20 percent in Bolivia, and 40 percent in Chile. Indigenous women, household heads and young women may also be discriminated against not only because they are female, but due to their age, ethnicity, status or gender identity.

Because they lack access to production resources, women are likely to be poor and not have enough to eat – even though they devote over 70 percent of their income to household needs. Livestock are one of the few farm resources that women can own and control. They provide nutritious food each day that women can use to feed their families. In areas where it can be hard to earn money in other ways, women can sell live animals, meat, milk or eggs to earn money to pay household expenses.

*Women's food insecurity has many causes: low income, low education, unemployment, residence in rural areas, health problems, separation or divorce*

### MORE WOMEN THAN MEN GO HUNGRY

Prevalence of moderate or severe food insecurity by gender, percent



© MEAT ATLAS 2021 / FAO

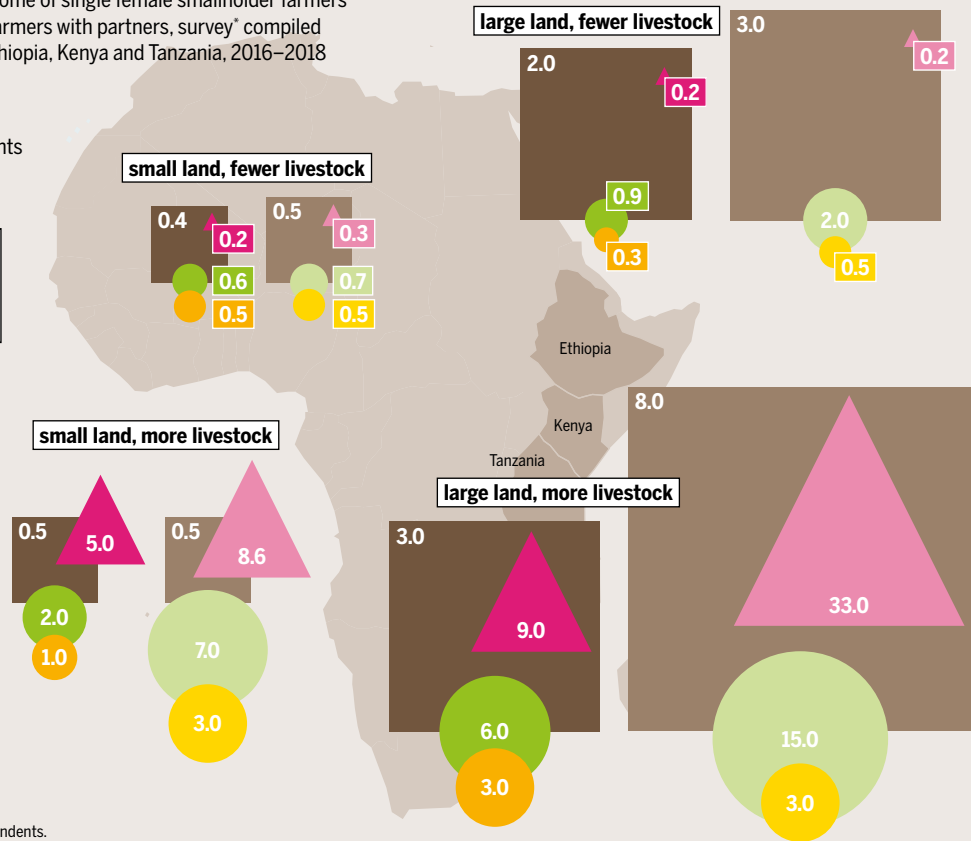
## WOMEN'S EFFORTS ON SMALL FARMS

Farm size, animal stock and income of single female smallholder farmers compared with those of male farmers with partners, survey\* compiled in the East African countries Ethiopia, Kenya and Tanzania, 2016–2018

■ female: single respondents  
 ■ male: respondents with spouse or partner

Single female smallholder farmers are mostly separated, divorced or widowed, and usually also have to care for children. Couples have an additional male worker

■ farm size, hectares  
 ▲ livestock holdings, TLU\*\*  
 ● farm income  
 ● off-farm income (income sources: 1,000 US dollars per year)



\* survey, 350 female and 1,691 male respondents.

\*\* TLU: "tropical livestock unit" of about 250 kg liveweight; cow = 1.0 TLU, cattle in herd 0.7, sheep 0.1, goat 0.08, chicken 0.01, with variations

© MEAT ATLAS 2021 / TAVENNER ET AL.

In many places, women and men typically have different tasks, with women and girls taking on a greater share of unpaid work such as childcare and domestic chores. This can worsen inequality and poverty for those who work with livestock. Even though the animals may be a source of income, they add to the women's workloads. The extra burden may mean they cannot go to school or attend training, which in turn harms their ability to earn money or take part in making decisions in their communities. In one anti-poverty program described by the UN Secretary-General where households were given livestock, the women ended up spending 217 percent more time on the animals – an extra 415 hours a year.

Deforestation in the Amazon and other areas is on the rise because of the need to produce meat and soybeans for global markets. That has reduced local communities' rights to the forests and land. Given that women rely heavily on these and other natural resources – in order to raise livestock, for example – such deforestation and environmental degradation has had a big impact on them.

The economic and social empowerment of women who keep livestock depends on a range of factors: securing their land tenure rights, addressing the burden of unpaid care work, improving their access to education and basic services, and ensuring they can use forests and other natural re-

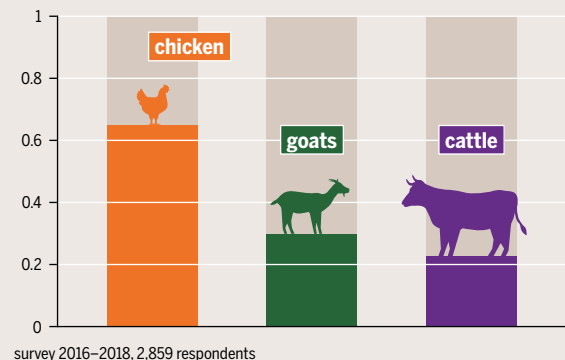
*Women mainly have control over small livestock and low-value products such as chickens and eggs – much of which is eaten at home rather than sold for cash*

*For small farmers with a few hectares of land, livestock are crucial. Large animals bring the most money, but they are mostly men's business*

sources. It is not possible to achieve food security and more sustainable food systems without involving women in planning, decision making and implementation. Guaranteeing women's ability to engage in small-scale livestock farming will help them secure steady incomes and a supply of clean and nutritious food. That will in turn help close the gender inequality gap. ●

## FOWL FOR THE WOMEN, CATTLE FOR THE MEN

Female control over livestock-related decision making in eastern Africa (Ethiopia, Kenya and Tanzania), 0 = not at all, 1 = entirely



survey 2016–2018, 2,859 respondents

© MEAT ATLAS 2021 / TAVENNER ET AL.

# SOY, FOREST, AND SAVANNA

**More than one-third of all crops worldwide end up in the stomachs of livestock. That includes one billion tonnes a year of soybeans and maize alone. The feed and livestock industries want to increase that even further.**

**G**lobal meat consumption has been rising for years, pushing up demand for livestock feed. For intensive animal agriculture, soybeans are one of the most important sources of protein in feed. Their share of international trade has risen more than fivefold since 2001. Soy is also used in human food, fuel and industrial materials, but almost 90 percent ends up in feed troughs.

The biggest soybean producers are Brazil, at 133 million tonnes, the USA at 117 million, and Argentina at 53 million. Almost 90 percent of global soybean exports in 2019 came from these three countries. At 74 million tonnes, Brazil is the biggest exporter, followed by the USA. As cultivation has expanded, so too has the proportion of farmland sown with genetically modified soybeans. In the USA it is now 94 percent, while in Brazil, 97 percent of the 2017 harvest consisted of genetically modified varieties. Soybeans account for almost 50 percent of all genetically modified organisms, or GMOs, worldwide. Rising demand for feed has stimulated an increase in the soybean acreage of over 70 million hectares in the last 20 years.

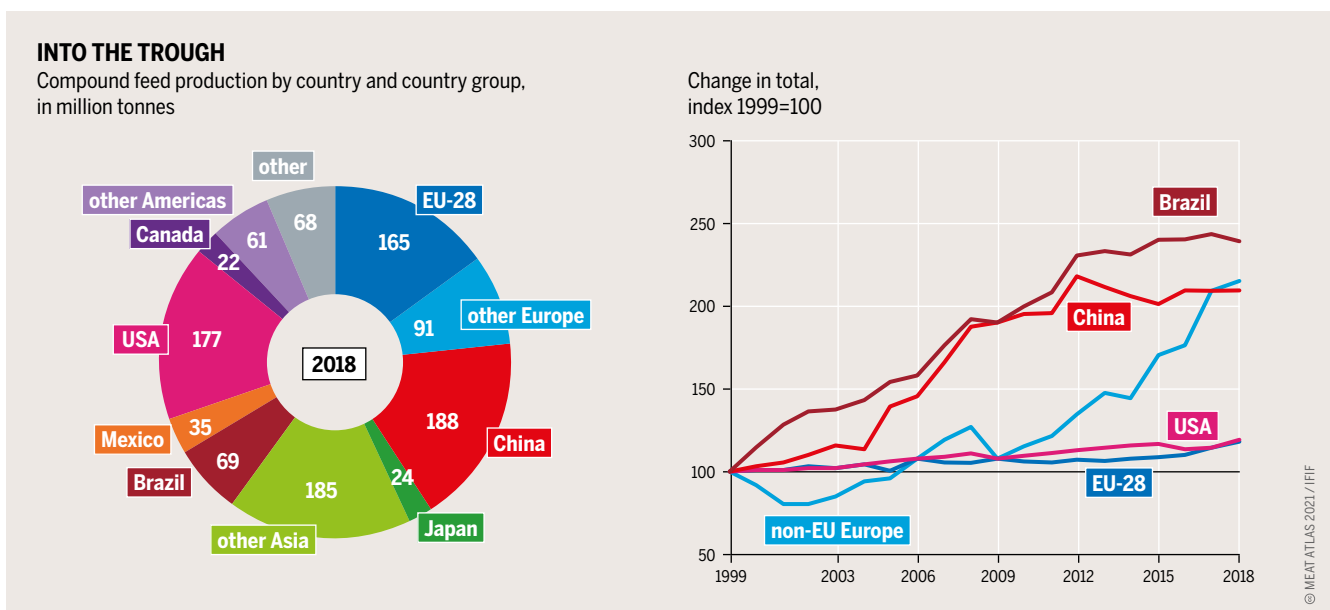
China is by far the biggest producer and consumer of meat worldwide. It has a correspondingly large appetite for feed, making it the world's biggest soybean importer. In 2019 it bought 74 million tonnes of the beans, almost two-thirds of all exports. It was followed by the European Union, with 13 million tonnes. Changes in global trade flows can be

similarly dramatic: between January and May 2020, China imported almost 37 percent more soybeans from Brazil, and bought less from the USA as a result of trade tensions.

Soybeans are processed into feed and traded by agricultural trading companies that invest in ports, ships and logistics around the globe. The biggest grain traders are the so-called ABCD companies: Archer Daniels Midland, Bunge, Cargill, and Louis Dreyfus Commodities. In 2018 they, along with the Brazilian trader Amaggi, were responsible for 56 percent of Brazilian soybean exports. Because demand is rising and it is difficult to push up yields on current fields, more land is needed to grow soy. In the 20 years leading up to 2019, the cultivated area grew from 77 to 125 million hectares. Soybean cultivation is now the second largest contributor to deforestation worldwide, after livestock farming. It is especially in Brazil and Argentina that forests and grasslands are being turned into soybean fields.

Between 2006 and 2017, some 220,000 square kilometres were cleared in the Amazon rainforest and the Cerrado savanna, a dry forest in Brazil valuable for its biodiversity. That is the same area as England, Wales and Scotland combined, or half the size of France. Most of the land was turned into livestock pasture, but 10 percent was used directly for soybean cultivation, according to a study by the initiative Trase, Transparency for Sustainable Economies. The massive deforestation in the Cerrado has a simple cause: the Amazon moratorium, which since 2008 has successfully prohibited trade in soybeans that come from areas cleared of rainforest – but only in the Amazon. Soybean production

*While industrial feed production in the USA is stagnating, it is booming in Ukraine and elsewhere in eastern Europe*

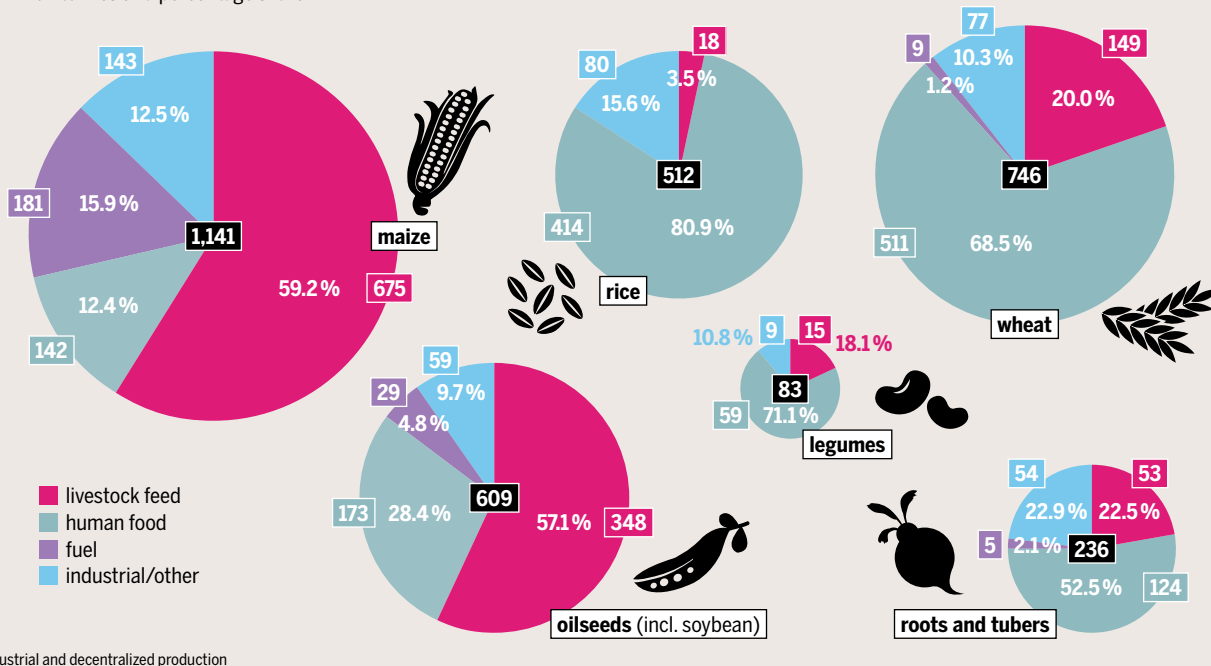




## MULTIPURPOSE COMMODITIES

Major agricultural “flex crops” by production and use, selected, average 2017–19, in million tonnes and percentage share

© MEAT ATLAS 2021 / OECD, FAO



has simply shifted to the Cerrado.

None of the big grain traders support the demand to extend the moratorium to the Cerrado. Cargill has even spoken out publicly against the idea. And in the Amazon, the moratorium applies only to land that has been deforested specifically to grow soy. Soybeans that are cultivated on land originally cleared for other reasons are not affected. That means that most of the soybean expansion is on former pastureland that used to be forest or savanna.

Progress can quickly be undone. This is shown by the forest fires of 2019 and 2020, which were mostly a result of slash-and-burn cultivation, including for soybean farming. A comparison of satellite images of the fires with maps showing the largest meat processing plants and soybean silos reveals that many fires blazed in the immediate vicinity of those plants, warehouses and other infrastructure. This was supported by the policies of Brazilian President Jair Bolsonaro, who has continuously relaxed the country’s environmental regulations. He has not only welcomed the expansion of agribusiness in the rainforest and savanna, he has also legalized it. In 2019, the deforestation rate in Brazil rose to its highest level since 2007/8. Forecasts predict that it will rise further.

A study published in the respected journal *Science* in 2020 found that 20 percent of the soybeans exported to the European Union from the Amazon and Cerrado come from land that has been cleared illegally. Meat consumption in Europe is thus directly linked to deforestation in Brazil, and to the conflicts that result from it. Alongside its negative

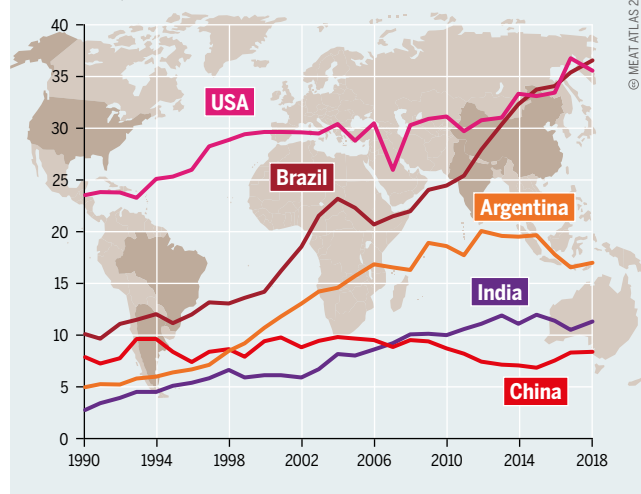
*The area sown with soybean alone has more than doubled since 1990. It is now three times the size of Germany*

*Only about 40 percent of the production of the most important crops is intended as human food. Almost as much is fed to livestock*

impact on climate and biodiversity, deforestation also causes disputes over land and violates the rights of indigenous communities. Global Witness, a non-governmental organization, says that conflicts between local communities and soybean and livestock farmers are on the rise, along with threats and violence against those who stand up for their ancestral land and for the climate. In 2019, 24 environmental activists were killed in Brazil – 90 percent of them in the Amazon region. ●

## BEAN THERE, DONE THAT

Harvested area of the five most important soybean producing countries, in million hectares



## CLIMATE

# A LIGHTER HOOFPRIINT

**Livestock’s share of global greenhouse gas emissions is understated. The climate footprint of the animals and the feed they need is significant. There are ways to change that.**

According to the Food and Agriculture Organization of the United Nations (FAO), livestock was responsible for 14.5 percent of global greenhouse gas emissions in 2013. FAO estimates that 45 percent of livestock-related emissions come from the production and processing of feed, and another 39 percent from enteric fermentation – methane gas produced from the digestive tracts of ruminants such as cattle, sheep and goats. Another 10 percent is attributed to the storage and management of manure.

Taken together, these emissions make up 56 to 58 percent of greenhouse gas emissions from the food sector – even though livestock contribute to only 18 percent of the calories and 37 percent of the protein supply of the world’s human population. According to the Intergovernmental Panel on Climate Change, the food sector accounts for 21 to 37 percent of global greenhouse gas emissions. In 2018,

17 percent of EU emissions stemmed from animal farming.

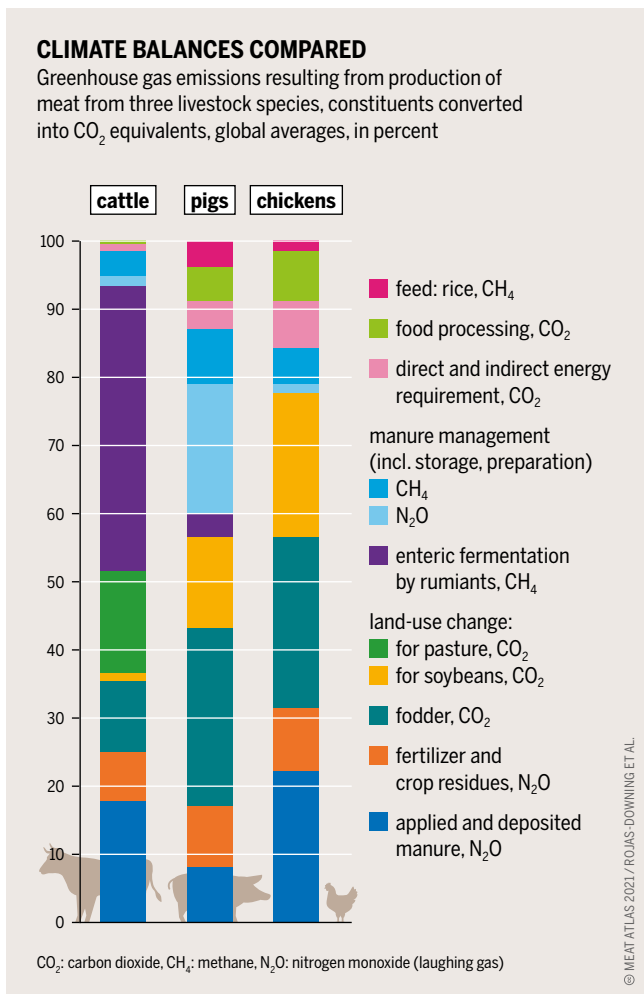
Livestock account for around 70 percent of all agricultural land. Expansion of livestock production into grasslands for pasture and other ecosystems for growing animal feed has led to land degradation, deforestation and biodiversity loss. About 40 percent of global cropland is used to produce feed. As feed use rises with increased pork and poultry production, land use change has resulted in lost carbon and more greenhouse gases from manufacturing and the use of fertilizers for animal feed. Not just ruminants, but poultry and pigs therefore have contributed to significant emissions in the last two decades.

In 2018, two non-profit organizations – GRAIN and the Institute for Agriculture and Trade Policy – calculated the emissions from 35 of the world’s largest meat and dairy producers. The findings were shocking: just five meat-and-milk giants, JBS, Tyson, Cargill, Dairy Farmers of America and Fonterra, produce more combined emissions per year than major oil players like Exxon, Shell or BP. Taken together, 20 livestock firms are responsible for more greenhouse gas emissions than Germany, Britain or France.

Around 90 percent of the emissions from meat producers come from the supply chain or from the animals themselves. Yet globally, not a single government requires meat producers to document their emissions or standardize their emission reduction targets so as to enable comparisons within the sector. Instead the sector relies on self-reporting. But few companies report their emissions, let alone any targets for reducing them. In 2016, only 3 meat companies had reported some of their emissions from their supply chains (JBS, Marfrig and NH Foods), and only one of these (NH Foods) had given credible figures that matched calculations by the researchers. JBS’s reported emissions were only 3 percent of researchers’ estimates. In 2016, none of the EU meat firms had reported their supply chain emissions.

Solutions proposed for livestock’s climate problem fall into different categories. Meat companies prefer reduced emissions per kilo of meat produced, known as “emissions intensity” reduction. This approach relies on further intensification of production by generating more meat per animal or using less feed per animal without necessarily reducing the number of animals produced. Agriculture science and various NGOs see reducing the production and consumption of animal products as key to climate protection – less and better is the guiding narrative.

A third complementary approach recommended by scientists to cut down production and consumption of food animals is through undertaking measures that reduce competition between food for humans versus feed for animals. For example, biomass unsuited for human consumption, such

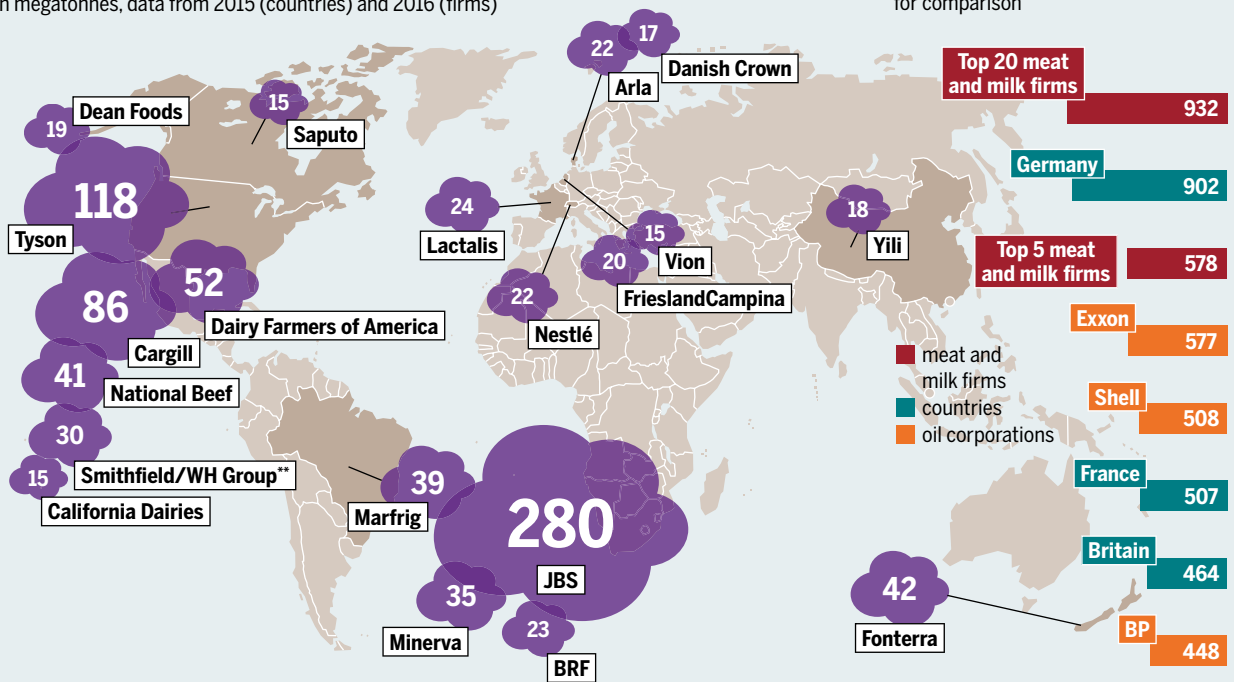


*Beef, pork and chicken contribute to global warming in very different ways – from enteric fermentation to fodder and manure*

### HEAVYWEIGHTS HOTTING IT UP

Greenhouse gas emissions of 20 leading meat and milk firms compared with emissions of countries and oil corporations, in megatonnes, data from 2015 (countries) and 2016 (firms)

emissions in megatonnes for comparison



\*Firms whose reports permitted analysis. \*\*US company under Chinese ownership

© MEAT ATLAS 2021 / IATP, GRAIN

as crop residues, food scraps and plant parts left over from the processing of crops, can be turned into livestock feed. The researchers estimate that this could produce between 9 and 23 grams of animal protein per person per day – compared to a total demand of 50 to 60 grams a day. They also discovered that such low-cost feeding, combined with the avoidance of competition between feed and food crop production, could lead to 19 to 50 percent fewer greenhouse gas emissions.

In addition, livestock management systems such as “adaptive multi-paddock grazing” have the potential to cut

*Methane from beef and dairy cattle, animal manure, feed crop expansion and fertilizer use dominate the greenhouse gas emissions of the agricultural sector*

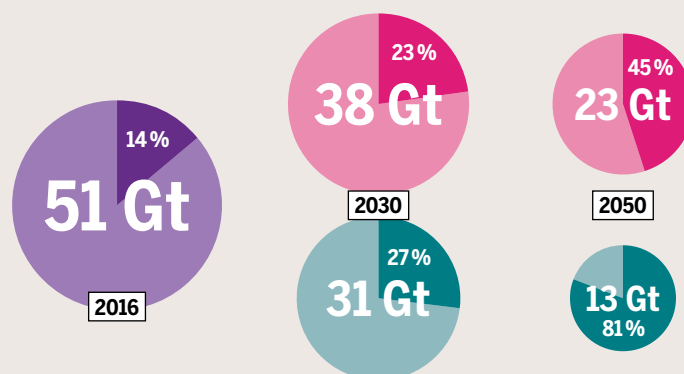
livestock emissions by more than half. In such a system, animals rotate between separate paddocks or grazing areas. This prevents overgrazing, promotes the growth of fodder between the grazing cycles, and imitates the movement of grazing animals in natural systems. This system has been shown to improve pasture productivity, carbon sequestration and fodder quality compared to conventional methods that maintain high numbers of livestock on permanent pastures. Eliminating cereals and replacing them with nitrogen-fixing legumes and a mix of perennial grasses in an integrated livestock management system could also make production more resilient in the face of climate change. ●

*Failure to reduce the industrial livestock sector may significantly jeopardize the planet’s ability to limit warming to 1.5 degrees Celsius*

### ATTENTION NEEDED TODAY

Greenhouse gas emissions in gigatonnes and share of meat and milk sector in percent

- base year 2016
- scenario: global warming at most 2 degrees Celsius
- scenario: global warming at most 1.5 degrees Celsius
- shares of emissions due to meat and milk sector



© MEAT ATLAS 2021 / IATP, GRAIN

## PESTICIDES

# BANNED BY BRUSSELS, ALLOWED IN THE AMAZON

**Pesticide applications are on the rise across the globe. Some of the most dangerous substances have been banned in the European Union, but are still being used on a large scale in other parts of the world. Many are intended for the cultivation of soybean and maize, which are destined mainly for use as livestock feed.**

**T**he worldwide use of pesticides has doubled since 1990, with over 4 million tonnes of active ingredients now applied every year to control weeds, insects and other plant pests. The quantities of pesticides traded are far higher than this, because the active ingredients are mixed with other chemicals and water to make them easier to apply and to boost their effectiveness. While applications have stagnated in many parts of the European Union over the last 30 years, they have increased sharply elsewhere in the world.

This increase results in part from the rising global demand for meat. This in turn stimulates the demand for protein-rich feed made from soybeans, the main producers of which are the USA, Brazil and Argentina. These three

countries are among the world's biggest pesticide users. The figures for China are contradictory. The country's statistics office has given the Food and Agriculture Organization of the United Nations a figure of 1.7 million tonnes – over 40 percent of global consumption. But an official Chinese specialized authority reports just 300,000 tonnes. It is unclear if the two numbers can be compared. Regarding herbicides, which are used to control weeds, the USA uses more than 250,000 tonnes, Brazil nearly 230,000 tonnes, and Argentina 161,000 tonnes. Together, that is nearly 70 percent of the global reported consumption.

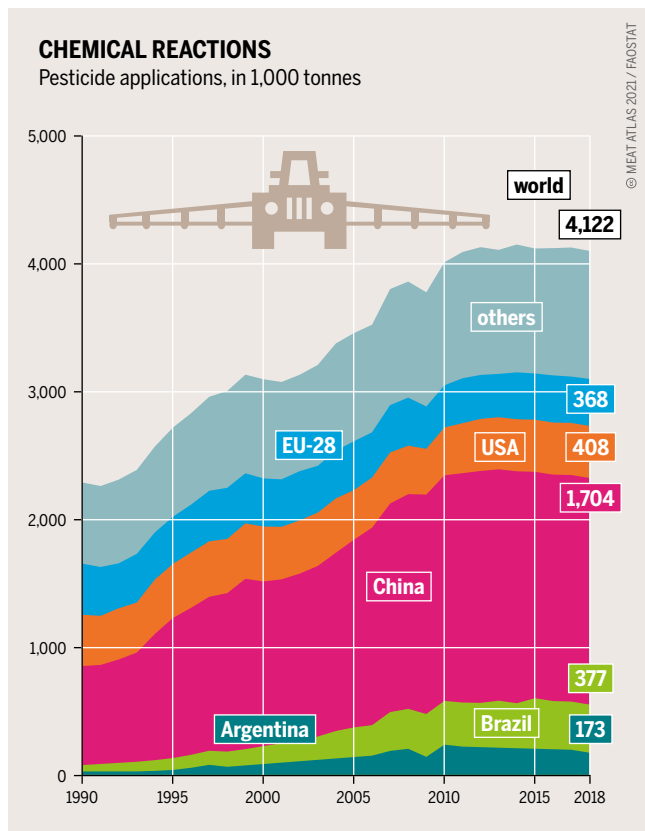
Agrochemicals are used to produce many crops in these countries. Soybeans, most of which are processed into livestock feed, play a special role. In Brazil, 52 percent of all pesticide sales are for soybean production. Rising in parallel to soy production, which has increased almost sixfold since 1990, is pesticide use: nine times as much pesticide is sprayed today in Brazil as 30 years ago.

The rise in pesticide consumption in Brazil and Argentina is linked to the introduction of genetically modified soybeans at the end of the 1990s. These plants are resistant to glyphosate, a broad-spectrum systemic herbicide. Glyphosate can be sprayed on soybeans while they are growing in the field to destroy any weeds that compete with the crop. But the more glyphosate is applied, the likelier it is that the weeds will become resistant to the spray – forcing farmers to spray even more, and to use different types of weedkillers. A vicious circle ensues.

It is the pesticide producers that reap the rewards. The main beneficiaries are Syngenta, headquartered in Switzerland; Bayer and BASF in Germany; and Corteva and FMC in the USA. These five firms control over 70 percent of the world market for pesticides, which was valued at an estimated 60 billion US dollars in 2019. Syngenta is the global market leader, accounting for one quarter of industry sales alone.

The pesticides sold by the five firms vary in their mode of action as well as in the risks they pose. Non-governmental organizations estimate that in 2018, the firms generated a combined 35 percent of global sales from substances that are particularly damaging to humans or the environment. The NGO Pesticide Action Network classifies such substances as “highly hazardous” on the basis of assessments by various national and international authorities.

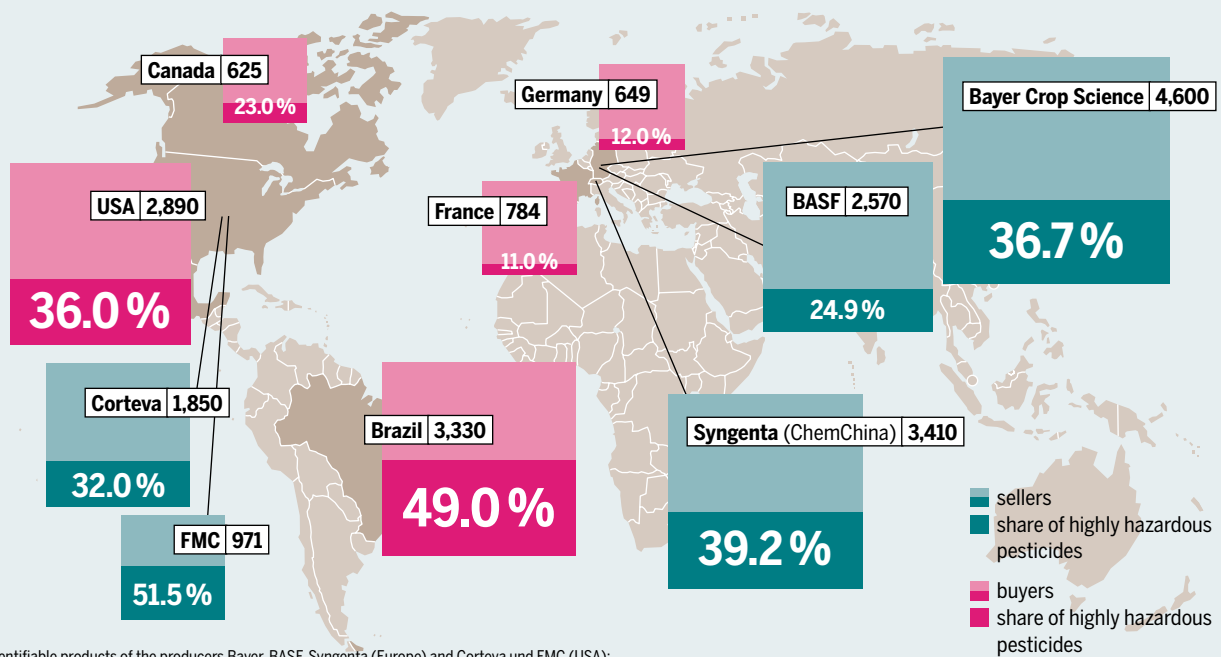
These companies are grouped into a trade association known as “CropLife International”. They do a particularly good business in highly hazardous pesticides for growing



*Global pesticide applications are no longer rising. For producers that means cutthroat competition and the search for new markets*

## TOP 5 PESTICIDE PRODUCERS AND CONSUMERS

Combined turnover of the five biggest international pesticide producers in their five most important markets, in million US dollars, 2018, and share of sold or purchased highly hazardous pesticides, in percent



\* identifiable products of the producers Bayer, BASF, Syngenta (Europe) and Corteva und FMC (USA); in the world's largest market, China, local producers have a market share of 90 percent

feed crops. Applications for soy and maize account for almost half their sales of such pesticides. In Brazil, their biggest market, soybean cultivation accounts for almost two-thirds of those sales.

The top seller is glyphosate, classified by the International Agency for Research on Cancer as “probably carcinogenic”. Besides Bayer AG, which acquired most of its glyphosate business through its purchase of the US company Monsanto, hundreds of other companies have long since sold this controversial product. For soybean cultivation in Brazil alone, 246 glyphosate-containing pesticide products from 50 different companies are approved for sale.

Other highly dangerous substances are also in use. Paraquat, for example, is popular. Because of its high acute toxicity, this herbicide, developed in 1955, has been banned in over 50 countries, including the European Union, Switzerland, China and, since September 2020, Brazil. Syngenta and other firms nonetheless still sell it in countries where regulation and enforcement are weaker. German and US companies also continue to trade in many pesticides that are banned in their home markets because of known risks. The German firm Bayer AG sells insecticides in South America that are banned in the European Union due to their high bee toxicity.

Many of these pesticides are produced in the European Union and then exported. Under the EU-Mercosur trade agreement, this trade could increase further because the customs duties for chemical products – including pesti-

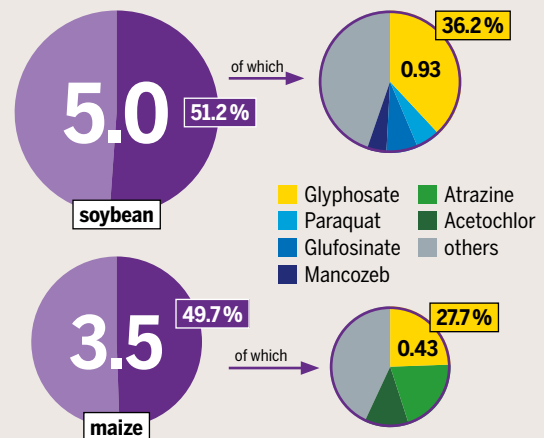
*Around half of the pesticides applied to soybean and maize are highly hazardous. Atrazine has been banned in the EU since 2004*

*After a wave of mergers, five big global pesticide producers remain. Smaller producers are active mainly in their own national markets*

cides – are to be reduced. Nonetheless, the European Commission wants to stop the production of chemicals for export if they are banned in the EU. A first success is in France, where such a ban will come into force in 2022. Exports from Switzerland were tightened in 2021, and the export of five pesticides is now banned. ●

## HAZARDS IN FEED TROUGHS

Pesticide sales and shares of highly hazardous substances in them, by crop, 5 biggest international producers,\* in billion US dollars and percent



\* identifiable products of the producers Bayer, BASF and Syngenta (Europe), and Corteva and FMC (USA)



## WATER

# THIRSTY ANIMALS, THIRSTY CROPS

**All animal products have a water footprint: the amount of water needed to produce them. It is not just the total amount that is important, but the types of water that are needed. There is enough “green” water. But the volumes of “blue” and “grey” water should be kept low.**

In general, more water is needed to produce meat than plant-based foods such as grains or beans. The average water footprint per calorie for beef is 20 times that of grain. But not all meat is the same, and the species of livestock and the management type affect the water requirements considerably.

Producing a kilogram of beef takes an average of 15,415 litres of water. The same amount of sheep or goat meat takes almost 9,000 litres, a kilo of pork 6,000 litres, and of chicken 4,300 litres. In all, 92 percent of the global water footprint goes towards agriculture, 29 percent of which is used in animal production. According to another calculation, agriculture uses 70 percent of all available fresh water, three times as much as 50 years ago.

But one beefsteak is not necessarily the same as another. The precise water footprint depends on the production system in which the animal was raised. Was the animal kept on pasture in a mixed system that included crops, or was it in an industrial system with high animal numbers per hectare, in which over 90 percent of the feed is brought in? Just as important are the composition and origin of the feed.

Here’s an example. The calculation that a kilogram of steak requires 15,415 litres of water assumes that the animal was slaughtered at three years of age. During its lifetime, it will have eaten 1,300 kilograms of feed concentrate composed of various cereals and soybeans, plus 7,200 kilograms of roughage (grass, hay, silage). It will have drunk 24,000 litres of water. Its housing must also be cleaned and sprayed. But most of the water goes into producing the feed.

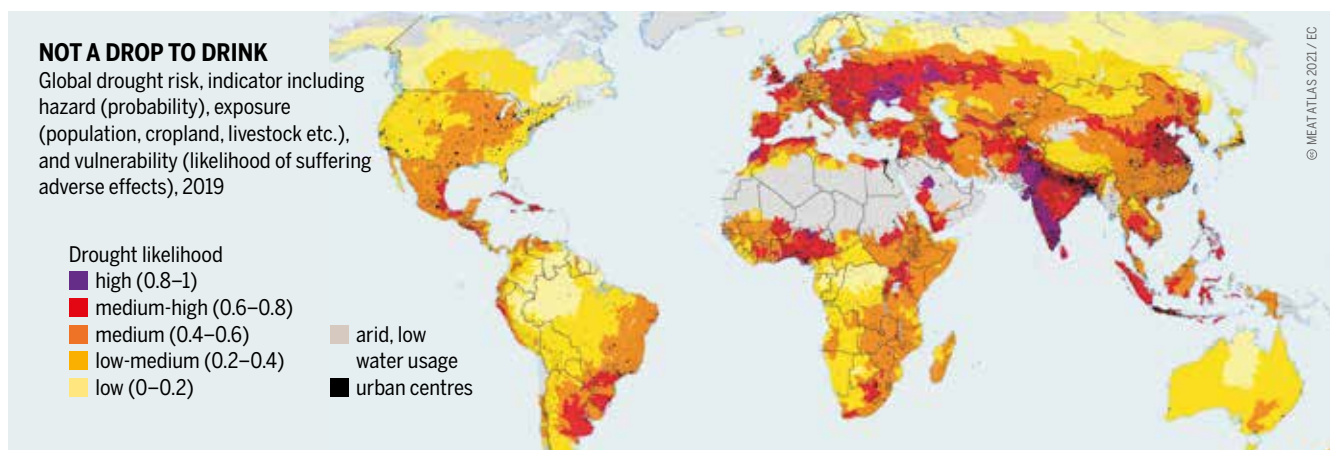
In making these calculations, we must remember that a cow that has spent its life on a pasture in a humid region will have a relatively large water footprint because the ample rainfall on its pasture is credited to the animal. Plus, it uses its pasture feed fairly inefficiently and takes a long time to reach slaughter weight. This means we should look at the water footprint more closely.

Experts distinguish between “green”, “blue” and “grey” water. Green water is the rainfall that is available to plants from precipitation. Blue water is the volume needed for irrigation. Grey water is the volume that would hypothetically be needed to dilute contaminants to a harmless level so they would comply with limits for water quality.

When calculating the water footprint of meat production, we must know whether it arises from green, blue or grey water in order to judge whether the limited water available is being overexploited. Yes, two-thirds of the Earth’s surface is covered with water, but most of it is salt water in the oceans. Only a tiny proportion, 0.4 percent, is fresh water that circulates in local, regional and global water cycles and is available to plants, animals, and us.

Because cattle kept in industrial systems convert their feed concentrate relatively efficiently, they generally have a smaller water footprint than cattle kept in other systems, including ecological production where the animals spend a lot of time out grazing. But industrial systems rely on feed from arable crops that are irrigated, fertilized and sprayed with pesticides. That means that the footprint for feed production for industrial livestock raising includes a large proportion of blue and grey water. The blue water footprint of feed concentrate is 43 times that of roughage; the grey water footprint is 61 times as much. That makes meat from pasture-raised animals preferable to that of industrially raised animals because it uses less water overall.


*People, industry, irrigation and livestock: they all need water. Climate change makes water stress much worse*



## PROBLEMS IN BLUE AND GREY

Water used in production of agricultural products, global averages, by categories of use, in litres per kilogram of animal or plant product

- green: naturally occurring rain or groundwater
- blue: groundwater or surface water extracted and used for artificial irrigation and production and not returned to a water body
- grey: water that is contaminated during production and which would be required to be restored to acceptable quality

 a bathtub contains about 140 litres of water



Problems for the ecosystem and for soils arise in dry regions if blue water is used to grow feed crops, which are then removed from the regional cycles. Ruminants fed with feed grown under irrigation are found mainly in the USA, China and India. Pigs raised under industrial management – which uses a lot of water – come mainly from the north-eastern USA, Europe and China.

The consequences for rivers, wetlands and groundwater levels in these regions are devastating. According to the Food and Agriculture Organization of the United Nations, the midwestern USA and western China suffer from soil salinity due to irrigation with groundwater. Nitrogen and phosphorus used as fertilizers are washed down rivers into the sea, where they give rise to dead zones. In these ma-

*Pork and beef have the biggest blue and grey water footprints. For fodder crops, it is the protein-rich legumes*

rine deserts, explosive algal blooms use up all the oxygen. Deprived of oxygen, marine animals and plants die. There are around 400 such dead zones around the world. The biggest is in the Arabian Sea, covering almost the whole of the Gulf of Oman. In the Gulf of Mexico in the USA, pollutants carried down the Mississippi create a dead zone each year that covers over 15,000 square kilometres. And whenever land-based water reservoirs, such as forests in Brazil and peatlands around the world, are converted into cropland, the overuse of water resources is especially severe. ●

## FERTILIZERS

# TOO MUCH OF A GOOD THING

**Nitrogen pollution from livestock manure is an increasing problem in many parts of the world. Countries in the European Union have lots of ideas on how to reduce such contamination of their environments. One approach is through closer monitoring of industrial livestock producers and restricting the amount of manure slurry that crop farmers are allowed to apply.**

**R**ivers, streams and lakes in many parts of Europe are polluted with nitrogen. One of the main causes is industrial livestock farming, which produces large amounts of slurry and manure which are used as fertilizer for crops. The nitrogen they contain is a nutrient that plants need to grow. But if too much is applied, it leaches down into the soil. Under unfavourable circumstances, it can end up as nitrates in the groundwater and ultimately in the sea.

The less nitrogen that the manure releases into the environment, the greater its value as a fertilizer, and the less of a threat it poses to water bodies. Optimal fertilization depends heavily on the timing and on the methods used. The loss of nitrogen into the atmosphere in the form of ammonia gas can be reduced if manure tanks are covered, or if the slurry is worked into the ground immediately after it is spread on a field. In standing crops, this is best done by injecting it into the soil rather than spreading it broadly on the surface. Farms that use the right techniques can significantly reduce their losses.

In practice, animal manure is not regarded as an adequate fertilizer to fulfil the plant demand in intensive production. Mineral fertilizers are therefore also applied to

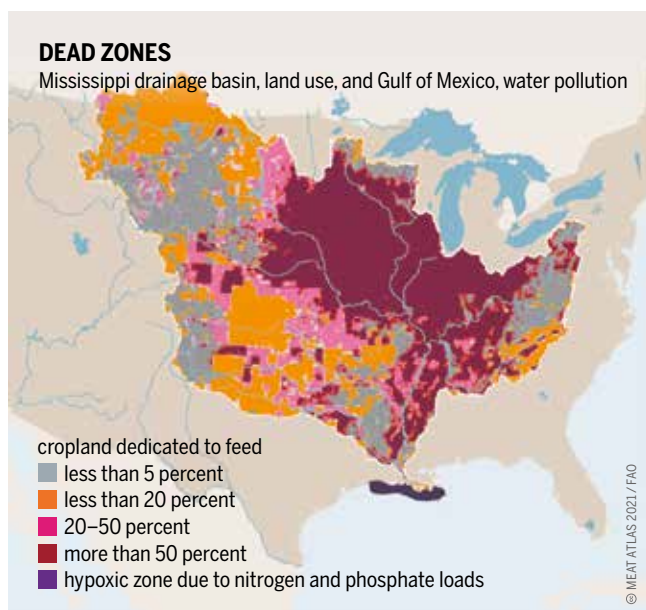
fields. This can also lead to excessive nitrogen loads that can contaminate the groundwater. The European Union's Nitrate Directive currently specifies a limit of 50 milligrams of nitrate per litre of drinking water, and a guideline value of a maximum of 2.8 milligrams of total nitrogen in surface water.

The EU's legal maximum total nitrogen level for animal manure is 170 kilograms per hectare. Applications of mineral fertilizers add to the amount of nitrogen. In many European countries, more than 100 kilograms of nitrogen surplus is spread on fields each year, exceeding the maximum and guideline levels for nitrates in groundwater. This is especially the case in regions with intensive livestock farming practices. Denmark, Germany and the Benelux countries, with their high concentrations of livestock, are particularly affected. They have had to take decisive countermeasures and adapt their regulations in recent years in order to comply with EU agricultural and environmental policies.

In Denmark, where export-oriented animal production is an important sector in the economy, the authorities have been taking effective action since 1985. Nitrate concentrations that sometimes exceeded 200 milligrams per litre in soil layers near the groundwater level have been halved over the past 10 years. Farmers are now obliged to keep digital records of their fertilizer plans. These plans must be based on the expected yield levels and had to be 10 to 20 percent below the calculated economic optimum until 2015. Spreading slurry in autumn, after the main harvest, is largely prohibited because the plants need scarcely any nitrogen then. These restrictions have triggered a comprehensive modernization of the machinery and equipment fleet in order to incorporate the manure effectively into the soil.

The use of low-emission application methods is now mandatory in many countries in western Europe, such as Belgium, Denmark and the Netherlands. This has also been true for arable land in Germany since 2020, but will not apply to grassland until 2025. To prevent an unchecked increase in livestock farming on vulnerable soils, the Netherlands imposes regional limits for the amount of manure that may be applied. If the amount per hectare is too high, the manure must be separated into solids and liquids at a separation plant. The manure can then be more efficiently exported to regions with fewer livestock and used in crop farming outside the country, if necessary.

In addition to capping the amounts of fertilizer, it makes sense to adjust how crops are grown. In Denmark, a minimum of six percent of the agricultural area must be devoted to "catch crops". These are crops that bind nitrogen in their biomass over winter and prevent it from being leached away. Depending on the cultivation system, legumes can be

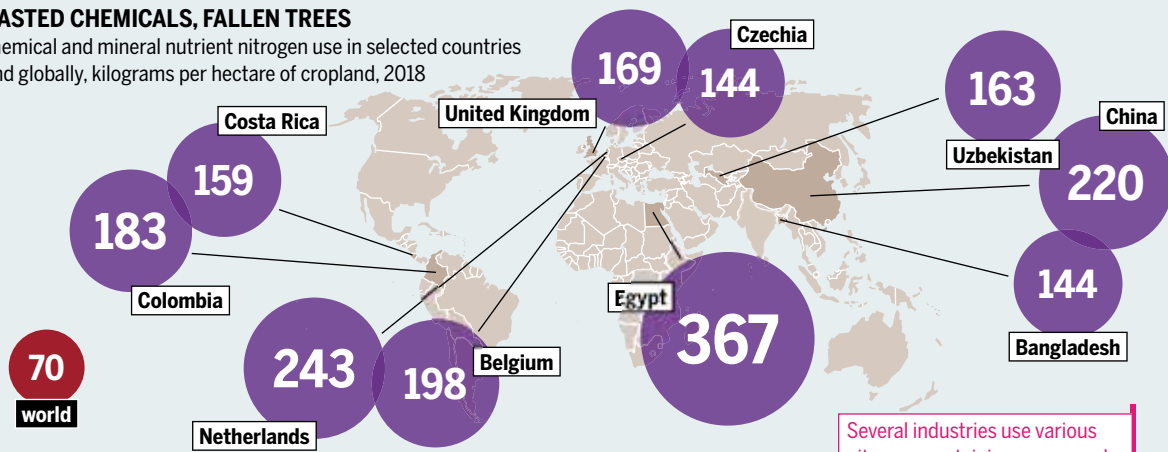


*The oversized footprint of factory farms: growing feed in the Corn Belt and spreading slurry in the Gulf of Mexico*



### WASTED CHEMICALS, FALLEN TREES

Chemical and mineral nutrient nitrogen use in selected countries and globally, kilograms per hectare of cropland, 2018



Anthropogenic sources of nitrate contamination in groundwater, percent



Overuse and improper timing of fertilizer applications are the source of most nitrates in groundwater

Deforestation reduces the ability of soils to retain nitrogen in rainfall

Several industries use various nitrogen-containing compounds. Improper disposal of waste material may add to nitrate concentration in groundwater

In areas with large numbers of people, faecal waste is the major source of nitrate pollution

© MEAT ATLAS 2021 / SHUKLA/SAXENA, OVIID

used as a catch crop to a certain extent. Legumes are plants whose roots host symbiotic bacteria that are able to fix nitrogen from the atmosphere. This enables the farm to avoid the need to apply additional synthetic nitrogen that would have to be produced in an energy-intensive way.

Other options open to farmers include “precision farming” techniques, and shifting the winter sowing of grains to as early a date as possible. Precision farming methods include using special sensors in the field in order to apply an amount of fertilizer that meets the plants’ precise requirements. Sowing earlier allows the plants to take up more nitrogen before the winter months. No matter the approach, it is necessary to monitor performance with the help of farm data. In Denmark, exceeding the legal limits for nitrogen incurs a levy of at least 1.30 euros per kilogram. In addition to regulations, many EU countries offer free advice to farmers on how to protect water. Starting with a fairly high level compared to other European countries, the Netherlands has been able to cut its applications of mineral fertilizer by 50 percent since 1990.

Despite such successes, official support for voluntary measures will lead to marked improvements only if protecting the environment pays off for livestock farmers and if they can factor it in over the long term. From the point of view of water protection, environmentally friendly live-

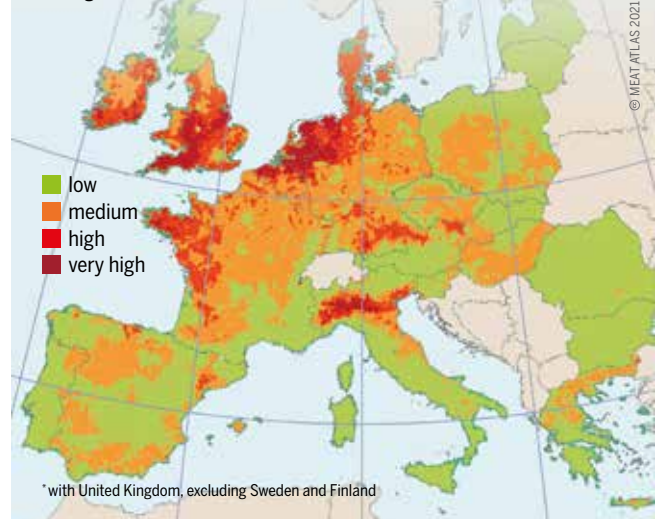
*In western Europe, manure is a major problem for groundwater. In large parts of the world, the main issue is the use of artificial fertilizers*

stock production can succeed only through policy instruments. Those include capping the surpluses of nitrogen and phosphorus that a farm is allowed to produce, and reducing EU agricultural subsidies for farms that exceed the limits. ●

*Too many animals, too much nitrogen: even if the over-fertilization ends, Europe’s soils would still need decades to recover*

### RED ZONES

Nitrogen contamination of soils in the EU\*, 2010



© MEAT ATLAS 2021 / EUROSTAT

## REWETTING

# GIVE PEAT A CHANCE

Across the globe, peatlands are being drained for farming and raising livestock. But dried-out peat emits huge amounts of greenhouse gases. Agricultural policy should initiate a transition to the climate-friendly use of these areas.

Over the millennia, waterlogged land has given rise to ecosystems that transform partly decomposed plant biomass into peat, and in doing so, store huge amounts of carbon in the ground. Although peatlands cover only 3 percent of the world’s land surface, they contain twice as much carbon as the biomass of all the forests which spread across 30 percent of world’s land. Natural wet peatlands are true multitaskers. By filtering out nutrients and pollutants, they act as the “kidneys” of the landscape. They are important water reservoirs, and cool the surrounding area. Last but not least, they serve as a home for rare flora and fauna.

But peatlands have been, and still are being, drained in order to extract peat, to make the land usable for farming and forestry, and to gain new land for settlement. Permanently lowering the water levels allows air to penetrate the peat layers. The carbon these layers contain oxidizes and is emitted as CO<sub>2</sub>, exacerbating climate change. The peat is consumed in the process, and the surface of the land sinks: by 1–2 cm per year in Central Europe, and up to five times faster in the tropics. After hundreds of years of use, the surface of peatlands in the Netherlands now lies several metres below sea level. In dried-out peat layers, devastating fires may smoulder for months on end. Indonesia is known as the global hotspot with the highest CO<sub>2</sub> emissions from peatlands, while the European Union is in second place. Within

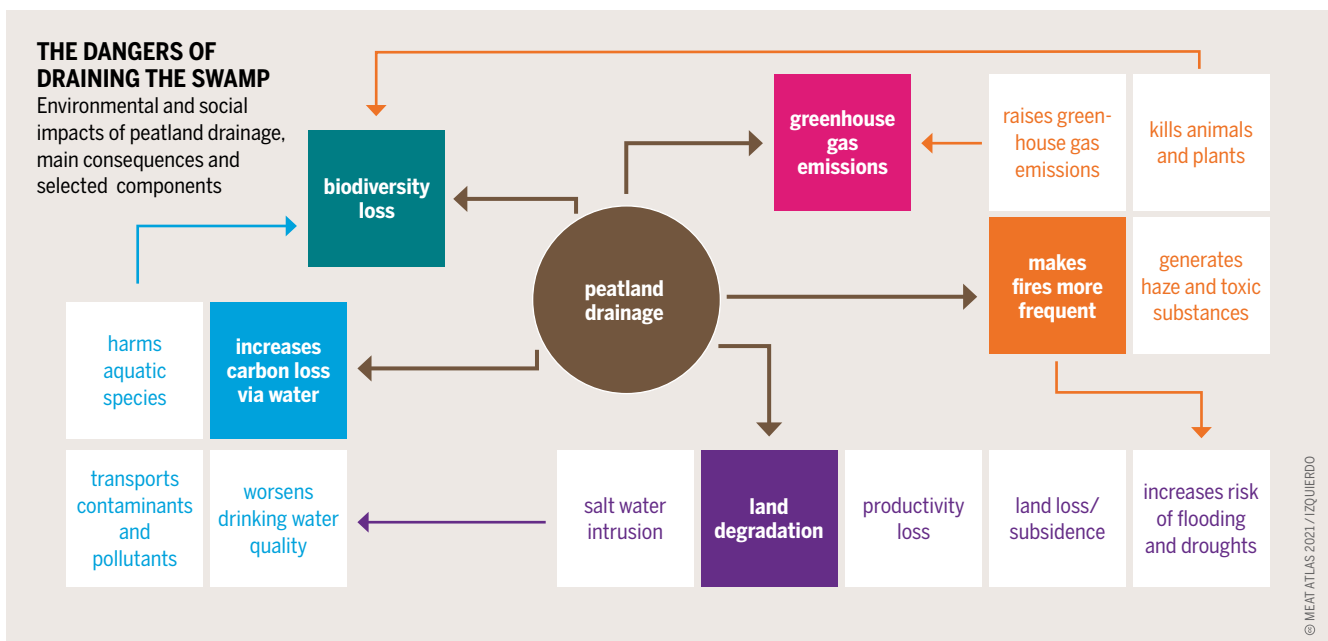
the EU, it is Germany, where 98 percent of peatlands have been drained, that accounts for the highest emissions.

Some 15 percent of the world’s peatlands have been drained, and half of those have been converted to agricultural use. Even though carbon-rich soils account for just 3 percent of the European Union’s agricultural area, their drainage is responsible for 25 percent of greenhouse gas emissions from agriculture and agricultural land use.

Most of the peatland soils drained for agricultural purposes in Europe are used for raising livestock. In some regions, such as southern Germany, Denmark, the United Kingdom and Switzerland, they are important for farming vegetables, potatoes and grains. In addition to being repurposed as meadows and pastures, peatlands are also used to grow fodder such as silage maize.

Dairy farms place high demands on the quality of their cattle feed, and especially on its energy content. The intensive use of peatlands for dairying is found in northwestern Germany, Finland, and especially in the Netherlands. The city of Gouda, which gave its name to the world-famous Dutch cheese, lies in the middle of a peat bog that was drained in the 11th century. With greenhouse gas emissions of 20 to 50 tonnes of CO<sub>2</sub>-equivalent per year, each hectare of intensive grassland and cropland on peat soils is especially damaging to the climate, and is also of negligible value in terms of biodiversity. These emissions increase the footprint of a kilogram of milk produced on peatland by 4 kilograms of CO<sub>2</sub>. That makes it around five times that of

*Human activities such as drainage and the destruction of native vegetation cause changes in ecological processes, ecosystem structure and species composition*



### INVISIBLY HARMFUL

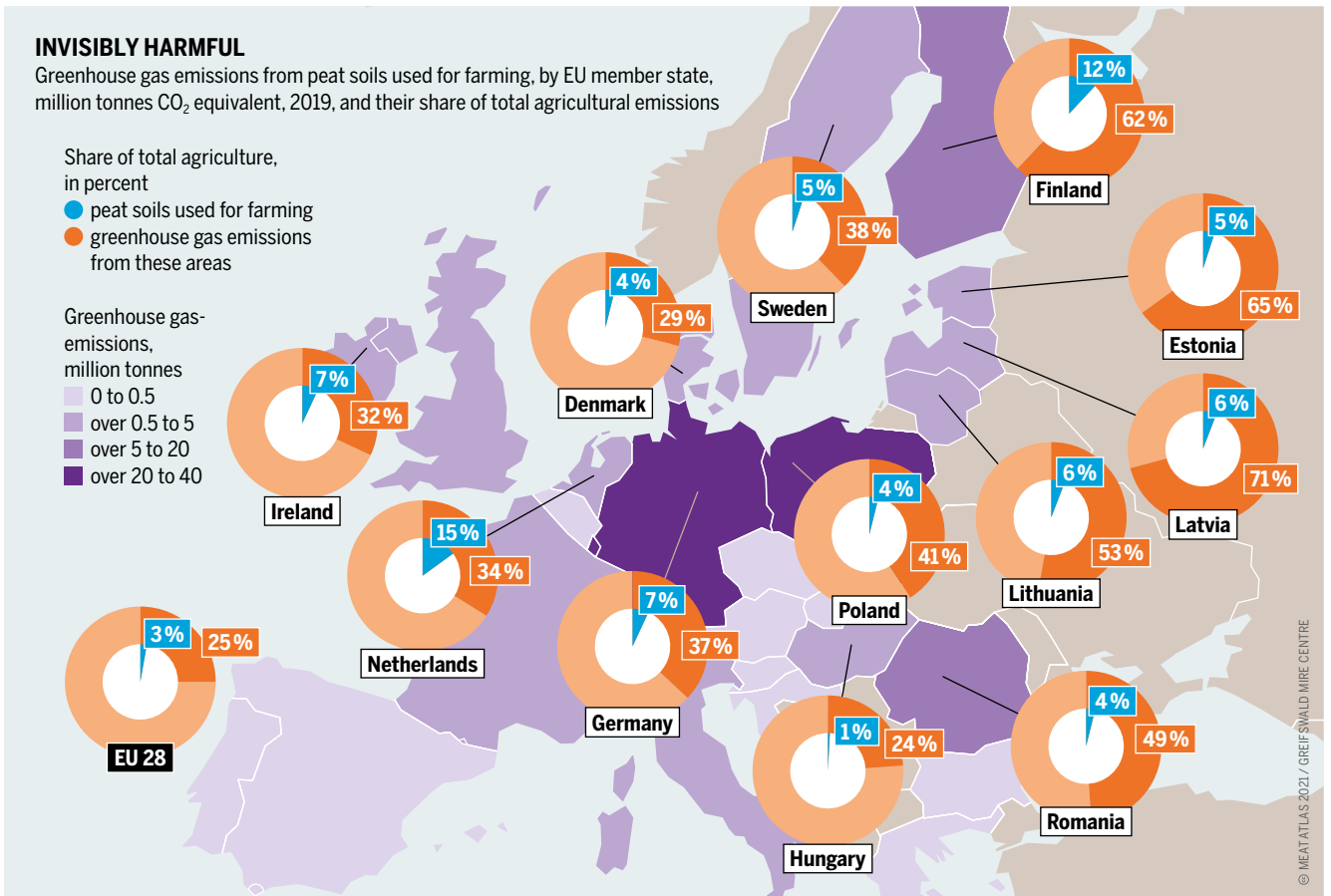
Greenhouse gas emissions from peat soils used for farming, by EU member state, million tonnes CO<sub>2</sub> equivalent, 2019, and their share of total agricultural emissions

Share of total agriculture, in percent

- peat soils used for farming
- greenhouse gas emissions from these areas

Greenhouse gas-emissions, million tonnes

- 0 to 0.5
- over 0.5 to 5
- over 5 to 20
- over 20 to 40



© MEAT ATLAS 2021 / GREIFSWALD WIRE CENTRE

milk produced on mineral soils, which is between 0.6 and 1.5 kilograms a year. The higher footprint applies to other dairy products as well. For a kilogram of cheese, made from 9 litres of milk, the annual CO<sub>2</sub> footprint is 45 kilograms, compared to 9 kilograms for non-peatland cheese. For a kilogram of butter, made from 18 litres of milk, it is 97 kilograms rather than 25.

For the productive and climate-friendly use of peatland areas, alternatives other than animal husbandry are needed. The answer may be “paludiculture” – from palus, the Latin word for swamp. Various types of plants are being tested that are suitable for cultivation on peatland sites that have been rewetted. Raw materials from paludiculture could contribute to the decarbonization of our economy. They include Sphagnum mosses, which can be grown on former bog grasslands, and which could replace peat being the predominant substrate in horticulture. Grasses and sedges from wet meadows can be used to produce fibre for paper and cardboard, disposable tableware and building panels. Reed and cattail can supply raw materials for construction and insulation.

In the European Union, it is the Common Agricultural Policy that determines whether peatlands are used in a manner that is both climate-compatible and socially acceptable. Scientists and civil society organizations are largely in agreement that funding practices have a key role to

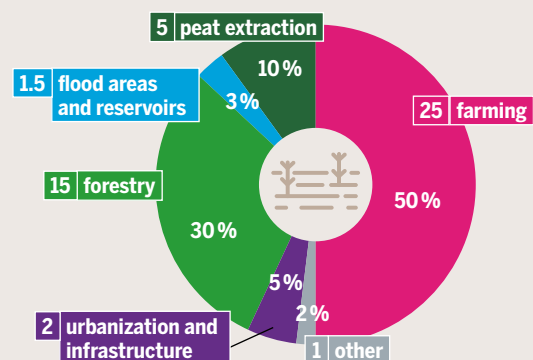
*Around 50 million hectares of peatland have so far been lost through human activity. Most have converted to arable and grazing land*

*Peatlands cover just a small part of the EU’s agricultural land. Rewetting them would minimize the emission of a disproportionate amount of climate-damaging gas*

play. Paludiculture and the periodic flooding of land could be supported in the future, while subsidies for draining peatlands should be withdrawn. Farms will need support to withstand such changes, starting with individual advice and investment, through to appropriate remuneration for their environmental and climate services. Protecting peatlands is not just the responsibility of individual farmers; it is a task for society as a whole. ●

### DRAINING THE SWAMP

Global conversion of peatlands, area in million hectares and proportion in percent, rounded



© MEAT ATLAS 2021 / GEC WI

# ANTIBIOTICS

## USELESS MEDICINES

Antibiotics help to treat many diseases. The big problem: in both humans and animals, pathogens can develop antibiotic resistance – a fatal danger. And in industrial livestock production, these drugs are still not being used carefully enough.

The global Covid-19 crisis has shown how dangerous it can be if there is a lack of effective medicines to treat people with diseases. Another global health crisis, one that already kills 700,000 people a year, is caused by bacteria that are resistant to antibiotics. The effectiveness of these medicines is limited because they are overused or wrongly applied, and the germs have become resistant to them. The World Health Organization has for years been warning of the spread of resistant strains of pathogens.

A large part of the problem is that 73 percent of the an-

tibiotics sold worldwide are used on animals, not to treat illness in humans. The proportion of industrial animal agriculture that routinely uses antibiotics is rising. Market analyses for pharmaceutical companies reveal that the global market for veterinary medicines has risen by 5 to 6 percent per year in recent years. If governments do not step in to regulate this more strictly, researchers predict a 67 percent increase in antibiotic use for livestock between 2010 and 2030.

Bacteria are constantly adapting. They develop genes for resistance, and they can pass these on to other bacteria, even from one species to another. That is especially a problem for zoonoses – pathogens that can infect both animals and humans – which can transfer resistance from the animal kingdom into the human body.

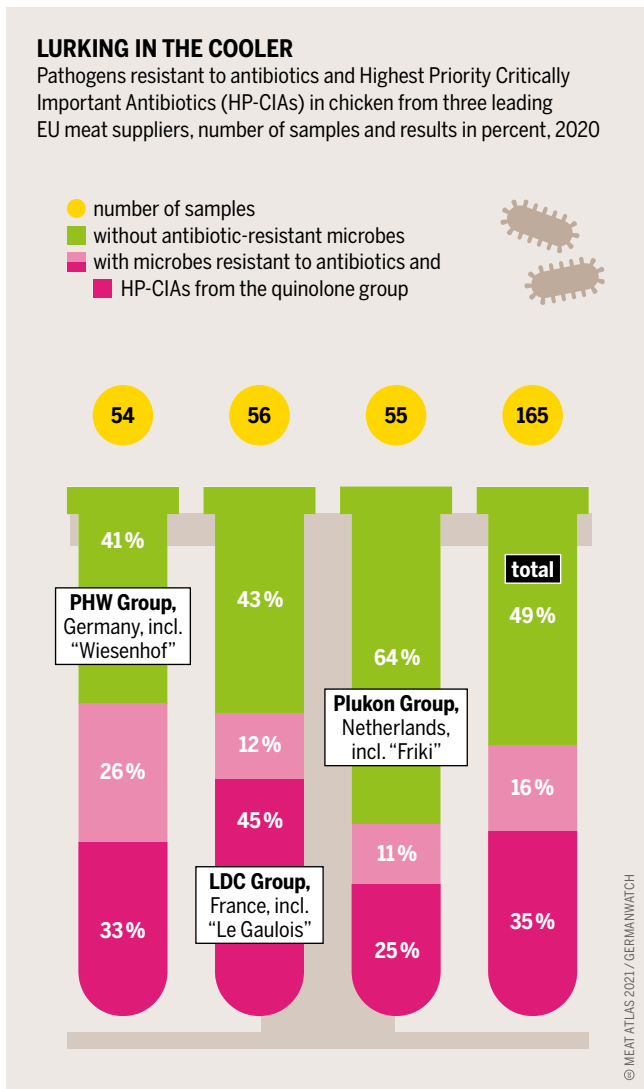
Resistance in livestock farms has increased markedly since the turn of the millennium in many countries. Parts of China and India are currently in the lead, but the numbers in Brazil and Kenya are also rising quickly. The World Health Organization warns that the excessive and inappropriate use of antibiotics in livestock is increasingly threatening their effectiveness in humans. That is because in animal husbandry, the bacteria develop resistance against the same antibiotics that are routinely used to treat infectious diseases in humans.

The use of so-called Highest Priority Critically Important Antibiotics (HP-CIAs) poses special problems. The World Health Organization recommends that these emergency antibiotics should be reserved for use in humans for cases where other antibiotics are ineffective. Although the EU Parliament has been calling for stricter rules for the application of HP-CIAs in stables for years, the EU Commission has not yet effectively regulated their use.

According to a study by the non-governmental organization Germanwatch, antibiotic-resistant pathogens were found in 51 percent of chicken samples from major poultry producers in five EU countries. Some 35 percent of the laboratory samples even had pathogens that were resistant to HP-CIAs and which could therefore render these last-ditch remedies ineffective. Meat from the poultry industry drags the resistant pathogens into the food chain, and therefore into consumers' kitchens. Humans could pick up the multi-resistant pathogens while preparing or eating contaminated meat. The resistant microbes may cause severe infections, against which hardly any antibiotics are effective. Or the genes that cause resistance can remain in the person's gut and render the medications used to treat other infections ineffective.

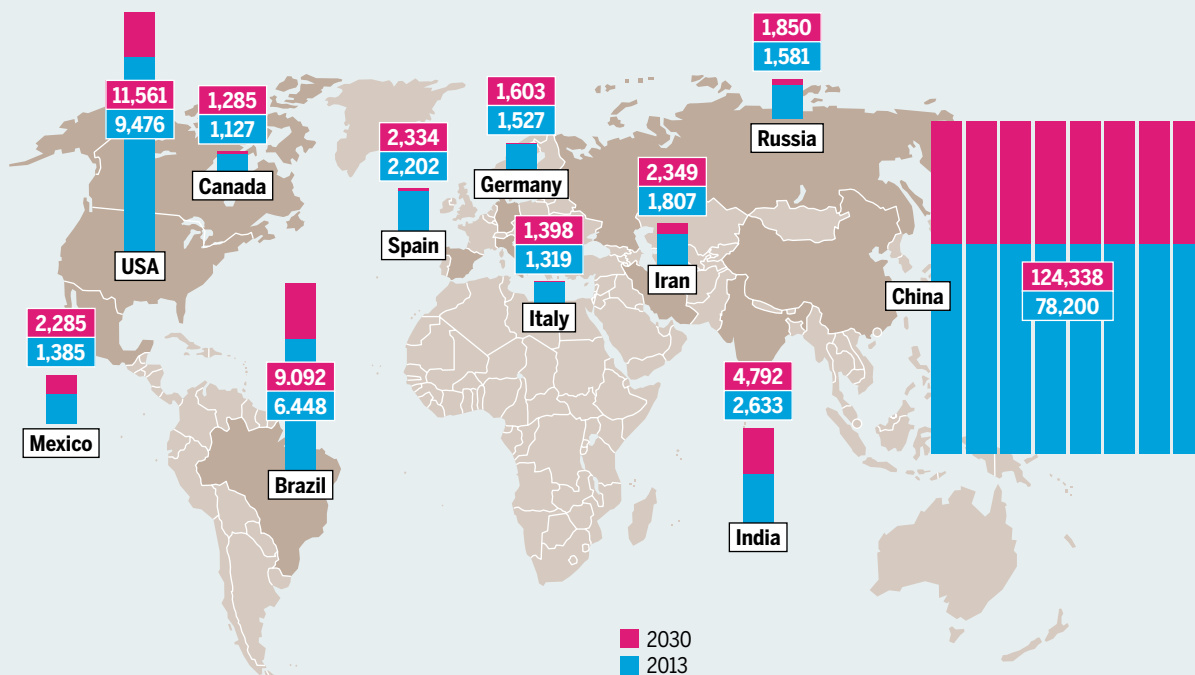
Livestock farms and abattoir employees, veterinarians, and residents of areas with large numbers of animals are

*Half of all chicken is contaminated with antibiotic-resistant pathogens. One-third even harbours microbes that are resistant to the most valuable antibiotics*



### GROWTH OF THE WRONG SORT

Countries with more than 1,000 tonnes of antibiotics sales for the production of animal-sourced foods, 2013 and expected increase to 2030, in tonnes



© MEAT ATLAS 2021 / VAN BOECKEL ET AL.

affected by resistant pathogens especially often. The risk of contracting these pathogens is 100 times higher for people who work in livestock enclosures than for people in nearby areas who have no contact to animals. The Covid-19 crisis has revealed the miserable working conditions for staff in many abattoirs. On top of that are the above-average health risks these workers face as a result of resistant pathogens.

Since 2007, no new class of antibiotics against infections in humans and animals has come onto the market. So there are no new mechanisms of action, and no new active substances. On the contrary: the patent protection for many antibiotics has expired, and the drugs are cheaply available. From a business point of view, it is worthwhile to research and produce new antibiotics only if they are used as often as possible. The logic of the market therefore contradicts the goal of maintaining the effectiveness of available treatments for as long as feasible so they can be used only in emergencies.

Antibiotics reduce the costs of livestock production in many ways. They can compensate for shortcomings in hygiene, management and care of the animals in the short term, yet account for only one to three percent of the total production costs. Some countries, including Brazil, permit their use to improve performance. The treated animals make better use of their feed and gain weight more quickly. This is forbidden in the European Union. Human and

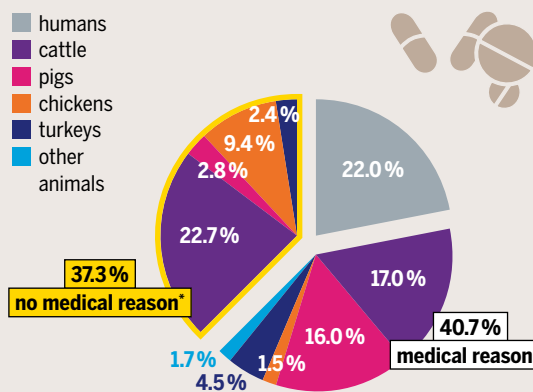
*Almost half of the antibiotics given to animals in the USA are not used to treat diseases but to prevent them – or to boost growth*

*China's meat producers feed their animals antibiotics primarily as growth stimulants. That amounts to half of the total worldwide use of these products*

veterinary doctors, consumer groups and environmental protection organizations around the world are calling for better laws to protect animals, a ban on the use of HP-CIAs in livestock, and high levies on other antibiotics, so that animal welfare that uses as few antibiotics as possible becomes more attractive to the farming industry. ●

### UNSCRUPULOUS APPLICATION

Use of antibiotics in the USA, 2017 (humans), 2018 (animals), in percent



\*e.g., prophylaxis for complete herds, use for fattening

© MEAT ATLAS 2021 / NRDC



# PANDEMICS

## DANGEROUS CONTACTS

**Livestock production and meat consumption stimulate outbreaks of diseases that can be transmitted from wild animals to humans. Such zoonoses can have catastrophic consequences – as Covid-19 has shown.**

The International Organization for Animal Health estimates that 60 percent of all infectious diseases in humans are zoonotic: they can be transmitted from animals to humans and vice versa. They cause some 2.5 billion cases of illness in humans each year, from malaria to Covid-19 – and 2.7 million deaths.

One of the best-known zoonotic diseases is rabies. It is still present in many countries. But many other zoonotic diseases have emerged only recently, like bird flu, severe acute respiratory syndrome (SARS), West Nile virus, and “mad cow” disease (bovine spongiform encephalopathy, or BSE). Then, of course, there is Covid-19, which is thought to have originated at a wildlife market in the Chinese city of

Wuhan, where the virus is said to have jumped to humans, possibly through the consumption of bushmeat.

The circumstances of meat production and consumption play a central role in the transmission of zoonoses to humans. Research has found that almost 75 percent of the various known zoonoses can be traced to wildlife – from consuming the meat of wild animals, for example. Because more and more land is being used for agricultural production and the habitat of wild animals is being destroyed, the spaces occupied by wild animals and humans increasingly overlap. This increases the risk of people contracting diseases from infected animals. Intermediate hosts such as ticks and mosquitoes also play a role. Unless there is a change in policy, the share of zoonotic diseases in the human disease burden will rise as the human population of the world increases and as consumption patterns shift towards more meat.

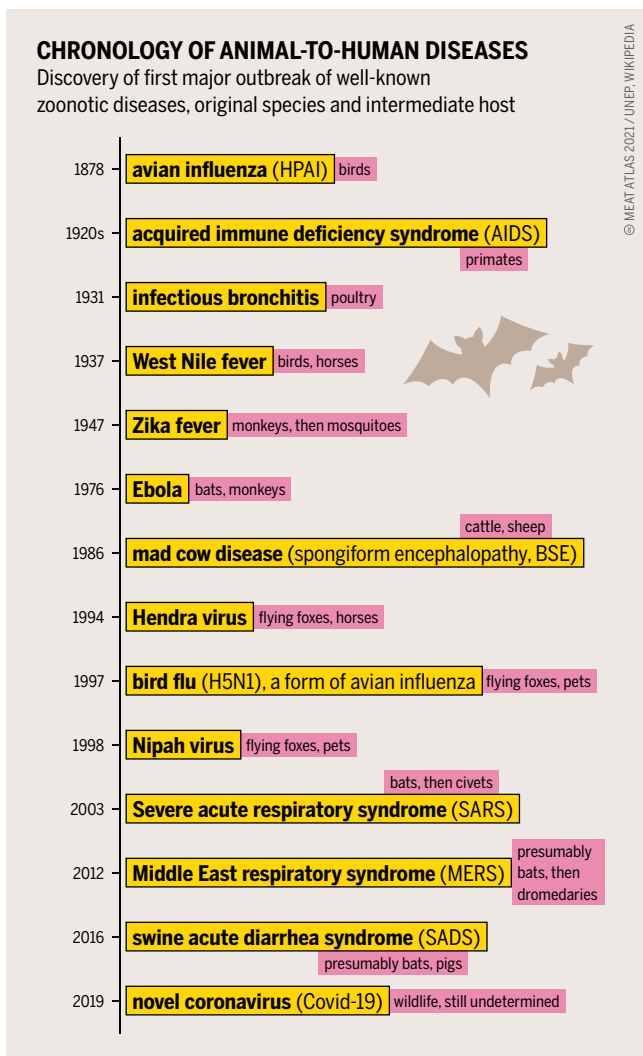
An example of the connection between environmental destruction and zoonoses is the well-researched outbreak of Nipah disease in Malaysia. Between August and October 1997, slash-and-burn agriculture and a severe drought in neighbouring Indonesia destroyed about 5 million hectares of forest. Huge plumes of smoke prevented large numbers of flowers and fruits in Malaysia’s forests from flourishing. Flying foxes, carriers of the Nipah virus, therefore sought feed in nearby mango plantations. There, the virus was transmitted – through either their saliva or their urine – to domestic pigs who also fed on the mangoes. The pigs in turn infected farmers, who fell ill from a form of encephalitis. This brain infection caused hundreds of deaths; the mortality rate was around 40 percent.

Increased human presence, a reduction in wildlife habitat and a higher number of domestic animals: these three factors make the transmission of diseases from animals to humans more likely. According to a study published in the scientific journal *Nature*, the clearing or draining of land for farming, as well as agricultural production, can be linked to over 25 percent of all infectious diseases and more than 50 percent of all zoonotic infectious diseases in humans.

Industrial livestock production also raises the risk of disease transmission. While the world’s human population has doubled in the last 50 years, global meat production has more than tripled. In 2017, the world had some 1.5 billion cows, one billion pigs, almost 23 billion poultry birds and more than 2 billion sheep and goats. Often, many tens of thousands of animals are kept together in confined spaces.

The World Health Organization and the Food and Agriculture Organization of the United Nations have for years warned of the dangers of pandemics in connection with in-

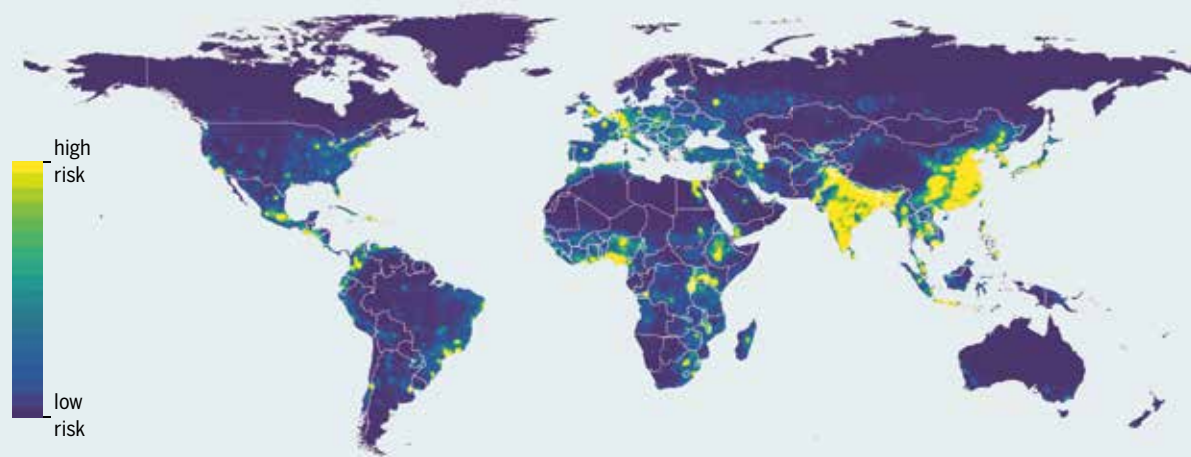
*It is not always clear which animal a virus comes from and whether there are intermediate hosts*





## WHERE THE NEXT PANDEMIC MAY START

Risk of the emergence of diseases that originate in animals and are dangerous for humans, geographical location of hotspots



© MEAT ATLAS 2021 / UNEP

dustrial livestock farming, especially regarding poultry and pigs. Intensive forms of management, where the genetic variability of the animals is low, are particularly problematic. If a virus enters such a farm, it can spread easily because it can find many suitable host cells in one fell swoop. Close contact then creates a high risk for humans too.

The trade in live animals and meat products can also spread zoonoses around the world. The Scientific Task Force on Avian Influenza and Wild Birds, which works with the United Nations, is convinced that the viruses that cause avian flu are not only transmitted by wild and migratory birds. It also sees a threat in the international trade in poultry, as

*Infections that are transmitted from wildlife to humans tend to fall into particular categories – though they are of varying severity*

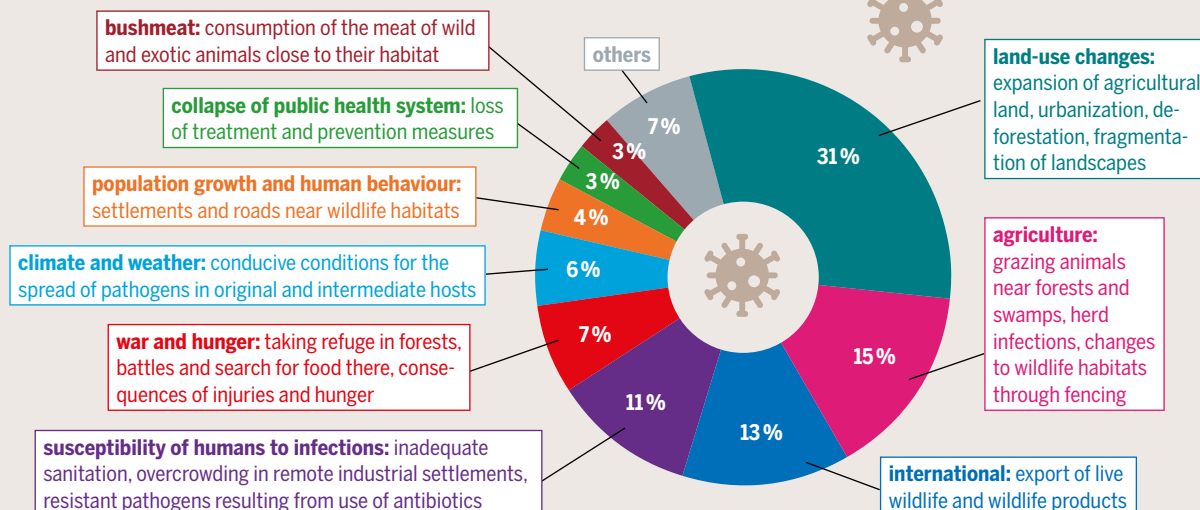
*Where many people and many livestock come into contact with pathogens that originate in wildlife, the risk of an outbreak of an infectious disease is high*

well as in infections on poultry farms. The viruses enter the wild from there and are transmitted to wild birds.

How dangerous avian flu is depends on the pathogen on one hand, and on the amount of human contact with diseased or dead birds on the other. Since 2003, around 850 people globally have fallen ill from avian flu caused by the pathogen H5N1. More than half of them, 450 people, have died. But if human-to-human infection were to occur, millions of deaths could result. The spread of Covid-19 has at least shown what has often been ignored: to reduce the risk of future pandemics, the biodiversity of our planet must be protected and industrial livestock production must be transformed. ●

## THE MORE FIELDS AND PASTURES, THE MORE INFECTIONS

Main causes of the spread of zoonoses in 183 documented cases, 1940 to 2004



© MEAT ATLAS 2021 / LOH ET AL.

# PASTORALISM

## BOUNTY FROM A BARREN LAND

Mobile herders move with their herds or flocks in the remotest of pastures. This form of animal production, known as pastoralism, is economically important and climate-friendly, but it is under severe threat.

The origins of pastoralism can be traced back more than 10,000 years. The practice emerged on the edges of the earliest permanent settlements in the Middle East. It was probably women who first domesticated goats and sheep by raising orphaned lambs and kids. Later, parts of the community started following the flocks to seasonal pastures in the desert. They formed the origins of numerous herding cultures that have ever since produced products such as meat, milk, wool, skins, fertilizer and fuel.

The term pastoralism – the often-mobile, extensive keeping of locally adapted animals on natural bush and grassland – refers to both an economic activity and a cultural identity. There are pastoralists on all continents except Antarctica, particularly in dry, steep, cold or hot areas with few other economic uses. They herd alpacas, camels, cattle, goats, sheep, reindeer, water buffalo and yaks. They inhabit over 26 million square kilometres – more than the combined areas of the USA, China and the European Union.

Although pastoralism mainly uses marginal areas for

production, it plays a central role in many countries. In Burkina Faso, over 70 percent of livestock are maintained in pastoral systems; in Niger and Chad it is over 80 percent; in Sudan, Tanzania and Somalia, over 90 percent. In India, the country with the largest number of poor livestock keepers, more than half the milk and 70 percent of the meat comes from pastoral production.

An estimated 200 million people live as pastoralists. The Food and Agriculture Organization of the United Nations (FAO) estimates that they manage about a billion animals. In parts of Africa and Asia that are dry all year round or that have pronounced dry seasons, as well as in the Andes in South America and in the Arctic, these animals are a major source of food and income for many people. In the northern Sahel, pastoralists have a more secure source of both food and income than sedentary farmers in the same region.

For the welfare of their animals, pastoralists accept many hardships and a lifestyle with few material belongings. They base their decisions about grazing areas and routes on traditional knowledge and on their experience with animal behaviour, weather conditions and the nutritional value

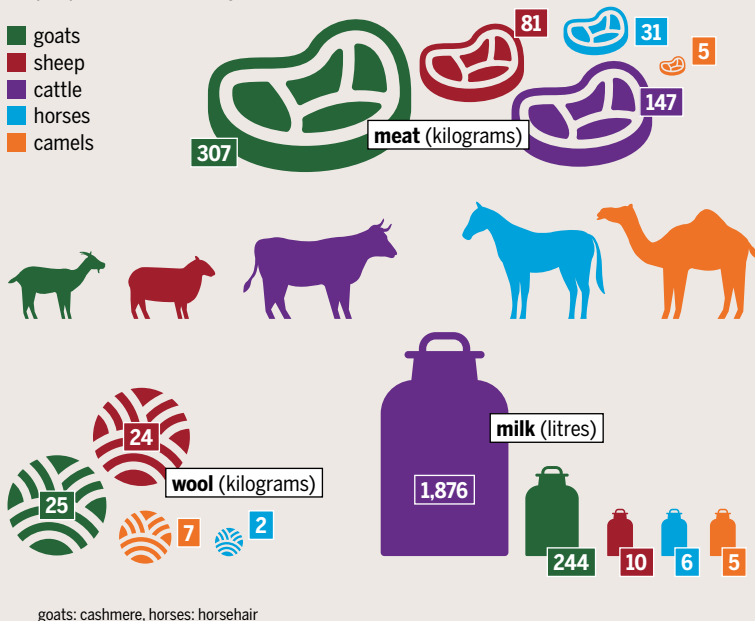
*For Mongolian pastoralists, goats and cattle bring in about the same amount of money, but cattle take less work*

### HERD PERFORMANCE

Income sources from pastoralist livestock keeping in Bulgan Province, Mongolia, 200 representatively selected from 943 households, 2016, data: 2012

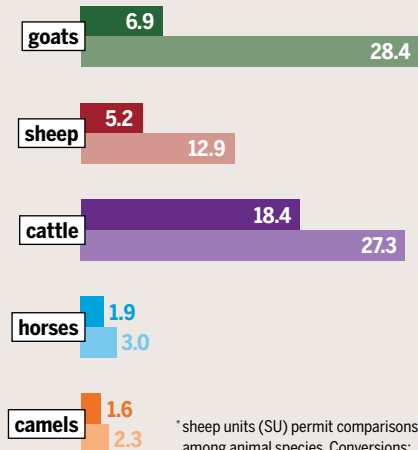
output per household and year

- goats
- sheep
- cattle
- horses
- camels

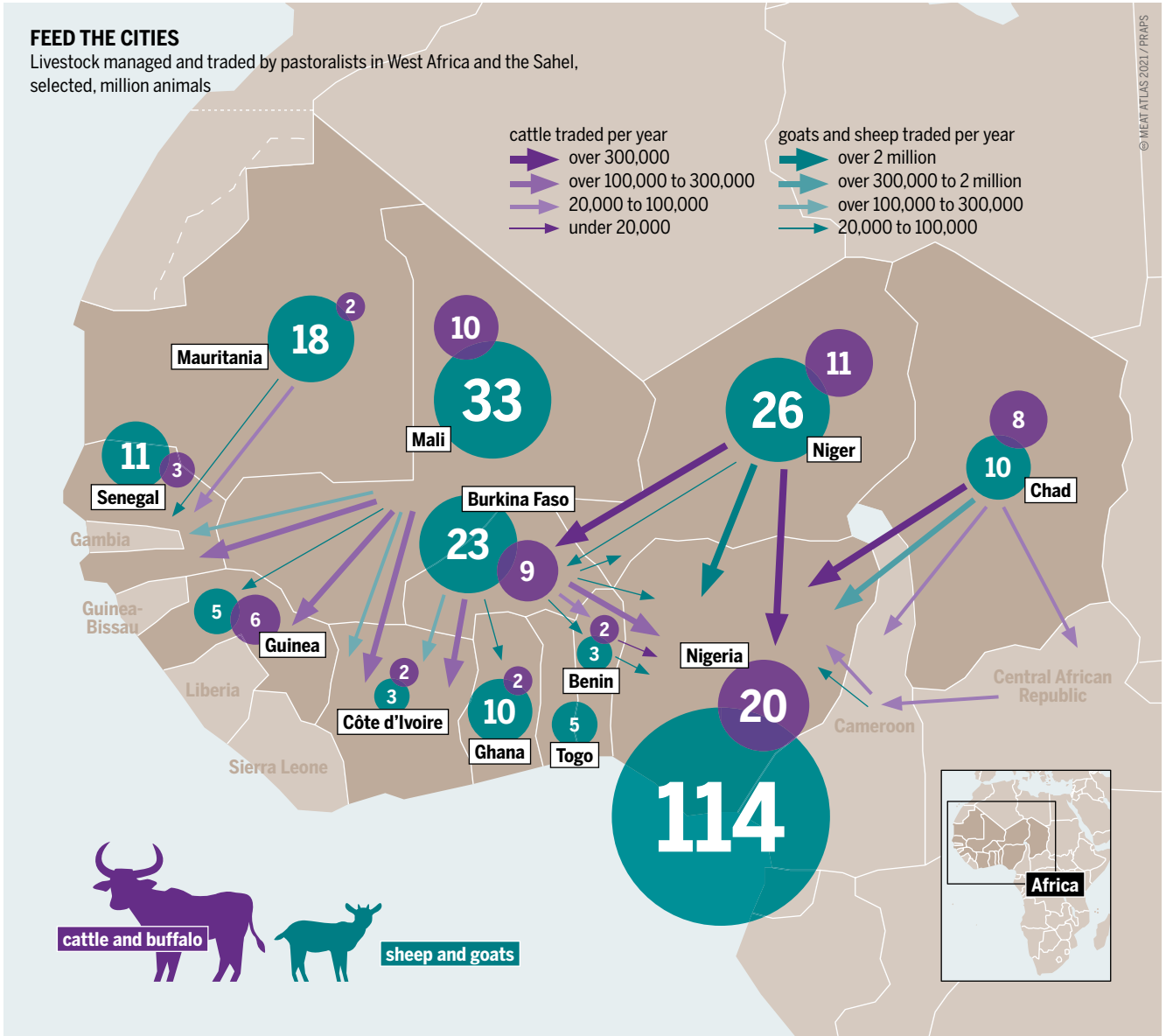


profit per sheep unit\* (euros)

- including labour costs
- excluding labour costs



\*sheep units (SU) permit comparisons among animal species. Conversions: 1 camel = 7 SU, 1 cow/horse = 5 SU, 1 sheep = 1 SU, 1 goat = 0.9 SU (adult animals)



of the vegetation. Social networks are also important. They are built up over generations and make access to particular grazing areas possible.

Pastoralism is of particular importance to the ecology. The manure distributed by grazing animals plays an important role in the landscape. It sustains insects, which in turn are food for birds, amphibians and reptiles. Grazed pasture is a vital carbon sink.

The pastoral way of life is threatened mainly by the increasing fragmentation of the grazing lands. Rising demand for agricultural products since around 2005 has led to a conversion to cropland and significant investment in industrial farming on the most valuable grazing lands. Only rarely do pastoralists have a say in what happens to the grazing lands they have used for generations. The state often claims ownership of the land for itself and decides on investments and use.

In times of climate change, pastoralists need as many additional options as possible to adapt their mobility and grazing methods to new feed, water and weather conditions. Some scientists assert that pastoralists are among the groups worldwide that are most threatened by climate

*Livestock connects – herds of cattle, and flocks of sheep and goats, are the most important intraregional economic factor in West Africa and the Sahel*

change. Altered temperature and precipitation patterns are changing feed and water resources and affect the incidence of diseases and the reproductive performance of the animals, and thus the herd size. A decline in animal numbers reduces the food security and income of the herders. Other specialists, on the other hand, regard the mobile economic model and lifestyle as an especially useful way to adapt to the consequences of climate change.

Pastoralism is gaining increasing support from scientists and from UN organizations such as FAO. But the political conditions in many countries are not conducive. Few countries formally recognize the herders' rights to their grazing lands or integrate them into their rural development policies. For pastoralists, however, land rights that strengthen the communal use of land and the promotion of knowledge sharing among the stakeholders would be the best recipe for sustainable living in times of climate change. ●

## PASTORALISM IN INDIA

# RANGELAND, NOT WASTELAND

**India is the world's largest exporter of buffalo, sheep and goat meat. Remarkably, the majority of this output is produced in traditional agropastoral systems.**

India's farm animal population includes 193 million cattle, 149 million goats, 110 million buffalo, 74 million sheep, 9 million pigs, 300,000 camels and 58,000 yaks. Around 77 percent of these animals are kept in extensive systems, meaning they are either herded or left to range on their own on common land. These animals produce about 53 percent of India's milk and 74 percent of its meat. The livestock sector comprises 4.5 percent of India's GDP, with two-thirds coming from such pastoralist production.

India is a collage of pastoralist cultures, and among its myriad castes and communities, some 46 have distinct pastoralist identities. They distinguish themselves from farmers by not owning land – or they have only very small plots. Instead, they use their herds or flocks to harvest “waste” biomass, grazing on harvested fields, in the forest or on uncultivated land. A tremendous variety of such systems exists. They include transhumance (seasonal migrations, such as between lowlands and mountains), nomadic and semi-nomadic movements, and village-based herding. Precise figures are lacking, but an estimated 1 percent of India's population, or around 13 million people, are practising pastoralists for whom managing and breeding livestock is a hereditary profession that goes back countless generations. Many of these communities believe that their primeval ancestor was divinely created for the express purpose of taking care of livestock. From this connection, they derive a sense of responsibility for the welfare of their animals.

Pastoralists are present in all parts of India. In the high-altitude deserts of Ladakh, herders keep yaks, sheep and goats. Other pastoralists move with their buffalo, sheep and goats between villages in the Himalayan foothills in the winter and alpine pastures in the summer. In the Thar Desert in India's west, herders breed sheep, camels, goats and cattle. Some of them undertake long-distance migration across states. In Odisha in the east, a number of communities herd pigs over harvested paddy fields.

Pastoralists have developed a significant proportion of India's livestock breeds: 73 out of 200 officially recognized breeds, according to one count. These breeds are very special, being on the one hand very alert, resilient, hardy and independent, but also bonded to their herders in a symbiotic relationship.

Herders need to ensure they can use grazing areas throughout the year. They also need to market their animals, meat and milk. To do this, they have to maintain extensive social networks with farmers and landowners, within their own community, and with local communities and traders.

Pastoralism is important for crop cultivation and long-term soil fertility. The animals distribute manure directly

on the fields where they are penned overnight. For some herders, manure is actually their main source of income, as farmers compensate pastoralists for this service in cash or in kind. The value of this manure as a source of nitrogen, phosphorus and potassium has been estimated at a massive 45 billion US dollars a year.

Pastoralists also play an important role in conserving wild biodiversity and in creating and upholding domestic animal diversity. Their livestock convert native vegetation directly into food, without having to go through the intermediate stages of clearing land, ploughing and raising crops. The animals also disperse seeds that get caught in their wool or hides and then fall off elsewhere. Pastoralists have learned to live with wildlife, including predators. Herders on the Deccan Plateau even worship the wolves that sometimes feed on their sheep.

The Indian government does not recognize “pastoralism” as an official category, so it does not collect data on it. The government operates under the assumption that most livestock are stall-fed and kept by sedentary farmers. It makes no special efforts to protect or secure the resource base of pastoralists: forests, village grazing grounds, fallow fields, and so-called “wastelands”, which are actually often rangelands that sustain major livestock populations. All these common-pool resources are shrinking rapidly – fenced, expropriated, built on, or barred for herders. Many pastoralists traditionally have their animals graze in forests during monsoon season, when fields are being cultivated. But the authorities believe that they damage the forests, so no pastoralist community has yet received grazing rights under the Forest Rights Act. Government veterinary services often do not reach migratory communities. And an emerging threat is the use of village grazing grounds and agricultural land for alternative energy projects, especially huge areas covered in solar panels.

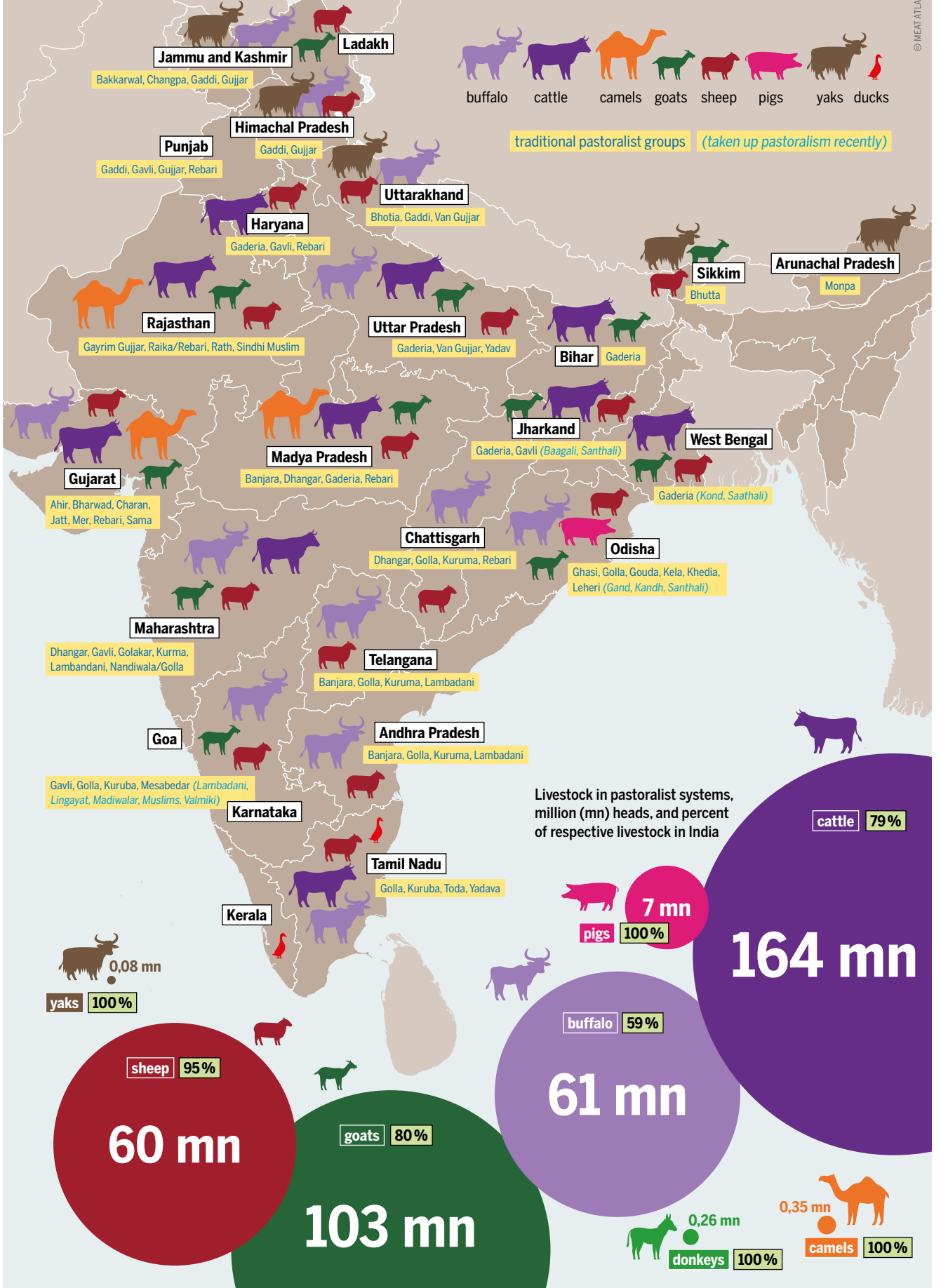
Due to several reasons young people prefer to migrate to cities rather than taking up herding – though a reverse movement has also been seen as a consequence of Covid-19. Camel herders are in an especially severe situation, as demand for draft animals has fallen and there are no other marketing options for their products.

Despite the absence of policy support, pastoralism has shown itself to be remarkably resilient in many parts of the country, even expanding in some areas, such as the Deccan Plateau, to respond to the growing urban demand for meat. By contrast, pastoralism has declined in the western drylands, including Rajasthan and Gujarat. But thanks to the activities of civil society organizations, awareness of the economic and ecological significance of pastoralism is gradually growing. ●

*Official data on India's livestock do not reflect the management systems used. The importance of pastoralists often goes unrecognized*

# UNPERCEIVED FORMS OF LIVESTOCK FARMING

Distribution of Indian castes and communities with specialized pastoralist identities – transhumance, nomadic, semi-nomadic and village-based – and animals reared





## ACTIVE STATE

# THE POLITICAL ECONOMY OF TRANSFORMING THE MEAT SYSTEM

Representative surveys in various countries have found a surprising amount of public support for reduced consumption of meat. Policymakers must find the right package and sequence of measures to stimulate the transition to a more sustainable future.

If the world is to hit the Paris climate targets and achieve the UN Sustainable Development Goals, we will have to reduce the amount of meat we produce and consume. This especially applies to the industrialized countries. Public policy must play a key role. On the supply side, potential measures include stricter animal welfare and environmental standards, targeted subsidies for environmentally friendly production, support for plant-based options, and restrictions on the number of animals that can be kept per hectare. On the demand side, possible policies include discounts for plant-based products, higher taxes on meat, labels to reflect the sustainability of products, and rules to increase the share of vegetarian meals in public eateries like company restaurants or school cafeterias.

Such measures need to be combined into holistic policy packages. The main barrier is not technical but political. The dominant theme of “consumer responsibility” plays into the hands of powerful interest groups which benefit from the current system and try to limit state intervention in food consumption. Politicians are afraid of conflict with such groups and want to avoid a public backlash against policies that interfere in people’s daily lives. Yet research

on public opinion in China, Brazil, the EU, India, Japan, South Africa, Switzerland, and the United States shows that people are in fact willing to reduce their meat consumption and are more accepting of policy changes than is commonly assumed. A recent survey for the European Investment Bank of 30,000 respondents in 30 countries, for example, found that 78 percent of Chinese respondents, 65 percent of those in the EU, and 54 percent of those in the United States, supported reductions in red meat consumption to fight climate change.

Similarly, a study by the Swiss Federal Institute of Technology found that over 50 percent of citizens in China, Germany and the United States supported measures to reduce meat consumption, even if they would mean higher prices and interference in their private lives. Particularly welcomed were measures that covered both production and consumption, such as a combination of higher animal welfare standards, increased taxes on meat, discounts on plant-based meat substitutes, and financial support to help low-income households purchase environmentally friendly food products.

The survey found great differences in public support for the various policy proposals: support for the most popular package was 55 percent higher than for the least popular. That means that packaging the policies in the right way,

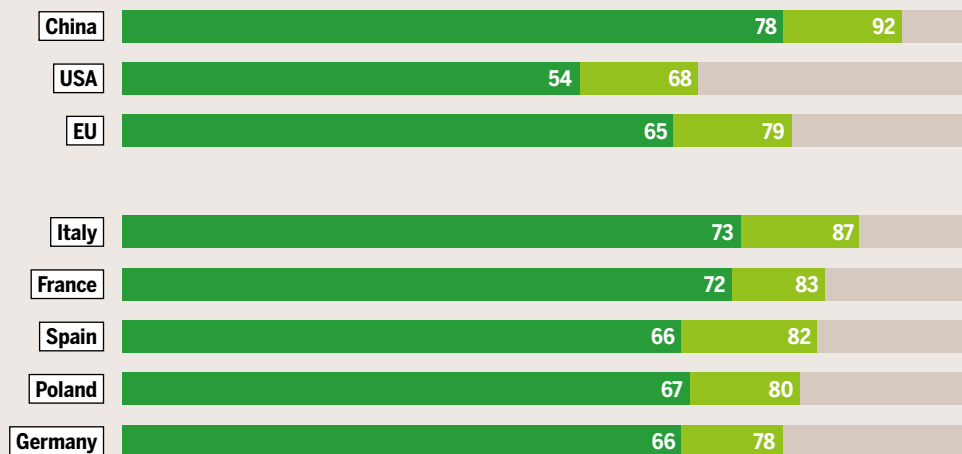
*Because many people already believe the climate is a reason to eat less beef and pork, governments have enough public support to reduce meat consumption*

### DOWNSIZING THE RED MEAT PORTIONS

Responses to a survey, 2019, percent

“Have you reduced your red meat intake to fight climate change?”

■ have done so already  
■ intend to do so



Participants: China, USA: 1,000, EU: 28,088, other: 2,000

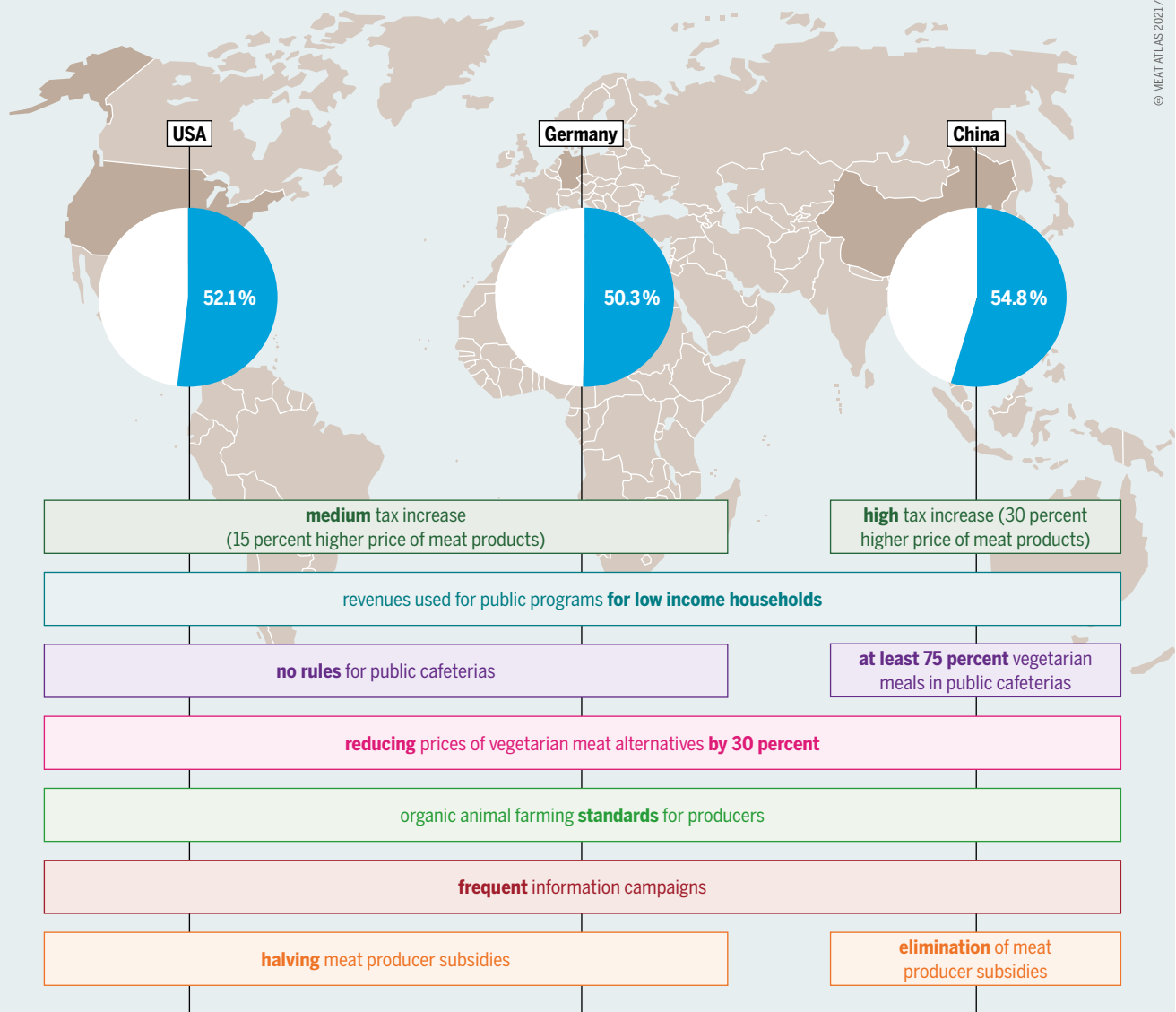
© MEAT ATLAS 2021 / EIB



## ENDORISING POLICY PACKAGES

Proposals for less meat consumption in the USA, Germany and China, survey\*, 2018

■ clear support, percent



\*4,874 participants; Germany and USA: representative of adult citizens' population; China: representative of adult higher-income and urban citizens' population

© MEAT ATLAS 2021 / FESENFELD ET AL.

and introducing them in the right order, will help reduce political risks and build supportive coalitions. Policymakers need to explain the reasons for demand-side policies to reduce meat consumption – e.g. by highlighting the climate mitigation benefits, rather than trying to reframe and hide the costs.

The survey found that support for meat substitutes (such as targeted producer subsidies) and incentives for plant-based diets (via tax discounts) was also high in China, Germany and the USA. Such measures could trigger changes in consumption and attitudes that could make more stringent demand-side policies, such as higher taxes on meat, politically feasible.

A recent study in China and the USA highlights that growing personal experience with plant-based meat substitutes is essential for transforming the meat system. If someone has already tried plant-based meat substitutes, they are

*In China, Germany, and the USA, a majority of respondents support stringent policy packages to reduce the consumption of pork and beef*

more likely to reduce their intake of meat and to support policies that cut meat consumption.

Policies could also increase the availability of vegetarian dishes in public eateries, for example, lower the consumer cost of plant-based options, and create coalitions between the producers of such products, retailers, investors, NGOs, and consumer groups. A combination of campaigns and product labelling, together with the greater availability of meat substitutes and vegetarian dishes, could trigger a virtuous cycle of change. Greater public support for change and awareness of meat-related sustainability issues could then open windows of opportunity to push for more transformative policies. ●

## THE EUROPEAN UNION

# COMMON LIVESTOCK POLICY

**Intensive livestock production creates environmental and animal welfare problems. Reforms currently being considered to the EU's Common Agricultural Policy do not go nearly far enough to resolve these. But improvements can be made even within the current system.**

**A**t 40 percent, livestock account for a big chunk of the value of the EU's agricultural output. The importance of livestock varies from one member state to another: from 21 percent in predominantly arable Romania, to 75 percent in Ireland with its many sheep and cattle. The number of animals per unit of area also differs, along with the problems associated with high stocking rates. The Netherlands has a high concentration of livestock, along with northern Italy and the northwestern parts of Germany and France.

Such concentrations lead to environmental problems, such as nitrogen and phosphorus pollution in water. Producing and consuming a lot of meat, milk and eggs emits significantly more greenhouse gas compared to diets based on plants. And animal welfare problems are widespread. There are no systematic, EU-wide surveys, but individual studies point to common health issues: joint diseases and tail biting in pig-fattening operations, lameness in cattle, and foot problems in poultry.

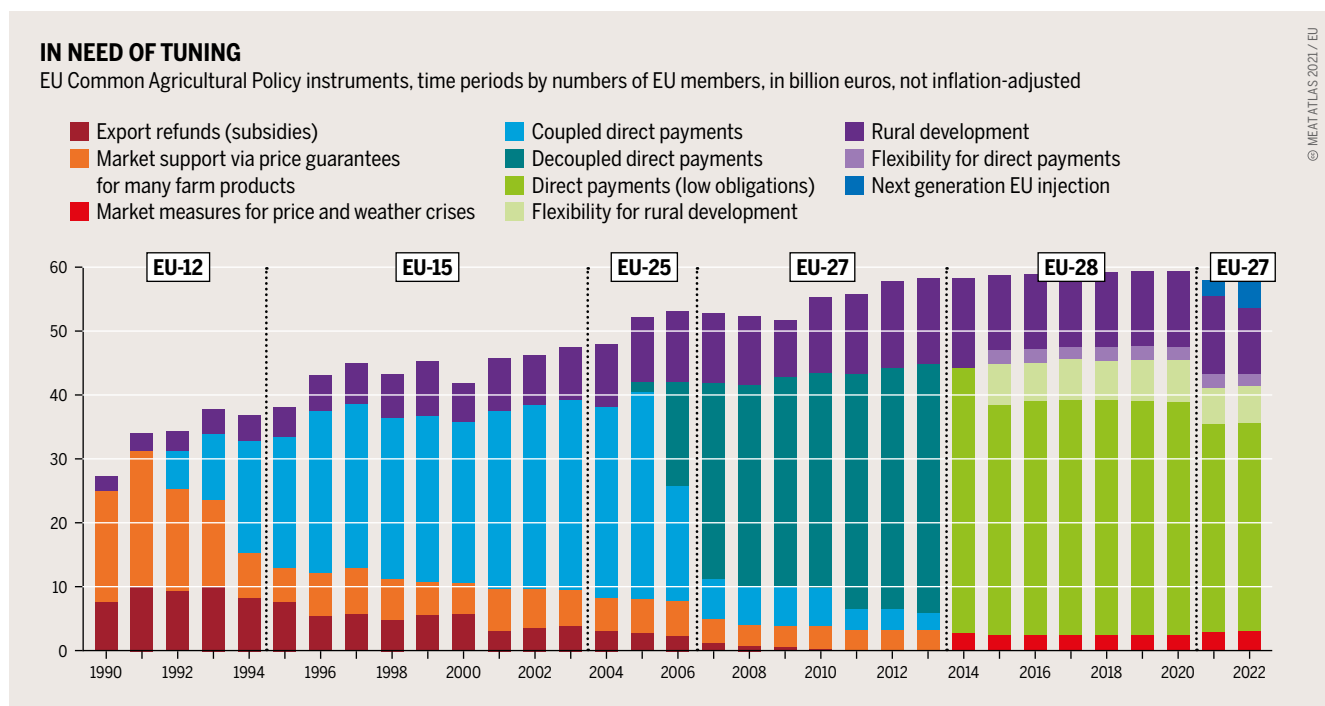
Surveys show that 82 percent of EU citizens think that more should be done to protect animal welfare in livestock production. This sentiment is widely shared across Europe

– from a sizeable majority of 58 percent of respondents in Luxembourg to a near-unanimous 94 percent in Portugal. But doing more to protect animals would not be cheap: the Scientific Advisory Council for Agricultural Policy, a body attached to the German Ministry of Food and Agriculture, estimates that significant improvements in animal welfare would cost between 3 and 5 billion euros a year in Germany alone. That is between 13 and 23 percent of current production costs.

Both production and consumption should be reduced to lower emissions of greenhouse gases. This is especially important with ruminants, which produce a lot of emissions per kilo of meat or litre of milk produced. A political and economic strategy that recognizes the scale of these challenges does not yet exist, either at the EU level or in any of the member states. Large differences in livestock production and consumption between countries mean that planning and implementing such a strategy must be the task of governments in each member state. The Common Agricultural Policy would have to provide a suitable framework for such an effort.

The Common Agricultural Policy consists of two “pillars”. Pillar I makes direct payments to farmers and is tied mainly to the area farmed, not to the services that farming provides. Pillar II, which covers rural development, offers the possibility of granting annual premiums to farmers for

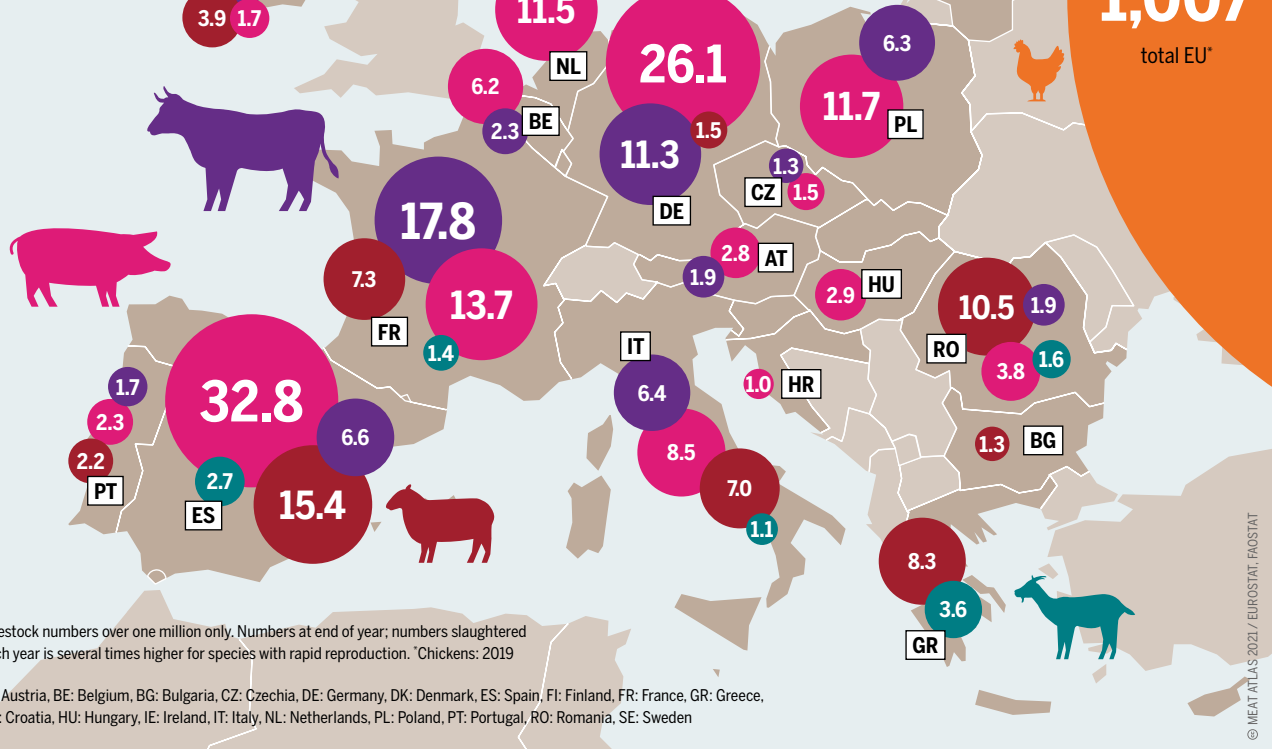
*At just under 60 billion dollars, financial support for farming now makes up around 40 percent of the EU budget. Thirty years ago, it was almost twice that share*



## PRODUCTIVE LIVES

Livestock numbers in the EU and their distribution by member country, selected, 2020,\* million animals

- cattle
- pigs
- sheep
- goats
- chickens



animal-friendly management. This can include providing grazing areas, allowing animals more space for movement, and enriching their environment – providing pigs with deep straw bedding or bales to keep them occupied, for example. But this flexibility is in fact rarely used. Between 2014 and 2020, only 1.5 percent of the Pillar II funds, or 205 million euros a year, were spent on animal welfare premiums. Even in welfare-conscious Germany, the figure was below 2 percent. That contrasts with area subsidies of 40 billion euros for the EU as a whole.

This comparison shows how poorly the EU’s farm budget is geared to the services that agriculture provides and the problems that it faces. Livestock farmers are up against particularly great challenges, with increasing obligations to protect groundwater and surface water, the climate, biodiversity and animal welfare. These requirements cannot be met merely by imposing more rules and regulations. Doing so would lead to significantly higher production costs and the increased import of cheap products from countries that do not have such stringent controls. That would negate the intended environmental and animal welfare benefits by shifting the problems abroad. The Common Agricultural Policy budget should be urgently reformed to reward compliance with the requirements and to cover part of the costs of doing so. Instead, a large part of the budget goes towards flat-rate subsidies

*Fateful trend: Direct EU payments to farmers stimulate industrial animal production, not better maintenance of grazing areas and animal welfare*

on land. In many member states, it is also spent on coupled payments for ruminants, such as suckler cows.

Unfortunately, negotiations among the key EU-level decisionmakers – the European Parliament, Council and Commission – did not result in a fundamental shift away from flat-rate subsidies tied to land area. But even with the current post-2021 CAP, member states have many options to target the budget towards supporting animal welfare and environmental services provided by farms.

First, to ensure that more money is available to pay for services, member states can shift up to 25 percent from direct payments to Pillar II for agri-environmental and animal welfare programs. Second, eco-schemes in Pillar I and conditionality can be designed ambitiously. Third, the possibility to link part of the direct payments to production should aim strictly at animal welfare and environmental protection measures, such as the maintenance of grazing areas. Such payments should be based on grazed land and not bound to animal numbers or specific species. In conclusion, member states can and should not hide behind CAP regulations, but make full use of existing flexibility to target the money towards societal objectives. ●

## LABEL

# THREE STARS FOR A BETTER LIFE

**Buy meat from a supermarket, and you can probably choose between organic and non-organic. But with the non-organic products, you have no way of telling whether the animal was treated well, or was stuck in a pen with little room to move. Calls are growing for meat labels that show the conditions under which the animals are raised.**

In business economics, it is called a “lack of market differentiation”. Consumers are willing to pay more for a product only if they are confident that the price reflects better production and animal welfare standards. Yet farmers whose products meet standards beyond the legal minimum – but do not qualify as organic – cannot communicate this to supermarket shoppers. They face a dilemma. If they cannot convince customers that their product is better, they cannot charge a higher price for it. They have no incentive to invest in improving animal welfare.

Whether animals are kept under suitable conditions is something that the customer cannot tell by looking at the meat itself. So it has to be shown on a label on the packaging. Credibility and safety are the most important features of such labels. For producers, the decision to use a label is accompanied by significant investments in their husbandry systems: in buildings, equipment and feed. The investments must pay off in the long run through heightened market demand for their product. Both sides – producers and consumers – need reliability, which only a compulsory official labelling scheme can provide.

Many civil society organizations claim that a uniform, obligatory scheme would make it possible to initiate a restructuring of animal management throughout the European Union. There is already an EU-wide labelling system for eggs according to the type of husbandry: from 0 for organic production, up (or rather, down) to 3 for cage farming. This has influenced consumer behaviour in many EU countries. It immediately forced retailers to decide which

products they wanted to stock, which in turn led to husbandry practices that were environmentally friendlier and more sensitive to animal welfare. In 2020, 18 percent of the eggs sold in the EU came from husbandry systems 0 and 1 – the organic and free-range categories.

Despite the success with eggs, politicians and the livestock industry have major reservations about mandatory, Europe-wide standards for meat. One reason is that in some EU member states, there is little public debate regarding higher animal welfare standards and the restructuring of livestock operations that this would require. Because of the single European market, it is not possible to establish national mandatory labelling schemes in each country and allow the different requirements to exist side by side.

A way out could be to set up voluntary national labelling schemes. Such an approach would not conflict with European law, but it has the disadvantage that only some of the meat on the market would be subject to labelling. While the “better” meat would probably carry a label, meat from less desirable management forms would not – and would sell at lower prices. Despite this drawback, voluntary labelling schemes can still be successful.

In the Netherlands, a label with one, two or three stars, similar to that for eggs, has been introduced for meat. “Beter Leven”, or “Better Life”, is the name of the scheme introduced by the Dutch Society for the Protection of Animals. It has a high market penetration. In some supermarkets, over 90 percent of the meat products carry the label. Organically produced meat has three stars, the highest level. This scheme proves that an animal welfare label focused on conventionally produced meat can also open opportunities for organic products: contrary to the fears of the Dutch organic sector, the market share of organic meat has actually risen since the introduction of the voluntary animal welfare

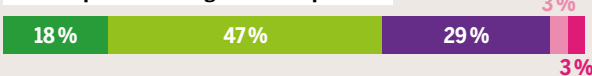
*Market opportunities for “Better Life” products have not yet been fully exploited, even if buyers are somewhat sceptical about promoting animal welfare*

### NOT YET ENOUGH

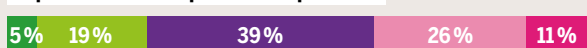
Popularity of the animal welfare label “Better Life” (“Beter leven”) in the Netherlands, survey among the public and supermarket customers, 2019

■ completely agree    ■ neutral    ■ somewhat disagree  
■ somewhat agree    ■ completely disagree

**“The addition of the ‘Better Life’ mark to meat products is a good development.”**



**“For me, the ‘Better life’ mark is more important than the price of the product.”**



**“My regular supermarket should only offer meat products with the ‘Better Life’ mark.”**



**“Surely my buying habits have no impact on animal welfare.”**

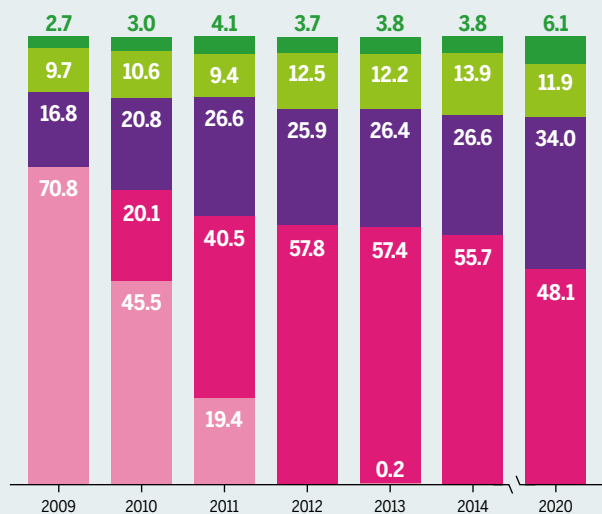


Public: 1,068 respondents, customers: 1,209 respondents

© MEAT ATLAS 2021 / GfK

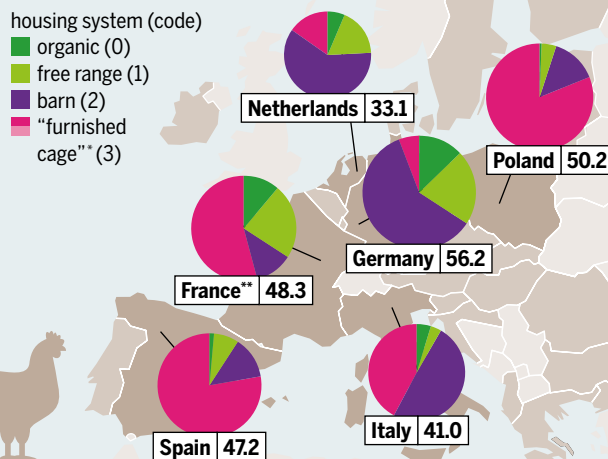
### CLEAR MARKING, CLEAR CONSEQUENCES

Laying hens by labelled housing systems in the EU, percent



2012: EU-wide ban on battery cages. Until 2009, included in "furnished cages" (larger than battery cages). \*furnished cages, until 2011 also battery cages. \*\*2019

Distribution of housing systems for laying hens in top 6 EU producer countries, and total laying hens, million, 2020



© MEAT ATLAS 2021/EC

label. Between 2014 and 2019, the percentage of customers buying Beter Leven products remained the same: between 70 and 81 percent, depending on the type of product. But the proportion of customers who bought the labelled items "regularly", "mostly" or "always" rose from 45 to 55 percent, and the number of male customers rose significantly.

In France, the voluntary, government-supported "Label Rouge" for poultry from small-scale, animal-friendly farms also has a high market penetration. Two-thirds of the whole chickens sold in France come from Label Rouge farms, and 97 percent of consumers are aware of the label. In Denmark, 60 percent of the population was aware of the label "Bedre Dyrevelfærd" (Better Animal Welfare) just a few years after it was introduced. This is a voluntary state labelling system for meat raised under animal-friendly conditions, which uses one, two or three hearts as symbols. For the lowest level (one heart), the farm must keep sows free-range, refrain from docking tails, and provide more space and straw for the animals than required by law.

In Germany, the Ministry of Agriculture has been delaying the introduction of an official label for years, referring the issue to the European Union. Yet 4 out of 5 respondents support compulsory labelling for all animal-based foods. Meanwhile, food retailers have become active and have introduced their own labelling system. Higher categories, such as "Neuland" and organic labels, have been introduced, but in reality they are rarely on offer, so consumer choice remains limited.

An EU-wide government labelling scheme would achieve better differentiation in the internal market, more transparency and better marketing opportunities for producers. A common solution would ease the long-overdue

*The management of layer hens in the EU has changed markedly in the last 10 years. Less than half are now kept in group cages*

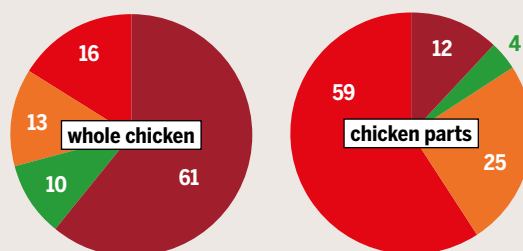
restructuring of livestock management. It could be accompanied by financial support using EU funds.

With regard to imports, the rules of the World Trade Organization must be observed. A compulsory welfare label could be construed as protectionism and a barrier to trade. One solution is to combine it with the traceability of products, which is now a universal requirement in international trade in meat. Specialists are studying whether it would be possible to include the husbandry system in the product code, alongside the country of origin and farm identity. The World Trade Organization would likely have no objection to this. Animal welfare labels are a good step forwards in improving meat production and consumption, however, they need to be accompanied by stricter laws. ●

### PROMISED AND PAID

Market shares of quality poultry "Label Rouge" including animal welfare criteria, France, 2016, percent

Label Rouge (dark red), extensive indoor (orange), organic (green), intensive indoor ("standard") (red)



© MEAT ATLAS 2021/FAO

*When it comes to whole chickens, the high-priced Rouge label dominates. For chicken parts, popular among poorer customers, the picture is quite different*



# A GOOD START, BUT COULD TRY HARDER

As part of its Green Deal, the European Commission has proposed a “Farm to Fork Strategy”. This is the EU’s most coherent attempt yet to respond to the fundamental challenges plaguing the food system. But much will depend on converting grand-sounding words into actual policies.

Announced in 2019, the European Green Deal is a set of policy initiatives by the European Commission to make the European Union the world’s first “climate-neutral bloc” by 2050, and to tackle other environment-related challenges. In May 2020, as part of the Green Deal, the Commission proposed a “Farm to Fork Strategy” for a “fair, healthy and environmentally friendly food system”. This aims to achieve a range of goals by 2030: cut the overall use and risk of chemical pesticides by 50 percent, farm 25 percent of the EU’s agricultural land organically, reduce nutrient losses (especially of nitrogen and phosphorus) by at least half, lower the use of fertilizers by 20 percent, and halve per capita food waste at retail and consumer levels.

Farm to Fork also addresses the livestock sector. It aims to reduce the contribution of livestock to climate change, limit biodiversity loss and pollution, lower the use of antibiotics, and increase animal welfare. The Commission wants to reduce the EU’s dependency on imported feed, such as soybeans grown on deforested land. It aims to do this by

promoting plant proteins grown in Europe, as well as alternative feeds such as insects, algae and byproducts from the bio-economy. Other measures include enforcing environmental rules and addressing nutrient pollution. Antimicrobial resistance linked to the excessive and inappropriate use of antibiotics in animal and human healthcare leads to an estimated 33,000 human deaths in the EU every year. To avoid this, the Commission wants to halve sales of antimicrobials for livestock and in aquaculture by 2030. It is considering revising animal welfare legislation and rules on animal transport and slaughter, and introducing product labels for animal welfare.

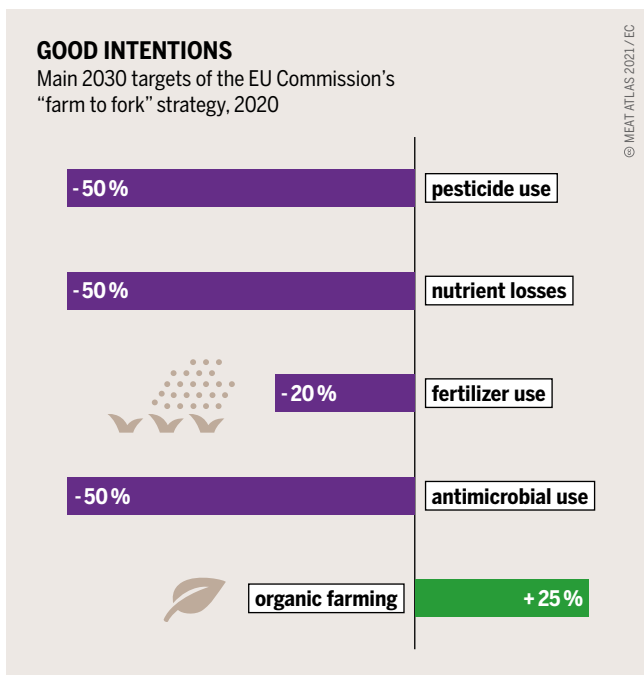
Current meat consumption patterns in Europe are unsustainable in terms of both health and the environment. Average intakes of red meat exceed World Health Organization recommendations, while consumption of whole-grain cereals, fruit and vegetables, legumes and nuts is too low. The Farm to Fork Strategy wants to change consumption through information, improved availability and prices, and tax incentives.

Despite these measures, civil society organizations criticize the Farm to Fork Strategy as insufficient to solve the problems of industrial animal farming and consumption. They say it only makes minor tweaks to the current, unsustainable system.

Plus, policies that conflict with parts of the Farm to Fork Strategy are still in place. Between 18 and 20 percent of payments under the EU’s Common Agricultural Policy go to livestock farms or farms that produce animal fodder, which supports the concentration of meat and dairy production in fewer and larger farms. The next funding period for the Common Agricultural Policy gives more responsibility to Member States for allocating money, and much will depend on their national strategic plans. But so far, no member country has a dedicated plan to transform the livestock sector and adapt it to the Commission’s climate and biodiversity goals. And plans for integrated nutrient management depend on tools that are not yet part of the regulations.

As the EU attempts to open up new market opportunities for European farmers, a large part of its promotional spending is still directed towards livestock. While most money indeed goes towards promoting organic products and the climate and environmental aspects of the agri-food sector, 138.7 million euros, or 24 percent of the total money used for promotion in 2016–19, was devoted to meat and animal products.

*With organic farming, consumer demand alone may ensure the desired expansion. With the other projects, the Commission has to make a real effort*

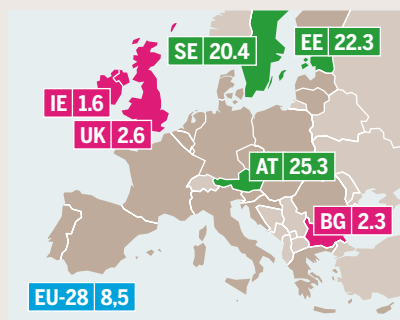




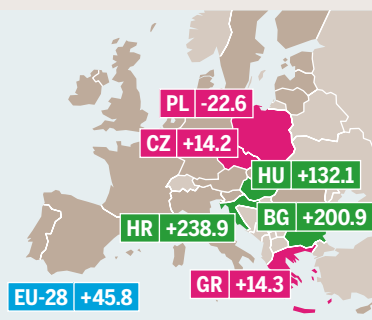
## ORGANIC FARMING IN THE EU

Total agricultural area and key product groups, ■ highest and ■ lowest top three member countries, \* 2019

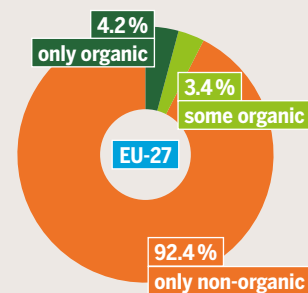
percent of organic area of total utilized agricultural area



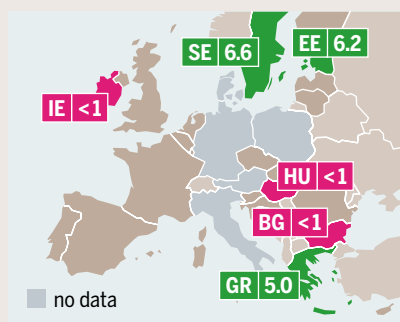
percent change, 2012–2019



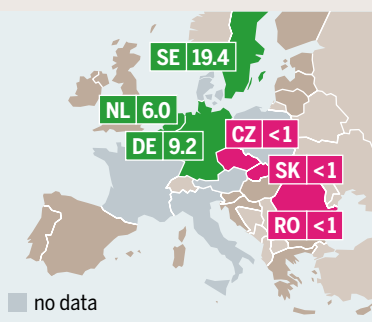
utilized agricultural area by type of management \*\*



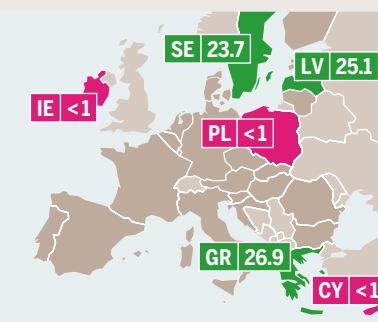
organic production as share of total products in category: cereals



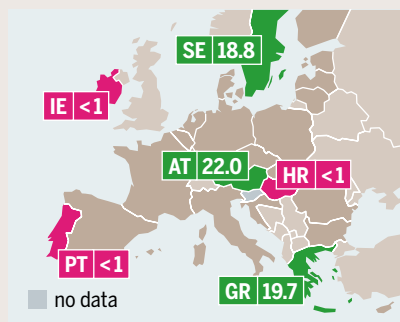
fresh vegetables



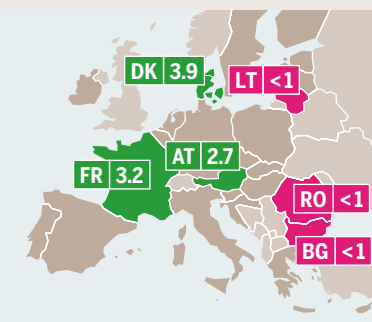
live bovine animals



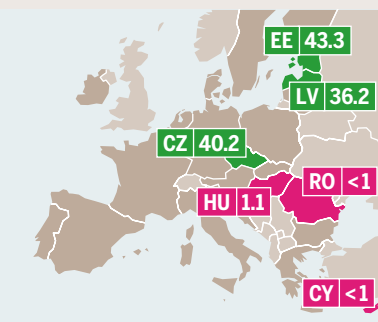
live dairy cows



live pigs



sheep and goats



AT: Austria, BG: Bulgaria, CY: Cyprus, CZ: Czech Republic, DE: Germany, DK: Denmark, EE: Estonia, FR: France, GR: Greece, HR: Croatia, HU: Hungary, IE: Ireland, IT: Italy, LT: Lithuania, LV: Latvia, NL: Netherlands, PL: Poland, PT: Portugal, RO: Romania, SE: Sweden, SK: Slovakia, UK: United Kingdom

\*without Malta; UK included when reported \*\* 2016

Current trade agreements reflect the strength of the EU's marriage to industrial livestock. They give high priority to new markets for pork and poultry, as well as imports of cheap feed. Current discussions on the free trade agreement with the Mercosur region illustrate that reaching the Farm to Fork goals will require changes not only in agriculture and food policy, but also in how the EU conducts international trade.

The Farm to Fork Strategy is a document of the European Commission and is not binding. The legislative measures

*Many meadows and pastures can lead to high organic shares of a country's total area. But the hard currency is cereals, vegetables and livestock*

that will come out of the strategy would need to propose concrete ways to contribute to those objectives. Support from national policymakers is vital, but the signals are mixed. In October 2020, the EU agriculture ministers welcomed the strategy but did not commit to working towards its objectives. ●

## LAB MEAT

# CELLSTOCK VS LIVESTOCK

**Lab-grown meat is a disruptive innovation that could help resolve sustainability and health issues related to livestock, as well as reduce the numbers of animals farmed. But the sustainability gains do not yet match expectations.**

**C**ell-based (or “cultured” or “cellular”) meat is an emerging technology that takes certain types of cells from animal muscle and cultures them in the lab. Fed with the right mix of ingredients, these cells grow and multiply to produce meat. This avoids the hassle, and the ethical concerns, of raising or hunting animals to kill them.

Its proponents say that cultured meat can fulfil the rising global demand for meat, and that it is healthier and more sustainable than livestock raising, as well as being better for animal welfare. The first studies supported such claims. Compared to conventional meat production in Europe, cultured meat was found to use 7–45 percent less energy, emit 78–96 percent less greenhouse gas, and use 99 percent less land and 82–96 percent less water. Although muscle taken from animals would still be required, far fewer livestock would have to be slaughtered, with consequent gains for animal welfare. And advocates have claimed that the final product is safer than conventional meat: a fully controlled lab environment would reduce the risk of food-borne diseases and eliminate the need for antibiotics.

But these purported benefits may be exaggerated. More recent studies show that producing cell-based meat is very energy-intensive. Taking the whole product life cycle into account, the energy demand is far higher than that of conventional meat production. Depending on the energy

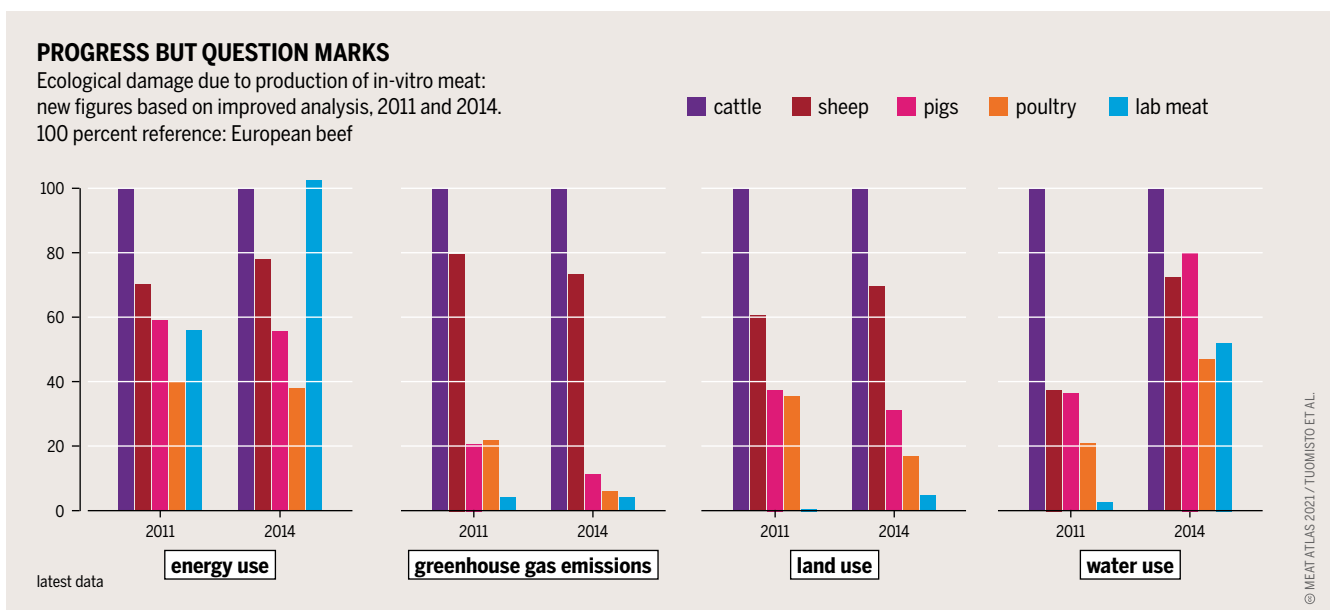
source, culturing meat may emit even more greenhouse gases than raising animals does. Livestock emit methane, a potent greenhouse gas, but one that does not stay in the atmosphere for a long time. Cell culture, on the other hand, produces carbon dioxide, which persists for hundreds of years. That makes any potential emissions advantage of cultured meat unclear.

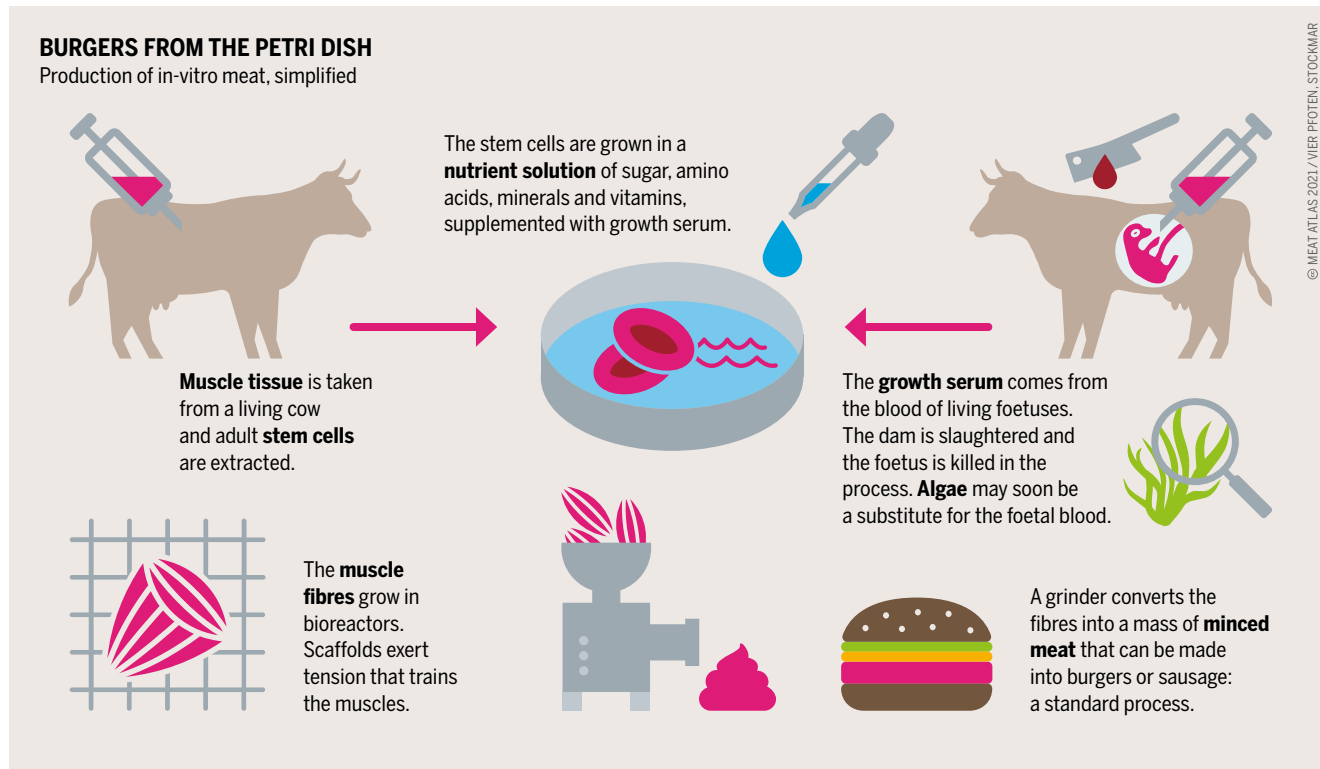
Another potential problem is pathogens. These might not be eliminated by lab-grown meat, but may simply change in nature. Keeping out contamination may prove a problem when manufacturing is moved to factory scale.

If cultured cells are to proliferate and create the muscle mass that an animal builds over years, they must be stimulated with growth factors. These include sex hormones. No limit currently exists for such hormones in cellular-based meat, but the European Union has prohibited their use in conventional meat production since 1981 due to their human health risks. And no method has yet been developed to ensure that cellular meat contains crucial micronutrients, such as vitamin B12 and iron, that are specific to animal products.

A rapid shift from conventional to cell-based meat seems improbable in the near future. Unlike livestock farming, cell-based meat requires a lot of expensive new investment. Industry projections assume price parity between conventional and cell-based meat by the early 2030s – but this appears optimistic. The same projections assume that the overall market for meat alternatives is growing fast. But even by 2035, cell-based meat is projected to add just

*Contrary to previous assumptions, producing lab-grown meat takes a lot more energy than conventional meat. The figures for water use have also been revised upwards*





6 million tonnes to the 97 million tonnes of all meat alternatives – though its share will grow rapidly after that. While some analysts expect the market for cultured meat to approach 100 billion US dollars by 2030, their figures are based on assumptions such as dramatically reduced costs, increased scale of production, and broader consumer acceptance. Even some of the most optimistic forecasters do not expect lab-grown alternatives to be comparable to meat in taste, texture and price until 2032.

Depending on how much of the market they capture, meat alternatives will affect various aspects of the livestock industry: economics, market dominance, employment and ecology. Cell-based meats are capital-intensive, so may become highly concentrated in the hands of a few large investors. These fundings have totalled more than \$1 billion since 2013. Current investors in cell-based meat start-ups include some of the world’s biggest meat processors and animal-feed firms, such as Tyson and Cargill. They also include billionaires such as Bill Gates (Microsoft), Sergey Brin (Google) and Li Ka-shing (CK Hutchison, a Hong Kong conglomerate).

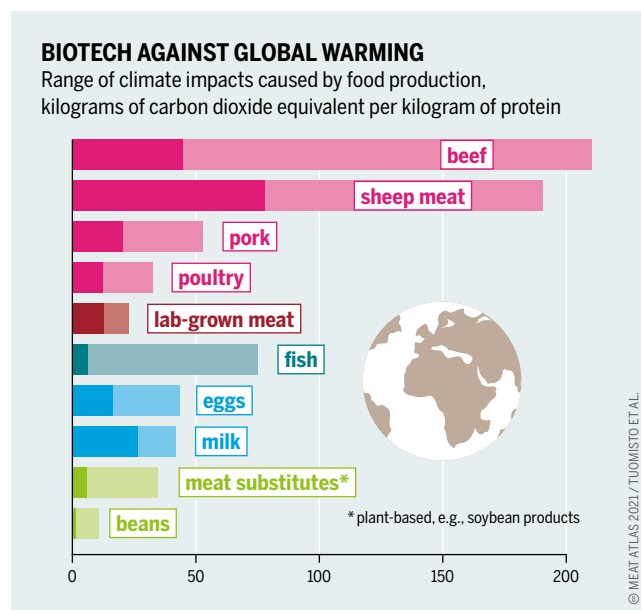
If the market share of meat alternatives increases steadily over the next two or three decades, it could lead to a significant overhaul of employment in food production: from a system primarily dependent on farmers, farm workers, meat processors and veterinarians to one based on chemists, cell biologists, engineers, and factory and warehouse workers. Although farmers and farm workers would still be needed to produce raw ingredients or inputs for meat alternatives, a decline in livestock production could lead to mas-

*In-vitro meat tends to have a smaller carbon dioxide footprint than the average for conventional meat. Only beans produce less CO<sub>2</sub> at the high end of estimates*

*Maybe lab meat can function without having to kill any animals. A problem remains: the melding of biotechnology and gene technology*

sive job losses in livestock farming and meat processing. It is unclear how many new jobs would be created by lab-grown meat industries.

From an ecological point of view, extensive and sustainable livestock farming maintains landscapes, conserves biomes and protects agrobiodiversity. Advocates of lab-grown meat promote the idea that people necessarily damage nature. But livestock play an important role in agroecological practices that protect ecosystems and livelihoods. ●



## INSECTS AS FOOD

# SNACKING ON SILKWORMS, LUNCHING ON LOCUSTS

**Adding insects to our menus could help overcome the world’s food-supply problems. But the industrial production of insects is controversial: would it be useful or dangerous?**

**M**ealworm-protein bars, insectburgers and noodles made from insect flour: flip through lifestyle magazines and you might easily think that entomophagy – the consumption of insects – has arrived in Europe. But it is rather the mixture of newsworthiness, the exotic, and the “yuck factor” that makes the consumption of insects such a popular media topic. In Europe, insects are not something the vast majority of people expect to see on their plates.

Things are different in much of the rest of the world. In over 130 countries and for an estimated 2 billion people, beetles, maggots and crickets are a traditional part of the everyday diet. Insects deliver valuable vitamins and minerals, along with lots of protein. Because a wide range of insects are available at different seasons, such a diet is always varied.

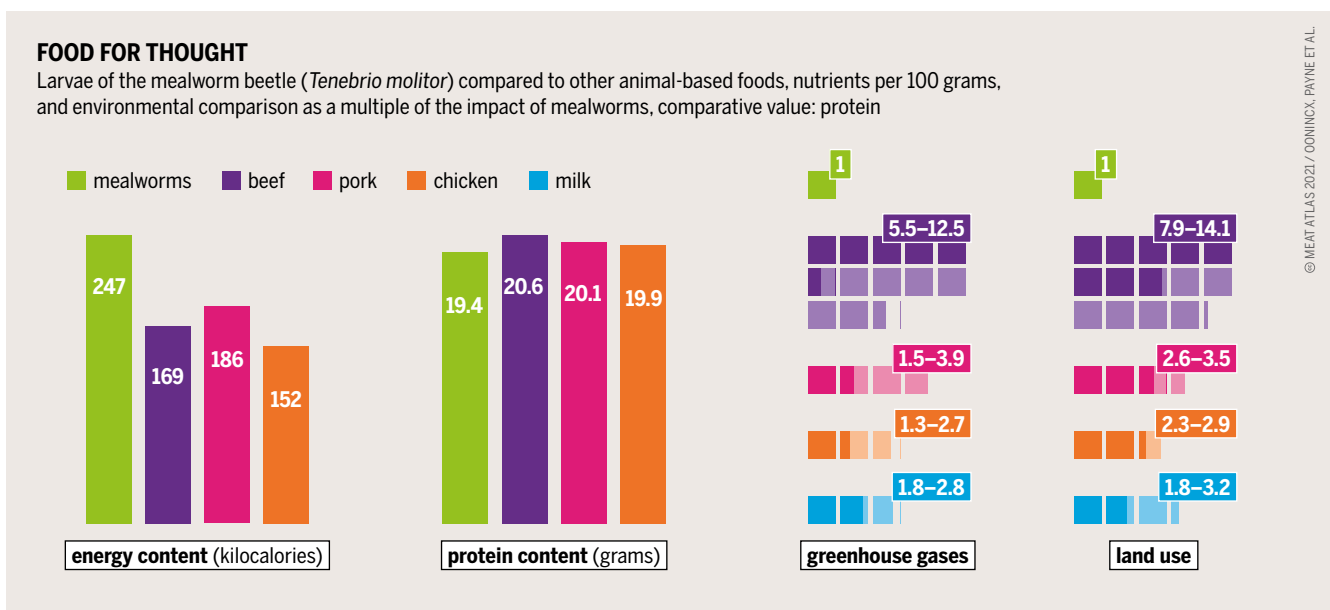
Companies that want to popularize insect-based foods in the West put forward convincing arguments: ecological benefits, animal protection, and above all, the high protein content of such foods. The number of these firms has risen sharply in recent years. The European Union’s Novel Foods Regulation of 2015 created conditions that permit the easier approval of individual insect species as food from the start of 2018. In doing so, it followed the lead of the Food and Agriculture Organization of the United Nations (FAO),

which for the past 10 years has promoted the idea of using insects as a major food source so as to feed the world’s growing human population. As of May 2021, the first-ever EU-wide approval of insects for human consumption was granted for yellow mealworms (*Tenebrio molitor*). ‘Transition measures’ in the 2018 regulation are allowing the use of insects at national level already. Three other insects – lesser mealworms (*Alphitobius diaperinus*), house crickets (*Acheta domesticus*), and migratory locusts (*Locusta migratoria*) – are sold in some EU countries. Further applications were made in 2019, for instance for the larvae of the black soldier fly (*Hermetia illucens*).

From an evolutionary point of view, insects are one of humanity’s oldest sources of protein. A large number of insect species are potentially very valuable foods, though their protein content and the amount of vitamins, unsaturated fatty acids (omega 3 and 6) and minerals they contain varies considerably according to the species, feeding and stage in the life cycle (egg, larva, pupa or adult).

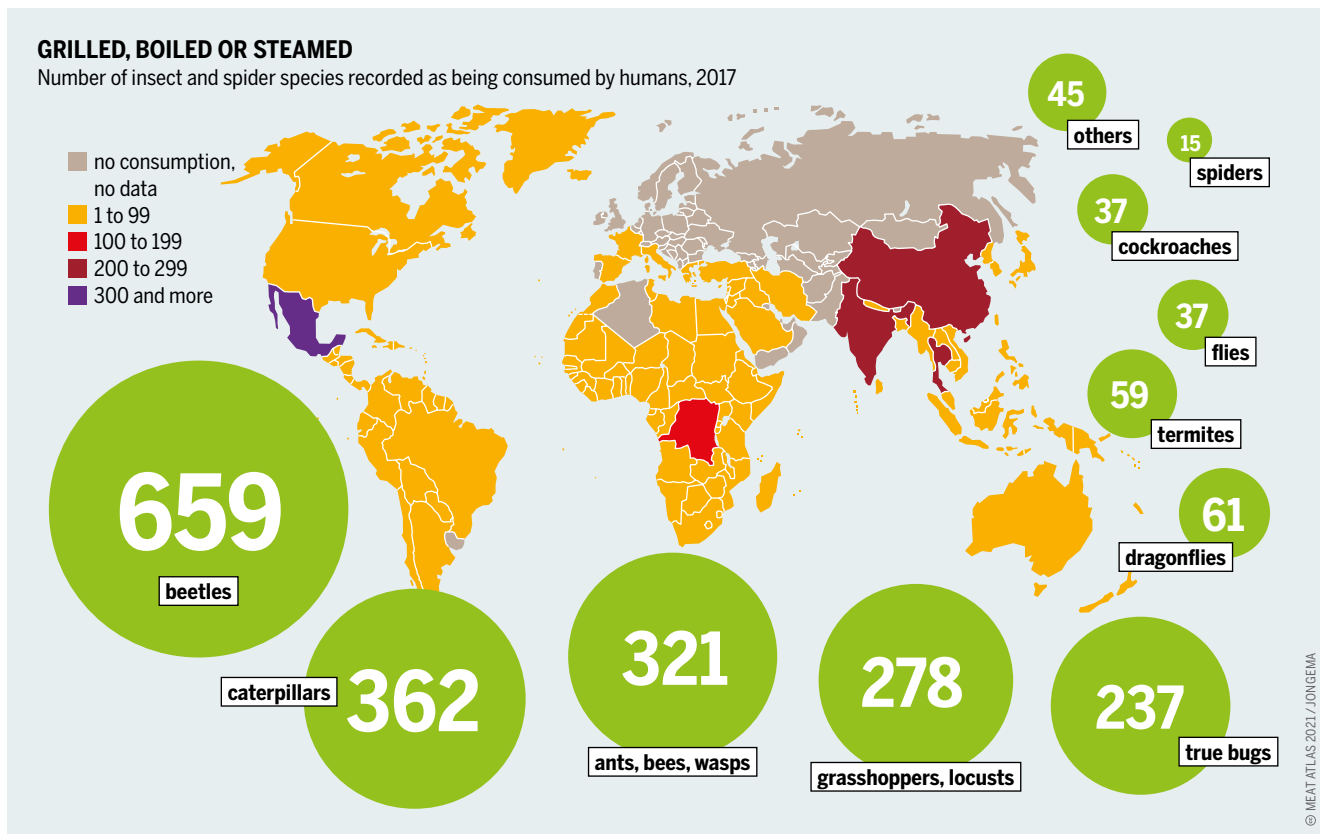
In Western industrialized countries it is mainly small start-ups that are trying to establish themselves on the market with the first, relatively expensive, insect-based products. These firms hope to cut their costs and boost their sales through more efficient breeding methods and industrial-style production techniques. The authors of a study by Barclays, a British bank, predict that the “insect

*Unbeknownst to consumers, most mealworms that are raised for human consumption in Europe are made into flour*



## GRILLED, BOILED OR STEAMED

Number of insect and spider species recorded as being consumed by humans, 2017



protein market” in Europe and North America might be worth as much as 8 billion US dollars by 2030, making it attractive for large food manufacturers.

Unlike in Asia, Africa and South and Central America, entomophagy in Europe and North America is rarely seen from a culinary point of view. The target consumers in Europe are mainly people who want to avoid eating meat or consuming other animal products for ecological or ethical reasons. In contrast to the slaughter of cattle or pigs, cold-blooded insects are chilled so they fall into a natural torpor and die without experiencing pain or stress.

At the same time, most species of insects can be raised en masse in factories. Breeding insects requires less space, feed, water and energy than traditional livestock-keeping – at least in theory. In practice, there is a shortage of empirical data, even in countries where insects are a regular part of the menu. There, most of the insects consumed are caught from the wild. Insects are indeed bred in China, Southeast Asia and southern Africa, but the proportion of farm insects accounts for only 2 percent of total consumption.

Most insect farms in Asia are run by small-scale farmers. Their experience is often not applicable to European conditions. They often do not raise their mini-livestock in enclosed facilities, but rely instead on the local climatic conditions and on ecosystems such as mangroves. That is especially true for many beetles and larvae that are of greater culinary interest than the species currently approved for

*Market researchers expect the turnover of edible insects to double in value in just five years*

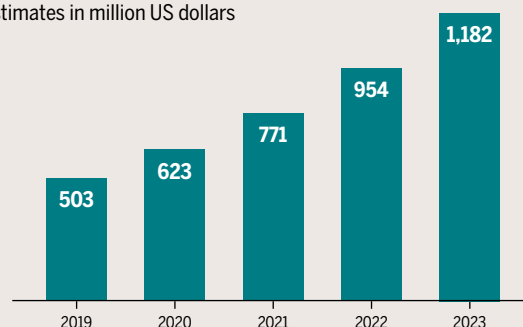
*Eating insects is commonplace throughout the world. But in a few places, especially in Europe, it is taboo*

consumption in Europe. Examples are the deep-fried water beetles regarded as a delicacy in northern Thailand, and the eggs of waterbugs, sold in Central and South America as “Mexican caviar”.

The demand for edible insects is rising, and there is a danger of overstressing natural populations, causing a collapse in numbers, as has happened with overfishing in the oceans. It is also questionable whether the global hunger for insects can be satisfied by industrialized farming. And experts warn that raising insects could repeat the same mistakes as with pigs, chickens and cattle, which have led to the loss of genetic diversity and the emergence of unexpected diseases that can destroy entire stocks. ●

## BIG MONEY FROM SMALL CREATURES

Forecast market value of edible insects worldwide, estimates in million US dollars



## MEAT SUBSTITUTES

# A NEW SECTOR EMERGES

**Vegan and vegetarian alternatives to meat are gaining popularity fast – making them tastier for big firms, too. Competition is likely to flare up around in-vitro meat: start-ups developing lab-grown products are sprouting everywhere.**

**T**he market for meat substitutes is changing faster than ever before. Experts predict a global annual growth in plant-based alternatives of 20 to 30 percent in the coming years. Worldwide sales already totalled 4.6 billion US dollars in 2017. That is still peanuts compared to the trillion-dollar global market for meat. But that market is growing much more slowly, and is even stagnating in some countries.

Alternatives to meat are becoming more popular for several reasons. The meat industry is coming under criticism for its working conditions, the livestock industry that it is based on, and its impact on the climate and environment. At the same time, meat alternatives have improved both technically and in terms of their taste and texture, and a wide range of different products is now on offer.

Products that have been available for years, such as seitan (made from wheat gluten), Quorn (fermented fungal protein) and tofu have been joined on supermarket shelves by new ones that closely resemble real meat. These contain proteins that are modified to resemble muscle fibres. New ingredients are also coming to the fore, such as proteins from peas and lupins, or heme proteins derived from plants which, like the hemoglobin in blood, give the finished foodstuff a reddish hue and a meaty taste.

In-vitro meat is not yet in supermarkets, but it is on the front burner for investors. By the end of 2019, 55 firms were

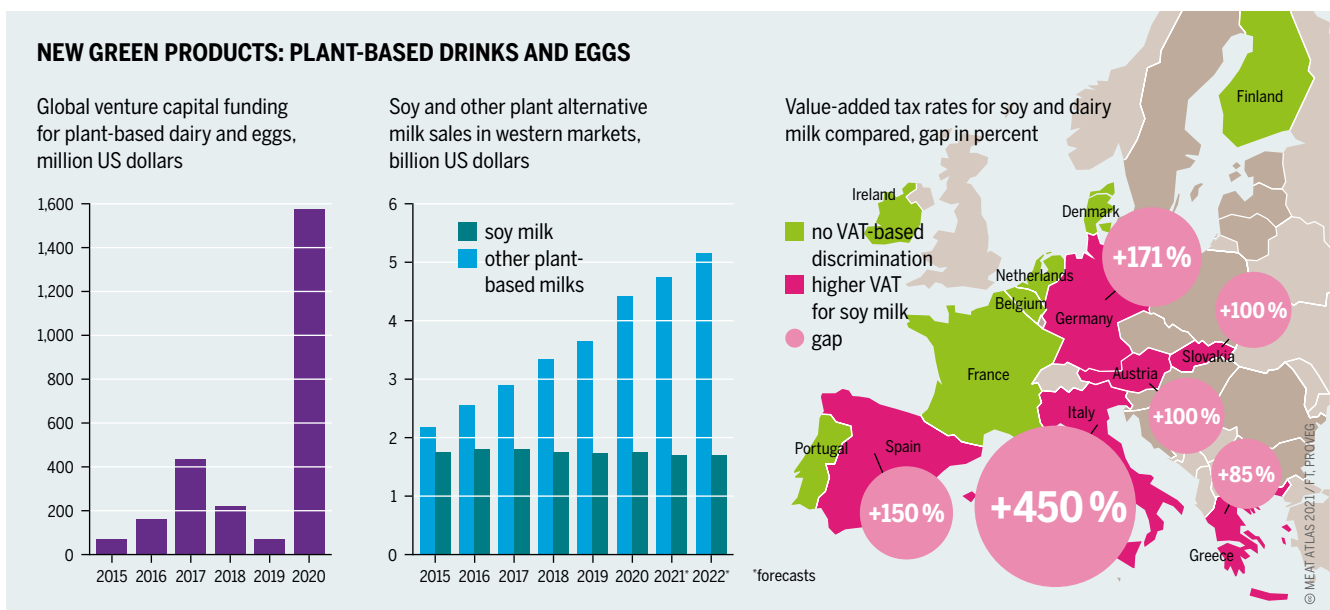
already involved in creating laboratory meat products from animal stem cells. Twenty of these firms were infant start-ups founded that same year. In December 2020, Singapore became the first country in the world to approve lab-grown meat for sale, following tests by its food authorities.

The role that meat substitutes will play globally depends largely on how demand develops and whether consumers accept these products. In 2021, a review of 91 scientific articles by Wageningen Economic Research in the Netherlands found that consumer acceptance depended on the meat alternative in question. The acceptance of insect-based products was lowest compared to conventional meat, followed by cultured meat. Pulses and plant-based alternative proteins were the most readily accepted. Factors influencing acceptance included taste and health, familiarity, attitudes, food neophobia (the fear of unfamiliar food), disgust, and social norms.

Compared to conventional meat, substitutes are in general a lot more environmentally friendly. Purely plant-based meat substitutes – items that also contain no eggs or milk – score the best. Compared to beef, their production emits 90 percent less greenhouse gas and requires much less water and land. But such products are often highly processed and contain many additives. Insect-based meat substitutes rate somewhat lower than plant-based products in studies. The health and environmental impacts of in-vitro meat are still difficult to assess, as the research is still in its infancy.

Whether meat substitutes will determine the food system of the future depends on which companies will shape

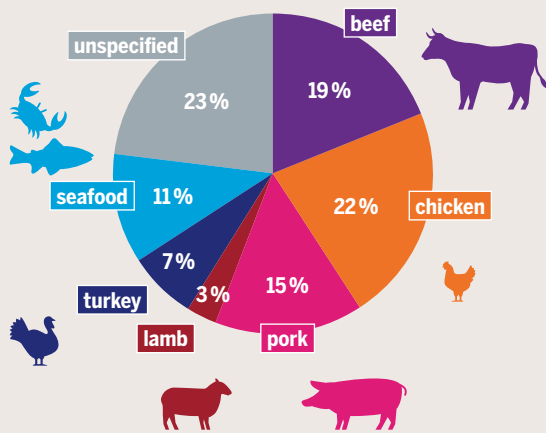
*The search for substitutes for animal products such as milk and eggs is just as intense as for meat and sausages*



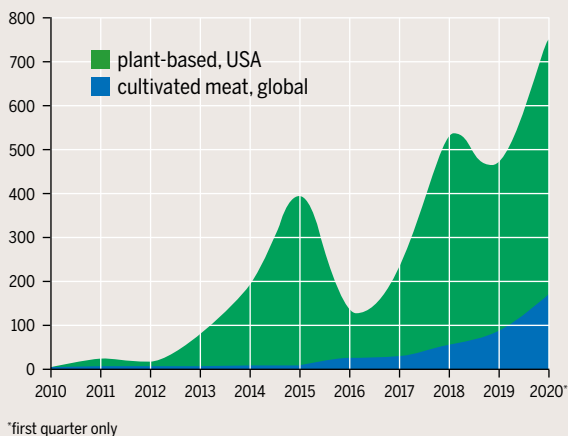


## MAJOR TRENDS IN A MAJOR SHIFT

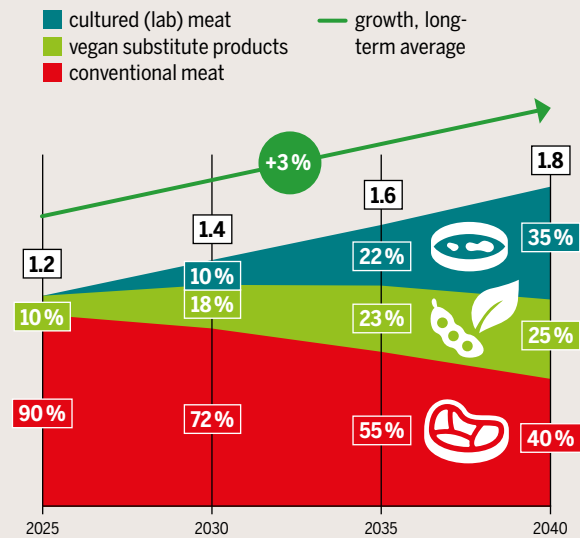
Primary products targeted for commercialization of plant-based meat alternatives by established companies, 2019, percent



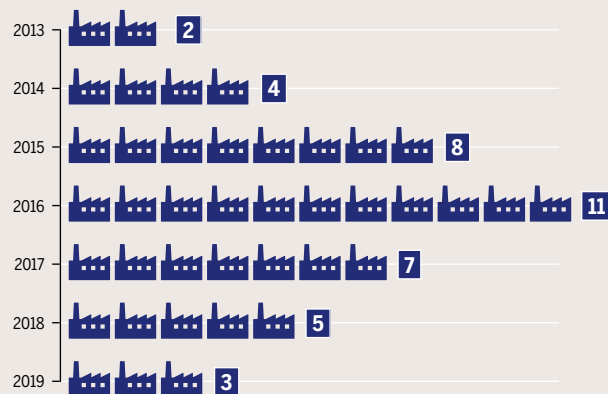
Venture capital invested in cultivated meat worldwide, and investments in plant-based food in the USA alone, million US dollars per year



Global market trends for meat and meat substitutes, in trillion US dollars and percent, and average annual growth to 2040, forecast



Number of newly founded US companies that claim their product boasts a meat-like taste and texture, or that brand their products with meat-like names to attract customers



© MEAT ATLAS 2021 / CHOUDHURY ET AL., KEARNEY, GFI

the market, which in turn depends on future agriculture policies and financial muscle. The market presence of large and established players may lead to their products gaining acceptance more quickly. The size and number of firms also influences the diversity or monopolization of the market – with all the associated consequences. A large number of new players and start-ups are currently jostling for position on the market. Large corporations from the technology and food sectors, such as Google, Nestlé and Cargill, are investing. Pharmaceutical companies are also becoming active and are developing culture media for the production of in-vitro meat.

PHW Group is one example. The largest German poultry grower and processor has gone into partnership with Beyond Meat as well as Super Meats, which is working on in-vitro poultry meat production. North America's biggest meat producer, Tyson, has also invested in Beyond Meat

*Industry and investors expect long-term growth. Strong fluctuations can be seen in the short term*

and has introduced its own brand of meat substitutes, called Raised & Rooted. The agricultural group Cargill has taken a stake in Memphis Meats, an in-vitro meat firm. The food giant Nestlé has launched a vegan range under the brand "Garden Gourmet". And in November 2020, McDonald's announced a vegan burger: the "McPlant" was first tested in Canada and is on sale in Europe now.

The animal welfare organization PETA does not want to wait for similar steps to be taken by other companies. In May 2020, it bought shares in the meat firms Tyson and Smithfields so it can play the role of a critical shareholder and encourage the companies to make a stronger commitment to plant-based meat substitutes. ●

## ACTIVISM

# PRESSURE FROM BELOW

Civil society is a sometimes underestimated stakeholder in the food system.

Supporting sustainable production and criticizing industrialized agriculture, it influences public opinion and habits and demands better policies and international solidarity. And it can hold governments and companies accountable for their actions, while offering solutions.

Evidence of problems related to intensive livestock farming is mounting. An increasing number of civil society organizations and activists are becoming involved in this issue, including farmers' organizations, community groups, animal rights and welfare activists, health groups, vegan and vegetarian groups, and organizations concerned with climate and the environment. While their interests and goals differ, they all demand more sustainable and sensitive animal production, and less consumption of animal products.

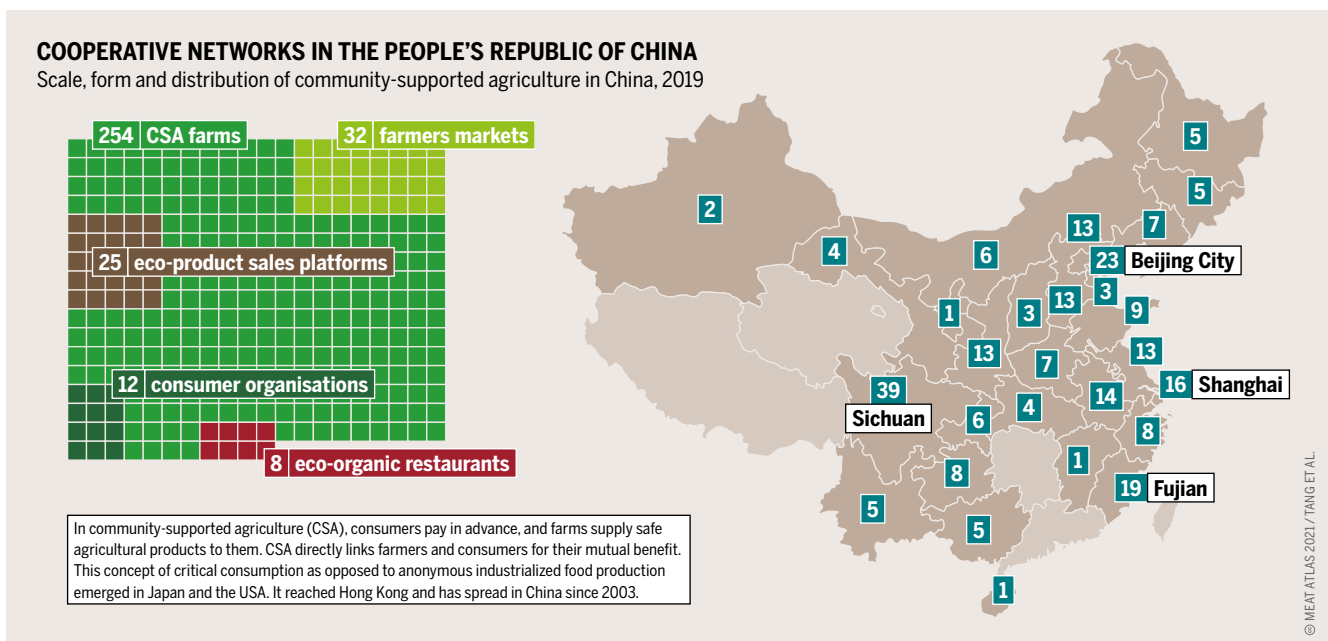
Farmers' organizations in Europe are concerned about the economics of livestock raising and the recurrent crises that have hit dairy, beef and pig farmers over the past decade. They are pushing for the transformation of the animal farming sector. The European Milk Board and the European Coordination Via Campesina, which represent thousands of farmers across the European Union, are alarmed by the drop in prices that producers are being paid. The Milk Board proposes that producers voluntarily reduce the production of milk during severe crises, and receive compensation for every litre of milk they do not produce.

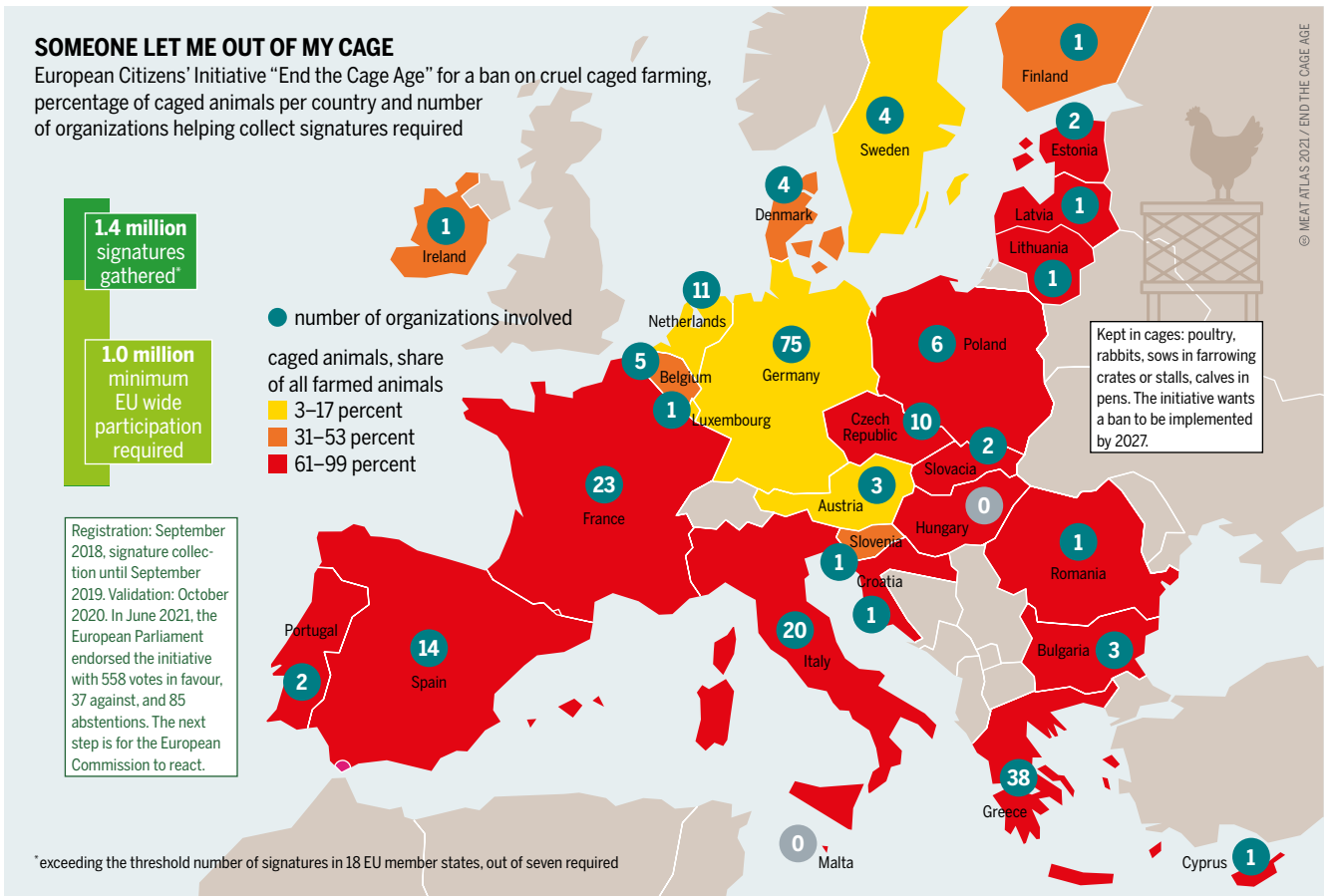
Via Campesina highlights the importance of revising regulation and competition rules to protect small-scale farmers. The two farmers' organizations want processing and marketing to be re-localized to give farmers more direct contact with consumers.

Organizations promoting animal welfare and animal rights are prominent. The End the Cage Age initiative brought together over 170 organizations calling for a ban on keeping animals in cages in the EU. The campaign was supported by 1.4 million citizens, making it only the sixth European Citizens' Initiative (a mechanism for citizens' involvement in policymaking) to surpass 1 million signatures among the 75 such proposals in the last 8 years. It was the first successful initiative to focus on animal welfare. The European Commission must now spell out what action it will take to address the issue of cage farming.

Various initiatives at national, regional and local levels are looking for ways to deal with the negative impacts of industrial animal farming. In Spain, for example, a national platform that brings together neighbourhood movements and communities calls for a moratorium on industrial livestock. In the UK, the Eating Better Alliance comprises over 60 groups concerned about health, environment, animal welfare and social justice. It wants a 50 percent reduction in meat and dairy consumption in the UK by 2030, and a transition to "better" meat and dairy. It advocates sustainable food and farming policies, demands improvements from food businesses, and inspires people to make positive changes.

*Frequent food scandals have unsettled China's consumers. New forms of self-organization are becoming increasingly popular*





For some of these organizations, animals are part of a sustainable farming model. But some animal rights and welfare organizations, together with parts of the vegetarian and vegan movements, regard rearing animals as unethical: they say it should not happen at all. Some see a solution in meat alternatives and in lab-grown meat; others warn of the effects these would have on farming in general. They worry that people will become further disconnected from their food, that farmers will be excluded, and industrialized food manufacturing and big investors in this growing sector will come to dominate.

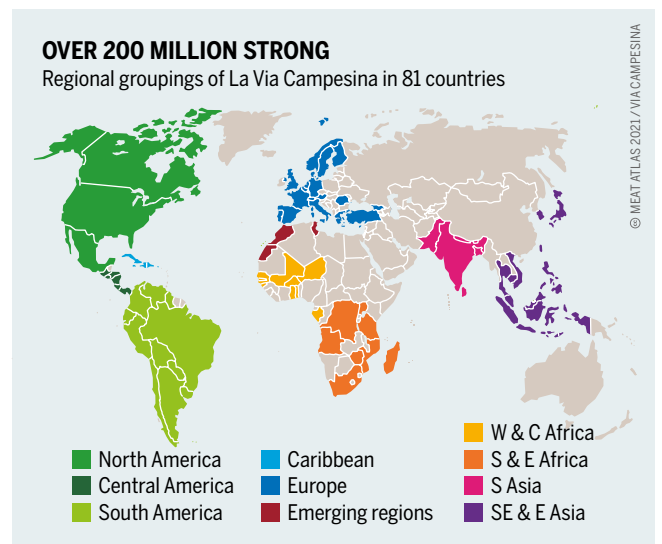
The sustainable meat movement is increasingly organized internationally. Intensive meat production in industrialized countries has effects elsewhere, and industrial meat production is also becoming an issue in the developing world. Calls to reduce the number of farm animals go beyond Europe, reaching countries like Brazil, Argentina and Paraguay, where activists join forces with European civil society to demand an end to unsustainable production methods. One recent campaign has opposed a trade agreement between Mercosur and the EU, which is expected to increase the production and trade of animal products and to trigger further deforestation in Latin America.

The role of livestock in emitting greenhouse gases is a focus for organizations working on the environment and climate change. These organizations see agriculture and food

*The small farmers' movement La Via Campesina campaigns for food sovereignty and is said to be the biggest social movement worldwide*

*Since 2011, only six grassroots issues have gone all the way through the European Citizens' Initiative process. "End the Cage Age" is the first on animal welfare*

systems as critical elements in the crises of human rights, biodiversity and climate. They demand urgent action from policymakers across the world. Many of these organizations have come together to call on the European Commission to develop an action plan to promote less and better consumption and production of meat, dairy and eggs, to shift away from industrial farming, and to support better animal farming and healthy, plant-rich diets. ●



# SURVEY ON YOUTH

## CHANGING HABITS

**Young people in Germany – the “Fridays for Future generation” – eat less meat than their elders. Their attitudes and habits are likely to steer food consumption and policy in the coming decades. Results of a representative survey.**

The consumption of animal products – meat, milk and eggs – in wealthy countries should be reduced to about one-quarter of today’s level. That is the result of a study by leading environmental and nutrition researchers, who have worked out how much animal-based food in our diets would be globally acceptable. The answer: 25 percent of the current average for the developed world, a figure that is a long way off for many Europeans.

Within the European Union, people in Spain currently eat the most meat, followed by those in Portugal and Germany. Slovaks and Bulgarians eat the least. In most EU countries, the consumption of pork and beef is slowly declining, while that of poultry is still rising.

Detailed consumption data are needed to design policies

that encourage changes in dietary patterns. Above all, a good understanding of the younger generation is important, as diets are based on habits that generally do not change much as people get older. But such information is scarce. Very few reliable data exist on the number of vegetarians, vegans and flexitarians in various European countries. A survey in 2020 by a vegan food company estimated that some 4.4 percent of the population in Germany has a vegetarian diet. In Austria, it was 3.7 percent; in Portugal, 2.0 percent, with lower numbers reported in the other countries surveyed. These figures are a rough approximation: other studies in individual countries have yielded significantly higher numbers. Some studies in Germany estimate that 6 percent of the country’s population is vegetarian or vegan.

To gain a better understanding of the younger generation, the University of Göttingen in Germany questioned 1,227 young Germans between 15 and 29 years of age in October 2020 about their intake of meat and milk and their motives for consumption. The online survey was representative for Germany in terms of gender, region and education.

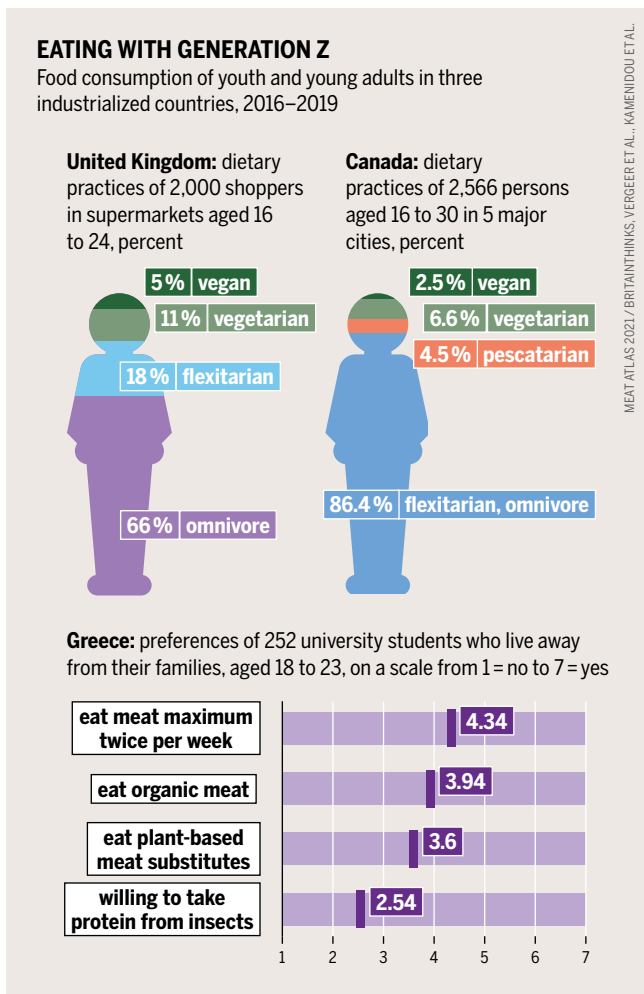
The results show that forgoing meat is the trend among adolescents and young adults. Some 10.4 percent of respondents had vegetarian diets, and another 2.3 percent were vegan. Together, just under 13 percent did not eat meat – more than twice as many as in the German population as a whole. The climate movement “Fridays for Future” and related developments have become important drivers for the rise in plant-based eating habits. Around one-third of the vegetarians and vegans in the survey had switched to meat-free diets only in the previous year.

Flexitarians, who make up around 25 percent of young Germans, also contribute to lower meat consumption. They eat meat only occasionally, mainly at social gatherings. When they do, they like to know where the meat comes from. Of those young people who do eat meat, 44 percent say they want to reduce their intake in the future.

Who are vegetarians and vegans? Around 70 percent of respondents in both categories are women. Younger people and students are somewhat more strongly represented. Those interested in technology and skilled trades tend to eat more meat. But on the whole, there are relatively minor differences between sociodemographic groups. Nor did the survey reveal a split between urban and rural areas.

Rather, meat consumption is strongly related to political attitudes. People who eat little meat tend to be more concerned about the environment, and especially about nutrition and animal welfare. Among vegans, 75 percent say they are part of the climate protection movement; almost 50 percent of vegetarians say the same, while only 15 percent of omnivores do so. Some 42 percent of vegetar-

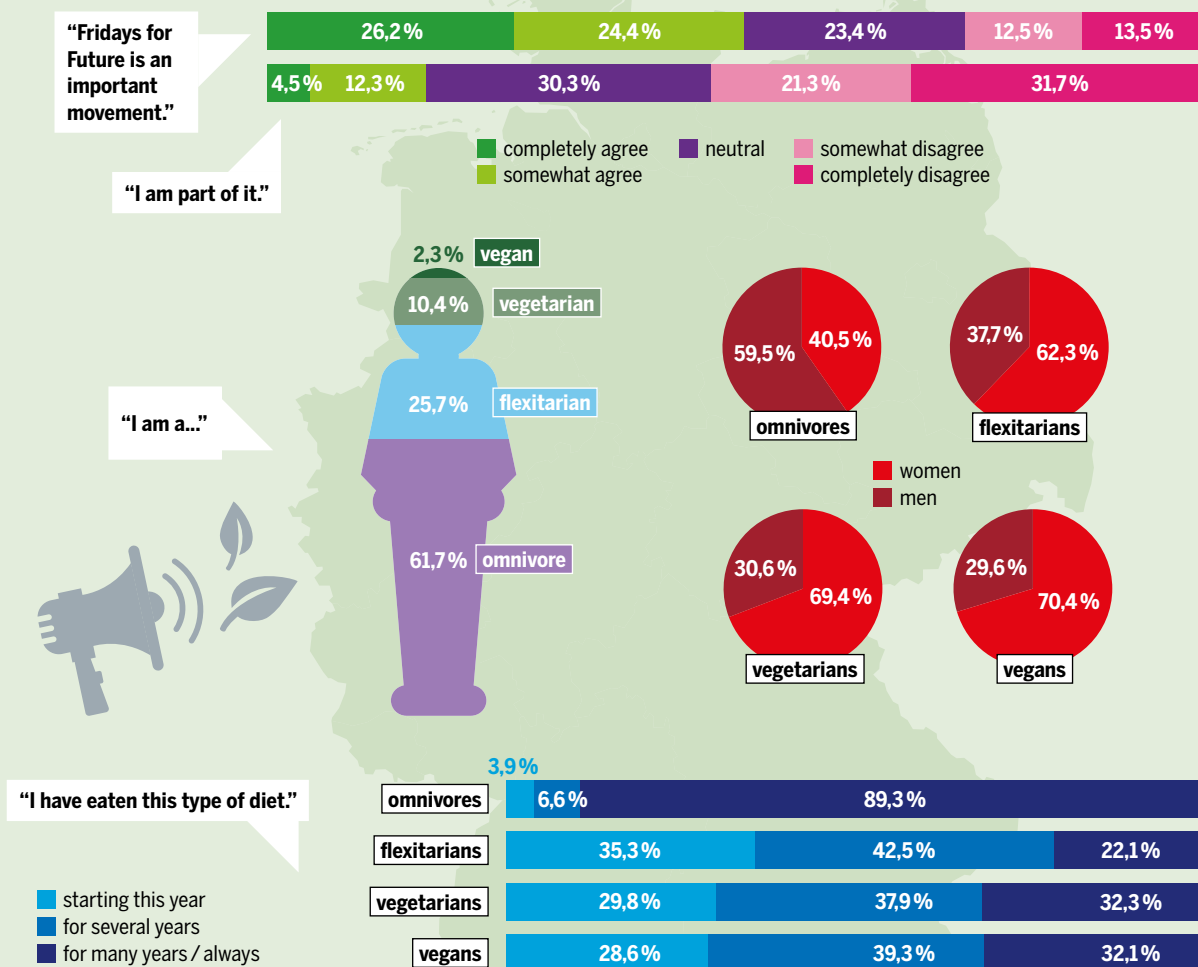
*Just a few years ago, there were no reliable studies on young people’s meat consumption patterns. That is about to change*



## YOUNG, FREE AND CRITICAL

Survey of 15-to-29-year olds in Germany about climate protests, diets and livestock keeping

© MEAT ATLAS 2021 / ZÜHLSDORF



Differences due to rounding

ians, and 63 percent of those who prefer a vegan diet, are committed to fighting food waste, while only 29 percent of meat eaters say they are.

For Germany, the survey reveals that meat consumption is a political issue and not a question of individual tastes. Supporters of vegetarian and vegan diets are clearly more concerned about sustainability and regard themselves as pioneers of sustainable consumption patterns.

The survey found large differences regarding attitudes on the future of livestock farming as a whole. Nearly all – 96 percent – of vegans, and 49 percent of vegetarians, would like to get rid of the practice altogether. For flexitarians it is just 15 percent, and among omnivores just 4 percent. What unites this generation is the rejection of the current form of animal agriculture. Almost no one thinks it is acceptable. "Less but better meat" is the preferred route for the non-vegetarians.

Young people in Germany see the state as having a shared responsibility for sustainable diets. Accordingly, there was clear agreement on many, but not all, of the policy options included in the survey that might support sus-

*The school strike has influenced millions of young people. New preferences are emerging: the desire for climate-conscious diets and an interventionist state*

tainable consumption. The respondents approved of a climate label for food and stricter animal welfare laws, as well as legalizing "dumpster diving" (taking food from waste containers) and making animal welfare labels mandatory. But they were more sceptical of the idea of a compulsory "veggie day".

On the whole, it seems that many young people are willing to take the path of change. Two options are emerging for the future of livestock: a vegetarian scenario, and animal- and climate-friendly farming. Within European Union policy circles, there is increasing discussion about the links between food consumption and agriculture – which the EU Commission describes as the "farm-to-fork" strategy. But signals to the contrary come from the EU Parliament: in attempts to restrict the product labelling of meat and milk alternatives, for example. It will be interesting to see how far young climate activists get involved in food policy. ●

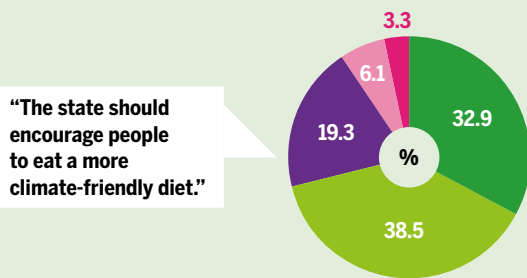


## MAKING ENDS TO MEAT

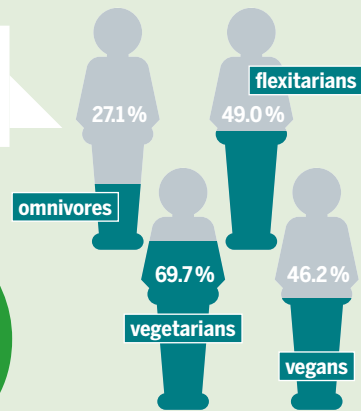
Survey of 15-to-29-year olds in Germany about climate protests, diets and livestock keeping

■ completely agree    ■ neutral    ■ somewhat disagree  
■ somewhat agree    ■ completely disagree

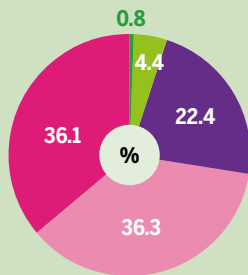
■ completely agree, somewhat agree



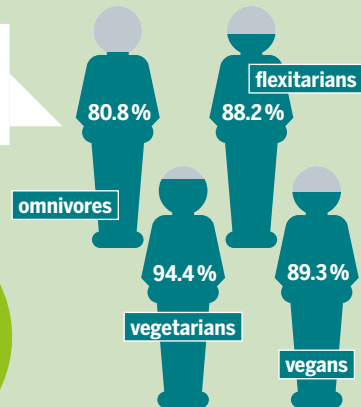
**"There should be government-sponsored campaigns to reduce meat consumption."**



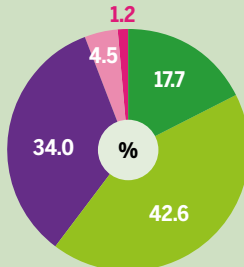
**"Livestock keeping is basically OK as it is."**



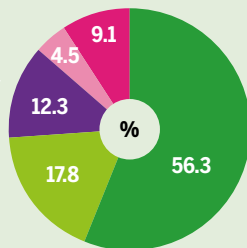
**"Animals should be kept in a species-appropriate way, even if that makes meat more expensive."**



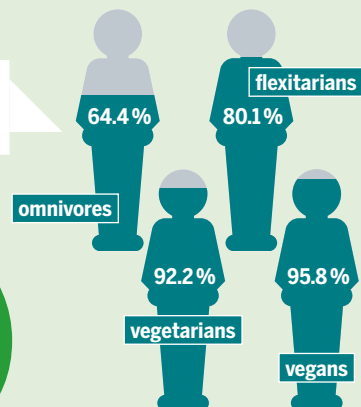
**"The food retail industry is unfair to farmers."**



**"I do not wish to support the meat industry."**



**"The working conditions in the meat industry repel me."**

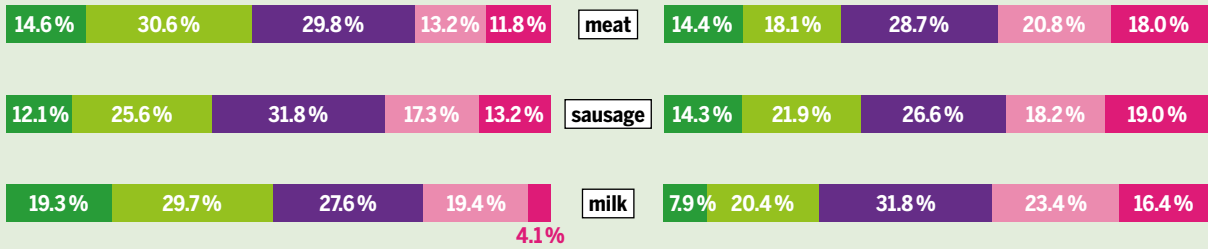


Differences due to rounding. \* Vegetarians and vegans only

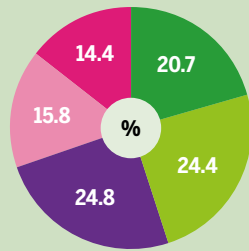


“Substitute products taste good, or I could imagine that they taste good!”

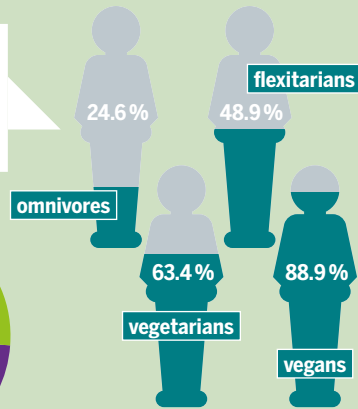
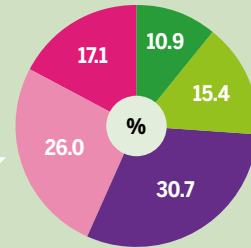
“Substitute products don’t reduce my appetite for the real thing.”



“The state should tax meat to push up its price and use the money to protect the climate.”

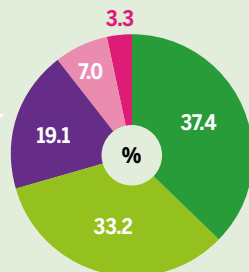


“Supermarkets should give preference to veggie items in product shelves and display them more prominently.”

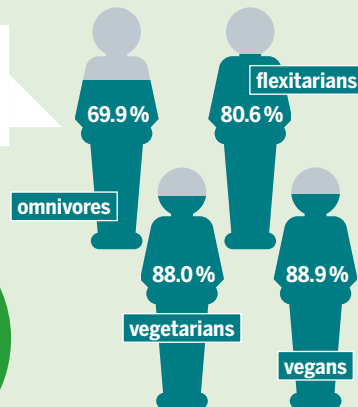
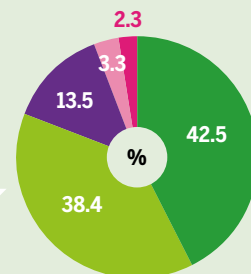


“Advertising for climate-harming products such as meat should be banned.”

“Only pictures that reflect reality should be allowed in the marketing of animal products.”



“There should be a compulsory label to reflect animal welfare.”



“I think that climate-friendly food should be labelled more clearly.”

# AUTHORS AND SOURCES FOR DATA AND GRAPHICS

All online links were last checked in August 2021. See page 2 for the websites where you can download a clickable PDF of this atlas. Unfortunately, some data base query results don't come with identifying internet addresses. Lengthy links have been shortened using the bitly web address conversion service.

## **12-13 CONSUMPTION EVERYDAY FOOD AND LUXURY GOOD** by Lisa Tostado

p.12: OECD-FAO Agricultural Outlook 2020-29, p.16, Annex C, p.10. <https://bit.ly/3owfvzc>. – p.13: top, bottom: Our World in Data, Meat and Dairy Production, <https://bit.ly/2IjaQkR>.

## **14-15 WORLD TRADE IN LORRIES AND SHIPS** by Christine Chemnitz

p.14, p.15 top: USDA Livestock and Poultry: World Markets and Trade, April 9, 2021, <https://bit.ly/2VV8mAd>, pp.4-5, 9-10, 14-15. – p.15 bottom: *ibid.* p.1.

## **16-17 MERCOSUR TRADING AWAY THE ENVIRONMENT** by Bettina Müller and Lia Polotzek

p.16: Eurostat database query, <https://bit.ly/3mc58mw>. UN Comtrade database query, <https://comtrade.un.org>. – p.17 upper part: Wikipedia, lower part: UN, 2019 International Trade Statistics Yearbook, vol. 1, <https://bit.ly/3mc58mw>, pp.24, 28.

## **18-19 PRODUCTION PROBLEM FOODS AND THEIR PRODUCERS** by Christine Chemnitz

p.18: Our World in Data, Meat and Dairy Production, <https://bit.ly/2IjaQkR>. Faostat database query, <https://bit.ly/2Xv8qXv>. – p.19: OECD-FAO Agricultural Outlook 2020-29, <https://bit.ly/3owfvzc>, pp.52-58.

## **20-21 ABATTOIRS CHOPPING BUT NOT CHANGING** by Peter Birke

p.20: media reports. – p.21: Faostat database query, <https://bit.ly/2Xv8qXv>.

## **22-23 MEAT WASTE A LOT LESS THAN THE WHOLE HOG** by Jonas Luckmann

p.22: Tridge trade data explorer query, HS 206, HS 207, <https://bit.ly/3sogsgp>. – p.23 top: Carla Caldeira et al., Quantification of food waste per product group along the food supply chain in the European Union: a mass flow analysis, 2019, <https://bit.ly/3xVgr4H>. – p.23 bottom: AHDB, 2019 pig cost of production on selected countries, <https://bit.ly/2W65LTm>, p.20.

## **24-25 LAND CONFLICTS CUTTING DOWN FORESTS, CARVING UP PASTURES** by Thomas Fatheuer

p.24: Global Witness, At what cost? Irresponsible business and the murder of land and environmental defenders in 2017, <https://bit.ly/2W2ymti>, p.13. Id., Enemies of the state?, <https://bit.ly/3mb6NZn>, p.8. Id., Defending Tomorrow. 2020, <https://bit.ly/3m7zNBn>, p.9. – p.25: WWF, Deforestation Fronts, <https://bit.ly/3mcfAu4>, pp.26, 31. Id., Stepping up? <https://bit.ly/2W0W3SE>, p.7.

## **26-27 COMPANIES DOMINATING THE MARKET FROM FARM TO DISPLAY CASE** by Shefali Sharma

p.26: Mary K. Hendrickson et al., The Food System, 2020, p.9. – p.27 top: [foodengineeringmag.com](https://bit.ly/3go1h0D), <https://bit.ly/3go1h0D>. Rabobank, <https://bit.ly/2L4bsf8>. – p.27 bottom: Philip H. Howard, Mary K. Hendrickson: The state of concentration on global food and agriculture industries, 2020, <https://bit.ly/3AKJIRk>.

## **28-29 FINANCE BIG BUCKS FOR BIG FIRMS** by Mia Watanabe

p.28: Fintel database query, <https://bit.ly/3k2jenH>. Yahoo finance database query, <https://yhoo.it/3CYQjCG>. – p.29: Feedback: Butchering the planet, 2020, <https://bit.ly/3AOun2f>, p.10.

## **30-31 GENDER AND POVERTY YET MORE UNPAID WORK** by Milena Bernal Rubio and Isis Alvarez

p.30: FAO, The State of food security and nutrition in the world, 2020, <https://bit.ly/3squk9L>, p.25. – p.31 top: Katie Tavenner et al., Intensifying inequality?, 2019, <https://bit.ly/37Tnpwk>. TLU: Peregrine Rothman-Ostrow et al., Tropical Livestock Units, 2020, <https://bit.ly/3xPSv2E>. – p.31 bottom: Katie Tavenner et al., Intensifying Inequality?, 2019, <https://bit.ly/3mawn0F>.

## **32-33 FEED SOY, FOREST, AND SAVANNA** by Silvie Lang

p.32: International Feed Industry Federation, Global Feed Statistics, <https://bit.ly/2LedLfr>. – p.33 top: OECD-FAO Agricultural Outlook 2020-29, <https://bit.ly/3owfvzc>, p.28. – p.33 bottom: Transnational Institute, Flex Crops: A Primer, 2018, <https://bit.ly/345vgFV> p.10. ussoy.org, Long-Term world soybean outlook, 2019, <https://bit.ly/2ImYnga>.

## **34-35 CLIMATE A LIGHTER HOOFPRIENT** by Shefali Sharma

p.34: M. Rojas-Downing et al., Climate change and livestock, <https://bit.ly/3mPTon0>, <https://bit.ly/36NpTgf>.

– p.35 top, bottom: IATP, GRAIN, Big Meat and Dairy's Supersized Climate Footprint, <https://bit.ly/3qsfq1z>.

### **36–37 PESTICIDES BANNED BY BRUSSELS, ALLOWED IN THE AMAZON** by Carla Hoinkes

p.36: Faostat database query, <https://bit.ly/2VIXamf>.  
p.37 top, bottom: Public Eye, Milliarden-Umsätze mit Pestiziden, die krebsregend sind oder Bienen vergiften, 2020, <https://bit.ly/3giFyaq>.

### **38–39 WATER THIRSTY ANIMALS, THIRSTY CROPS** by Heike Holdinghausen

p.38: Reliefweb, Global Drought Risk and Water Stress, 2019, <https://bit.ly/2W7giy5>. p.39: FAO, The State of Food and Agriculture 2020, Mekonnen et al., <https://bit.ly/3lOB8ZO>, p.11.

### **40–41 FERTILIZERS TOO MUCH OF A GOOD THING** by Thorsten Reinsch

p.40: FAO, Livestock's Long Shadow, <https://bit.ly/2XvLRC5>, p.212. – p.41 top, upper part: Our World in Data, Fertilizers, <https://bit.ly/2VVdmot>, lower part: Saurabh Shukla, Abhishek Saxena, Global Status of Nitrate Contamination in Groundwater, <https://bit.ly/2UrGByl>, p.6. – p.41 bottom: European Atlas of Soil Biodiversity, 2010, <https://bit.ly/3iTz6cl>, p.62.

### **42–43 REWETTING GIVE PEAT A CHANCE** by Sabine Wichmann

p.42: GRID Arendal, Environmental and social impacts of peatland drainage, <https://bit.ly/3soQt8q>. – p.43 top: Greifswald Mire Center, Peatlands in the EU. Common Agriculture Policy (CAP) after 2020, <https://bit.ly/2JRCcz9>. – p.43 bottom: Global Environment Centre, Wetlands International, Assessment on Peatlands, Biodiversity and Climate Change, 2008, <https://bit.ly/3mPqZxA>.

### **44–45 ANTIBIOTICS USELESS MEDICINES** by Reinhild Benning

p.44: Germanwatch, Hähnchenfleisch im Test auf Resistenzen gegen Reserveantibiotika, 2020, <https://bit.ly/3mS0veE>. – p.45 top: Natural Resources Defense Council, David Wallinga et al., Very High Livestock Antibiotic Use Undercuts Effective Drugs, 2019, <https://on.nrdc.org/3lPOAN4>. Giorgia Guglielmi, Are antibiotics turning livestock into superbug factories?, 2017, <https://bit.ly/2JYvNlt>. – p.45 bottom: Natural Resources Defense Council, David Wallinga et al., New Data: Animal vs. Human Antibiotic Use Remains Lopsided, 2020, <https://on.nrdc.org/37Gfq5f>.

### **46–47 PANDEMICS DANGEROUS CONTACTS** by Inka Dewitz and Christine Chemnitz

p.46: UNEP, Preventing the next pandemic, 2020, <https://bit.ly/37Fau0D>, pp.22-23. – p.47 top: id., p.14. – p.47 bottom: UNEP Frontiers 2016 Report,

<https://bit.ly/36MQnya>, p.22. H. Loh et al., Targeting Transmission Pathways for Emerging Zoonotic Disease Surveillance and Control, <https://bit.ly/36KIqtx>, p.432.

### **48–49 PASTORALISM BOUNTY FROM A BARREN LAND** by Ilse Köhler-Rollefson

p.48: Ganzorig Gonchigsuulaa, Competitiveness of pastoral livestock, <https://bit.ly/39UhB7Y>, pp.8-9, 16, 55. – p.49: PRAPS/Inter-réseaux, Pastoral Livestock Farming in Sahel and West Africa, <https://bit.ly/39PS7J0>, pp.3, 12.

### **50–51 PASTORALISM IN INDIA RANGELAND, NOT WASTELAND** by Ilse Köhler-Rollefson and Kamal Kishore

p.51: League for Pastoral Peoples and Endogenous Livestock Development, Accounting for pastoralists in India, 2020, <https://bit.ly/3m8m11m>.

### **52–53 ACTIVE STATE THE POLITICAL ECONOMY OF TRANSFORMING THE MEAT SYSTEM** by Lukas Paul Fesenfeld

p.52: The EIB Climate Survey 2019-2020, <https://bit.ly/37OZhez>, p.30. – p.53: Lukas Paul Fesenfeld et al., Policy Packaging can make food system transformation feasible, 2020, <https://bit.ly/3yZzWKA>. Supplementary information, <https://bit.ly/3yb2Q9F>.

### **54–55 THE EUROPEAN UNION COMMON LIVESTOCK POLICY** by Harald Grethe

p.54: EC, Overview of CAP Reform 2014-2020, 2013, <https://bit.ly/3gaBxWS>, p.4. EC, CAP in the EU budget, <https://bit.ly/3xV0ITf>. – p.55: Eurostat queries: <https://bit.ly/2W7hJwT> (cattle), <https://bit.ly/3y0h6BH> (pigs), <https://bit.ly/37XZ5cF> (sheep), <https://bit.ly/3D6ijeO>. Chicken data by Faostat query, <https://bit.ly/3iVEdcx>.

### **56–57 LABEL THREE STARS FOR A BETTER LIFE** by Katrin Wenz

p.56: GfK, De Kracht van Beter Leven Keurmerk, 2020, <https://bit.ly/3AOXxOH>. – p.57 top: EC CIRCABC data base query, <https://bit.ly/3j0MrQx>. EC, EU Market Situation for Eggs, 2021, <https://bit.ly/3CXRppp>, sheet 7. – p.57 bottom: FAO, The Benefits of a Public Label, 2019, <https://bit.ly/3m9gPub>, sheet 4.

### **58–59 EU STRATEGIES A GOOD START, BUT COULD TRY HARDER** by Stanka Becheva and Lisa Tostado

p.58: EC, 2030 Targets for sustainable food production, <https://bit.ly/3iX2ajQ>. – p.59: Eurostat, Organic farming statistics, 2021, <https://bit.ly/2VVg8tT>.

### **60–61 LAB MEAT CELLSTOCK VS LIVESTOCK** by Francesco Ajena und Philip Howard

p.60: Hanna L. Tuomisto et al., Environmental Impacts of Cultured Meat Production. Environmental Science & Technology 2011, <http://bit.ly/1ktmchR>, pp. 6117-6123. Id.,

Environmental impacts of cultured meat: alternative production scenarios, LCA Food 2014, pp. 1360–1366, <https://bit.ly/3CXULsg>. – **p.61 top:** Vier Pfoten, In-Vitro-Fleisch, <http://bit.ly/2kpmFjX>. – **p.61 bottom:** Hanna L. Tuomisto et al., Environmental impacts of cultured meat: alternative production scenarios, LCA Food 2014, <https://bit.ly/3zhuXp2>, p.1364.

## 62–63 INSECTS AS FOOD SNACKING ON SILKWORMS, LUNCHING ON LOCUSTS by Hanni Rützler

**p.62:** Dennis G.A.B. Oonincx, Imke J.M. de Boer, Environmental Impact of the Production of Mealworms as a Protein Source for Humans – A Life Cycle Assessment, 2012, <http://bit.ly/34bqt2H>. C.L.R. Payne et al., Are edible insects more or less ‘healthy’ than commonly consumed meats? A comparison using two nutrient profiling models (...), 2015, <http://bit.ly/2PbEhWA>. Thorben Grau et al., Sustainable farming of the mealworm *Tenebrio molitor* for the production of food and feed, 2017, <https://bit.ly/37QcZgW>. – **p.63 top:** Yde Jongema, List of edible insects of the world, 2017, <http://bit.ly/2BCDWTv>. – **p.63 bottom:** Statista, M. Shahbandeh, Forecast market value of edible insects worldwide from 2018 to 2023, 2018, <http://bit.ly/2Pa9z02>.

## 64–65 MEAT SUBSTITUTES A NEW SECTOR EMERGES by Stephanie Wunder

**p.64:** Judith Evans, Emiko Terazono, How to milk a pea: the battle for the plant-based drinks market. Financial Times, May 9, 2021. ProVeg, Plant Milk Report, 2019, <https://bit.ly/3mckTcY>, p.29. – **p.65 clockwise:** Deepak Choudhury et al., Commercialization of Plant-Based Meat

Alternatives, 2020, <https://bit.ly/3CTb49P>, p.3. Kearney, Kearny-Studie zur Zukunft des Fleischmarkts bis 2040, <https://bit.ly/37Cq516>. Good Food Institute, ew GFI State of the Industry Reports show alternative proteins are poised to flourish post-Covid-19, 2020, <https://bit.ly/37PkDsb>. Choudhury, see above.

## 66–67 ACTIVISM PRESSURE FROM BELOW by Stanka Becheva

**p.66:** Haiying Tang et al., Current Status and Development Strategy for Community-Supported Agriculture (CSA) in China, 2019, <https://bit.ly/3yYa8yr>, pp.3-4. – **p.67 top:** End the cage age website, <https://bit.ly/3sonbqF>. – **p.67 bottom:** La Via Campesina website, <https://bit.ly/37TQyHL>.

## 68–72 SURVEY ON YOUTH CHANGING HABITS by Achim Spiller, Anke Zühlsdorf, Kristin Jürkenbeck and Maureen Schulze

**p.68:** Britainthinks, Future Consumer: Food and Generation Z, 2019, <https://bit.ly/3iRUKy2>, p.62. Laura Vergeer et al., Vegetarianism and other eating practices among youth and young adults in major Canadian cities, 2019, <https://bit.ly/3mfxmwy>, p.612. Irene H. Kamenidou et al., Segmenting the Generation Z Cohort University Students Based on Sustainable Food Consumption Behavior: A Preliminary Study, 2019, <https://bit.ly/3xTKdqA>, p.8. – **pp.69–71:** Universität Göttingen and Zühlsdorf + Partner, Fleischkonsum in der Generation Fridays for Future, survey results for the Heinrich-Böll-Stiftung, 2020, unpublished.

## HEINRICH-BÖLL- STIFTUNG

Fostering democracy and upholding human rights, taking action to prevent the destruction of the global ecosystem, advancing equality between women and men, securing peace through conflict prevention in crisis zones, and defending the freedom of individuals against excessive state and economic power – these are the objectives that drive the ideas and actions of the Heinrich Böll Foundation. We are closely tied to the German Green Party (Alliance 90/The Greens), and maintain a worldwide network with currently 32 international offices and well over 160 partner projects in approximately 60 countries. Our Study Program considers itself a workshop for the future; its activities include providing support to especially talented students and academicians.

Heinrich-Böll-Stiftung  
Schumannstr. 8, 10117 Berlin, Germany  
[www.boell.de](http://www.boell.de)

## FRIENDS OF THE EARTH EUROPE

Friends of the Earth Europe is the largest grassroots environmental network in Europe, uniting more than 30 national organisations. We campaign on today's urgent environmental and social issues. We challenge the current model of economic and corporate globalization, and promote solutions that will help to create environmentally sustainable and socially just societies. We advocate for an ecological and fair agriculture that protects natural resources, supports small scale family farms, and halts exploitation of developing countries. We are engaged to reform the EU's agricultural policy. We work towards environmental, social, economic and political justice and equal access to resources and opportunities on local, national, and international levels.

Friends of the Earth Europe  
Rue d'Edimbourg 26, 1050 Brussels, Belgium,  
[www.foeeurope.org](http://www.foeeurope.org)

## BUND FÜR UMWELT UND NATURSCHUTZ DEUTSCHLAND

We view ourselves as a driving force for ecological renewal, social justice and sustainable development. We work to promote small-scale, ecological farming practices, healthy food production, action on climate change, forest and waterway preservation, the expansion of renewable energies and the protection of endangered habitats and species. With more than 660,000 members and supporters, BUND is one of the largest environmental organizations in Germany. With 16 regional chapters and 2,000 local groups, it is present and active throughout the country. BUND is a member of the Friends of the Earth International (FoEI) network and has partner organizations in 72 countries.

Bund für Umwelt und Naturschutz Deutschland (BUND)  
Kaiserin-Augusta-Allee 5, 10553 Berlin, Germany  
[www.bund.net](http://www.bund.net)



# PUBLISHED IN ENGLISH



**MEAT ATLAS 2021**  
European Union

**Further editions:**  
German: Federal Republic of Germany  
[eu.boell.org/meatatlas](http://eu.boell.org/meatatlas)



**EUROPEAN MOBILITY ATLAS 2019**

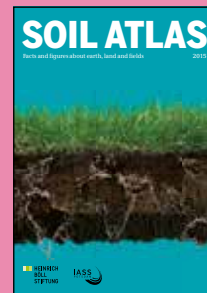
**Further editions:**  
German: Federal Republic of Germany  
[eu.boell.org/European-Mobility-Atlas](http://eu.boell.org/European-Mobility-Atlas)



**OCEAN ATLAS 2017**  
United States of America

**Further editions:**  
German: Federal Republic of Germany  
French: France/Senegal/Tunesia  
Spanish: Latin America  
Arabic: Palestine  
Chinese: China  
Khmer: Cambodia  
Russian: Russian Federation  
Turkish: Turkey

[boell.de/ocean-atlas](http://boell.de/ocean-atlas)



**SOIL ATLAS 2015**  
European Union

**Further editions:**  
German: Federal Republic of Germany, Austria  
French: France  
Czech: Czech Republic  
[boell.de/soilatlas](http://boell.de/soilatlas)



**INSECT ATLAS 2020**  
European Union

**Further editions:**  
German: Federal Republic of Germany, Austria  
[boell.de/insectatlas](http://boell.de/insectatlas)



**AGRICULTURE ATLAS 2019**  
European Union

**Further editions:**  
French: European Union  
Spanish: European Union  
German: Federal Republic of Germany, Austria  
Italian: Italy  
Polish: Poland

[boell.de/agriculture-atlas](http://boell.de/agriculture-atlas)



**AGRIFOOD ATLAS 2017**  
European Union

**Further editions:**  
German: Federal Republic of Germany  
Portuguese: Brasilia

[boell.de/agrifood-atlas](http://boell.de/agrifood-atlas)



**MEAT ATLAS 2013**  
European Union

**Further editions:**  
German: Federal Republic of Germany  
French: France  
Portuguese: Latin America  
Spanish: Latin America  
Czech: Czech Republic  
Turkish: Turkey

[boell.de/meat-atlas](http://boell.de/meat-atlas)



**PLASTIC ATLAS 2019**  
United States of America

**Further editions:**  
German: Federal Republic of Germany  
English: Asia, Nigeria, Palestine  
French: France/Marocco/Senegal/Tunesia  
Spanish: El Salvador  
Portuguese: Brasilia  
Arabic: Palestine  
Burmese: Myanmar  
Bulgarian: Bulgaria  
Chinese: China  
Georgian: Georgia  
Greek: Greece  
Khmer: Cambodia  
Russian: Russian Federation  
Czech: Czech Republic/Slowakia

[boell.de/plasticatlas](http://boell.de/plasticatlas)



**ENERGY ATLAS 2018**  
European Union

**Further editions:**  
German: Federal Republic of Germany  
French: France  
Czech: Czech Republic

[boell.de/energy-atlas](http://boell.de/energy-atlas)



**COAL ATLAS 2015**  
European Union

**Further editions:**  
English: Nigeria  
German: Federal Republic of Germany  
Spanish: Latin America  
Bosnian: Bosnia-Herzegovina/  
Macedonia/Albania  
Czech: Czech Republic  
Polish: Poland

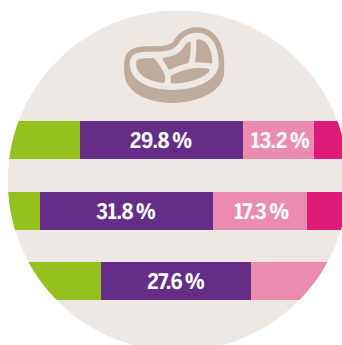
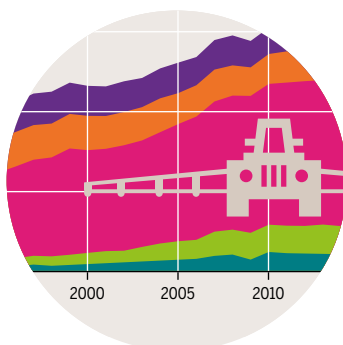
[boell.de/coalatlas](http://boell.de/coalatlas)

Survey results show that forgoing meat is the trend among adolescents and young adults.

from: **CHANGING HABITS**, page 68

Low wages, hard work, and precarious employment are the price that workers pay to supply us with cheap meat.

from: **CHOPPING BUT NOT CHANGING**, page 20



Livestock production and meat consumption stimulate outbreaks of diseases transmitted from wild animals to humans.

from: **DANGEROUS CONTACTS**, page 46

Current trade agreements reflect the EU's marriage to industrial livestock.

from: **A GOOD START, BUT COULD TRY HARDER**, page 58