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Dear Reader,

If I asked you to sit and think for a moment about food, what comes to mind? Your last meal? The people you shared it with? The vegetables in your kitchen still left to cook? Or perhaps where you buy your food?

What comes to mind will differ for every reader – some of you might think of the environmental or social costs associated with our food, others might be thinking of their upcoming harvest or even the exciting innovations in our food system. And still, some may be thinking about where their next meal will be coming from.

Food is a basic human need and right. It's what fuels and connects us – bringing people together across cultures, generations, and even classes. Food is a building block for our communities at every stage of its journey, from production, transport and trade to final consumption. Food has the power to uplift and support communities, but also to devastate and exploit them. So with an ever so complex food system, how can progress in a way that brings all our communities forward?

I hope you carry this question with you as you read through this special United Nations Food System Summit edition of our FoodUnfolded® magazine. The pieces within these pages are not written in hopes to discourage you. We believe that systemic change is possible, but we need to understand the complexities and nuances of our food systems in order to best answer, “What can we do about this?”

We can no longer afford to just talk about the impacts and inequities of our food system. Now it's time to act.

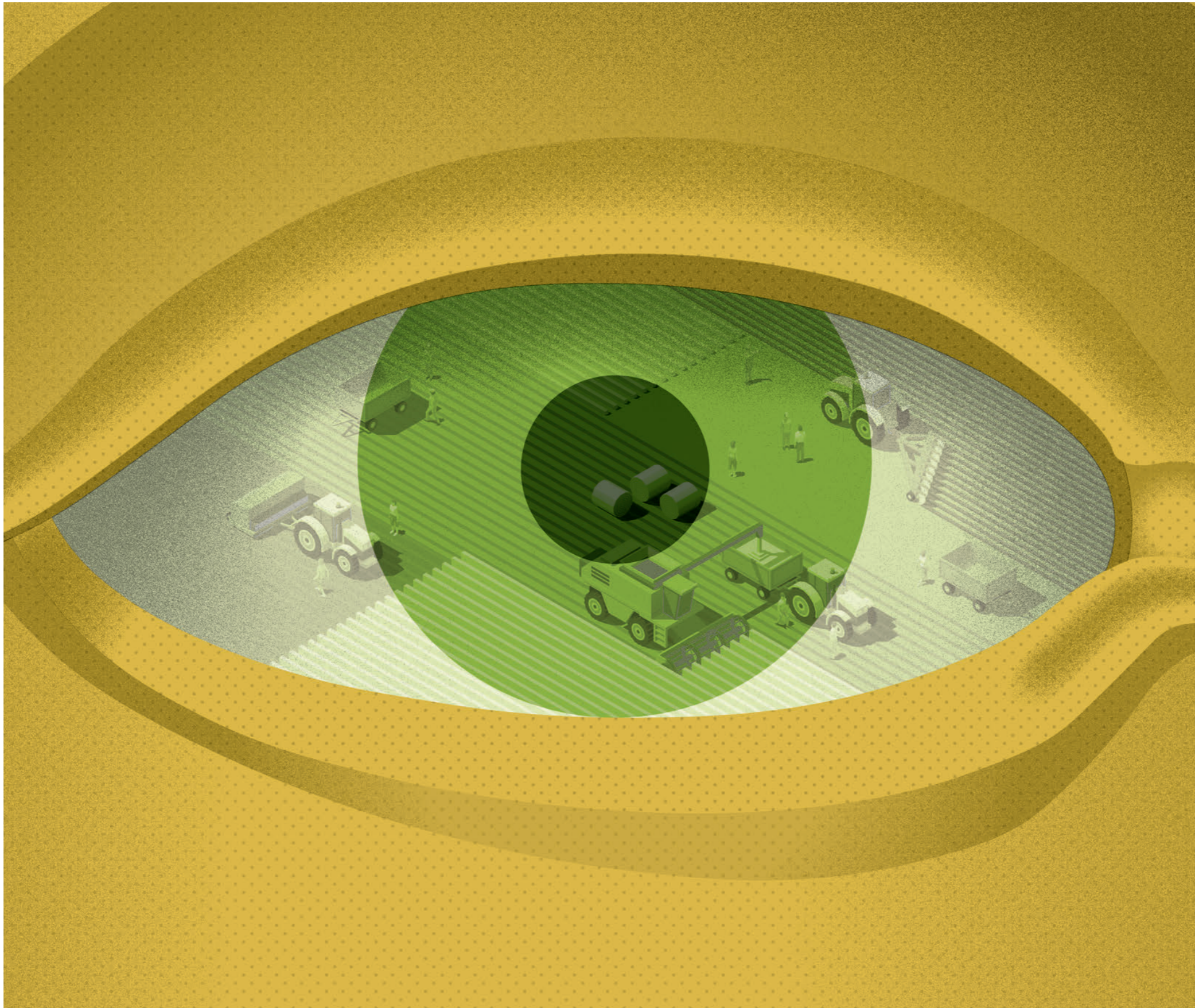
Today, we have access to the knowledge, tools and technologies that can enable us to take our words into tangible action. But to make change happen, we also need the unison of political, corporate, social and personal responsibility. We need everyone to take responsibility, commit and fight for change.

Will you join us?

A handwritten signature in black ink that reads "Jane". The signature is fluid and cursive, with a long, sweeping tail that loops back under the name.

Jane Alice Liu
Editor-in-Chief, FoodUnfolded®

Human Rights



We must face facts: our current food system is built on the exploitation of many of the people who grow and produce our food. In fact, those working in agriculture make up the biggest group of people living below the poverty line worldwide.

by Silvia Lazzaris

Part of the problem is that our food system is globally imbalanced. While only less than 5 percent of the population of high-income countries is currently employed in agriculture, more than two-thirds of the population in lower-income countries still make their living producing our food. Of those 2.5 billion people relying directly on agriculture for their livelihoods, 1.5 billion are extremely poor small-holder farmers, often exposed to exploitative conditions, unreliable weather and volatile prices and demand for the food that they grow.

Meanwhile, most of the money in the food system is made in higher-income countries, where food is processed, packaged and sold in the world's most valuable markets. The buying power of consumers and companies in rich countries also forces down the price farmers get paid for their crops, leading to a very peculiar paradox: some of the world's poorest citizens get poorer just so that the world's richest citizens can spend less on their food.

It's hard not to agree that we need a system that empowers those who help bring food to our tables, rather than exploiting them. But as consumers, we will have to make compromises if we want our food system to take better care of those that work within it. Are we willing to do what we must in order to make change possible?

What Is The 'True Cost' of Food?

Why cheap groceries hurt people and the planet

Climate change, obesity, child labour, plastic pollution, and so on: these are all food-related problems and costs we don't take into account when buying our groceries. How can we include these hidden costs, in order to pay the real price - the true cost - for our food?

The German discount supermarket Penny recently made the news with double price tags for a selection of their products: one for the price you need to pay at the cash register for a certain product, and another for the 'true price', or the price including the social and ecological impact of the production of that food. The German supermarket asked researchers from the Universities of Augsburg and Greifswald to calculate the true cost of 16 products, based on 4 parameters: the impact of nitrogen, greenhouse gases, energy and land-use change. The result? Gouda cheese should be 88 percent more expensive than it is, and a kilo of ground beef at a stunning 173 percent increase. The differences are smaller when it comes to fruit and vegetables, with a 19 percent

price difference for bananas, 12 percent for tomatoes and 8 percent for apples. For organic products, the difference is smaller as well, but even then, organic meat would have to become 126 percent more expensive to include all hidden costs.

How do you calculate the true cost of food?

It's not an easy task to calculate the true cost of a product because what exactly do you include in a model? Environmental damages like carbon and nitrogen emissions, the energy used, the consequences of over-fertilisation? And what about social costs like working conditions and child labour? How do you quantify all those factors?

When looking at the retail cost versus the true cost of products, there are two important concepts we can use. The 'farm gate price', which means the price of the product available at the farm, excluding any separately billed transport or delivery charge. Then there is the 'external costs' of cultivation, also called 'true price gap', which means the costs created by economic activities which are not reflected in the farm gate price. External costs can also be classified as environmental costs if they have a direct effect on the environment, and as social costs if they have a direct effect on the well-being of people.

Scientists from various disciplines are looking for ways to provide insight into external costs. The Dutch organisation True Price has been working on calculating the true cost of products since 2012, and is now the world-leading expert in methods and tools to measure and monetise societal impact. Together with the Initiative Sustainable Trade (IDH), True Price published 4 review studies on the real price of coffee, cocoa, cotton and tea with a clear list of 14 types of external costs divided between environmental and social costs.

The studies are a good example of comprehensively calculating the true cost of food. Each of the four food products scored differently on these 14 aspects: this means that the true costs of certain products are not always driven by the same factors. For example, the true cost of certain foods might be driven by environmental costs, while others could be determined by the social cost of manual labour.



The true cost of cocoa

When taking a closer look at the cocoa from Ivory Coast, the study concludes: the true price of conventional cocoa beans is 7.10 EUR/kg. This is the sum of the *farm gate* price (1.35 EUR/kg) and the *external* costs of cultivation (5.75 EUR/kg). The external costs are more than four times the farm gate price of cocoa beans. This shows that at farm level there are substantial hidden costs relative to the market price, with social costs accounting for 84 percent of total external costs.

Why should we know the true cost of food products?

Ok, now we have an idea of what the true cost consists of, but why is it important to know what we should be paying for a product? The German supermarket claimed raising awareness for their customers as the reason for showing the true cost next to the market price. However, according to True Price, this is not the only reason why it's important to quantify all these extra costs.

"The aim of calculating a true price is to manage risks, steer innovations and reduce social and environmental costs by improving transparency throughout the entire supply chain of a product."

So this information is not only useful to consumers, but also to businesses. By knowing the external costs, businesses can improve the social and environmental impacts of their own operations and their supply chain. They can identify alternative modes of production that are more sustainable and cost-effective.

But in which ways could this information be applied to really impact food production and consumption?

The case of carbon taxes

Since companies might not make the switch to sustainable production on their own accord, the German researchers advise to start introducing a carbon tax. This would help allocate costs to make all the stakeholders along the value chain pay up. The companies can then decide whether they pass on the external cost - so, the true cost of production they have to pay for now - to the consumer, or try to eliminate the external costs. A carbon tax would make polluting businesses pay, in turn favouring companies that invest in more environmentally-friendly production.

This is what the German study has shown: if we paid the true cost of products, organic produce would actually be cheaper in the long run than conventional farming. The true price gap is smaller, because organic products' external costs are less significant.

The same goes for fair trade products, they tend to cost a bit more but have a much smaller true price gap, because - like organic products - they already include the external costs in the production chain. A study published in 2017 by True Price and the British organisation Trucost on the true price of bananas around the world, shows Fairtrade-bananas have 45 percent lower external costs than the sector average. That happens because Fair Trade pays farmers a better farm gate price for their produce.



So by applying this sort of tax, dirt cheap products would suddenly become insanely expensive. Of course, a carbon tax wouldn't be easy to implement in this globalised world. After all, setting a higher bar for everyone would require new international rules.

How supermarkets are bringing more awareness to true costs

Although changing the food system towards fairer priced products is hard, we see more and more experiments, like the one in the German supermarket, popping up. A Swedish supermarket was the first in the world to start with a carbon tax to increase consumer awareness of the true impact of their food choices. In The Climate Store, the currency is carbon. Customers who shop in the supermarket have a weekly budget of 18.9 kilograms of carbon dioxide equivalents. Carbon intensive items, such as animal products, are priced higher than their vegetable counterparts. The company thinks that it will be an eye opener for many to see how certain choices affect their footprint. By giving consumers a carbon footprint budget, they hope to halve the effect of the average shopping basket on the climate. In Denmark, a supermarket presented an app that allows customers to see the estimated carbon impact of their product. And several brands are announcing on-pack carbon footprint information.

Would you pay the true cost of food?

The Problems With Trade Today

Why is there inequality in conventional trade?

In low-income regions, small-scale agriculture is the biggest source of income, jobs and food security for around 70 percent of households. Although much of the world's agriculture and food is supplied by small-scale farms, its producers and workers are often left vulnerable to higher levels of risk, imbalanced bargaining power and unfair trading practices.



The trading system is complex and full of different actors and risks. Within trade, you have producers, buyers (like manufacturers, suppliers, or traders), transporters and distributors (for example, wholesale retailers or grocery stores), each with their own set of risks like pest infestations, transport availability, or loss in product quality or quantity. All these actors are also exposed to the general market risks of demand and price changes too. So if every group has its own risks, what makes small-scale producers in low-income regions so much more vulnerable?

1 Lack of Market Infrastructure

Small-scale farmers are often exposed to *uninsured risk*, particularly if they are from poorer regions with less developed market infrastructure. They often lack access to information on market prices, demand, or even alternative trading channels. This already puts small-scale producers at a lower bargaining position with buyers, especially if they are trading as individual smallholders with larger, more established buyers.

Within a globalised trading system where written contracts and conditions are commonplace, small-scale producers may face additional challenges enforcing agreements as they may be accustomed to a trade culture based on verbal agreements and interpersonal relationships. Without written contracts, buyers can back out of pre-agreed sales without any legal consequences, leaving the producer with an unsold perishable supply — lowering its value.

2 Production Costs & Risks

Producing quality food in high

quantities can be difficult and costly for small-scale producers. On top of the usual production risks like pest attacks, droughts and floods, many smallholders still have production costs — whether it's investing in land, pest deterrents, fertilizers, agricultural technologies and systems, or even hired labour if they don't have enough helping hands in the family. These production costs only increase as producers adapt to problems caused by climate change, like increased water scarcity and natural disasters. It has an even stronger impact on smallholders, as they tend to have lower production volumes and slimmer profit margins.

3 Price Variation & Volatile Markets

While production costs grow, small-scale producers have additional pressure from a volatile market - products may have higher demand and market prices one month, but then drop in demand and price in another. These fluctuations ultimately affect the revenue of small-scale producers, whether for better or for worse. When it's for the worse, small-scale producers are often financially impacted more intensely than other actors in the trading system. Sometimes market prices even drop below production costs. This means a loss for small-scale farmers, which can be jarring when you realise that many of those producers are already living in poverty conditions.

Such strained finances and resources consequently impact farmworkers and labourers, whether in the form of unfair pay, illegal labour, or harsh working conditions (such as long working days and poor hygiene

conditions). These are only some of the biggest issues of inequality in the trading system — not to mention issues with price manipulation and buyer defaults.

What's being done to challenge this?

Fair trade was a movement born to challenge and end inequities in the trading market, by empowering small-scale producers and workers through fairer trading conditions. Today, there are different certification systems that are part of this movement, including international certifications like Fairtrade, Rainforest Alliance and UTZ. Organisations like The Sustainable Trade Initiative (IDH) are building coalitions with all kinds of stakeholders across food supply chains - from businesses to financial institutions, government and civil societies - to transform production and trade through partnership. Several countries of product origin have stepped in with legislation to protect their farmers and workers, like sales policies that require traders to pay premiums on goods. Change is also happening on the consumer level, with more of us committing to paying fairer prices every year.

We still have a long way to go before trade becomes a more level playing field for everyone along the supply chain, but we all need to do our part for systematic change to happen.

Read about Fairtrade Certification on page 98



reverse auction

noun /rɪ'vɜːs 'ɔːkʃ(ə)n/

an occasion when farmers compete to offer the lowest prices to supply their food to importers and retailers

Human Rights In Our Food System /

What's being done about human rights issues today?

with Dr Nadia Bernaz

Human rights are inherent to all human beings, regardless of race, sex, nationality, ethnicity, language, religion, or any other status. I interviewed Wageningen University's Dr Nadia Bernaz, a business and human rights scholar, to understand how human rights and food systems might be connected.

What do human rights issues look like in food supply chains?

There are three main areas where you might see issues with human rights and food systems.

1 Labour

The most obvious issues are the ones related to labour. So, we're talking about health and safety in facto-

ries or in fields, wages, union issues, forced labour, and in extreme cases, modern slavery.

2 Land rights

These are issues that have to do with the land on which agricultural products are grown. Often companies lease out a large area of land from the government of a country to grow food crops. Then it turns out that there's actually people living on that land, but they don't necessarily have a formal title to the land or own the property. Because of this development, they have to leave the land that they've been occupying for a very long time. So that leads to displacement of people and them losing a whole lot of rights in the process.

3 Food safety

Thirdly, there are issues related to the safety of

the food. These are of course technical or scientific issues, but you can also approach food safety as a human rights issue. For instance, some years ago, there was a food fraud scandal involving baby formula from China. Due to a safety issue, several infants, very unfortunately, died or had lung health issues. The right to health, right to life, and right to food are internationally recognised human rights and food safety plays an important role in realising them.

Is the environmental impact of growing food connected to human rights in any way?

It's interesting — the two agendas (the human rights agenda and the environmental agenda) don't always align, and I think it's important to recognise that. Of course, we should strive for policies and systems that benefit humans while not destroying the environment: that is the golden standard. But there are also situations where something that is good for the environment is not going to be good for people, or the other way around, and I think sometimes companies need to juggle these contradictions.

Who is responsible for ensuring that we do not infringe on the rights of people while producing food? Is it governments, companies or consumers?

Everybody is responsible, and that's why it's so difficult to make it happen. I can give you the legal answer, which is that it is the responsibility primarily of governments. Secondly, it is the responsibility of the companies themselves, especially regarding situations that governments have limited control over.

For example, the Dutch government has a responsibility to oversee what a company based here in the Netherlands is doing. But the Dutch government cannot monitor precisely what the company is doing when it is buying things abroad. Then it becomes the responsibility of the company to have an idea about the issues in the supply chain and tackle those issues in a way that is going to advance human rights rather than engaging in human rights abuse. There are also other governments

involved. So, if you have a Dutch company that purchases mangoes from Guatemala, it is also the responsibility of the Guatemalan government to regulate the activities of the company that is picking the mangoes. But we know that the protection of human rights can be more efficient in some countries than in others, so, the responsibility is spread among various actors.

As consumers, our responsibilities are not the same because the power of the consumer is to buy or not to buy. That's very limited. I also personally don't think it's a very effective way of pushing for change. If I don't buy a bar of chocolate, it's a conscious decision but at the end of the day, does that really change policies that companies or governments have in place? I don't really think so. I'm not convinced we have that much power individually — but individuals as actively involved citizens could potentially make a difference in policy.

How can we ensure that companies, especially those operating overseas, respect human rights?

It is challenging. I think there's no point denying this or making it sound like it's an easy task. It's challenging also because it's an afterthought. Over the past 30 years, supply chains have delocalised, and let's face it, for a very long time, without any recognition of the human rights impact. In fact, many supply chains have expanded internationally precisely because of the low level of protection for workers in certain countries, and in the hope of providing more diversity to consumers at low prices.

Now we're coming in and asking companies to precisely track where they buy from and the issues they have in their supply chains. This is very difficult because the whole system was built with no regard for these issues, or worse, with precisely the idea of exploiting shortcomings. So, it's really an uphill battle — and I think it's just only starting.

We often see products with sustainability labels on them – like the Fairtrade label on a bar of chocolate. Do labels or certifications like these help with protecting human rights?

I think they serve a purpose and might have some impact. First of all, they get the consumers to think about the alternative. So, if one chocolate has the Fairtrade symbol and the other one has nothing written, that means you can assume that it's not fairly produced, right? So, if nothing else, it's at least pointing out the deficiencies of the other product.

From a human rights perspective, the problem with certifications is that there's a sea of standards and all of them have different requirements in terms of labour rights, wages, union rights, etc. This lack of uniformity makes labels difficult to read for consumers.

Next to this, the problem is also with how companies acquire these labels. Often, the only way to get certified is through an audit. So, you have auditors with a checklist who go into the fields or factories for an inspection. I have heard lots of stories from people who are auditors themselves about why it isn't the most effective method to check compliance with human rights. For example, I know of an auditor who checked a factory and then went to have lunch across the street. There, she saw fire extinguishers being taken from the factory she had just audited to the next factory due to be audited! So, there's all sorts of issues like that with audits.

Certifications and labels are a reaction to something. They are not a human rights-driven change. It's a way for companies to show that they are doing the bare minimum by getting a stamp of approval at a moment in time, but without, in my view, deep re-thinking of the problem itself.

What might change in the coming years regarding how companies are held accountable for their actions?

Two big changes can be expected here in the European Union. One is the Farm to Fork Strategy, which was just



Everyone is responsible, and that's why it's so difficult to make it happen

adopted in 2020 and includes talking about adopting a code of conduct for food companies that will hopefully cover these issues. The second development is the adoption of a due diligence legislation. This would require companies to research and investigate the area of human rights and environmental protection within their supply chains. The expectation is that companies will be held liable for not having a due diligence system in place.

In parallel, negotiations for a UN treaty on Business and Human Rights have been ongoing since 2015. Though, we are far from having a final draft, and state support is rather limited for the moment. Despite these difficulties, the negotiation process has allowed civil society actors to organise around the idea of corporate accountability for human rights.

So how can consumers make sure that their favourite brands are producing food in a way that does not violate human rights?

Consumers are also citizens. My advice to people would be to start by learning more about these issues and push for them to be on the political agenda. We've seen in the past few years that these issues are not talked about unless companies are really forced to do so through government regulation. So it's important that the people who advocate for this actually push for it to be on the political scene - both at the domestic level and international level.

Tomatoes in Italy: The Social Cost of Production



How can tomatoes be so cheap?

Tomatoes from Italy are a staple ingredient in many homes across Europe, but the story of how they reach your plate may surprise you.

This is a dark story of the invisible people who pick our tomatoes in Italy, but the story parallels many of the other fruits and vegetables we love and eat today, and many of the countries that proudly grow them. The story opens with a rather cheap and affordable tomato sauce tin sitting on a supermarket shelf. It took kilos of tomatoes to make it, countless hands to harvest and process it, and yet the final product is very cheap - perhaps costing even less than 1 euro. But how is that possible?

The problem with cheap tomatoes

In Italy, tomatoes and tomato sauces are cheap because retailers buy them for a very cheap price from farmers and/or the companies that processed the tomatoes and packaged them. They are cheap because retailers have most of the negotiating power and very often get to decide their own buying price. Some retailers, for example, buy their products from “reverse” auctions. First, retailers launch an auction for a stock of products, let’s say two tonnes of tomatoes. Then, every farmer or supplier who is interested in selling two tonnes of tomatoes to the retailer will try to pitch the cheapest selling price. It’s basically a battle for who gets paid the least: the producer who manages to pitch the cheapest price wins.

If we take a further step back in the process, we find the packagers and processors who buy raw material from tomato producers, and sell it to retailers. They have to

pay for transportation, processing, and packaging of tomatoes. But they know that the retailers will only pay a cheap price for their goods, so they also need to buy the raw material for cheaply to be able to make some profit.

What's left at the beginning of this chain is the tomato farmer. With the downward pressure on prices just described, you can conclude yourself that farmers don't make much money. However, they need to keep everything running: the raw materials, the land, the machinery, the labour, all to be paid for. Bringing together all of these costs, they need to ensure that they can still make a living. Oxfam has analysed the policies of some of the major supermarket chains in Europe and the US, finding that supermarkets retain an increasing share of the price paid by consumers - up to 50 percent in some cases - while the share for workers and producers is often less than 5 percent.

So how can farmers survive?

There are two ways of making tomato production so inexpensive that even cheap supermarket prices wouldn't make farmers broke. The first one is to use machines to perform labour-intensive tasks, such as harvesting. A machine is still a cost to the producer, but: 1) it works significantly faster than people; 2) you don't need to pay a salary for its work; and 3) you need just a few people to operate it.

For these reasons, today much of the tomato harvest is mechanised, and hand-picking is now comparatively marginal. However, the need for hand-pickers also depends on weather conditions, so their work tends to vary season to season. If it rains, for example, machines can't enter the fields, and it's necessary to harvest by hand. Different organisations claim that hand-picking accounts for different amounts of the overall tomato harvest, but we would be safe to say that it accounts for roughly 15 percent of the harvest.

The toll on invisible workers

Here's where our story gets darker. The second way of maintaining low prices and stable farm income even when humans are at work comes at a serious cost to farm

workers. Farm labourers often have their fundamental rights neglected, working 12-hour shifts without a contract and without the guarantee that they will be paid minimum wage - or that they will be paid at all.

But who is willing to take this job - or rather, to endure this form of modern slavery? As the FAO reports, agriculture is currently the fourth sector most affected by modern slavery, behind fishing, construction, and manufacturing. Agriculture on its own accounts for two million people affected by modern slavery worldwide, among which migrants represent the most vulnerable group.

Italian "caporalato", the gangmasters

In Italy, the "caporalato" is the illegal form of workforce recruitment that makes cheap labour possible. The "caporali" are middle men who find farm labourers and manage their relationship with farm managers, often receiving bribes from both sides. In English, they are sometimes called team leaders or gangmasters, as they are in charge of the whole recruitment process, international trafficking, and logistics of the lives of the labourers. These include housing (full-fledged slums), food, transport to and from the fields, and payments.

The caporali decide arbitrarily who gets to work and who doesn't, who gets paid and who doesn't, but also when and how much. "This phenomenon has both pre-industrial aspects and aspects of a global society. These people live in nothingness, poverty, as agricultural labourers lived a century ago. But they are recruited through targeted online ads, asking them 'Do you want to earn 30 euros a day? Come to Italy!'" claims Diletta Bellotti, human rights advocate and expert in migration and human rights. But caporalato was born to help solve an issue: without them, it would be very hard for Italian farmers to find enough people to work in their fields. "It is in all effects a mafia activity," Bellotti added, "and as other mafia activities, it was born to fill an institutional void."

Many of the people who hope to move to Italy to find a better future - and to other European countries, as similar forms of illegal recruitment happen also in countries such as Spain and the UK - get stuck in the slums without a way to leave them. In Italy, for



example, to get a residence permit you need to provide proof of a job contract and a rent contract. But if you're a trafficked farm labourer, you have neither. And so you remain stuck in a limbo of legal, social, and moral invisibility.

In slums, labourers die of pneumonia because they refuse to go to the hospital; women perform home-made abortions that can often lead to complications and even

death. They avoid the hospital because they fear being sent back to their home countries. As a trafficked farm worker, you wouldn't be able to interact with the communities outside of your slum. You can't, because you need to be in the slums to be able to work. You rely completely on the caporale to bring you to the fields, who brings you to the fields from specific pick-up points. And in any case, you most likely wouldn't even have the money to afford your own housing.

Is it possible to have a more ethical tomato?

In 2016, the Italian government introduced a law making caporalato illegal, and began an investigation into this phenomenon in 2018. A new law against reverse auctions was approved by the parliament in 2019, and is currently awaiting a decision from the senate. In the UK, the Gangmasters and Labour Abuse Authority (GLAA) was formed in 2005, which has been strengthened by the Modern Slavery Act introduced in 2015 to investigate forced or compulsory labour and human trafficking offences. A European directive addressing these issues (2019/633) was also approved in April 2019, and will have to be implemented by all EU countries no later than 1 November 2021.

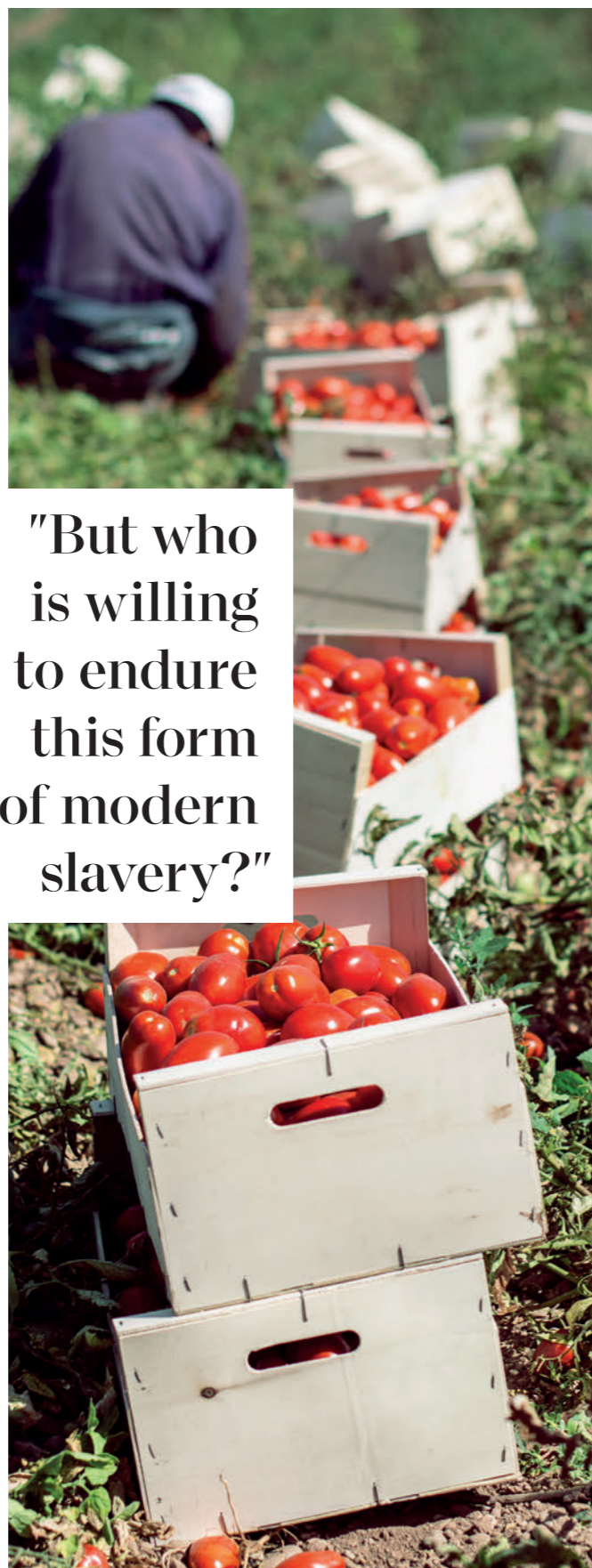
These are all fundamental steps, but they're not enough in of themselves to solve the situation. The introduction of these laws in both Italy and the UK hasn't led to guaranteed human rights for all farm workers. Unfortunately, the introduction of a law doesn't automatically mean that the law will be properly and consistently applied.

Realistic changes for producers, retailers, and consumers

So is there anything we can do to solve this situation? Some people claim that, where it's possible and convenient, the only alternative to the caporali seems to be mechanisation. But it's not uncommon for people who operate the machines to be recruited by the caporali too! Below are some solutions suggested by journalistic and institutional reports, academics, human rights advocates, and labourers themselves, to fight trafficked labour:

1 Transparent packaging labels

At the moment, it's compulsory to have some basic information on labels, including ingredients, nutritional values, and expiry dates. However, product chains could be made more transparent if other information had to be presented on food packaging labels. Below are some examples of information that, appearing on labels, would contribute to create a fairer supply chain. It's a lot of stuff to put on a tomato package, but we could come



"But who is willing to endure this form of modern slavery?"

up with creative ways to make it accessible online – for example using QR codes, or links, that allow people to view the following information on producers and distributors' websites.

Origin: not only state, but also region and province. This would make it easier for people to understand which products they should buy for both environmental (local products) and traceability reasons (allowing them to investigate which kind of practices are employed at the origin of the products).

Register of suppliers: all of the suppliers that were involved in the making of that product.

Name of the company responsible for transport: the food transport sector is among those most prone to infiltration by organised crime. Making it more transparent would push distributors and producers to employ people who are not involved in illegal businesses of any kind.

Number of workers in the field and number of cultivated hectares: a quick cross-check between these numbers would allow authorities to find out immediately whether they should be suspicious of any undeclared work.

Transparent price: a breakdown of the price into percentages, clearly showing how the price is distributed to pay each entity in the chain: distributors, processing companies, logistics and transport companies, producers, and raw material.

2 Subsidies to fair producers

Governments could give subsidies to companies that commit not to resort to illegal forms of hiring and managing the workforce.

3 Citizen-led initiatives

"Vivere senza supermercato" is an Italian initiative started by a group of friends who decided that they wanted to create an easier way for consumers to be more ethically responsible. The initiative created a map, on which they've pinned down all the retailers that sell local and ethical products around the country. Using or creating tools of this kind could drive a signifi-

cant amount of consumers away from "illegal" products and from large-scale distribution, which often retains a large part of the final price of a product.

4 Spending more, if possible

Caporalato-free products rarely make it into large-scale distribution, and even when they do, they are more expensive than regular products. However, if you are aware of this issue and you can afford to pay just a few cents more, this could be a big help to producers who are trying to do the right thing.

5 Using our voices

These issues will be solved mainly through politics. But for politics to move, we need to show that this is a need of ours at a national and international level. Looking out for petitions and using our voices to spread awareness of this issue is going to be crucial to ensure that politicians know that there's public backing to solve this situation.

I hope that, if we all speak and make our friends and families aware of this issue, hold our governments accountable, and do what's in our power as consumers, this article soon won't be timely anymore. The story will hit its resolution, and tomatoes will stop reminding me of blood.

10 Human Rights Organisations

Fighting for food security and fairer practices in the food system

→ **La 72, Hogar-Refugio para Personas Migrantes**



Mexican organisation La 72, Hogar-Refugio para Personas Migrantes (The 72, Home - Refuge For Migrant People) promotes the life, dignity and human rights of refugees by offering meals, shelter and necessary services to Latin American refugees traveling through Tenosique, Tabasco. This region often sees vulnerable Salvadoran, Colombian, and Honduran migrants and refugees travelling for two or more days without food on their route to seeking a better life.

→ **OfERR Ceylon**



OfERR Ceylon (Organization for Eelam Refugees Rehabilitation) facilitates the transition for Sri Lankan refugees back into an active and secure role in society following their return after the civil war. With the help of local community organizations and government officials OfERR Ceylon provides necessary inputs such as livestock (cattle, goats and poultry), paddy seeds, cashew plants, water pumps, delivery pipes, fencing materials, sprayers, fishing nets and gear, etc. to enable newly settled families to begin farming again and secure an income.

→ **Compassiva**



Compassiva is a Brazilian social organization that serves children, women and refugees adjusting to life in São Paulo, Brazil. Their Levando Ajuda Ao Refugiado (Taking Aid to

Refugees) program assists Syrian refugees adaptation and integration to Brazilian society by helping them to secure four basic needs: health, food, housing, and social integration. By providing food basket donations and opportunities for employment and social integration, Compassiva empowers Syrian refugees to gain a secure food future.

→ **Action Against Hunger**



Action Against Hunger is an international humanitarian organisation working across nearly 50 countries to take action against the causes and effects of hunger. They train small-scale farmers, enable cash-for-work programmes, set up research to ensure the scalability and sustainability of projects, and provide emergency aid to communities hit by disaster.

→ **Forest Peoples Programme**



Forest Peoples Programme works with Indigenous people residing in forests or on natural lands to secure rights to their lands and their livelihoods. They work alongside more than 60 partner organisations representing Indigenous peoples and remote communities. FPP promotes a vision of how forests should be managed while respecting human rights and native knowledge and cultures.



Whether it is ensuring citizens' right to safe food or advocating for those growing and processing our food, civil society organisations play an important role in moving towards a more equitable and fair way of producing and consuming food. Here are 10 international organisations that address diverse human rights and food issues.

→ **International Land Coalition**



The International Land Coalition works to ensure the rights of marginalised individuals in the food system. Their mission is to promote equitable access to land through advocacy, dialogue, knowledge sharing, and capacity building. They are committed to building stronger small-scale farming systems, protecting land rights defenders, fighting for equal land rights for women, and offering transparent and accessible information to all actors in supply chains.

→ **La Via Campesina**



La Via Campesina unites millions of peasants, small and medium size farmers, landless people, rural women and youth, Indigenous people, migrants and agricultural workers from around the world to defend rights to food sovereignty and to promote it as a means to social justice and dignity. They oppose corporate driven agriculture that harms social relations and nature.

→ **Human Rights at Sea**



Human Rights At Sea raises international awareness of human rights abuses at sea and is committed to delivering social justice through legal and policy development. Their work includes (but is not limited to) advocacy for the human rights of fishers and fishing communities around the

world, including the right to fair wages, humane working conditions, and employer accountability.

→ **FIAN International**



FIAN International advocates for the right to food and nutrition by supporting grassroots communities and movements. Through national chapters and networks, FIAN is active in over 50 countries. Their work includes exposing social injustice in our food systems and fighting for fair access to food.

→ **SOMO**



SOMO (Centre for Research on Multinational Corporations) is an international non-profit knowledge centre conducting research on multinational corporations, including those active in the food and agriculture sectors. Paying special attention to the role of supermarkets in the food supply chain, SOMO provides advice on issues such as unfair trading practices, right to food, land conflict, and sustainability certification.

Vanilla Beans: The Cost Of Production

It's a bittersweet story for Madagascar's vanilla bean farmers

You would never know when looking at it, but vanilla happens to be one of the most volatile spices on the global market.

As a spice, vanilla comes second only to saffron for how much it costs—a kilogram of these featherlight pods can run up to hundreds of euros. Meanwhile, the demand for real vanilla beans is going up, as more consumers push food companies to use “natural ingredients” in their products.

On the whole, natural vanilla bean extract makes up only 1 percent of the vanilla flavour on the global market with the majority of vanilla flavouring coming from synthetically-produced vanillin. More than half of that will come from the Northeastern region of Madagascar, where the rise and fall of vanilla's price takes a very real toll on the fates and fortunes of the local community.

The human toll of vanilla bean farming

Natural vanilla passes through dozens of human hands as it goes from farm to your kitchen table. No part of farming or curing the vanilla beans is mechanised, and small farms are the very backbone of natural vanilla production. Agriculture is Madagascar's largest sector thanks in large part to vanilla, but ask a Malagasy local

if they use vanilla in their own cooking, and the answer is almost certain to be a “no”.

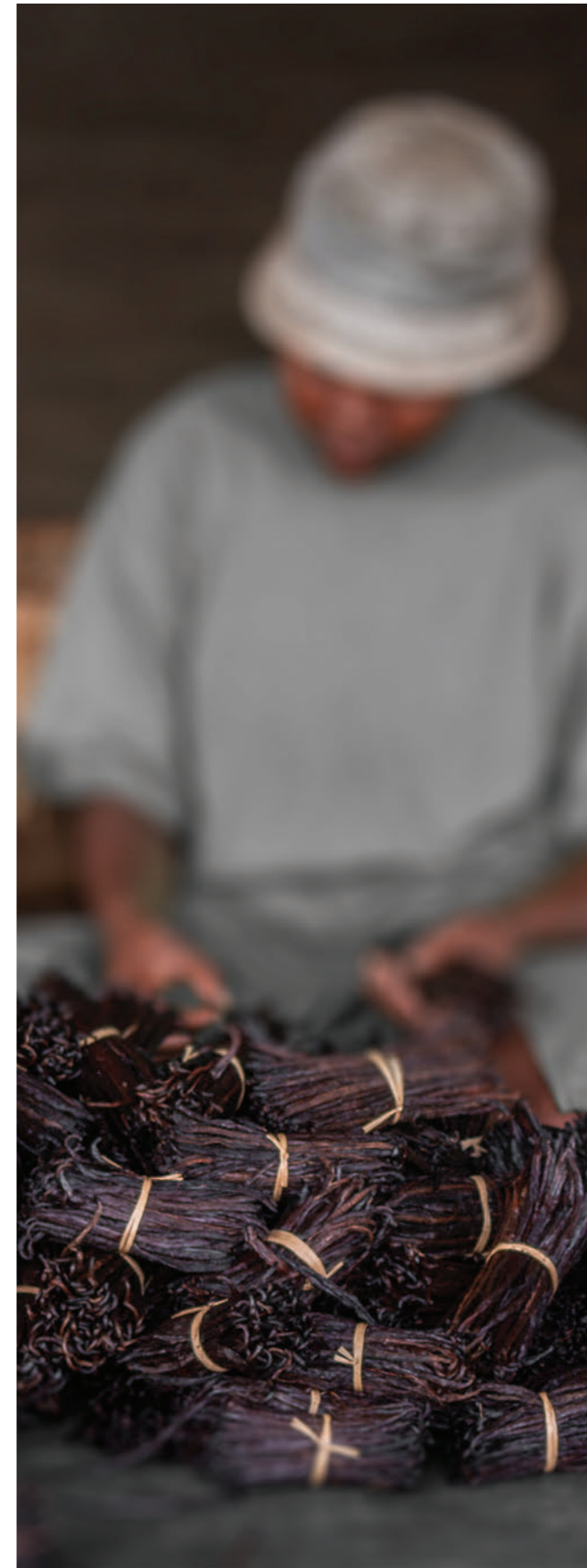
Vanilla for them is something that foreigners consume—a crop grown entirely for profit—and yet farmers receive only the smallest cut of the profits for their months of back-breaking effort. While it is undoubtedly true that many farmers' lives have been improved from producing vanilla, Madagascar remains one of the poorest countries in the world with close to 75 percent of its population living on less than 1,60 EUR per day. Comparatively, a Malagasy vanilla farmer would require an estimated living income of 3,75 EUR per person per day to be able to afford all essential needs such as food, water, housing, clothing, education, transportation, and healthcare.

In the hierarchy of Madagascar's vanilla beans industry, farmers sit on the very last rung. To produce just 1kg of vanilla beans, they must grow 600 orchid blossoms; yet in 2018, these farmers received 38,20 EUR for every kilogram of vanilla they grew—which is only around 5 percent of the export price for natural vanilla that year (875 USD/kg). Despite this disproportionate payoff, vanilla is still a money-making crop for smallholder farmers, and most of their time and effort is put into vanilla, whereas other crops such as cassava, bananas, and rice are grown to be consumed, not sold.

Moreover, small growers have little power to negotiate the price of their vanilla harvest. Freshly plucked vanilla beans begin fermenting immediately and must be sold off quickly to “commissionaires” or middlemen before they go bad. The real profit from natural vanilla is made at upper levels when beans are sold to curing facilities and traders that export vanilla to the suppliers who sell the spice around the world.

Vanilla bean-related crimes on the rise

Vanilla orchids only bloom and fruit annually, so farmers invest all their effort into just one crop and one payoff each year—in some cases, young children will have to miss out on school to help with the demanding work of hand-pollinating and harvesting. Unfortunately, as vanilla has become more lucrative, it has led to a rise in



vanilla-related theft and crime.

Farmers have reportedly been killed or attacked for their coveted beans, and some choose to pick their vanilla beans prematurely rather than lose them to thievery, although this results in inferior beans with poor flavour. Because the local community in Madagascar has little faith in what they see as a corrupt police force and justice system, they prefer instead to take matters into their own hands.

They organise armed militia to patrol the vicinity of villages and apprehend would-be thieves. Anyone suspected of stealing vanilla is treated harshly, and instances of mob justice are becoming more frequent in these vanilla-growing communities. Locals speak of “vanilla murders” where thieves and gang members are rounded up and beaten or killed by machete-wielding groups—all in the name of protecting the community’s livelihood.

Keeping the vanilla bean industry alive

Madagascar is hardly the only place where vanilla is grown, but the beans from this region bear a signature flavour that makes this so-called “Bourbon vanilla” the most desirable of its kind. At present, the island state is facing crises on multiple fronts: rising violent crimes, forest destruction, money laundering—all have direct impacts on the supply of vanilla now and in future.

On the other hand, vanilla farmers in Madagascar are among the most vulnerable to increasingly frequent extreme weather events under a changing climate. While tropical cyclones are currently seasonal from November to May, climate models predict that these cyclones will likely become stronger and more intense in future, which will be devastating to growers in the region. Previous weather events like Cyclone Enawo in 2017 caused damage to 90 percent of the crops in the main vanilla growing regions of Antalaha and Sambava—that year, most farmers lost out on their main income, and the global price of vanilla pods hit record highs due to the shortage.

All this uncertainty drives the price of natural vanilla like a rollercoaster ride — going from lows of 8 EUR to highs of 700 EUR/kg. The Malagasy government has



tried to counteract this by setting a minimum export price of USD 250/kg, but without more intervention, the supply and quality of Madagascar’s vanilla pods will deteriorate as well as the lives of its rural farmers. International food companies have realised this, and there are now several initiatives in the region that aim to improve the lives of growers while ensuring the future supply of natural vanilla.

Through such programmes, farmers receive training in sustainable farming techniques, and in exchange, are promised fairer wages if they commit to selling directly to the spice producer instead of middlemen who take a cut of the price. Having formal contracts like these between vanilla buyers and farmers is important because it builds trust and gives growers a sense of security, so that they don’t end up picking their vanilla beans too early just to make a sale during a lean season.

Our responsibility as consumers

As consumers, there isn’t much that we can do on a personal level to improve the lives of the vanilla bean farmers in Madagascar, aside from supporting fair-trade spice producers. While the jump in global demand for natural vanilla has meant that vanilla farmers are sometimes earning larger incomes, it has also come at the cost of personal and financial safety for many of them. Their reliance on this one lucrative crop is under threat because like other under-served communities around the world, farmers in Madagascar are disproportionately affected by human-driven climate change.

There will always be a market for natural vanilla, but because this supply is likely to be limited by geography, climate, and finicky plants, consumers can also look to other synthetically-produced vanilla alternatives for their cooking needs. In the majority of cases, only true connoisseurs can taste the full complexity of natural vanilla, and the flavour compounds from the bean are cooked out of foods anyway.

So if you’re just baking a batch of cookies, maybe save your vanilla beans and use some synthetic vanilla extract instead—odds are, you won’t even taste a difference.

Fisheries & Aquaculture



Seafood is a daily source of nutrition for more than 3 billion of us, and supports the livelihoods of around 1 in 10 people across the globe. But our relationship with marine foods is changing.

Technological and scientific advancements in recent years have shown us a more complete picture of the ecosystems in our oceans. We now know that ocean supplies aren't infinite and

our fisheries practices have real, long lasting impacts. Yet, our persistent seafood demand continues to rise. So where does that leave us?

Aquaculture has stepped forward to fill the void: in a few short decades farmed fish has surpassed global wild-caught production to provide more than half of the seafood on our plates. Advancements in fish nutrition, genetics, alternative feed types, and technology

have facilitated what is now the fastest growing food sector worldwide. While aquaculture can undoubtedly relieve pressure on oceans to meet our demand, it still feeds into an underlying issue - our preferences.

We only want *the best*. We send fishers to haul nets, only to ask them to throw a portion of their catch overboard, lifeless and wasted, so they have space for the fish we want. They simply provide us

with what we ask for, and what we ask for isn't sustainable. But perhaps it's time for us to give fisheries producers options. By diversifying our choices and embracing uncommon seafoods, we can give producers those options.

From policymakers to consumers, we all have the collective means to reshape our seafood narrative by catching, producing, and eating more sustainably. It's time to get on board.

Marine Conservation & Fisheries/

Is there a way to move forward together?

Jessica Tengvall and **Jessica Fuller** are both PhD students at the University of Bergen, Department of Biological Sciences in Norway. Opinions expressed in this article are their own.



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When we began our careers at the interface between science and policy, one of our biggest challenges was navigating the grey lines between fisheries and conservation. Over the course of our education and career, we were led to believe that the differing agendas between fisheries and conservation groups could never be reconciled. In light of this, we had to ask ourselves: how do we navigate the often contradicting messages that can come from both sides? And how

can we dismantle the dichotomy we were taught: that fisheries management is an industry against conservation, and vice versa?

A culture of polarization

Fisheries is a prime example of a field where interdisciplinary thinking is necessary, yet difficult in practice. For example, how should we prioritize ending hunger and poverty, while also preserving the ocean and its ecosystems when so many communities depend on fish for their economy and livelihood? Adding to the complexity for decision-makers, fisheries and marine conservation narratives have become marred with sensationalist messaging and notorious stories that can heavily influence public perceptions. Take the recent viral sensation *Sea-*

spiracy, for example. What puzzles us, is that a film like this is premiering in 2021 and still spreads outdated and inaccurate information. The issue with media touting doom on global fisheries is that it introduces a new generation of minds to this perceived dichotomy between fisheries and conservation — the "good" vs "bad", and as a result, vilifying one side with little regard to the social and economic struggles faced by many fisherfolk and coastal communities. We, the authors, sincerely hope that we can refrain from stepping back to a time where the "my way or the high-way" attitude dominated much of marine conservation and fisheries work. Surely, we have gone beyond damning an industry to now being able to understand that sustainable fisheries equally supports nature *and* people?



Is there a commonality?

In this article, we explore the idea of a common goal. We individually interviewed fishers (active and retired) and environmental non-governmental organization (eNGO) employees in our professional networks to try and understand their perspectives on fisheries and conservation. In listening to the views of different stakeholders, we found a silver lining: both 'sides' share a commonality, as both groups want healthy and sustainable oceans.

What does sustainable fisheries mean to you?

"It means I have to pass it to my generations, to my son, my children, because this is the best in life."

Fisher, Philippines

"One doesn't take all one can, but maybe saves more than one must. It is not just for us humans, it is also for the whole - all of earth."

Fisher, Norway

"It is better to harvest fewer fish for a good price, than it is to harvest a lot of fish for a lower price."

Fisher, Norway

"Sustainability is all about taking care of the system, the fisheries, that provides for us."

Retired fisher, UK/Norway

"It's about ensuring there is enough stock and spawning biomass to support the stock in the long-term. But it is also that people are able to fish, and not waste

too many resources on fishing."
eNGO employee, Philippines

"Fishing should occur on stocks with scientifically based environmentally sustainable limits, without having too high of an environmental impact on bycatch species and habitats. There needs to be effective regulations and a holistic management approach"

eNGO employee, Norway

What does conservation mean to you?

"Conservation is allowing people to live in harmony with nature. We are not conserving nature for people only or only for itself. We have to balance the need for people to fulfill their livelihoods and sustain resources for the long-term."

eNGO employee, Philippines

"Conservation is about conserving the life support system, which is the planet we have. If we humans are going to live on our planet then we are completely dependent on the natural world we have around us."

eNGO employee, Norway

Is there a future for the fishing industry?

"There has to be a future. It's not necessarily the future we would like to see - for example, the industry itself will be smaller. It's dependent on us getting our head around it now."

Retired fisher, UK/Norway

"There has to be a future for the fisheries industry because millions of people rely on it."

eNGO employee, Philippines

"The willingness to see it holistically, is the most robust way of building conservation and sustainable management."

eNGO employee, Norway

The importance of conversation

Despite a diverse demographic in age, geographic location, background, and occupation, the common thread was an overwhelming appreciation for the oceans and the services it provides us, and a sense of urgency that we are running out of time to sustain our way of life. These people from both fisheries and conservation groups all recognize the importance of sustaining fish for the future, while also recognizing the fragility of the resources upon which it depends and the subsequent need for holistic management. Their individual motivations for sustainable fisheries might vary from a holistic view of the planet to a more place-based perception of individual people and their livelihoods, but the underlying message is the same and focuses on people and nature.

So then, is the dichotomy between marine conservation and the fisheries industry just an illusion? The dichotomy certainly exists, as long as there is an absence of open communication and mutual understanding in this space. To move away from this dichotomy towards our common goal, we need to speak with

and not at each other across all levels of society - from fishers and their communities, to scientists, policy-makers, NGOs and civil society organisations, even consumers.

Everyone has a role

If our goal is to have sustainable fisheries that support people and nature, we each need to be responsible for our own role in the system. The fisheries industries still have immense problems that need to be addressed, but we need the support of all stakeholders to drive us forward - and that includes the support of consumers. As consumers, we have the power to demand change from fishers, suppliers and policymakers, and steer products towards more sustainable standards. But we, as the two authors entering the science-policy interface, have come to realize that we also have the responsibility to communicate clearly and openly between these different stakeholder groups. If we are forthright about what we are trying to sustain and who we are trying to sustain it for, we will avoid many of the common pitfalls created by dichotomies. We believe these challenges are not unique to us as early-career researchers in this field of fisheries and conservation, and we hope that this piece can encourage others to embark on some self-reflection to answer the most critical questions in the sustainability debate: what are you trying to sustain and who are you sustaining it for?

Low-Trophic Aquaculture: Farming The Food Web

Are we farming the right species?

If I say ‘seafood’ to you, what springs to mind? Chances are low-trophic species like seaweed, sea squirts or shellfish weren’t first on your list, but they should be. Here’s how low-trophic level species could change the way we farm - for the better.

Why go low?

Trophic levels are an organism's position in the food web – think of a pyramid with apex predators at the top and plants at the bottom. A motley crew of primary producers, detritivores, and foragers, low trophic species lay the foundation for the entire food web. But as primary producers like algae (level 1) become food for plant eaters like shellfish (level 2), who are then consumed by level 3 species, and so on, the energy needed to support the same weight of organisms gradually increases. By the time we reach the top predators like salmon or tuna (level 4 or 5), the amount of energy needed per kilogram is far higher. In the wild, eating these top predators is more energetically costly. On farms, the story differs slightly, but the principles remain the same.

When we farm top level species, they need energy - a lot of it. That energy comes in the form of feed - either from animal or plant-based sources, depending on the species. One of the main controversies around the sustainability of aquaculture revolves around the resources needed to produce farmed fish. Thanks to developments in aquaculture feed, technology and management, far less of

it is now needed to produce that fish, but innovators and producers are exploring new ways to integrate lower-trophic species into production that could reduce the need for inputs even further.

Zero input, high value

While lower-trophic species generally need much less energy to grow compared with traditionally farmed species, some species take the benefits a step further. If designed correctly, both bivalve and seaweed farms can positively impact the environment around them – all the while producing nutritious foods.

Bivalves

Shellfish feed by filtering passing water - some species filtering up to 100L of water per day - picking out excess nutrients, organic matter and naturally purifying their surroundings. On top of their potential to fix and store carbon, shellfish farms also provide fish with structural habitats that support biodiversity in the area.

Seaweeds

One of the true unsung heroes of sustainable marine foods, algae flourish freely off natural inputs that don't cost a dime – needing only sunlight, carbon dioxide, and water to thrive.

Seaweed farms also offer coastal protection from storms, habitats for neighbouring species, reduced local effects of ocean acidification and hold significant carbon capture potential. A recent study estimated that global macroalgae farming captures 2.48 million tons of carbon per year, making it clear that algae offer a real solution for climate change mitigation.

A multi-trophic approach

Following the aphorism; “Nothing is created, nothing is lost, everything is transformed”, low-trophic species offer sustainability seeking aquaculture producers new ways to reimagine this principle in practice. For example, Integrated-Multi-Trophic Aquaculture (a concept dating back to 2100 BCE in China) involves joint farming of species

from different trophic levels that are ‘ecologically complementary’. These bio-integrated systems allow one species’ uneaten feed, waste, nutrients and by-products to be recaptured and translated into feed, fertiliser, or energy for other species in that system. By harnessing ecological connections, producers can actively transform lost energy, which was once considered waste, into new and profitable products, while offsetting other negative impacts of the farm system.

Despite the benefits, there are still a few steps needed before these approaches can be implemented on a larger scale. With regulations for single-species production already lacking in many regions, regulatory frameworks and industry expertise needed to support these more dy-

namic systems will take time to carefully develop and implement.

The catch

Despite the drawbacks, the environmental and social benefits of increasing the diversity of our farmed seafood to include more low-trophic species are hard to deny. For large high-trophic producers, it yields an opportunity to offset their impact and create more circular production systems. For small producers and lower-income regions, it provides viable low-input and low-cost means to provide food security and livelihoods without the burden of high upfront costs. So while trophic levels aren't a standalone indicator of sustainability in aquaculture, the humble critters low on the list can certainly play a key role to improve it.





maximum sustainable yield

noun /'mæksɪməm sə'steɪnəb(ə)l jɪ:ld/

the highest catch that can be routinely taken from a fish stock without causing long-term depletion



What misconceptions are there around this phrase?

Listen to our Food For Thought Podcast with Prof Ray Hilborn.

Expanding The Gaze Of Modern Fisheries Management/

The key role of Indigenous
knowledge & perspective

with Dr Andrea Reid

Dr Andrea Reid is a citizen of the Nisga' a Nation, an Assistant Professor of Indigenous Fisheries at the University of British Columbia, and cofounder of Riparia, a Canadian charity that connects diverse young women with science on the water. Dr Reid's work employs Indigenous research methodologies

and community-based approaches in her studies of fisheries to improve our understanding of the complex interrelationships between fish, people and place. I sat down with her to discuss the role of Indigenous knowledge in the future of fisheries management.

How did you become involved in the Indigenous fisheries space?

I grew up on the east coast of Canada in a tiny fishing and farming community on a place called Epekwitk, now known as Prince Edward Island (in Mi'kma'ki territory). I grew up loving to swim and spending hours on the beach, so I think that instilled in me a deep care for the sea and all its inhabitants.

When I got to University, an amazing advisor took me under her wing to work with Ugandan fishers on Nile perch in the Lake Victoria basin. But as I was applying the scientific methods to these fisheries, I was blown away by how much the fishers I was working with knew about the landscape, how much they could read the water and tell me where, when and how we were going to find the fish. It really was that deeply human aspect and relationship that pulled me further into this.

Throughout these studies and experiences, I'd been getting support from the Nisga' a Nation, the First Nation that I belong to—that my Dad and my Grandmother and our ancestors going back millennia belong to. I realised that I needed to do more to give back to my own people through my work as a scientist in this space.

How have you connected Indigenous knowledge and scientific training in your work?

A major methodology that I used in my work is this idea of Two-Eyed Seeing (*Etuaptmuk* in Mik'maq). It means learning to see from multiple perspectives and bringing together the strengths of Western sciences alongside the strengths of Indigenous knowledge systems, and using both together for the benefit of all. It's about finding ways that invite those multiple perspectives to be validated, legitimized and brought together as evidence when we're working on problems that affect everyone in that space.

I think that there's real recognition on the part of many communities that we're going to learn a lot more about exactly where our fish travel to at various life stages. The Unama'ki Institute does some great collaborative

work here, bringing in biotelemetry* to track and monitor fish in ways that we wouldn't have had insight on otherwise. But they also have other means of looking at the fish and understanding those histories by speaking to elders who carry stories that date back generations. I do the very same in my own work. We can understand historical baselines of fish abundance through a view that we hadn't previously considered, and in areas that we often don't have that kind of baseline data for. But it's fundamentally so much more than just data – it's a whole different way of viewing and being in the world, and I think it's this understanding, this relationship to so-called nature, that could be profoundly transformative for the current status quo of how we interact with and relate to the natural world.

*Biotelemetry is the tracking or monitoring of a free-ranging animal by means of electronic equipment that receives signals from a device attached to the animal.

How has the general response been by Indigenous communities to share knowledge and work alongside non-Indigenous fisheries scientists?

On the whole, I encounter a great deal of enthusiasm and optimism. Increasingly, I see so many nations that want to engage. They see huge value in bringing together multiple tools and approaches, just as many Indigenous frameworks for thinking about learning have always embraced multiple ways of knowing. There's a really wonderful quote by Cook Islander Thomas Davis, who says that *'if my ancestors had fiberglass, they would have used it'*. We have long histories of using the tools that are available at our disposal.

But there are pockets of scepticism or criticism, of course. On the part of non-Indigenous scholars, I think that there are many who doubt the validity of Indigenous knowledge systems or see them as scientifically unworthy of being included in these spaces. And while we have this school of thought within the academy that undermines the validity of Indigenous knowledge systems, there is also hesitance on the part of Indigenous peoples—well placed hesitance in certain circumstances—as to the motivations of employing these collaborative approaches.

If Two-Eyed Seeing is misappropriated and used as simply a new way of extracting Indigenous knowledge, so that it can be used as data and fed into Western science framings for Western scientific ends alone, then it is extremely problematic and it is not Two-Eyed Seeing as envisioned by the carrier of this teaching, Mi'kmaq Elder, Dr Albert Marshall.

Why do you think non-Indigenous scholars doubt the legitimacy of Indigenous knowledge?

Accepting alternatives requires a relinquishing of power and space on the part of those that hold it. That's a big ask and one that many do not want to partake in. People don't want to give up those positions or to complicate the decision-making process—that's a big part of it for fisheries managers in many contexts. They want to make a clear decision based on something that they think holds the best information available to them. There's a lot of work to be done to have collective discussions about what constitutes evidence and what constitutes expertise - it is not just people who, like me, hold PhDs. There are experts in our communities who know the fish far better than I ever will.

But I think that people are increasingly willing to engage in these conversations and interrogate their own biases, privileges and what kinds of values they carry into these spaces. There are so many studies that do a really beautiful job of bringing together ways of knowing, and it makes it clear that we have the methods to work in this way. It's more about the institutional and political will to make change. But we're very much at a starting point. I think what people need to see is a successful application of these collaborative fisheries management methods for them to become widely accepted.

How do Indigenous connections to nature influence the ways that a fishery is managed?

To be clear, I just want to recognise that not all Indigenous peoples hold the same perspectives and values,



It's a whole different way of viewing and being in the world, and I think it's this understanding, this relationship to so-called nature, that could be profoundly transformative for the current status quo of how we interact with and relate to the natural world

there's a plurality of Indigenous cultures that have distinct worldviews. But from my experience in the Canadian context, the way that many nations look at fisheries here stems from a vastly different worldview than mainstream approaches to management. A foundational component of that comes from taking a relational perspective, where fish are seen as relatives to live in reciprocity with - not as objects to be commodified, and treated through command and control systems that we use commonly today.

Many Indigenous fishing ethics across the land now known as Canada really hinge on these values. They center on not taking more than one needs, of not taking all that can be seen, and of minimizing harm through our activities. Those culminate in fisheries practices that are really couched in thinking not only about this present circumstance we live in, but in being responsible descendants to our ancestors and responsible ancestors to our descendants. It's the whole notion of 'seven generations'—reaching back to my great grandmother, and to my great grandchild. These are both individuals I could meet in my lifetime and my impact as an individual can span those seven generations, so I'm accountable to all of them. This concept is shared across many nations here and I think it stands in stark contrast to that capitalistic, commodified view of fish and fisheries.

What would it mean to Indigenous communities you've worked with for a key fishery to collapse?

When fish populations or species do get depleted in these contexts, it's far more than just a loss of food for so many people. It is a loss of culture, of tradition, of language and all of the things tied to that fish. For example, if industry comes in and makes the water unliveable for fish coming up river, as many Indigenous scholars are making clear, that is cultural genocide. It's removing this cultural keystone species that is foundational to who we are as people. I've had elders ask me, '*Who are we as Nisga'a if the salmon aren't there? We're salmon people, we can't exist without them.*'

I've also had elders ask whether the loss of the species is purposeful and is meant to disempower or to disen-



They center on not taking more than one needs, of not taking all that can be seen, and of minimizing harm through our activities

franchise communities. I think that there are some really well placed concerns there, but there's also some brilliance contained within it as well. I see nations here recognizing that reality and that tension and many are trying to find creative ways of confronting it by developing 'culture camps' with communities. These culture camps allow us to come together around those fewer fish, and make sure that there is space for elder-youth knowledge transfer, so that those practices and those histories aren't lost as the fish diminish.

How could acknowledging social and cultural ties to fisheries impact how they're managed?

If you look at the history of fisheries science, there's been an increasing recognition of the important role of fishers. Bob Johannes' work famously identified that 'you need to bring fishers on board, or you miss the boat'. How do you enact policies, if you don't have buy-in from those who are supposed to follow them?

But I think there is now a growing recognition that those strictly ecological approaches aren't satisfying the needs of these truly coupled social-ecological systems, so there needs to be this social dimension that also factors in. That's the direction that ecosystem-based

fisheries management and adaptive management have been pushing people towards for several decades now. And there are, of course, adaptive practices embedded in Indigenous knowledge systems that date back millennia that could lend insight into how we deal with the uncertainty and unprecedented change that we're grappling with now. I think there's such a real risk to thinking that we can deplete a fish stock to a certain point and it's not going to have these ripple effects on everything else in the ecosystem that it's attached to.

Could the Two-Eyed Seeing approach apply to international fisheries contexts, or is it restricted to localised fisheries?

The challenge is definitely a lot more simplified when we're looking at a localised context. For example, here in British Columbia, the way that Indigenous peoples used to live in the landscape was often distributed throughout an entire watershed* and they would have boots on the ground throughout the river system. Pre-colonization, they were there to monitor it, take care of it and to see what was going on in the waters and with the fish. Through colonization, people have been concentrated onto reserve land and removed from being those active care-takers throughout the watershed. I think Two-Eyed Seeing is one approach, of

several, that could help us get back to a place where Indigenous understandings of aquatic health are valued and utilized in the care and management of a system.

But it certainly gets really complex when we venture into international waters or to big trans-boundary fisheries. Two-Eyed Seeing and these kinds of methodologies are not a panacea. They're not one size fits all kinds of solutions. The larger the scale we attempt to tackle, the more people need to be involved at the decision-making table.

Two-Eyed Seeing as a practice is really meant to be a reflexive practice that we carry with us through the entirety of a decision-making scheme or research project. It allows us to think at every stage about all perspectives and to create space to enable those voices and perspectives to be there at the decision-making table. This can be applied across scales, but like many systems in the world, when we operate on such large scales, we lose touch with our ability to adaptively manage and fit to the landscape. I'm a big advocate for localizing our fisheries, and for managing them on a watershed level scale that's appropriate to the environment, to the threats, to the fish and to the people that are there.

**Watershed: Land area that channels rainfall and snowmelt to creeks, streams, and rivers, and eventually to outflow points like reservoirs, bays, and the ocean.*

Are you optimistic about the role of Indigenous knowledge in the future of fisheries management?

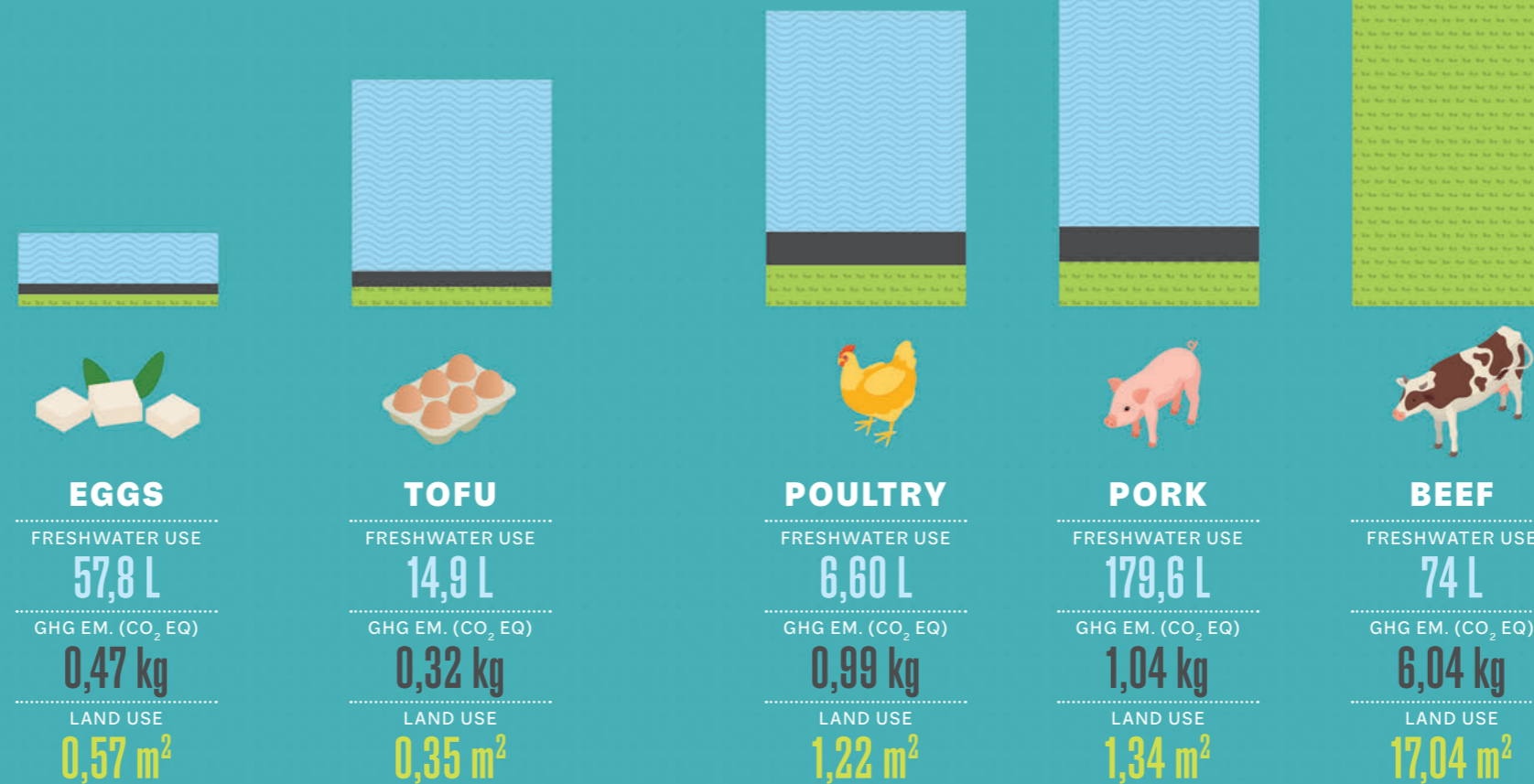
I really love the approach that elder Albert Marshall has told me about - that as Indigenous peoples in a country that is moving towards legislating UNDRIP (UN Declaration on the Rights of Indigenous Peoples) as law, there will be increasing inroads for Indigenous peoples to play really active roles. We're some of the few in this country who can take the government to court for polluting a waterway or removing fish because those actions infringe on rights enshrined in UNDRIP. I think that there is a great amount of agency and responsibility that is bestowed on us because of this, and we have an ability to oversee these waterways and to supersede provincial and federal legislations. I think that's where there's real power. I think that's where we need to see this shift going, especially if we want to move towards more localized and small-scale fisheries and their management.

Protein Sources

PROTEINS for 100 g



Impact For 100g Of Retail Weight



Source: Poore & Nemecek, Science (2018).

It's never been clearer that the consequences of eating too much meat are dire—for the climate, the environment, and our own health. Nevertheless, we're now collectively eating over four times as much meat as we were 50 years ago—and each year sees greater consumption than the last.

Low- and medium-income countries, currently urbanising and rising above poverty, have recently seen a huge rise in the consumption of meat—a food historically enjoyed by the wealthy and viewed as a status symbol. But despite the rise in meat consumption in urbanising communities, rich countries still eat by far the most meat globally. The average per-capita meat consumption in 2014 was 43 kilograms, ranging from 100 kilograms in the United States to only 5 kilograms in India.

Not all meat is produced equal, however. Just one-quarter of beef farms contribute to over half of all beef-related environmental damage. But even beef produced by the most environmentally friendly farms has a greater environmental impact per gram of protein than the absolute “worst” vegetables.

So changing *how* our food is produced can have an impact, but changing *what* we're eating in the first place can make a much bigger difference. In some ways, this makes our mission as consumers (particularly those in higher-income regions) much simpler: reduce our consumption of animal products, in particular beef and lamb. Luckily, the modern world has plenty of nutrient-rich, environmentally friendly and often delicious protein alternatives for us to turn to instead to ensure we remain happy, healthy, and well-fed.

Not All Meat Is Made Equal

What is the real environmental impact of beef production?

We've all heard that meat (and beef in particular) is bad for the environment. But it's not just what meat you eat that matters – how meat is produced can also significantly change its environmental impact. Some beef farms, which use more sustainable methods, do far less damage to the natural world than others.

Beef production carries an enormous environmental footprint, contributing to land and water degradation, deforestation, acid rain and biodiversity loss. But it looks like the issue is much more nuanced than simply “meat is bad” after all.

In 2018, researchers from Oxford University and Agroscope (the Swiss Agricultural Research Institute) found large differences in the environmental impact between different producers of meat and animal products. The researchers closely examined the environmental impact of almost 40,000 farms and 1,600 processors, packaging factories, and retailers—creating the most comprehensive database of the food sector's environmental impact ever compiled.

High-impact and low-impact methods of beef production

The results of the Oxford-Agroscope research show that not all farming practices are equally sustainable. A farm's size, methods, and geographical location—as well as the amount of processing, packaging, and transport that its products undergo throughout their lifecycle—all contrib-

ute to the farm's environmental impact. To give you an idea of scale, farms range in size from around 0.5 hectares in Uganda to 3000 hectares in Australia; and the use of mineral fertiliser ranges from 1kg of nitrogen per hectare in Uganda to 300 kilograms in China.

Taking these different factors into account, researchers were able to distinguish between “high-impact” and “low-impact” meat producers by quantifying different aspects of environmental damage – such as the amount of land or freshwater used, the level of greenhouse gases emissions, or a farm's contribution to acidification and eutrophication of rivers.

When it comes to the beef industry, high-impact beef producers vastly differ from their low-impact counterparts. They release 12 times as much CO₂ as low-impact producers, and use up to 50 times more land than low-impact farms. These staggering differences explain why only 25 percent of beef farms contribute over half of all beef-related environmental damage.

What if all beef farms became low-impact?

Unfortunately, even meat produced by the most environmentally friendly farms has a greater environmental impact than the very environmentally “worst” vegetables. A concrete example: a low-impact litre of cow's milk uses almost twice as much land and creates almost double the emissions than the average liter of soy “milk.”

Eating less meat compared to a plant-based diet

Products from the meat, aquaculture, eggs and dairy industries already use around 83 percent of the world's farmland and contribute more than half of food's emissions – so it's no surprise that this study confirmed that a plant-based diet remains the most sustainable choice. If we all went plant-based, we'd halve CO₂ emissions, acidification, and eutrophication associated with our diets, and reduce the amount of land used to grow our food by 76 percent globally. In the US, where people eat three times more meat than the global average, going fully

plant-based would help reduce food-related greenhouse gas emissions by up to 73 percent. However, there is good news for those who want to be more sustainable but can't or don't want to remove all animal products from their plates. The study found that if we halved our consumption of animal products and only bought them from low-impact producers, it would be 70 percent as effective as going totally vegan.

The need for new sustainability labels on food packaging

Sadly, most of us still have no idea of how to distinguish a high-impact producer from a low-impact producer in a supermarket. One solution might be the introduction of packaging labels, which could help identify the environmental impact of each specific producer (for example, a green sticker for low-impact, a yellow sticker for medium-impact, and a red one for high-impact) and therefore help us all make more informed decisions about what we buy.

Governments must step up too

However, the study highlighted that consumers' intentions alone can't make a difference unless they are supported by policies around transparency and financial incentives that support more sustainable consumption. The burden of responsibility cannot fully fall on consumers' shoulders – it's time for our governments to ensure sustainable choices are easier for us to make.

The World Of Hunting On The West Coast Of Norway/

What is the world of hunting like? I sat down with Susanne Tonheim to hear her experience growing up in a hunting family on the western coast of Norway.

with Susanne Tonheim

How were you introduced to hunting?

I come from a hunting family. Throughout my childhood, I've always joined hunting trips with my dad and brothers. But I've only officially hunted myself after receiving my license at the age of 14. Since I grew up with it, it's just a hobby that I do — like when others play football or the piano.

Wow, you were quite young when you started. Were there restrictions to what you could hunt at such a young age?

Oh yes, it's not like you turn 14 and then you can hunt anything and everything. In Norway, when you're 14 years old, you're only allowed to hunt smaller game, like birds. When you turn 16, you're allowed to hunt larger game — but you also have to be supervised by someone else until you turn 18. So, there's a long learning process in hunting, something which isn't always communicated out to other people.

I'm sure in the beginning, taking an animal's life was very difficult. How do you feel about it now?

I remember the first time I pulled the trigger. I was hunting birds. There were a lot of emotions going through my body, but then I also thought: "Okay, it was a good shot." It was over very fast. I definitely felt a lot — and I still do, though maybe less than the first few times.

I think it also varies depending on what I'm hunting. Killing a very sweet-looking deer makes me much more emotional. There's an adrenaline rush. You see the reaction of the deer the moment the bullet hits its heart and lungs. Seeing it fall and die, you empathise with the animal who just lost its life. But then, when you know you have fired a good shot, and you can see that the animal is hit well, you process those feelings and understand that you have to refocus on following the animal and see where they fall to check they're not suffering.

What are the biggest driving reasons behind why you hunt?

For me, it's definitely about keeping the populations healthy, as well as tradition. From an environmental perspective, it's nice to be a part of sustainable harvesting. It's more like conservation in a way — you're harvesting from the population surplus, which helps to keep the populations alive and healthy rather than being overpopulated, in which some animals would die and suffer from starvation. You're also keeping the peace, as the farmers are also happy, because there are less animals who will eat the grass that he's supposed to give to his animals, like the cows and sheep.

Traditional heritage is also very important for me, so keeping the traditions alive because this is something that we've been doing since I don't know how long — ages. I learned a lot from my father and I will continue to teach my children about this. But there is also a very important social aspect to it. I like the feeling of being a part of a bigger group, going out and harvesting from nature - that the effort and energy you put into it comes back in the form of food. Since I moved from my hometown to the city, this has become a very nice way to connect with my family, to go back to my roots. So now it's like a family tradition to go hunting and help each other process the game we bring home.

Do you hunt throughout the year?

It's important to mention that in general, all game is prohibited to hunt, but we are given permission to hunt at certain times of the year. All game is prohibited during breeding season, so we hunt mostly during the autumn. Where you hunt also depends on what you're hunting — we have hunting sites for each species. You can go online and check when and where hunting is allowed.

Does the government work with different researchers or associations to establish what and where you can hunt? How do they ensure that populations aren't overhunted?

I would say that hunting is more often for harvesting from a sustainable population. The government has set quotas, at least for various bird species and larger game like deer and moose. There are also restrictions when it comes to birds, so you could have a bag limit on what you are allowed to bring back. All those quotas are set by the ecology, including predictors like food availability [for prey and predators], pressure from hunting, and how the population is doing.

But I also think this is where improvement is needed — we need to ensure that quotas are set correctly with proper assessments and data. For example, you might receive data from a farmer who has a beautiful field that attracts deer to come and feed from, who reports on all the deer he sees that aggregate around the area and give an impression of a large population. But if you distribute all those deer into a larger area where they migrate from, it may not be that high of a population.

Right, it might not be as accurate of an assessment from a proper field study. But how does the government reinforce the quotas? Perhaps I'm being a bit cynical, but are the quotas really respected by hunters?

I would say that they are mostly respected. As a hunter, you have to hand in the jaw of the animal — at least for deer hunting — because the jaw shows the age of the deer. You also have to give information on the animal's details (like was it a female or male, was it young), the number of hunters in your group, where you hunted, how many animals you saw etc. I should also point out that if you're caught hunting illegally, then you'll receive at minimum a fine, maybe even a withdrawal of your hunting license and weapons. But I would like to believe that people follow the set quotas, because they are there for a reason.

Walk us through a hunt - what's the process like?

There's a lot happening at the same time. During a hunt, your pulse increases and you become so aware of your surrounding environment. You hear all the small sounds in the forest, and you can even see the smallest movement from afar. When you spot the animal, you have to figure out what kind of animal it is. Is it something you're allowed to shoot or not? Is it a female, male, old, young, calf, etc. At the same time, you always have to remember to have a safe background, because you are handling a fatal weapon. Once you make sure your background is safe, you should try to make the deer stop by shouting or making a sound. Before pulling the trigger, you have to aim at the right spots to kill it as humanely as possible. As hunters, you learn to shoot right behind the front leg, through their heart and lungs because it shouldn't feel any pain.

When we take our hunting license, we are taught that you should never regret an unfired shot. So, if you're unsure or not feeling comfortable, it's better to let the deer go rather than firing a bad shot.

When you are on a hunt, how are you able to tell apart the animals you are legally allowed to hunt from the ones you aren't?

That comes with experience. It takes a lot of time and encounters with deer to really be sure if you're allowed to shoot. Sometimes it's easier to spot, for example with male deer. Male deer have antlers, and in general, the more branches on the antlers, the older he tends to be. For female deer, it's more difficult to spot as you have to look at the length of their snout and size of their bodies — it might even be running as well.

Do you always come home with game?

No, and I think that is a good thing. Because then you feel like you have to put in effort. Remember, this is also nature you're harvesting from. It shouldn't be like going to the grocery store to buy your food.

Today, there are more species around the world that are being threatened and placed under protection.

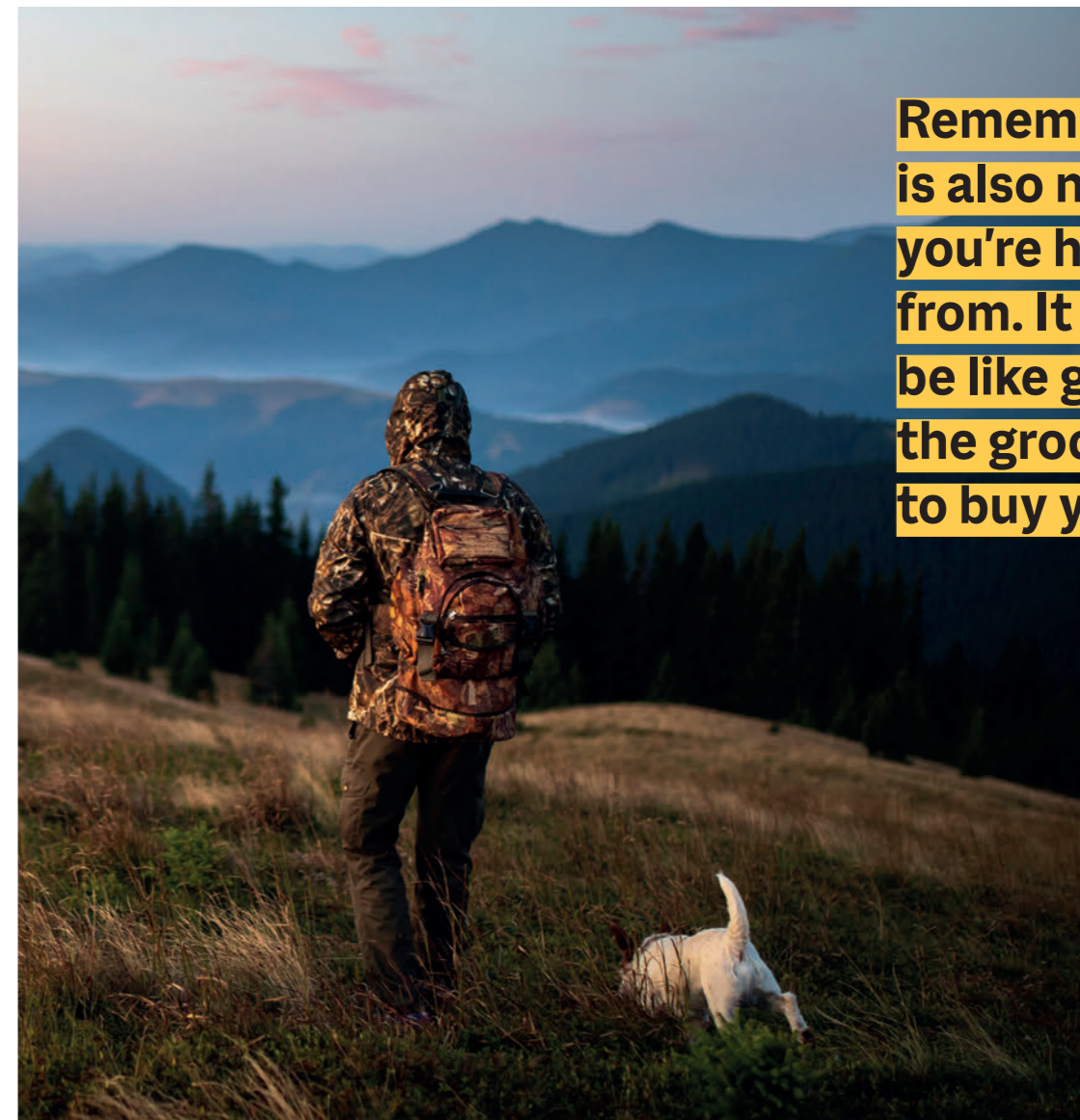
Are you worried that future generations won't be able to experience the same connection with food and the environment that hunting has allowed you?

I think it's a very good but tricky question to answer. Here in Norway, hunting isn't really our main food source. But if you have people in other parts of the world who go hunting mainly for food, how will they survive if they are no longer allowed to hunt? Are we going to give them food? Are we putting money into their food budget?

I would like to believe that if there is more scientific data put into quotas, then the quotas can help indicate which species you could hunt from surplus, which can allow people to still hunt.

What tips and cautionary warnings would you give to someone who would like to start hunting?

You should definitely start by taking training and your hunting license, but also learn from the traditions and history of hunting; ask hunters what their experiences are. Lastly, never regret an unfired shot.



Remember, this is also nature you're harvesting from. It shouldn't be like going to the grocery store to buy your food

5 Alternative Protein Sources

Many of us traditionally think of meat, fish and dairy products as being excellent sources of protein - but they are far from the only foods that can help us meet our protein intake needs. Here are 5 alternative protein sources that could help us meet the growing global demand for protein.

Soy

Soy is the most popular bean on the planet and the plant of choice for most alternative protein food products, partly because it contains all the essential amino acids our bodies need. But the popularity of soy among consumers has been declining over the past 15 years due to a range of factors, including uncertainty over GMO soy the overall sustainability of soy farming as well as the growth of other plant-based protein options such as pea protein.

Pea

Pea is the world's second most popular plant-based protein, with interest among consumers increasing in the past couple of decades as it avoids some of the negatives associated with soy. However, pea protein has a strong unpleasant flavour - meaning we need additional processing and flavourings or to breed more neutrally flavoured pea strains to make pea protein palatable.

Wheat gluten

Wash the starch out of a wheat flour dough and you're left with pure gluten - best known as 'seitan'. The name was coined in 1961 by the Japanese inventor of the macrobiotic diet, but the earliest record of wheat gluten-based food dates back to 544 CE in China. Unfortunately, like most grain crops, wheat gluten is deficient in the essential amino acid lysine.

Forgotten crops

Just three crops - wheat, rice and maize - provide over half of the world's food energy. The focus on these few crops means we neglect others, such as quinoa - which contains twice as much protein as rice. There are thousands of other nutritious roots, cereals, pulses, nuts and vegetables which could help feed millions of people if we invest in growing them.

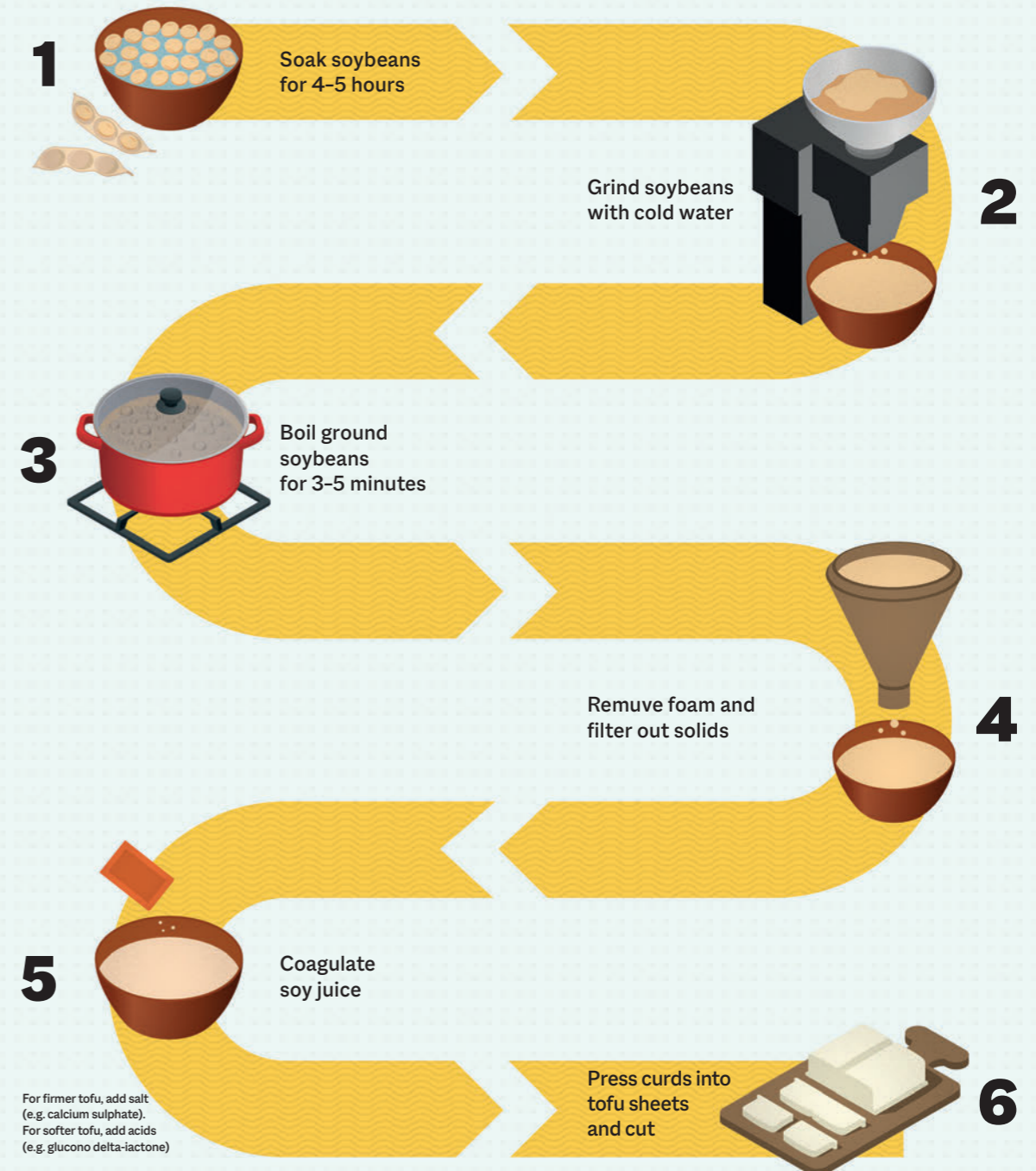
Mycoprotein

In the 1960s, scientists who feared the world was rushing towards an impending global shortage of protein searched for a fast-growing fungi strain that could produce protein from starch. After screening over 3000 different strains, they settled on *Fusarium venenatum*. Mycoprotein produced by this strain of fungi is now sold worldwide under the brand name Quorn.

Read more about how innovative approaches could help us produce protein differently in future



TOFU: HOW IT'S MADE



Is Whey A Sustainable Protein Source?



How you measure impact is key

Whey is a protein-rich liquid isolated from cows' milk. Historically often considered a waste product from the cheesemaking process, whey is now processed and turned into protein-rich products, particularly for high-income markets. But dairy products are one of the major drivers of land use, water use and greenhouse gas emissions worldwide — so does that leave whey with a high environmental footprint too?

The problem with whey waste

Whey is often a waste product. It is what's leftover after curdling milk and separating out the 'curds' (milk solids that can be turned into cheese), making 'whey' the liquid left behind. There are many different uses for whey, and traditionally farmers did their best to find a use for this protein-rich by-product; for example, by turning it into whey-based cheeses like ricotta or simply using it to enrich their animal feed.

However, in many cases, excess whey was simply dumped into sewers or waterways, or spread onto agricultural land. These disposal methods came with environmentally devastating consequences as whey's high sugar and protein content lead to contamination of soils and nearby waterways. Some estimates show that dumping whey is 175-times more damaging to the environment than dumping raw, untreated human sewage. Dumping whey into the environment was eventually banned in both the US and Europe, the world's two largest cheesemakers - though some other countries do still permit whey disposal. This legislation eventually led to a new approach: filtering, concentrating and drying leftover whey to turn it into new products, including the whey protein powders and supplements many use today.

From waste to wonder

The invention and popularisation of whey protein powders and supplements turned leftover whey from waste products into a highly valuable by-product, creating an incentive to use (rather than discard) it. This also helped support legal changes to prevent the dumping of whey into the environment — meaning each product sold represented a little more whey that wasn't polluting our planet.

Illegal dumping aside, whey's status as a by-product means whey protein qualifies as a sustainable and planet-friendly protein source in its own right - even if its origins are in cows' milk. Since whey protein is mostly made from the by-products of other industries like cheesemaking, very little of the massive carbon footprint associated with producing dairy is attributed to whey. In life-cycle assessments, these emissions are attributed to the product that is the primary driver for farmers to produce the milk — in this case, cheese.

This means raw whey that would otherwise go to waste is assigned a carbon footprint of almost zero. In fact, the only emissions usually associated with whey protein powders and supplements are those generated in transporting, processing and packaging them, which gives these products a very small carbon footprint - even smaller than most alternative and plant-based protein sources, including peas, lentils, chickpeas and grasshoppers.

Whey protein's carbon credentials are considered so good that if you're using whey protein to replace some of your usual protein sources, it's likely that you're actually reducing the carbon footprint of your diet in the process. Coupled with the damage that eating whey helps prevent by leaving less to be disposed of, those using whey protein as a supplement to their normal diet might actually be doing the planet a favour.

Whey protein isn't future-proof

Despite being a huge environmental success story so far, whey protein may not be the best sustainable protein source for our future. For starters, the processing required to refine and dry whey into protein-rich products is energy-intensive — but the greatest issue is the dependence of whey protein on milk and cheese production. On an industrial scale, huge quantities of whey

(and therefore dairy milk) are needed to produce whey protein. With demand for whey-based protein products growing at a rapid rate (~10 percent per year), there is a risk that future demand could outstrip the amount of leftover whey the cheesemaking industry can supply. In this scenario, demand for whey protein could conceivably become a driver for increased milk production (with cheese becoming the leftover by-product).

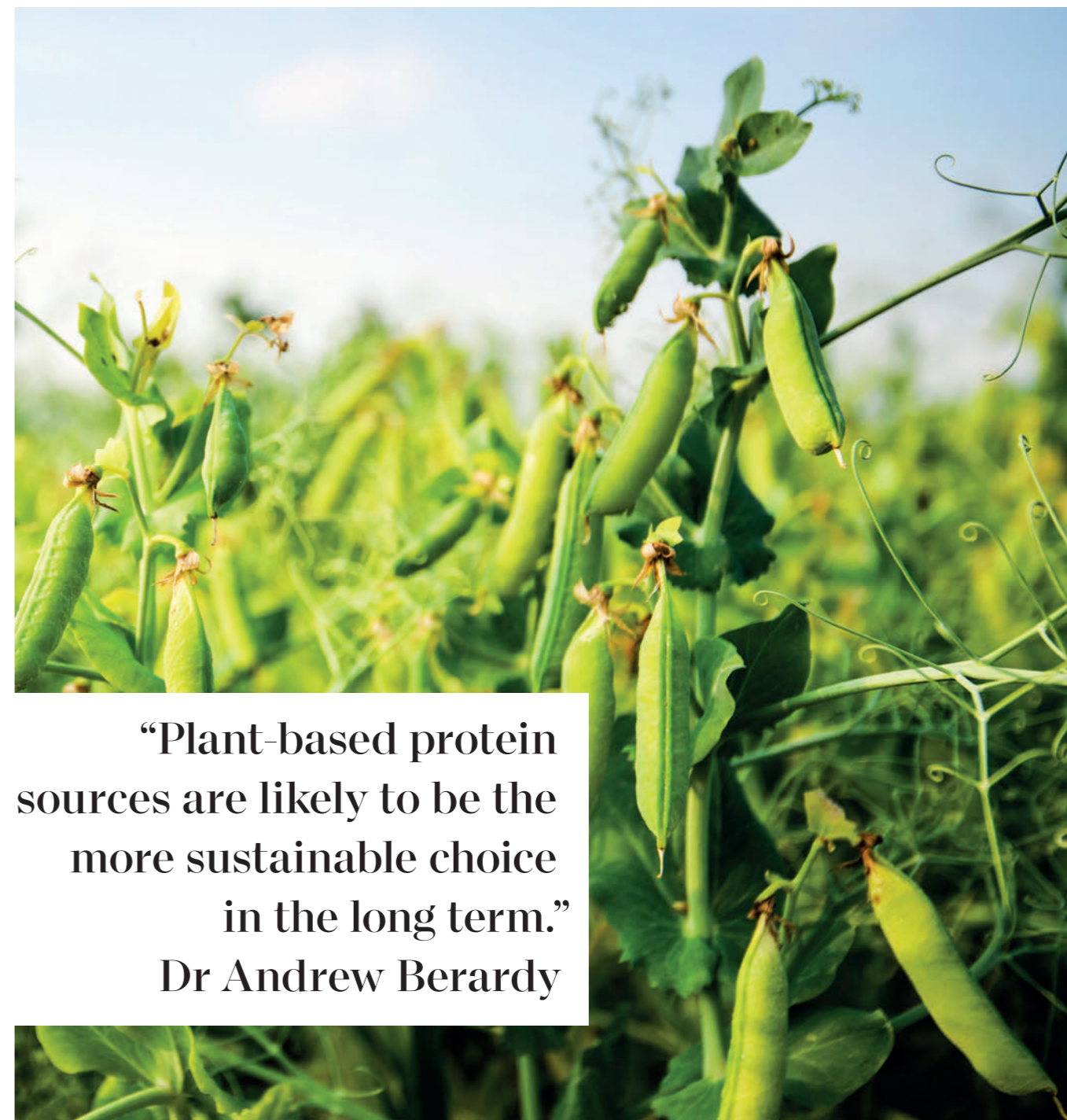
So while whey products are not currently a key driver of milk production, they could become a driver if dairy cheese falls in popularity in the future (or if the growth in demand for whey protein dramatically outstrips the growth in demand for cheese for years to come.) Were this to happen, far more of the environmental costs of raising cattle and producing milk would need to be allocated to whey protein products rather than to cheese, which would dramatically increase whey protein's environmental footprint and make it a wholeheartedly unsustainable source of protein compared with plant-based alternatives.

“Thanks to the way many life cycle assessments assign environmental burdens to different dairy products, whey protein is often determined to have a relatively low environmental impact that is comparable with that of some plant-based proteins,” notes Dr Andrew Berardy, Environmental Nutrition, Loma Linda University. “However, future changes in industry practices or rises in consumer demand that increase whey's economic value would also increase its share of the burdens of milk production, making whey protein a less sustainable choice.”

Plant-based proteins have a brighter future

So for the foreseeable future, we can safely consider whey protein supplements an environmentally friendly option - but things might not stay that way forever. Luckily, today's world offers plenty of alternative protein sources made from other ingredients.

For example, pea protein currently has a similar environmental footprint to whey protein gram-for-gram. But when the production of raw ingredients is compared side-by-side, pea protein is estimated to be between 4-7 times less greenhouse gas-emitting than milk protein, clearly showing that if dairy farmers were to start pro-



“Plant-based protein sources are likely to be the more sustainable choice in the long term.”
Dr Andrew Berardy

ducing milk just to make whey protein products, plant-based products like pea protein would be a far more sustainable choice.

“The lower overall environmental impact of plant-based production systems means that the environmental footprint of plant-based proteins is less sensitive to changes over time than that of whey protein. This means plant-based protein sources are likely to be the more sustaina-

ble choice in the long term.” - Dr Andrew Berardy.

So is whey a sustainable source of protein? The answer is, of course, it depends: on the way products are produced and on how you measure the impact of different foods. Right now, whey protein is a highly sustainable way to use up waste whey, but it's also a great example of the nuance and care we must take when evaluating the impact of the food we eat and demand.

Bioavailability Of Plant-Based Proteins

Not all plant-based proteins are the same!

Even if the nutritional label shows that a product has a high amount of protein, it doesn't mean we are able to digest and absorb all of it. But why is that? Aren't all proteins made of the same amino acids? Yes and no.

Plant-based proteins have different amino acid sequences

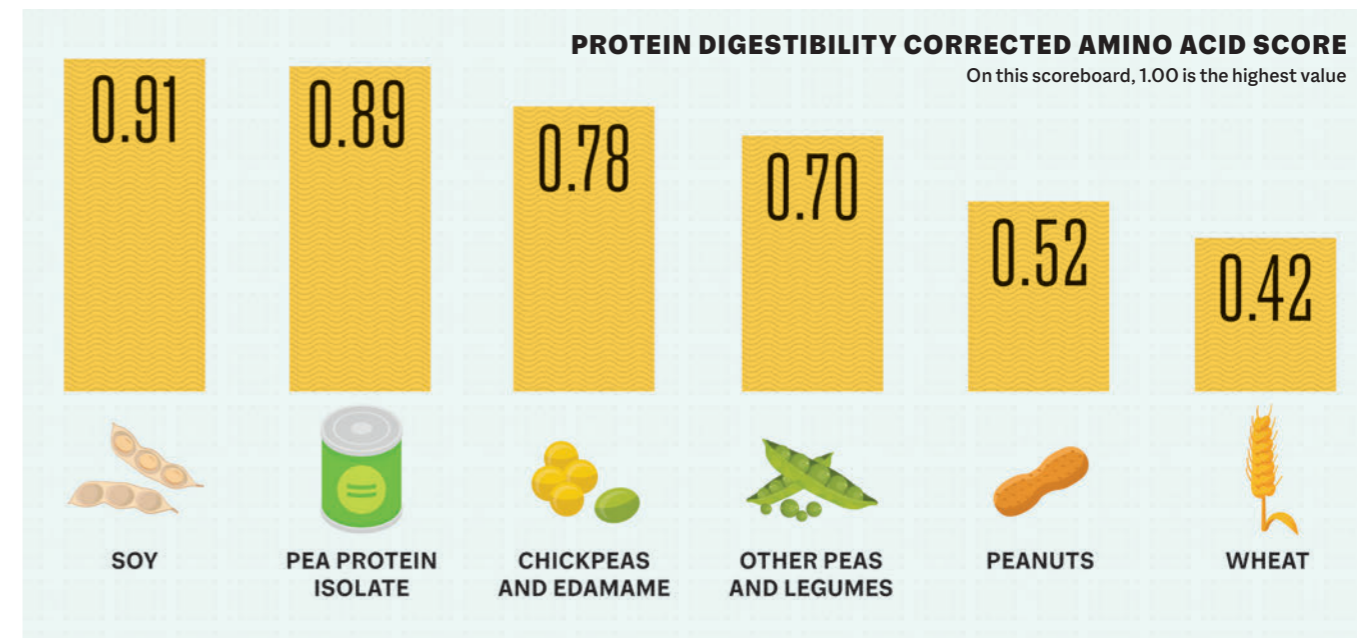
Although all proteins are made of the same amino acids, their sequences and structure can be different. The structure of plant-based proteins is different from animal-based proteins. While animal-based protein sources contain high levels of all 9 essential amino acids, plant-based sources may lack one or two of those essential amino acids your body needs. Eating a range of different plant-based proteins across the day will provide a complete amino acid profile in your diet.

The different protein structure along with antinutrient compounds* can actually decrease the protein our digestive system absorbs from the food. Although we cannot calculate exactly how many grams of protein we absorb per 100 grams of food, the best way to measure which protein sources are more nutritionally valuable is with the Protein Digestibility Corrected Amino Acid Score (see infographic on right).

*Antinutrients are natural or synthetic compounds that interfere with the absorption of nutrients.

Best plant-based protein sources

While vegan-vegetarian cuisine has improved greatly in look and taste in recent years, we should not forget that



the protein yield of some of these meals is rather low. That is not to say plant proteins are not valuable, it just means that soy, pea, peanut and seed proteins have very different protein profiles and should not be put in the same box. Legumes, especially soy, have the best plant sources of protein in terms of amino acid profile and bioavailability.*

*Bioavailability of protein is the amount of protein that can be broken down by your body into usable amino acids.

Are plant-based protein supplements better digested?

Soy protein isolates, or other legume protein supplements actually have an improved digestibility that is very close to that of animal proteins. This is because these protein isolates receive a heat treatment that inactivates 80% of the compound that decreases their digestion, making them just as bioavailable as casein (cow's milk protein). So for those that might need higher protein intake, plant-based protein isolates would be viable supplements to consider.

Who should consider protein supplements?

1 **The elderly** are known to reduce their protein intake due to decreased appetite for animal products and

possible changes in metabolism. This, accompanied by a decreased rate of muscle synthesis puts them at risk of sarcopenia or muscle loss.

2 **Athletes** who undergo strenuous physical exercise need a surplus of protein to repair muscle tissue. Plant-based proteins have a lower leucine* content (which stimulates protein synthesis and inhibits protein degradation); so if you are an athlete on a plant-based diet you may want to consider boosting your protein intake to guarantee a safe muscle recovery.

*Leucine is an essential amino acid used by the body to synthesize protein and slow degradation of muscle tissue.

You should always first consult with your own doctor or dietician for nutritional advice. It's just important to bear in mind that plant-based foods vary greatly on their protein value and digestibility. While some sources provide high quantities of readily available protein, you could be overestimating your daily protein intake if all you do is snack on some nuts and seeds here and there. If you follow a plant-based diet and you need more protein, you should focus on getting high quality protein and even consider supplementation.

Read more about
the 9 essential amino acids
your body needs



Food Waste

One third of the food we produce never reaches our plates. So where does it go?

One third of global food production equates to about 1.3 billion tonnes of food that is lost or wasted every year. In most parts of the world, the amount of food lost before it reaches consumers is relatively comparable. The stage of the food supply chain in which waste

occurs, however, varies considerably. In production stages, natural conditions like unpredictable weather or human-induced conditions like a sharp drop in prices might force farmers to discard their crops at the farm level. During the transportation stages, more losses occur where infrastructure like refrigerated transportation is lacking, or where poor planning and logistics causes food to spoil during transit. At

the processing and packaging stage, excessive trimming to attain certain aesthetics or technical malfunctions can lead to more food unnecessarily leaving the supply chain. When food reaches our shops and restaurants, it may also be discarded because of incorrect packaging, overstocking, or a lack of consumer demand. Finally, when it reaches our homes, some countries will throw as much as half of it into the

trash simply because we overbought, overcooked, or just plain forgot to eat it. Undoubtedly, rewiring the food system for less wasteful supply chains requires systemic change, but we can all do something about it. Informing ourselves about the issue, being mindful about the amount of food we purchase, and holding businesses and governments accountable for their actions can all make a significant difference.

by Madhura Rao



COVID-19 Impacts on Food Waste

How the crisis might lead to more food waste

Food supply chains are complex systems and the food we purchase locally often makes a long, carefully orchestrated journey before reaching our supermarkets. But today's advanced food supply networks are not without shortcomings and are not immune to times of crisis.

On any regular day, inefficiencies along the food supply chain and improper management at the household level see 30 percent of all food that is produced ending up as waste. However, the past year has been anything but ordinary. As the COVID-19 pandemic alters our everyday lives, it also impacts how our food is produced, procured and consumed.

COVID-19 impacts on household food waste

In high-income countries, around half of the total food waste is estimated to come from households. This makes consumers the biggest contributors to food waste. As a result of the coronavirus crisis, consumers' food purchasing habits have changed drastically. We saw regular trips to the market replaced by stockpiling of large quantities of shelf-stable foods. Increased immediate demand for perishables like bread, dairy products, vegetables, and fruits has also added pressure to producers and contributed fur-

ther to our wastage. But the changes haven't been limited to households.

Farmers' harvest gone to waste

Besides consumer behaviour, other changes in the food supply chain can cause food waste. Restriction on movement and migration affected the harvest of seasonal fresh produce. In Germany for instance, growers of white asparagus had feared that their 2020 crop would have gone to waste because seasonal workers from eastern Europe were restricted from crossing international borders because of early lockdowns.

Similarly, due to catering businesses and restaurants being shut down, farmers and wholesale suppliers were stuck with sizeable quantities of fresh produce and food ingredients without a market to sell them to. In 2020, Dutch potato farmers dealt with a million tons of unsold potatoes because they could no longer be sold to catering businesses that turn them into fries. Live-

stock and fishery businesses also recalibrated their operations to match the sudden changes in demand. Unlike preserved products, pivoting the course of perishable food supply chains is immensely challenging.

What has been done to mitigate these issues?

While the scale of the crisis is unprecedented, so is our access to information and technology. From social media users sharing ideas for utilising kitchen scraps to community-led initiatives for food redistribution, innovative interventions to ensure food security and minimise food waste are making appearances all over the world.

Hubei Province, the epicentre of the outbreak in China, ended up with several thousand tons of unsold food products. After transportation restrictions were lifted on March 25th in 2020, a large portion of these products was saved from going to waste because people from

across the country purchased them rapidly and eased Hubei's burden. In the Netherlands, a non-profit digital marketplace was set up for suppliers with excess stock to sell their products directly to consumers during early stages of the pandemic. In Norway, the government encouraged those who have lost their jobs due to the crisis to take up temporary employment in the agricultural sector and replace migrant workers this season. Several organisations such as Disney parks in the US and supermarkets in Belgium donated their excess supplies to foodbanks.

Adaptations such as these show us that through collective action we are capable of rapidly bringing about systemic change. The pandemic might increase food waste, but it might also leave us with new perspectives and ideas to tackle the problem. Through small actions such as purchasing only how much we can consume, or supporting local initiatives to reduce food waste, we can help improve the situation to a great extent – during the COVID-19 crisis and long after it ends.



Fighting Food Waste With Social Initiatives

→ Ghana

Food for All Africa is West Africa's first and largest community food redistribution organisation. Through its 'food banking' model it collects surplus food and distributes it through food drives to vulnerable groups. The concept of the organisation is to 'have fun whilst getting involved in the fight against hunger' and to provide a platform for retailers, wholesalers and growers to recover and redistribute edible surplus food.

→ Kenya

Twiga Foods connects different actors in the food chain by providing an organised marketplace. The platform connects thousands of food outlets with fresh produce and processed food suppliers (farmers and vendors) on a daily basis. According to Twiga Foods, the efficiency, transparency, and minimalism of their network has helped members in Kenya reduce their post-harvest losses from 30 percent to as little as 4 percent.

→ Bangladesh

Cartons for Good is an initiative that buys food unsold during harvest time, cooks meals and stores them into special carton packs that preserve them for months without refrigeration. The meals are then put into a mobile food unit and are transported to rural regions, or used to provide school meals for underprivileged children through a collaboration with Bangladesh's biggest NGO.

→ India

No Food Waste is a project serving the remaining foods from weddings, parties, and other events to underprivileged communities. There is a hotline number that can be called in order to have a minivan (called "Foodiva") come to collect the food. The food is then sampled for quality and freshness and quickly transported to nearby distribution locations (also called 'Hunger Spots').

→ South Korea

In 1995, Seoul introduced *new composting laws* that saw residents charged a 'pay as you throw' fee for their waste. In 2013, the system was overhauled: households are now charged a fee based on the weight of the food waste they collect, which covers the cost of the scheme while recycled food is turned into animal feed or organic fertilizer.

→ Denmark

Too Good to Go saved their first meal in Copenhagen in 2016, and have since recruited more than 18 million users and 38,000 different food outlets around Europe. By letting retailers sell a 'Magic bag' filled with discounted food products that would otherwise be thrown away, the mobile App has saved 29 million meals - or more than 72,000 tonnes of greenhouse gas emissions!



The fight against food waste and food loss is growing and diversifying. Every year, more communities, governments and companies are turning their attention to this huge problem with far-reaching consequences. Here are 8 of our favourite social initiatives from across the globe that are finding creative ways to ensure that food is not wasted or lost, but rather eaten and enjoyed.

→ France

Garot Law (Loi Garot) in 2016 saw France become the first country to pass legislation banning large grocery shops from throwing away food. The law requires supermarkets to have systems in place for donating unsold food products to partnering charities, with the objective of halving retail food waste by 2025.

→ United Kingdom

Toast Ale is marketed as 'planet saving beer' since it is brewed using bread surplus that bakeries would have otherwise thrown out. The best part? The profits that the company makes go directly to a charity organisation called Feedback, which addresses food waste issues across all points in the food chain.

→ Mexico

Disco Sopa is a citizen initiative that 'recycles' otherwise thrown away foods in an amicable setting. Volunteers search for and recollect foods in Mexico City and then, in a public space, the foods are cooked and served to anyone that wants a free meal (and with live music in the background!).

→ Guatemala

Random Impact use organic waste from homes and restaurants to feed cockroaches that are then turned into protein powder for animal feed and human foods, addressing the circular disposal of waste as well as creating a new sustainable protein source.

→ Argentina

The Wiolit initiative has developed software that optimizes canteen menus, allowing users to choose their dish in advance to avoid overproduction while at the same time gathering data about food preferences. The result is a reduction of up to 51 percent of the waste produced in food services such as school canteens.

→ New Zealand

Kiwi Harvest works with supermarkets and hotels to rescue the good food that they are not able to sell because of oversupply, damaged packaging, cancelled orders or mislabelling. Up to 200,000 items of surplus food gets rescued by Kiwi Harvest every month and diverted back to struggling communities that have less access to fresh foods.

Innovations That Transform Food Waste

Here are some of the most innovative ways we can rescue, repurpose or recycle out food waste to save it from simply being dumped.



WASTE TO FOOD

The best option for putting food waste to use is to rescue it and turn it back into food fit for human consumption.

3D Printed Food

Bread is one of the most wasted foods in the Netherlands, so Dutch company Upprinting Food are turning unwanted bread (along with 'ugly' fruit and vegetables) into a puree and 3D printing it into delightfully artistic baked snacks. 3D printers can even turn fish scraps into Michelin-starred dishes!

Pressed Snacks

Brewing beers using grain or making juice from fruits and vegetables leaves behind lots of "waste" pulp — but with a little ingenuity, these waste streams can be dried and pressed into new products like granola bars, veggie burgers or vegetable crisps!



WASTE TO FEED

Food waste that isn't fit for human consumption can sometimes be used as feed for animals, allowing us to still capture its nutritional value.

Pig Feed

Just over half of surplus food from the Japanese food industry is currently treated and converted into eco-friendly feed, largely for pigs. This has simultaneously slashed the environmental impact associated with the nation's food waste, reduced feed costs for farmers and created a new market for premium, eco-friendly Japanese pork.

Insect Feed

Though comparatively new on the scene, edible insects are incredibly efficient food recyclers. Insects require very little space or time to farm, are packed with valuable protein, minerals and other nutrients, and crucially, will eat almost anything - including food waste!



WASTE TO MATERIALS

Even if we can't rescue their nutritional value, many forms of inedible food waste can be given a new life by turning them into materials and products.

Fish Skin Bags

MarinaTex is a new bioplastic made of fish scales, algae and the shells of crustaceans. Around 1,400 bioplastic bags could be made from the waste skin of one Atlantic cod, with each one fully compostable in just a few weeks!

Coffee Cosmetics

Spent coffee grounds are of no more use to the food industry — but they're invaluable to UpCircle Beauty, who rescue coffee grounds destined for landfill and repurpose them into beauty products like scrubs and exfoliators (along with old tea leaves and discarded fruit stones!)

Milk Paper

QMilk can turn old, soured milk into helpful new materials by extracting milk proteins (specifically casein, which form solid curds when milk curdles) and turning them into fibres. These fibres can then be woven into textiles, or even sheets of crisp white paper.



WASTE TO ENERGY

Food is our fuel — but when we can't find any other uses for wasted food, we may be able to turn it into fuel for machines instead.

Biogas

Digesting food waste allows us to capture the methane and other gases produced. This 'biogas' can be burnt for energy or purified and compressed into biomethane, which can be used as fuel for cars or pumped into the main gas grid. Swedish public buses run partially on biomethane produced from household food waste!

Waste-to-Energy

Food waste can be sorted and burned at over 1,000 degrees Celsius in waste-to-energy plants, with the energy released used to produce heat water or drive turbines and produce electricity. Sweden is a leading example here too, and now imports rubbish from neighbouring countries to burn in its waste-to-energy plants, producing hot water to heat local homes.



WASTE TO COMPOST

If all else fails, there's one final choice we can make — avoiding sending food waste to landfills at all costs. Food degrading in landfills is broken down by bacteria, which produce methane (a potent greenhouse gas) in the process.

To avoid our food waste contributing to climate change, we can instead compost it. By creating the right conditions and introducing the right microorganisms, food waste can instead be turned into a natural fertiliser for growing the next generation of crops, thereby also retaining nutrients in our food cycle that would otherwise be buried in landfills and lost. For example, Serbian company *EkoFungi* uses local organic and food waste to grow mushrooms in a truly circular system they call "waste-to-taste"!

Eco-friendly Food Packaging

How do we decide which material is the best choice for the environment?

Recent years have seen plastic become the villain of the food packaging world, with many companies suddenly switching to paper, glass or new 'biodegradable' materials instead. But how can we be sure that - from an environmental perspective - this is the right decision? How should we compare one material against another?

To answer this question, researchers use a technique called Life Cycle Analysis (LCA). "In a nutshell, an LCA assesses all the environmental impacts for the materials, resources and emissions associated with a product's complete life-cycle, including extracting the materials, manufacturing, transport, the use phase and the end of its life," says Dr Rukayya Ibrahim Muazu, a chemical-environmental engineer at the University of Sheffield. LCAs are highly rigorous, governed by an international standard, and generally done by practiced experts.

Comparing different packaging types

A good LCA will consider a wide range of environmental impacts, including carbon emissions, energy consumption, land and water use, toxic chemicals, and of course, what happens to the material at the end of its life. But even when done properly, an LCA can only give us an approximation or a range for a material's im-

pact because it will depend on exactly how individual pieces of packaging are produced, used and disposed of. For example, an LCA of a packaging material might consider the energy used to produce it (*was it sourced from renewables, or fossil fuels?*), where the raw materials come from (*does it contain any recycled content? For paper, was the wood harvested from sustainably-managed forests?*), how heavy it is and how it's transported around the world (*by land, sea or air?*), how easily can it be recycled or reused (*does it contain special food-safe coatings that prevent recycling?*), and whether that recycling process uses energy or produces wastewater or toxic chemicals. LCAs taking a broader view might also consider social issues, such as whether production involved unfair pay for workers, or forced or child labour.

Context is key

One issue with LCAs is that they can be very reductionist. Every type of



packaging has both good and bad features. For instance, despite the recent backlash against single-use plastic, it has proved immeasurably useful during the COVID-19 pandemic for producing PPE, protective screens and vaccine syringes. The most environmentally-friendly packaging for one context won't be the same as for another.

Consider glass as an example. Certain brands of yogurts and chilled desserts have switched from plastic to glass because glass is often seen as being 'better for the environment.' But whilst glass can be recycled indefinitely, transporting and remelting it have high associated carbon emissions. It's why Santiago Navarro, CEO & Co-Founder of Garçon Wines decided to launch a new type of wine bottle for his business; flat bottles made from recycled PET plastic. "Our flat bottles pack like books, meaning we can fit up to 91 percent more wine on the same transport pallet compared with using round, glass bottles. Combined with the lightweight nature of PET, this reduces the carbon emissions of our bottles by approximately 50 percent, according to two LCAs conducted by third parties on our bottles," he says.

However, in a closed-loop or deposit-return system, such as a milk delivery round, glass containers may be the best option, since they can be washed and reused directly for the same purpose many times. In such a system, it's thought that glass milk bottles have a lower carbon footprint than single-use plastic bottles after being reused just 20 times. Similarly, more durable containers can also be the lowest-impact option for new home-delivery subscription services, such as TerraCycle's Loop, where they can be simply washed and reused many times over.

Sometimes single-use is the best

Whilst it's easy to reuse containers in some situations, in others, reusing or recycling food packaging is much more difficult. In these cases, single-use, disposable packaging may actually be — counterintuitively — the most environmentally-friendly option.

For instance, an LCA study which compared different single-use takeaway boxes concluded that, across all 18 environmental impact categories assessed, non-recyclable Styrofoam containers had a much lower total impact than recyclable plastic or aluminium containers. "Because expanded polystyrene (EPS) containers have low



To reduce packaging waste without causing more damage to our environment, we have to consider more than just the materials we are using



See our a generalised comparison between the life cycle impacts of the main types of packaging we use every day

density (Styrofoam can be more than 95% air), they don't require much material" lead author Dr Alejandro Gallego-Schmid from the University of Manchester explains. "We found that, depending on the impact category, you would have to reuse a Tupperware container between 16 and 208 times, until it became a better environmental option than EPS - and when it comes to terrestrial ecotoxicity, reusing Tupperware is often actually a worse choice because of the chemicals involved in washing the container and the electricity required to heat the water." Nevertheless, there are other issues with single-use, disposable takeaway containers - including a high propensity to be littered and the pollution of ocean ecosystems with microplastics — which are not always included in or well considered by LCAs. Perhaps the ideal solution would be for the takeaway food industry to be designed with reuse in mind, so that containers could be used hundreds of times over and washed in bulk (using non-toxic detergents) to minimise their environmental impact. Pilot schemes (such as Fresh Bowl in NYC, which encourages customers to return their reusable glass jars in return for free credit) show it may be possible, but doing this on a large scale will require considerable investment, as well as national policies that all stakeholders — including packaging producers, consumers and retailers — can commit to.

Designing better systems

Clearly, to reduce packaging waste without causing even more damage to our environment, we have to consider more than just the materials we are using. If we want reusing packaging to be the most environmentally-friendly option every time, we need to optimise entire systems, taking into account waste management infrastructures and human behaviour.

Though plastic pollution remains a major issue, plastic itself is not intrinsically evil — indeed, plastic packaging can play an important role in reducing food loss, particularly for perishable products such as salads and some vegetables. In an ideal system, it's likely that every packaging type will have a role to play. To achieve this, we'll have to shift away from over-generalising and be prepared to embrace different packaging types — perhaps even single-use plastic — when the evidence shows it makes the most environmental sense.

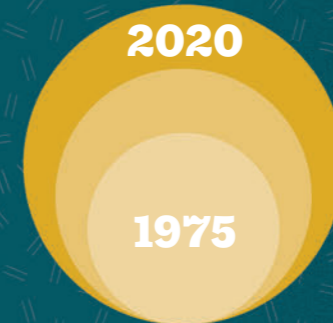
Health

WORLD POPULATION NOT BEING FED A HEALTHY DIET

MALNOURISHED
PEOPLE

663 MILLIONS

34%



WORLDWIDE OBESITY
NEARLY TRIPLED SINCE 1975

OBESE
PEOPLE
2+ BILLION

Sources: Our World in Data

We now know better than ever that a balanced diet is essential for good health. Scientific insights into our food are getting ever more refined: we know the specific calories and nutritional content our diet should contain in order to guard against disease. But knowing is only half the battle.

On the one hand, there's a lack of food. Almost 10 percent of the world's population are undernourished globally. Even today, undernourishment is still a leading risk factor for death and illnesses, especially in children. On the other hand, there's also excess food. Processed foods, rising urbanisation and changing lifestyles have led people to consume more foods high in energy, fats, free sugars and salt. This has led many not to eat enough fruits, vegetables, and fibre — with the result that 39 percent of adults are now overweight or obese.

While undernourishment and obesity are in some ways polar opposites, they have the same issue at their core: an inability to access the right nutrients in your diet. In both high-income and low-income countries, access to a healthy diet is often limited by education, the local affordability of nutritious foods, cultural traditions, and the geographical and environmental setting we live in.

As an increasingly interconnected, global society, we need to ensure everyone has access to a diet that won't compromise their health. Addressing this so-called 'double burden' of malnutrition will require changes to international policies, food chains and the way food companies do business — but the impact on the health of the world's people could be immense.

by Silvia Lazzaris & Lynn Liu

The Global Nutrition Epidemic Of 'Hidden Hunger' /

From undernutrition to malnutrition

Isabella is a registered nutritionist and current PhD student at King's College London, conducting her research in iron deficiency in young West African infants in collaboration with the Medical Research Council Unit The Gambia at the London School of Hygiene and Tropical Medicine.

Dora is a biochemical engineer by training with a PhD in Gut Microbiome and has conducted academic research in human nutrition for over 15 years. Dora now works in Medical Affairs where she maintains a strong focus on providing safe and efficacious treatments for iron deficiency and anaemia across different patient groups.

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Historically, the World Health Organisation defined malnutrition as a lack of caloric or protein intake. Its impact was apparent and devastating, with infants and children not having enough food to eat, leading to stunting and wasting, and even death from extreme hunger. Today, we also face a new, less visible form of malnutrition, 'hidden hunger' - enough calories but too few micronutrients.

Some still define malnutrition as undernutrition, but it also includes overnutrition leading to overweight and obesity, often due to an inadequate intake of vitamins or minerals. With the rise of extreme shifts in diets worldwide, hidden hunger is not only seen in low-resource countries, but is a global trend. An estimated 2 billion people worldwide today suffer from a chronic deficiency of micronutrients, like vitamin A and iodine, with far-reaching consequences. To understand how hidden hunger can impact us all, let's take a closer look at the most prevalent form of micronutrient malnutrition: iron deficiency.

The impact of iron deficiency

Mild iron deficiency impairs intellectual development in young children, while more severe cases like iron deficiency anaemia is associated with an increased risk of serious morbidity, poor motor and mental development in children, reduced work capacity in adults, poor pregnancy outcomes and impaired immune function.

Today, iron deficiency anaemia is estimated to affect 1.2 billion people worldwide and remains one of the leading causes of disease burden in low- and middle-income countries. In Africa, the number of children under five suffering from anaemia is over 60 percent in 2019. This is related to the broader issue of equity and lack of access, as for many low-income population, affordable foods often lack in many nutrients. This is apparent in Sub-Saharan Africa, where iron rich foods are not diet staples due to lack of access and affordability.

A cause for global concern

Iron deficiency anaemia is not a problem confined to low-income regions. High rates of iron deficiency and iron-deficiency anaemia are still prevalent in resource-secure countries and are often overlooked. Worldwide, one-third of women and 40 percent of children under five suffer from anaemia. Menstruating women are more susceptible to iron deficiency anaemia as they lose iron through blood loss, and there may not be enough iron

in their diet to balance this blood loss. Young children, during periods of rapid growth, are also susceptible to iron deficiency anaemia if they are not exposed to iron-rich foods in early life. This is particularly the case for children born to iron-deficient mothers.

With a rise in processed food consumption, modern diets often lack the nutrients our bodies require. In the UK, for example, about 70 percent of diets are made up of processed or ultra-processed foods. Diets that are thought to be 'healthy' — if improperly considered — may also lack adequate nutrition. For instance, with the growing popularity of exclusive plant-based diets, some key nutrients may often be overlooked — particularly nutrients that are more bioavailable in animal products, like iron. The most iron-rich foods are animal-based protein (e.g. liver, red meat, sardines, oysters, mussels and clams), while our body's absorption of iron is lower from plant-based sources.

Plant-based iron tip:

Of course, adequate iron nutrition can be secured through plant-based sources, however, plant-based eaters must take care to diversify their diet with nutritious iron sources such as dark leafy greens, dark orange vegetables, bread (especially sourdough), beans and pulses. Iron from plant sources that is ingested to-

gether with vitamin C rich foods is also better absorbed by the body. However, meals taken in combination with coffee, black tea or alcohol will reduce iron absorption.

A holistic view of nutrition

So, while many populations may be at less risk of undernutrition today, hidden hunger is increasingly present. Unfortunately, this does not simply come down to good and bad food choices. It's vital to not only look at nutrition through a singular lens. To improve nutrition status, we must look at our overall diet and lifestyle choices. Are we getting enough sleep, drinking enough water and eating a varied diet? Are we eating foods, such as probiotics like fermented foods (yoghurt, sourdough, kimchi), that benefit our gut microbiome? This is also of importance for absorption of some important nutrients. However, this also ties into the ethics of access to food, where in resource poor settings these foods or lifestyle choices are often not accessible, which must be addressed to effectively combat against hidden hunger.

Innovations against iron malnutrition

These modern forms of malnutrition are a threat to our global public health and future prosperity. Luckily, there are exciting initiatives against iron malnutrition

that are beneficial to both low-income and resource-secure regions.

1. Iron Supplementation

Older forms of iron supplements were not well-absorbed by the body (less than 10-20 percent absorption), with the majority of the iron passing through the intestine unabsorbed, where it can cause some side effects such as constipation or diarrhoea. New forms of iron supplementation are more readily absorbed or better-tolerated by the body, and are being developed and tested in clinical and field settings. IHAT (Iron Hydroxide Adipate Tartrate), for example, attempts to mimic natural food iron found in plant and animal sources. There are novel forms of iron application, like intravenous iron* for the more severe cases of iron deficiency anaemia.

*Intravenous iron therapy is a supplementation of iron by infusion with a needle into a vein.

2. Iron Fortification

Scientists are also developing novel home and food fortification strategies, specifically targeting low resource regions. These include the use of multi-micronutrient powders, single-dose packets of vitamins and minerals in powder form that can be sprinkled onto any ready-to-eat food. These powders readily increase the micronutrient content of a child's diet without changing their usual dietary habits. Prebiotic compounds have recently been shown to be useful when added to iron formulations to increase absorption of fortificant iron and alleviate the gastrointestinal side-effects of unabsorbed iron in the gut.

3. Biofortification

Biofortification is also a promising strategy, looking at fortifying staple crops through selecting varieties with increased content of particular micronutrients such as vitamin A in golden rice. This new technology looks at using agronomic practices to increase nutrient levels of crops during plant growth. For example, HarvestPlus is developing new more nutritious varieties of staple food crops with higher amounts of vitamin A, iron or zinc. Biofortification may offer alternatives for populations where supplementation and traditional fortification are limited.

The driving forces behind malnutrition are many and nuanced. The consequences are not only immediate, but also impact the prosperity of future generations with hidden hunger inhibiting adequate development. There needs to be a shift in our dietary focus on adding in more variety and nutrient-rich foods to alleviate micronutrient deficiencies. Together with healthier diets, there are many exciting modern innovations that help tackle both traditional malnutrition, hidden hunger and the double burden of malnutrition.



Cashew Nuts: The Hidden Cost Of Production

Does growing cashew demand come at a greater cost?

Alongside the dramatic rise in health conscious and vegan diets, cashew nuts are fast becoming the world's favourite nut. But does this rise in demand come at a greater cost?

Main cashew nut suppliers

India is a key figure in the global cashew nut trade, a food product with a market value expected to grow to almost 7 billion dollars by 2025. Following Vietnam, India is the largest grower, processor and supplier of cashew nuts to international markets. In fact, in 2019, India and Vietnam accounted for 76% of the world's share. So next time you buy cashew nuts, check the packet – they'll likely be from one of these countries.

Global popularity

Farming and processing cashews took off in India in the early twentieth century, making cashew nuts available to wealthy western consumers by the 1920s. Since then, cashew nut sales have continued to climb – in 2019, over 830,000 metric tons were consumed worldwide, nearly twice the amount consumed 15 years ago. To put this into perspective, the world ate the weight of almost 67,000 London double-decker buses in cashews that year. Today, cashew nuts are the fourth most consumed nut in the world, falling just behind peanuts, almonds and walnuts.

Being both highly nutritious and versatile, the cashew nut has found itself in steep demand and a particular favourite of India, the US and Germany – the world's top consumers. More recently, external forces at work have seen the cashew catapulted to the mainstage. With the rise of health conscious as well as vegan and dairy-free diets, the nut has become a central ingredient in foods like vegan cheese, nut milks, nut butters and energy bars. In fact, out of all nuts, cashew imports have increased the most recently.

The cashew nut catch

While this shift to plant-based alternatives could be considered a win for dietary health and the environment, if you scratch beneath the surface, this boom in demand comes at a cost often paid by the cashew processors, which in India is a 90 percent female workforce. As demand rises, buyers – largely supermarkets looking to maximise profits – pressure Indian suppliers to lower costs, who, in the face of intensified market competition, tend to oblige.

Investigative research, including a detailed report by ActionAid, has revealed the incredibly low wages female processors often receive for their hard work. Paid by weight of cashews shelled rather than by hour, a kilo of shelled cashews can pay just 0.06 EUR, while in some supermarkets the price of cashew nuts per kilo can be higher than 10 EUR. Unfortunately, low wages are not the only concern. Cashew nut processing is extremely labour intensive and health-threatening work. To cut costs, factory owners often ignore basic health and safety, putting more workers at risk of permanent physical injury.

Cashew nuts' complex supply chains

At the heart of this problem lies a complex supply chain, where stakeholders at every level – from the buyers, importers, exporters and suppliers – are looking to make a profit. Unfortunately, this often results in negligible profit for those at the bottom of the chain – in this case,

the processors. What's more, supermarket demand for low prices pushes importers to buy cashews from cheap, unregulated processing units, where adequate working conditions and fair pay are not secured.

Then, what will make a difference?

Don't worry, this isn't a call to urge you to boycott cashews altogether, especially since many workers depend on the industry as a crucial source of income. Rather than renouncing the nut, it's important that as consumers we recognise the amount of work that has gone into cashew nut production and use our wielding position to encourage supermarkets to review their supply chains and ensure they only work with suppliers who are complying with basic working conditions. As Nazneen Kanji, author on the subject and independent researcher, explains; "the demand needs to come from consumers wanting to know about supply chains, how retailers are managing them and whether they are guaranteeing certain labour conditions".

However, since the largely female workforce typically comes from impoverished, marginalised communities, they are often dependent on any available local work, which further reduces their bargaining strength when rallying for better pay and working conditions. For this reason, increased consumer advocacy needs to be coupled with change at a local scale. Community NGOs and workers unions must press the Indian government to enforce pro-working laws, adequate health and safety and fair wages. This two-pronged approach would make all the difference, as Kanji tells me; "NGOs and local organisations need to work with the government to promote the industry as an important source of employment for women and insist on basic labour and safety standards – this is what will really help".

Learn more about
how cashew nuts
are made



Doctor, What Should I Eat? /

*Why it is important
to teach nutrition
to medical students*

Winston Gilcrease works in multilateral cooperation with NGOs, academia and international projects focused on the nexus of sustainability in urban development, energy, human health, and food systems.

Access the MOOC
and learn more



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Diet is the strongest single risk factor for preventable diseases in the world and a key driver of several medical conditions, such as diabetes and heart disease. Doctors certainly know nutrition is important, but providing advice on a healthy diet has to contend with the competing priorities of often more pressing healthcare needs. On top of this, many doctors are uncertain about how effective they can be in helping people improve their diet. In fact, a key obstacle is their lack of specific training in nutrition, starting from medical school. A MOOC (Massive Open Online Course) is teaching the new generation of physicians how to support their patients in their transition to a healthier and more sustainable diet.

Limited nutrition training in medical school

Most medical schools provide nutritional lectures, teaching concepts like the biochemical pathways of vitamin A metabolism, or the pathway of vitamin D activation in the skin. Of course, vitamins play a key role

in nutrition, yet the way they are explained to medical students is more closely aligned to biochemistry than to patients' everyday needs. For example, a medical student might be able to explain that sun exposure converts 7-dehydrocholesterol to vitamin D₃, which becomes 25-OH vitamin D in the liver, and then is metabolised by enzymes in your kidneys into the active 1,25-OH vitamin D. While this is very useful knowledge, the physicians of tomorrow need additional practical understanding when trying to help patients live healthier lives.

Many of the common questions that people want to know are things like – “Should I eat more meat?” “Less bread?” “More olive oil?” “Less butter?” “Is white sugar bad?” “How often should I eat carbs?” “How do I lose weight?” Unfortunately, practically addressing important health questions is still not homogeneously covered in medical school training.

A new way of training medical professionals

In order to support the transition to a more sustainable and healthy diet, the European Innovation and Technology (EIT) Food designed an open online course to guide medical students to explore different forms of sustainable diets, and to apply current health guidelines to different groups of people based on their life stage and health. Supported by University of Reading, University of

Groningen, University of Torino and Consejo Superior de Investigaciones Científicas, the *Nutrition for Health and Sustainability* is an online course offering interactive materials with user forums and discussions, in addition to traditional course materials, such as readings, videos and case studies.

This course aims to strengthen interactions among students and educators on the topics of diet, nutrition and sustainable and healthy eating through evidence-based approaches. By the end of the course, students will hone their understanding in identifying healthy diets and dietary patterns, including how and which types of foods are essential for health and well-being that play an important role in treating or preventing disease. Additionally, guidance in developing motivational interviewing skills will be provided. Although the course has been designed for medical students, professionals in the medical field might find this course useful for providing an up-to-date analysis of topical nutrition debates, such as the emerging crosstalk between diet and cancer.

By understanding the link between food, nutrition, diet, and sustainability, attendees of the course will be able to assess human health at different life stages more effectively. Students will ultimately be provided with clear and practical guidance when a patient asks them: *Doctor, how should I eat better?*



bioavailability

noun /ˌblaɪəʊəveɪləˈbɪləti/

the proportion of the nutrient from your food that is absorbed by your body and used for your bodily functions



Read 4 tips to improve your iron absorption from food

Rekindling Our Relationship With Food

Eating Disorders

It is estimated that 8 million Americans have an eating disorder - 7 million women and 1 million men. I am one of those 7 million women.

Like many who suffer from an eating disorder, mine started when I was an adolescent entering my early teenage years. I became extremely self-aware of my body and the changes it was going through. As a dancer, I didn't accept that curves were just a natural result of growing up: instead I associated any amount of weight gain with failure, ugliness, and disappointment. So rather than thinking of food intuitively as fuel, I ended up asking myself questions like, "How many calories are in this food?" or "Will this food make me fat?" Almost two decades later, I still struggle with my relationship with food. But I'm here writing this in the hope that, as a society, we can learn to rekindle our connection to food.

What is disordered eating?

Disordered eating describes a range of irregular eating behaviors. Often times it is used to describe unhealthy eating behaviors and worries about body image. Some common examples include restrictive eating or yo-yo dieting. The term is used to suggest that an individual moves away from listening to what their body is telling them (e.g., hunger and fullness cues) and develops habits that



go against these cues. As disordered eating persists it eventually interferes with daily social and psychological function. Eating disorders are physically, mentally, and socially disabling and are associated with the highest rates of cause-specific mortality among mental disorders.

How does disordered eating develop?

One, perhaps obvious, contributing factor to the development of disordered eating is social pressure. As a young child I learned the social value of physical attributes — values that were reinforced in me as a ballet dancer. But the need to be thin was not limited to ballet culture. A diet advertisement would appear every time I turned on the television, teaching me that starving myself would make me look better, feel better, and be perceived to be better by others.

The problem is that some companies benefit from making us feel uneasy in our bodies. Between 2000 and 2018, the global prevalence of eating disorders increased from 3.5 to 7.8 percent. This number parallels the growth of the weight loss industry over the same timeframe: in 2018, the U.S. weight loss industry hit a peak of \$72 billion. Although there is a strong body-acceptance movement today, the weight loss industry continues to push their “tea detoxes” or “lollipop appetite suppressants” across all social media platforms. Young teens and adults are constantly reminded that they “need” to achieve a certain look, and that there are fast ways to obtain it.

Eating disorders aren't just about being thin

Social pressure to be thin isn't the only driver of eating disorders though. For example, another common approach that can lead to disordered eating is being too health-conscious. Becoming more aware of the contents and effects of the food we eat is a natural consequence of living in a complex society where food — often sold as a branded product — has come to represent so much more than mere energy. But this can lead to a psychologically unhealthy relationship to food.

Disordered eating doesn't just refer to those who eat too little either. Behaviours such as binge eating or night eating, linked to chronic illnesses like obesity, can be considered eating disorders when engaged in compulsively or in excess, but are actively encouraged by the fast food industry. In the UK, fast food advertising spent by the top 18 national brands exceeded £143 million on advertising in 2016, corresponding to around 27.5 times more the annual government's spending budget on healthy eating campaigns.

We are constantly surrounded by marketing advertisements that tell us how we should eat, when we

should eat, or how eating something will make us feel. Though these messages may not be the only reason why people develop eating disorders, it can undeniably be considered a main factor.

How can we rebuild a healthy relationship with food?

The way eating disorders are treated is continually changing as more research becomes readily available. Disordered eating is such a complex topic, intertwined with physical health, social health, and mental health — so solving the issue will need interdisciplinary work. The best advice for whoever is struggling in their relationship with food is to talk to a health professional.

What I've learned

As a young adult recovering from disordered eating, I have found some takeaways from several eating disorder intensive outpatient therapies and treatments that might also help others who struggle with their relationship with food:

1. Through therapy, I have learned to practice mindful and intuitive eating*. When I start to eat, I now

ask myself if I'm enjoying the food. I take pauses to enjoy what I'm eating and allow myself to connect with my body.

2. I find it important to avoid strict rules governing what or how much I eat. I remind myself that research is still ongoing to understand whether certain foods have positive or negative effects on our bodies and in what quantities.

3. I've learned to appreciate where my food comes from — without obsessing about it. Learning where and how food is sourced helps me to approach food with a positive attitude, connecting with it beyond mere calorie-counts.

4. Finally, I keep reminding myself that I have to unlearn years of habits and norms that dictated the way I perceived food and health. Now I accept that might be a long process, and allow myself to take the time I need to rekindle my relationship with food.

*Intuitive Eating is an approach to food based on physical hunger rather than prescriptions from diet books and experts.

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The Rise Of Eating Alone

A Case Study: The South Korean 'Honbap'

For millennia, humans have shared meals together with their communities. The social aspect of eating is so strong that solo eating is seen as a sad — or even worse, despicable — activity in many cultures. But in South Korea, things are starting to change.

The social stigma of eating alone

In recent years, the stigma associated with eating alone has been increasingly challenged in rich societies. Food-delivery apps, online streaming services and the fast food industry are turning eating alone into a more enjoyable activity. As a result, “primary eating” (eating together with other people) is declining around the world, while “secondary eating” (eating while doing other things) is on the rise. Surveys have shown that almost half of all adult American meals are consumed alone, while one-third of Europeans eat all their meals alone.

Fighting the blanket statement that eating alone is simply bad, many people have come to argue that solo eating is a worthy activity that deserves no judgment from others. But the debate still revolves around whether the digital advancements that made this possible are truly empowering us — or are actually just increasing our social isolation.

'Honbap': empowering young South Koreans

In South Korea, eating alone has become a symbol of empowerment for young generations. In just a few years, South Korea — like many other countries around the world — has become dominated by a cyber-mediated consumer culture where everyone is only one click away from anything they might need, including food. Currently, more than one-third of people live alone and eat approximately half of their meals in solitude in South Korea. Solo eating has become such a widespread phenomenon that young Koreans created a new term to describe it: “honbap”, stemming from a combination of hon (“alone”) and bap (“rice”, which also means “food”). Over the past few years the use of this new term has been growing exponentially — hand in hand with the rate of smartphone ownership.

A rise in people eating meals alone is perceived as a big deal in a country like Korea, where food has historically been seen as a vehicle to forge ties



and define social roles. “Food eaten alone doesn’t taste good,” recites an old Korean saying. But this link between food and social structures might be precisely the reason why many more young Koreans prefer to eat meals on their own: for many, the dinner table still represents the inequalities of a heavily formal and hierarchical social system.

When Koreans sit at the table with others, it is necessary for them to quickly gauge their table companions’ social ranking: at a family meal it might be based on age; at a business lunch, on title; with acquaintances, on social rank. Without information that allows us to understand who are the more or less authoritative people among us, it would be hard to understand when we can begin to eat (since the oldest person or highest-ranking person eats first) or where to sit (the youngest must sit closest to the door). Eating alone, in this sense, is

seen by many young Koreans as a revolutionary and defiant act.

Businesses are ready to support this trend, giving rise to a hon-conomy where doing things on one’s own is presented not as embarrassing, but cool. In shops it is now easier to find kitchenware for one person, mini-dishwashers, and special deals on single-portion prepared foods. More and more honbap restaurants are opening, offering single-seating tables each set up with plexiglass dividers, a television screen, and an electric burner.

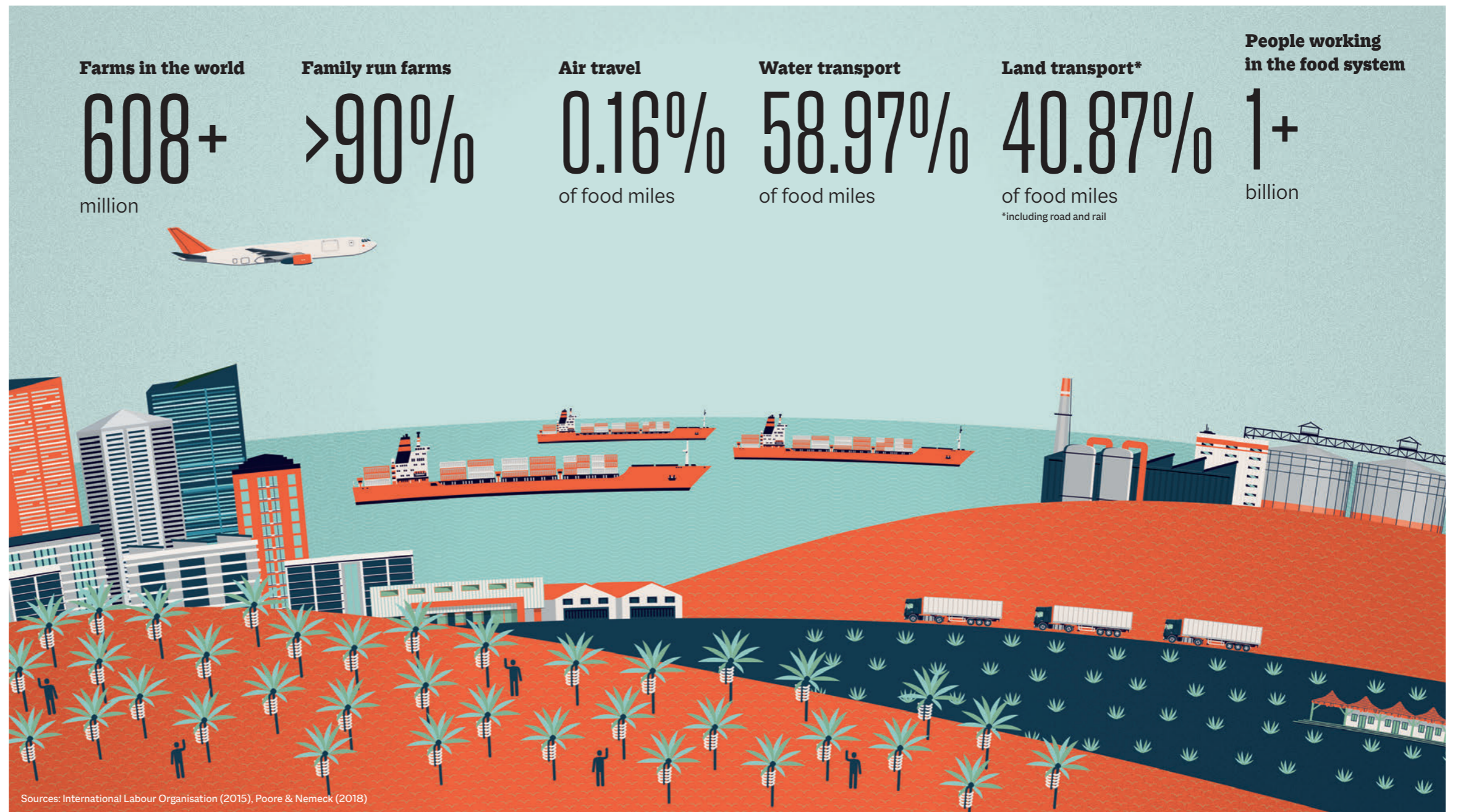
Solo eating: a challenge to health and culture?

While the honbap movement may have made solo eating more acceptable, it hasn’t overcome some of the other downsides of eating alone. Surveys have shown that

Koreans who eat alone pay more attention to comfort and functionality than to nutrition, taste, or tradition: the result is that fried eggs have become the most popular meal for honbapers. Research has also shown that those who have a habit of sharing meals tend to eat more nutrient-rich foods, have better self-esteem and less depression, and a healthier body weight.

Some believe that phenomena like honbap are the result of a system that constantly seeks our money and our attention — they argue that a system forcing us to eat alone rather than with other people will ultimately destroy the shared heritage of our food cultures. So while some are celebrating the freedom from oppressive traditions that solo eating can offer, others are mourning the loss of shared culture and history that comes with it. As with every social and cultural transformation, both sides probably have a point.

Sustainable Food Chains



Enjoying a hot cup of tea or coffee or a piece of fruit is a daily ritual for many of us. But how often do we stop and think about just what was needed to get that food onto our tables?

Many of us are more disconnected than ever from how our food is grown. It's understandable, given just how far away much of it comes from. In 2010, the world's total food miles were esti-

mated to be almost 10 billion tonne-kilometres (the equivalent to moving one ton of food to the sun and back around 30 times), with food losses and greenhouse gas emissions adding up over each and every mile.

We also need to consider more than just the environmental costs of how our food reaches us. Over a billion people worldwide make their living producing

our food, with many others involved in processing it, transporting it and selling it to us. The food we eat has often passed through dozens of pairs of hands belonging to farmers, factory workers, truck drivers, pilots, sailors and retailers before it reaches our mouths. What we choose to eat (and the price we pay for it) impacts the lives, incomes and working conditions of everyone that makes up that supply chain.

Making our supply chains more sustainable would therefore bring benefits not only to our environment but also to farmers, fishers, and the many less visible actors who make sure our food reaches us in one piece. If we truly want to reduce the global impact of our food, we need to look at every step in the journey our food takes to reach us - and remember that the story of our breakfast doesn't stop at the farm gate.

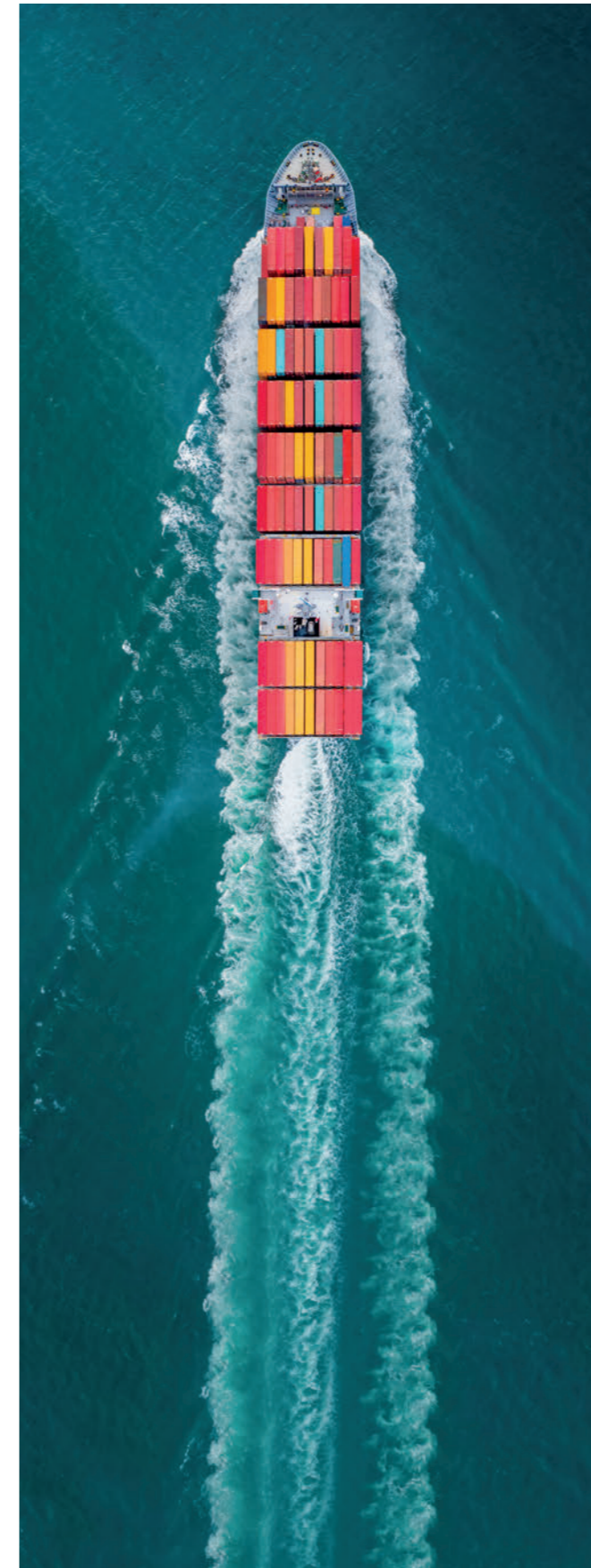
Ocean Transportation: What It Takes To Ship Our Food

What impacts the import and exports of food?

with Stephen Tang

Ocean transportation underpins the majority of global trade, with around 80 percent of our goods carried by sea. So what does it take to transport our food from one country to another?

Stephen Tang, the Sales Director of YangMing Marine Transport Corporation's Los Angeles office, shares his 30 years of insight in the ocean cargo shipping industry.



How much food does YangMing transport globally via cargo shipping each year?

Food cargo is around 10 percent of our total transportation. The commodities we transport are protein, fruit and vegetables, dairy and other frozen foodstuffs.

What are the big challenges when transporting food from one destination to another?

The top challenge would be transit time - the shorter the time it takes to reach the destination, the better it is for the food quality. The best option would be for importers to source their product from a nearby country. For example, in Taiwan, if you can source a product from Japan, it would definitely be fresher on arrival compared to the same product coming from the United States.

Another challenge, particularly for low-income regions, is weak or absent infrastructure. Some countries don't have strong cold chain* infrastructure to support the export of foodstuffs, so there is no guarantee that good quality products are loaded into the container every time.

*A cold chain is a temperature-controlled supply chain.

Regarding shelf-life, how do you ensure that the food arrives in selling condition and quality?

Transport time can take between two and three weeks, sometimes more depending on shipping routes. But each food usually has its own shelf life, so the exporter needs to know the maximum transit time that a product can afford. If the product has a shorter shelf life, for example if you're shipping cherries, it might be better to choose transport by air instead of by ocean.

With ocean transportation, particularly for fresh or perishable foods like fruits and vegetables, the air flow and temperature setting are important to keep them fresh. To regulate the container temperature, we have crewmembers who check the containers 3-4 times

a day during the voyage and take necessary action to repair any temperature malfunctions. We also have a lot of technologies that change the atmosphere, which keeps produce ‘asleep’ during transportation and extends their shelf life.

Is there a way to check the contents inside the container? How can the crew be sure the loaded content is as it was declared?

To be very honest with you, we can’t fully be sure. We handle hundreds of containers a day, so we don’t have the manpower to verify the contents of every single container. We usually just follow the declaration form submitted by the shipper to tell us what they loaded into the container — we work off mutual trust.

That being said, ocean transportation usually relies on the coast guard and customs, beside ocean carriers, to reinforce declarations. However, reinforcement also depends on terminal productivity and infrastructure. Most terminal ports have x-ray facilities, weighing scales and port police with K-9 (dog) units, but they also don’t have the manpower to trace the contents of every single container that arrives. Terminal ports today are already very congested with ships and

containers, so enforcement is still a big issue for terminal operators, customs and coast guards — not just ocean carriers.

How does consumer demand impact imports and exports?

This is a big question with no straightforward answer, but I can give you an example. Households use onions all year round to cook all kinds of foods, but domestically grown onions are only available during a certain season. Taiwan, for instance, only has a domestic supply of onions from December to May. Once the domestic season ends, importers will fill the gap to import from other countries.

The fresh produce market doesn’t have strong financial support, so importers will always look for price alternatives to keep their product competitive in the market, because in the end, consumers are mostly looking to buy cheaper quality goods. Let’s say Taiwanese importers place an order with major onion growers from the US west coast, but then it turns out that these onions are more expensive than those grown in Japan or Korea. Then Taiwanese importers can change their import in a snap of a finger to Japan or Korea exporter to save costs.

Would you say that ocean transportation has a strong stake in the world economy?

When everything is running smoothly, no one thinks about ocean transportation as a key part of the world economy. We don’t realise the importance of ocean transportation until we see serious disruptions, like the Suez Canal incident earlier this year. Billions of cargo and manufacturing components are shipped every day worldwide, so any disruption in ocean transportation definitely would have a serious impact on the world’s economy and on food distribution. That’s why reliable transportation is so important.

What vulnerabilities does the cargo shipping industry face? Did COVID-19 have an impact on ocean transportation?

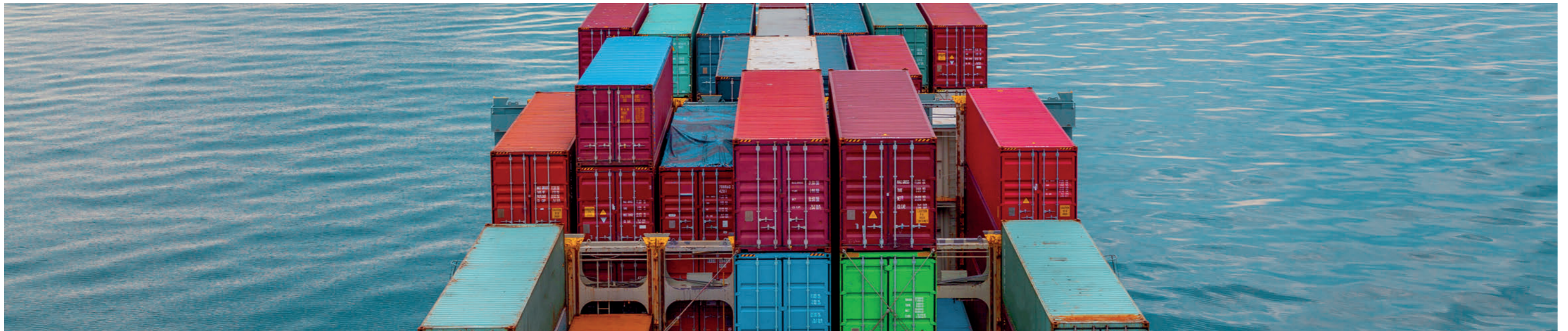
We are vulnerable to weather changes, and today we have a lot of issues with labour and terminal port congestion. Since the outbreak of COVID-19, the challenges seem to never end. For example, in the past during port landings, the crew members could get off the vessel for a break or for some shopping. But now since COVID-19, some ports do not allow the ship crew to get off the vessel or the base. The rules for the crew have been really tough, and sometimes the crew might even

need to live on the ship for 7 or 8 months without getting off the vessel.

Port productivity has also been at a very low capacity where automation is not utilized, which has caused a lot of congestion at ports, with shipping vessels anchored in open water for maybe 30-35 days. This is also particularly bad news for importers who ordered commodities with a shorter shelf life.

What have been some of the biggest evolutions in cargo shipping in the last few years?

Shipping really has had a lot of evolution in the past decades. The number of maritime carriers is downsizing, but on the other hand, some carriers are getting bigger and bigger. We’ve had to evolve with e-commerce, and we’ve made changes to cargo and terminal safety. There’s also been a lot of investment in the reduction of carbon emissions. Most shipping vessels have now changed their fuel type, but have also updated their engines so that they comply with the environmental regulations set by the International Maritime Organisation. It’s a big investment — I think over billions of dollars — but people cannot always pursue profit at the expense of the Earth.





greenwashing

noun /'grɪ:n.wɒʃ.ɪŋ/

when a company or organisation spends more time, money or resources marketing themselves as ethically driven than actually pursuing ethical practices



What does greenwashing look like?

What can we do about it?

Listen on our Food For Thought Podcast

The Problem With Sustainability Labelling /

How can we choose the most sustainable food and drinks on the market?

Tony Benson is a Research Fellow and Lecturer in Health Psychology at Queen's University Belfast. This article was written as part of TrustFood, an EIT Food project.

Learn about the MSC seafood label and its sustainability standards



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people across the world are becoming increasingly concerned about climate change and the environment. Many of us are also becoming more aware of the impact that our choices, from transport to clothing, can have on the environment and wider society. However, food and drinks have some of the strongest effects, responsible for 20-30% of consumption impact on the environment. This includes many of the factors which make up sustainability, such as land use, water use, pollution, deforestation, and waste - although it's important to note that animal welfare and fair pay for workers are also important factors for sustainability.

Choosing a more sustainable diet

One way to reduce our impact on the environment is to make better choices when buying and consuming our food and drink. For example, buying only as much food as needed to help reduce the amount of food wasted, or eating less

processed meat and more locally grown fruits and vegetables. While more people are adopting vegan and vegetarian diets, it might be more difficult for those who want to continue eating meat to understand the other choices they can make to be more sustainable.

How can we make these sustainable choices? Recommendations from experts and governments can help, but it can be difficult to fully understand and use these recommendations in everyday life. What we need are practical guides that help us make sustainable decisions when buying products. One such way of providing this information would be through standardised sustainability labelling on food and drink, as this would allow us all to understand the sustainability impacts of different products at the point of purchase.

The issue with sustainability labels

While several different environmental and sustainability labels already exist, these are typically accreditation schemes or labels which focus on only one aspect of sustainability. For example, a food's carbon footprint tells us only about greenhouse gas emissions.

This is a problem, because there are many more factors which make up sustainability: indeed, the United Nations' Food and Agriculture Organisation (FAO) states that sustainable diets are "protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimising natural and human resources".

Then should there be different sustainability labels?

The answer may be one overarching label which considers many different aspects of sustainability. For example, it might show if there was a high level of animal welfare, if the workers used to produce the food were paid fairly, the level of water used, and the carbon footprint of a product. Putting these all on the product pack for all to see would be a dramatic improvement compared to the general lack of information currently available on our food's packaging. If someone was interested in a single aspect of sustainability - such as water use - they could then easily compare products and choose what they deem best. However, simply putting

lots of information on the packaging may actually just cause even more confusion. If we were interested in sustainability and the environment as a whole, it would still be difficult to make a choice between different products with so many different factors to consider. One way to make this easier might be to create a consumer-friendly label which not only shows information relating to different parts of sustainability, but also colour codes these parts to show which are good for that particular product and gives an overall 'sustainability rating' for the product - very similar to the 'traffic light' nutrition labels which many of us are now used to seeing on our food. Such a sustainability label does not currently exist but research is underway to understand what consumers might like to see and in what format. However, before a label can be developed there are a number of other considerations and challenges. All of the information and metrics to be displayed on the label must be collected, it must be decided how these can be graded or rated, and to ensure that the label is trustworthy it must be accredited. Ultimately, though, such a label would not only help us, as consumers, but also lead to a greener and more sustainable planet.

Does Fairtrade Really Work?

A critical take on Fairtrade

The Fairtrade certification system was created to support and empower marginalised small-scale producers and workers in low-income regions of the world. Fairtrade enables farmers and workers to tackle poverty and improve their own financial sustainability by creating a trade model with fairer prices and working conditions. But to what degree does it work in practice?



Within the Fairtrade model, certified-buyers and traders must pay the Fairtrade price on any goods they purchase from Fairtrade co-operatives (a group of small-scale producers). The Fairtrade price is comprised of the 'minimum price' or market price, whichever is higher, plus a 'Fairtrade premium'. To support small-scale farmers who often already struggle with poverty, the minimum price acts as a safety net against volatile market prices that could result in losses. The premiums are additional funds for cooperatives and workers to reinvest into their communities – like building infrastructures or funding education.

Read this to learn more about how the Fairtrade certification works in detail



Do producers really benefit from fairtrade?

It's important to point out that benefits for Fairtrade producers will vary depending on product and region. Different studies focusing on coffee producers have demonstrated that Fairtrade's system does indeed improve the lives of producers and their surrounding community. Fairtrade farmers have higher bargaining power in trade negotiations, they receive higher shares of revenue because of the minimum price model, and the Fairtrade premium has had a significant impact on the social welfare of their community as a whole. However, other studies have raised questions about the long-term impacts of the Fairtrade model. Here are four ways in which

the Fairtrade system may be limited in its benefits for small-scale producers:

1 Not enough Fairtrade sales

Producers only receive the Fairtrade price if Fairtrade-certified buyers purchase their products. If farmers can't find a Fairtrade buyer, they will have to sell their crop under standard negotiation terms, which means no minimum price and no Fairtrade premium, and this can lead to a lower revenue. So even if the producers abide by Fairtrade standards, there is no guarantee that they will always sell at Fairtrade prices.

Some products sell better under the Fairtrade label, while others may not. For example, according to a review by The State of Sustainable Initiatives, only 6 percent of total Fairtrade produced tea was sold to Fairtrade buyers in 2014. On the other hand, two-thirds of Fairtrade produced bananas were sold to Fairtrade buyers in 2018. But what's worth remembering here is that the number of Fairtrade sales is *growing* – Fairtrade tea sales had more than doubled after UK retailers (Sainsbury's and Co-op) switched all their tea brands to Fairtrade, and Fairtrade banana sales have grown by 114 percent in the last 10 years. The more retailers switch to Fairtrade products and consumer demand increases, the more producers receive the Fairtrade price.

Another point to remember is that while it may not seem like much to us, farmers can at least rely on a portion of their products selling at a Fairtrade price – a stable income, which farmers under conventional

trade standards may not always get to enjoy. Fairtrade farmers also benefit from other non-monetary aspects, like protection of workers rights.

2 Auditing and licensing fees

Some have raised the concern that Fairtrade's auditing and licensing fees may detract from producers' benefits. To be clear, while cooperatives are responsible for auditing fees, licensing fees are paid by companies near the end of the Fairtrade chain who want to show that their product is Fairtrade certified with a label. Like all certification systems, these fees are necessary for operation costs. As Fairtrade certification is built on ethical standards, auditing is integral to maintain the integrity of the certification. The auditing fees are necessary to ensure that Fairtrade producers and traders are moving towards better, fairer standards.

In my interview with FLOCERT, the third-party auditing body for Fairtrade, they explained how auditing fees are determined: "The fee depends on the size and setup of the cooperative or company and of the number of products it wants to certify." For Fairtrade cooperatives or organisations that cannot afford to pay their fees due to circumstances, FLOCERT applies fee adjustments.

3 Long-term financial sustainability?

While Fairtrade focuses on the long-term financial sustainability of its producers and workers, one potential issue lies in its fundamental philosophy of an open-door system: Fairtrade always welcomes producers who want to join the Fairtrade chain. But what happens when you have a

growing number of farmers focused on producing one specific crop? You potentially end up with oversupply. This ultimately impacts the number of products that end up being sold under Fairtrade terms, meaning again that farmers may need to sell their products under conventional trade.

In 2020, Fairtrade put temporary rules to limit the entry of new producer organisations into their system. Nicolas Lambert, CEO of Fairtrade Belgium, explains this was done so that: “People are not disappointed from becoming Fairtrade certified but end up not selling anything under Fairtrade terms. While the [Fairtrade] demand is growing, it’s not as fast as the number of people joining the system.” Another aspect Lambert mentions is the impact of this growth on the limited number of Fairtrade staff, who become stretched thin and cannot provide the usual quality guidance and support to farmer cooperatives. Lambert is still hopeful that this limited entry rule will be released in accordance with Fairtrade’s open-door philosophy.

4 Environmental challenges

Growing clusters of monocultures also present an issue from an environmental perspective. And this represents another problem: long-term financial sustainability cannot be achieved without considering environmental sustainability. Fairtrade International say it themselves on their website: “Farmers are on the front line of climate change,” facing higher temperatures, droughts, extreme weather, crop failure and more. Fairtrade is now exploring the concept of climate risk insurance for its small-scale producers, and

is working with smallholder farms to increasingly diversify their land. However, while Fairtrade standards encourage sustainable agricultural practices (like responsible water use and waste management, enhance biodiversity and soil fertility), these are not mandatory. Though, it’s important to consider that sustainable agricultural practices like organic farming can also have higher costs. The benefit of being part of the Fairtrade system, though, is that producers can earn more and reinvest some of their higher revenue into sustainable practices.

Are farm workers really protected from exploitation?

Perhaps one of the biggest critiques the Fairtrade system faces is its unapparent impact on farm workers. It’s important to distinguish here that farm workers are usually found on larger Fairtrade-certified farms, plantations or estates — not as much on small-scale farms, as they are typically family-owned and worked by family members. Here are two ways in which the Fairtrade system may be limited in its benefits for workers:

1 Limited wages for workers

One study in the Costa Rican coffee sector showed that Fairtrade certification successfully increased the income for coffee millers and had benefited their local community overall, but pointed out that unskilled workers (like coffee pickers and farm labourers) saw no increase in their wages. Under Fairtrade, all labourers are guaranteed the legal minimum wage of their region. How-

ever, there is often a gap between minimum wage and living wage — living wage would ideally pay for the costs of having a decent home, decent food, medical care, etc. How does paying a minimum wage then line up with Fairtrade’s aims to empower the most vulnerable actors of the trade chain?

Lambert sheds light on the complexity of the situation: “It’s very delicate from an ethical standpoint, because the farmer himself is already poor. First you have to make sure that a small farmer is getting enough pay, so that he can then afford to pay his workers correctly. Otherwise you’ll chase the farmer into poverty. But it’s a very difficult issue and that’s something we have and are trying to regulate and check,” said Lambert.

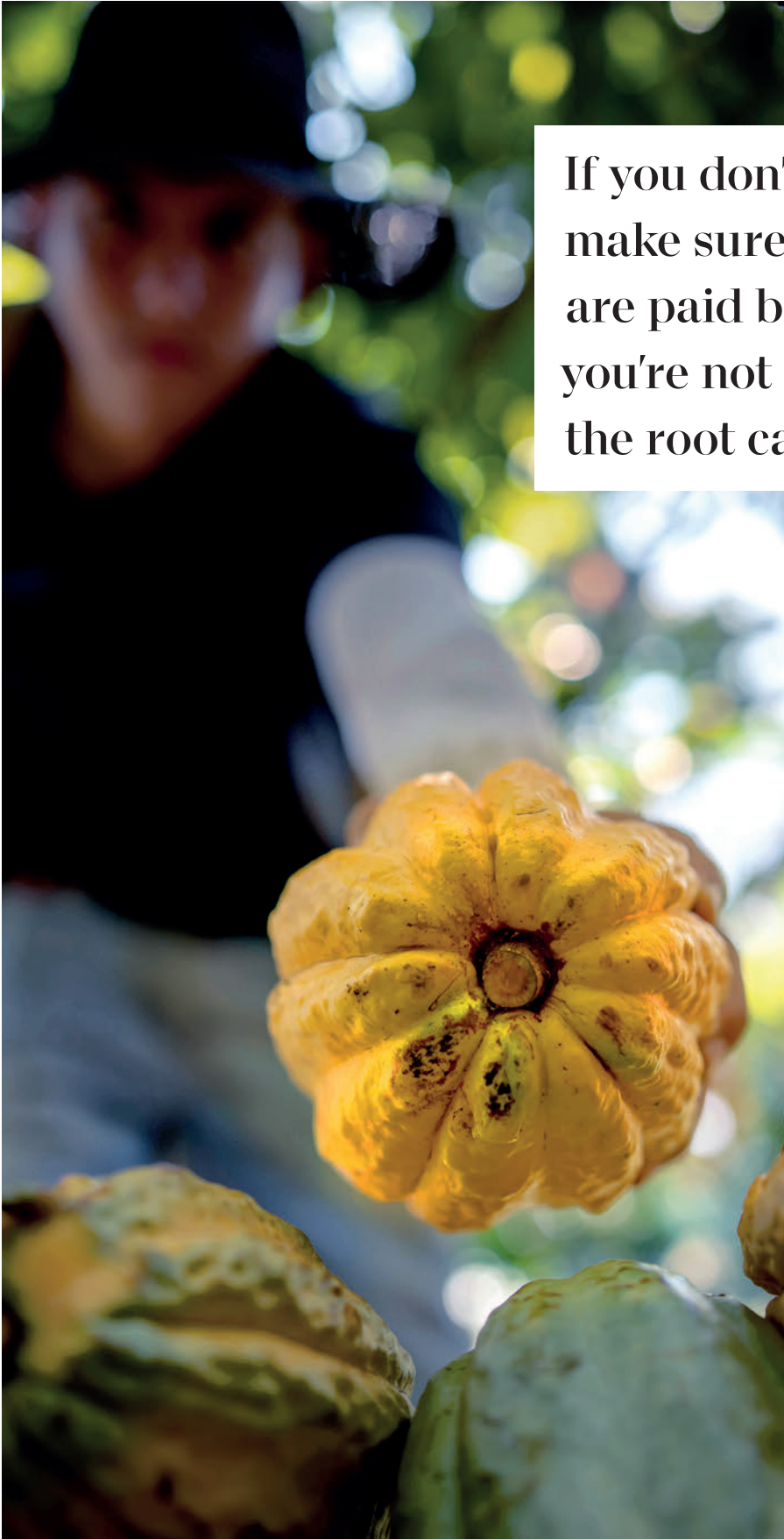
So what has been done to improve conditions for workers? On Fairtrade-certified plantations and estates, Fairtrade premiums are 100 percent reserved for labourers. The workers manage a joint committee that receives the premiums, and there, they can collectively agree to use part of the money as supplemental wages (additional to their minimum wage). However, other times, as Lambert shares, they have decided to use premiums on buying coats, distributing milk to families, or paying for tuition fees for their kids. The most important aspect of the Fairtrade system is that it leaves the decision solely up to the workers, not plantation or estate owners — allowing them to invest these additional funds in what they feel best fits their needs.

2 Cases of child labour

Fairtrade’s auditing system has



While the demand for Fairtrade is growing, it's not as fast as the number of people joining the system



If you don't do anything to make sure that these people are paid better prices, you're not going to tackle the root cause of child labour

also come under fire as child labour was allegedly found on a Fairtrade cocoa plantation in the Ivory Coast by an investigative journalist team from Danwatch in 2020. It's unclear whether the lack of auditing is due to travel restrictions under COVID-19 or systematic flaws. But whenever you hear one case, it makes you wonder: how many more cases like this exist?

Especially considering many other non-Fairtrade cocoa farms in West Africa have been discovered to have a widespread use of child labour. How does Fairtrade truly ensure that its producers are not using illegal forms of labour? Fairtrade audits are usually announced in advance, as auditing often takes time to prepare — for example, cooperatives prepare paperwork for review, and they also have to arrange time with farmers so the auditor can visit their fields, or organise meetings for interviews. But by announcing their audit schedule, how can they be sure



that there are no opportunities for cover-ups? Fairtrade has criteria to identify high-risk situations, and in areas that have shown to have a higher risk of illegal labour, certifiers do conduct unannounced audits.

“The general spirit of auditing is one of trust,” explains Lambert. “Sometimes the Western point of view is to say, ‘We are going to check these guys because they are the bad guys.’ But they’re not necessarily the bad guys — they’re just people like you and me.” That’s why Lambert stresses that auditing is only a part of the certification process, that it’s only a means to an end. Auditing can help improve situations and prevent malpractice from happening, but it doesn’t solve the root issue. Lambert explains that sometimes farmers feel compelled to have their children work on their farms because they can’t afford to hire someone for a few weeks to help them harvest their crops. “These people don’t want their

children to work on their farms, they would rather send them to school, but they often can’t afford it. If you don’t do anything to make sure that these people are paid better prices, you’re not going to tackle the root cause of child labour,” he concludes.

Fairtrade’s approach is one of balance between strictness and gently encouraging development. Of course, if major certification requirements have been breached, then certifiers will suspend or decertify a producer organisation or trader. But Fairtrade’s overall focus is to give their producers the opportunity to address problems and improve over time.

But what do Fairtrade producers and workers think?

It’s clear that Fairtrade is not a perfect system, but it’s a good start. Fairtrade now counts 1.7 million

farmers and workers in 72 different countries and territories, as well as 35,000 certified-products. It might seem like a lot, but Fairtrade producers actually account for less than 1 percent of the 570 million smallholder farms worldwide. This means that more than 99 percent of smallholder farms do not work under a trade model that can guarantee fair prices or the respect of basic working rights. However, the number of Fairtrade producers is enough to put criticisms in perspective. While the studies we referred to were conducted to assess the real impact of Fairtrade’s model, they’re also inevitably limited in their scope and voice. While they study specific product chains and specific cooperatives, they cannot represent the voice and felt impact of all the people in the Fairtrade system. That’s why it’s important to hear directly from farmers and workers when asking: did Fairtrade really work for you?

Participatory Food Cooperatives /

An alternative way to shop your groceries

Fabienne Ruault was brought-up on a small organic farm in the west of France. She has spent the last 11 years working as a programme manager on diverse European projects at the European Commission and at EIT Food.



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Once a month I change hats. Normally, I'm a project manager working behind a computer. But today, for a few hours, I'm a receiving clerk here in my local food cooperative in Brussels.

I arrived here around 9 am. After a short briefing on the tasks of

the morning, the 7 of us in charge of the morning shift went to work. I'm glad I've been paired with Arthur, as the task for today is not an easy job. Together, we will have to take care of the huge beer delivery of the day: two full wooden pallets of around 50 crates. For almost 3 hours we check the delivery, shelve the beer, and carry the rest in storage.

Arthur and I are two of the 1600 co-operators of the biggest participatory food cooperative in Belgium, BEES Coop. Launched in 2017 in Schaerbeek, it is a unique supermarket where you have to participate to earn the right to shop. About 80 percent of the workload is assumed by the coop-

erative members, including daily management, inventory shelving, checkout, cleaning, and receipt of deliveries. Each co-operator works a monthly shift of 2,75 hours, and 8 employees ensure the continuity of activities.

We are all partly owners of our supermarket: we each invested at least a 25 euro share when joining the project. The majority of the shopping clients are cooperative members, who have the right to vote at the General Assembly Meetings through participatory governance. This feeling of ownership influences the way I shop: in a regular supermarket, I'd look for the longest possible Best-Before-End expiry date, but in my own co-op, I naturally want to re-

duce waste (both material and financial) and favour products that might expire soon.

Our cooperative is not for profit: we are not looking for any returns. The goal is to offer healthy and quality food — preferably locally sourced. We can offer our products at attractive prices compared to traditional organic supermarkets because our economic model is based on three pillars: a low and transparent gross margin, a minimal recourse to intermediaries, and savings on labour costs (through the active participation of all).

More than just a supermarket

BEES Coop is a one-stop shop: from food to cleaning products and toiletries, it offers 3300 products. I can even find my favourite magazine and air tube replacements for my bike! The shop interior is rather minimalistic with wooden shelves and clay walls, as much natural materials as possible. The buyer's experience is relaxed and we feel at home. There's no stress induced from aggressive marketing campaigns you'll typically find at traditional supermarkets.

Walking around you will find basic potatoes at 86 cents per kilogram and organic eggs at 34 cents a piece, local organic mushrooms at 12,50 euros per kilogram, a fine cheese selection (sliced by co-operators themselves to reduce the price) starting at 13 euros per kilogram, and a beer selection to make your head spin with nearly 150 references. You will not find big brand names, but thoroughly selected al-

ternatives chosen by our dedicated co-operators' committee through agreed sustainability and health criteria. Thanks to this selection process, I trust the products I find here and I spend less time browsing for items that match my values.

But BEES Coop is more than just a supermarket — a community has been created through the project. My family shops at BEES Coop once a week to buy our groceries. Our boys run through the 350m² shop and get comfortable in the little wooden house that was created for them at the back, where they read and play with other kids. I usually meet friends and neighbours and we stop for a chat about what's going on locally.

The cooperative movement in brief

This participatory cooperative might seem like an unusual model, but it is, in fact, nearly 200 years old. The first consumer cooperatives were created in Europe at the beginning of the 19th century as "associations for the purpose of joint trading." They originated among the less fortunate and were conducted always in an unselfish spirit.

Nowadays, cooperatives come in all shapes and sizes with a basic principle to bring people together to realise their common socio-economic needs and aspirations. Major consumer cooperatives can be found in several European countries. For some, the principle has been reduced to be able to buy products at cheaper prices.

But the participatory model used at our BEES Coop was created by following the example of the Park Slope Food Coop, which has prospered for 45 years in the Brooklyn district of New York. We were not the only ones to get inspired: you can find several examples of similar projects throughout Europe.

Challenges of accessibility

Critics might describe the co-op as an upper-middle-class-quinoa-eaters club in the heart of a working-class district. What saddens me is that they might be right. Through the constructive years of the project, our wish for BEES Coop to be a meeting ground for all social classes, shifted down on the priority list. Of course, not every family has 2,75 hours per month to devote to such a project. And the selection of products is still considered as restrictive for bigger local families that cannot afford a 3 euro can of jelly.

However, we are trying to change that through several actions: by proposing a number of basic products at a lower price, and by opening our spacious kitchen and meeting space to local NGOs and clubs, allowing them to develop activities with the local neighbourhood.

On the bright side, membership continues to grow at a good pace and we are optimistic and motivated for an even better future. There is still a lot of work to be done, but it feels good to have started a movement and allowed a number of people to introduce a real change in their habits. Big change starts small.

by Aran Shaunak

Agriculture & Community



Over generations, farms have become bigger and more industrialised in the drive to become more efficient — but growing and distributing our food in other ways can help bring people and communities together. Here are 5 alternative ways of growing sustainable produce that are also helping to bring people closer to each other and closer to their food.

1. Community Supported Agriculture (CSA)

Community Supported Agriculture (or CSA) schemes allow local communities to share the responsibilities and risks of farming, in exchange for a share of the rewards. Citizens might invest in a local farm or volunteer in exchange for a share of the harvest, allowing them to reconnect with how their food is produced whilst supporting local farmers.

2. Direct Trade

In theory, shorter supply chains should mean farmers see a greater share of the price consumers pay for food. Through 'direct trade', companies like Coup de Chocolat cut out the middlemen by buying their raw ingredients directly from food producers, often resulting in higher quality food and a better deal for farmers — without having to ask consumers to pay more.

3. Farming with Refugees

Refugees can be left reliant on handouts from aid programmes and relief agencies to put food on the table — but a UNHCR-supported initiative in the Democratic Republic of Congo has taken a different approach. It's empowered refugees by bringing South Sudanese refugees together with Congolese farmers to till the land together, harvest and sell their produce at local markets, and share the profits.

4. Community-Focused Regeneration

Farming can be a novel way of regenerating our environment and local communities at the same time. Camino Verde rejuvenated Amazonian communities along with the Peruvian rainforest by planting a variety of valuable local tree species and giving local farmers training in how to harvest and sell products from the new areas of forest in a sustainable way. Meanwhile, CultiCuidad's 'Huerto Tlatelolco' programme transformed a neglected pocket of Mexico City into a thriving urban farm, which now runs educational visits for schoolchildren and training workshops for setting up new urban farms — as well as a market selling fresh produce!

5. Urban Farming

Space might be limited in cities, but where there's a will there's a way — and in recent years urban citizens have taken to rooftop gardens, balconies and city allotments in record numbers to grow their own food in the heart of the city. The number of registered beekeepers in London is now at an all-time high; closed-loop, no-waste aquaponics are being adopted by urban farmers from Berlin to Singapore; and the roof of the Paris Expo Porte de Versailles is now home to the world's largest urban rooftop farm, which produces several hundred kilos of fruits, vegetables and spices every day right in the heart of the French capital.

Listen to how this Singaporean University manages their own aquaponics system



Source: European Institute of Innovation and Technology (EIT) Food TrustTracker® 2020, a survey of 19,800 consumers across 18 European countries on trust in the food system and confidence in food products.

Farmers



67% Trust

56% Believe farmers act in the public's interest



Manufacturers



46% Trust

38% Believe manufacturers act in the public's interest



Retailers



53% Trust

41% Believe retailers act in the public's interest



Authorities



47% Trust

44% Believe authorities act in the public's interest



“Citizens are at the heart of our mission to transform our food system to be healthier and more sustainable; and helping to build trust between consumers and the food sector is critical for us to work together to improve food for everyone.”

Saskia Nuijten

Director of Communication and Public Engagement at EIT Food

Why we Need Open Innovation For Our Food System/

Transformation through collaboration

with Dr Andy Zynga

Have you heard of OI — open innovation? If you think it means openly sharing ideas and technologies in industry, you're on the right track, but it's much more than just that. I sat down with Andy Zynga, CEO of the European Institute of Innovation and Technology (EIT) Food, to learn how open innovation can help solve challenges in our food system.

Why is open innovation so necessary for transforming our food system?

The answer to this lies in the nature of what open innovation really is. Open innovation is about organisations

going outside their own four walls to find and inspire technologies and knowledge — moving away from the old “silo mentality”. You can find the solutions to your problems from outside your own technology domain. It's actually a proven empirical fact that breakthrough innovation is more probable when you repurpose an existing innovation from other technology domains!

We all know the food system needs solutions to pressing problems, right? There's already a lot of innovation going on in different sectors of the agri-food industry, but you can argue that potential solution providers might be lingering in other industries, like medical, chemical, you name it. Open innovation is about leav-

ing your comfort zone and talking to people from other industries that might have a really, really good answer.

One example I found a few years ago was with avocado growers, who had the challenge of assessing how ripe an avocado is at any given time. This is important for logistics, shipping, shelf life, etc. One avocado grower had gone outside his own four walls and told me, “In the auto industry, there's this device that checks how stable a steering wheel is.” He said that that particular auto tool has a very soft touch and can be applied to assessing the ripeness of avocados, which he did. Lo and behold, that is now the prevailing technology to determine the ripeness of an avocado! So that's just one example of open innovation from the auto industry applied in the avocado industry.

What would you need to kick start open innovation?

The starting point is always a ‘technology need’. Your organisation has to have a well-defined problem that you can't or don't want to solve with your own resources, either because you don't have the capabilities or capacity to solve it in-house. The problem with looking outside your own industry is that you don't really know where to look. So that's where two things come in handy: a ‘problem statement’ and a service provider that connects different industries with solutions — like NinaSigma, the business I ran for 10 years.

The important part of a problem statement is to talk about the technology need - without mentioning the industry or the application. For example, one of our clients was looking for a way to reduce wrinkles in shirts when they come out of the dryer. This was the problem statement: “Our client, a large multinational, is looking for a way to reduce surface tension in an organic material.” There is no mention of the application (i.e. wrinkles), just purely focusing on the technology. Guess what happened? A person reached out — he had developed a polymer for integrated circuit research. This became a solution for the company because it turned out that spraying this polymer technology on cotton fibre relaxed it! A good problem statement doesn't preclude others from submitting solutions. If you mention your industry

or how you want to apply a solution specifically, people from different industries might be discouraged and think, “This is not something I can answer,” even if they might have a technology that could be a solution.

What barriers do we still need to overcome to reach open innovation?

Just to be clear on this, open innovation is not a state you achieve, it's more a tool you use — you can either use it successfully or unsuccessfully.

1 The first barrier is that many organisations have the ‘Not-Invented-Here Syndrome’. The mentality is, “We've spent our entire lives researching, developing and innovating in this sector. *This* is where the smartest minds in the business are - why should we look for or engage with outsider's solutions?”

2 Another barrier is often the lack of support from top management in the organisation. If you really want to make a cultural change, it has to be sponsored by the top. Of course, one part is finding the solutions, but it's another part to integrate them into the business. If there's blocking factors from inside the organisation, that could be a problem.

3 A third barrier is funding — you need to have sufficient budget available for the people with the solutions. Nobody will submit technologies for free, just for a good cause.

Then, wouldn't patents also be a barrier to open innovation? Aren't trade secrets common within business and research - particularly within the same industry?

It's a great question and often asked in the open innovation business. The going wisdom is that going to the market faster is probably more important than having a patent because patents are not a guarantor for financial success. In fact, patents are expensive to maintain - it could be \$5-10k for a patent. So that's another reason why a lot of businesses turn to open innovation. For example, a lot of companies have patents for

technologies and inventions that just end up on their shelves but might be useful solutions for others to use. Through open innovation, companies can get license fees for these patented technologies. Henry Chesbrough's book "Open Innovation: the New Imperative for Creating and Profiting from Technology", mentions IBM has an annual income of \$1.4 billion just from licence fees of unused technologies that they had developed but never used for their own products or services! Of course in some instances patents can be a barrier, but patents can also help connect different industries to new innovations. I actually know of quite a few open innovation practitioners and large firms that are saying they'd much rather have a firm that already has a patent. It means they can negotiate about a protected technology, rather than just an idea that leaves a little bit of room for possible legal complications later.

Can open innovation also be applied to less economically beneficial problems within (or created by) our food system, like minimizing environmental impacts?

So, OI works particularly well when you have tangible products, like robotics, sensors, ingredients, etc. When we're talking about the environment, the Canadian Carbon Emission Management Board had a huge project to find solutions to take CO2 out of the air and convert it into useful products. NineSigma ran a Grand Challenge, a big prize tournament that brought together different stakeholders and industries, with 30 million Canadian dollars of prize money. Over five years, we found some fabulous solutions in tangible products that could be produced from that CO2 - solutions in food, construction and other industries.

You've already mentioned the need for the involvement of top management, researchers and innovators, as well as service providers. Who or what else would we need for open innovation to be successful?

It's important that you keep the lawyers out of the discussion as long as you can. When lawyers are in-



involved early on, deals tend to happen much slower — particularly when a smaller player talks to a larger player. When there are lawyers involved, that's often a bit of a barrier for them to even want to collaborate. So instead, you've got to have a commercial negotiator. These are the people who understand the mechanics of how to make deals with solution providers, rather than legal frameworks.

You also need tech scouts: somebody from the organisation or from a service provider, who finds different technologies and connects them with the people who need solutions. But you sometimes may need additional support or knowledge, and that's where a consortium with different types of organisations (i.e. universities or other industry stakeholders) could be very helpful. It can create an ecosystem of different people that helps bring the solution into reality.

But how would you bring together these different organisations if they typically work in silos?

Well, this is a huge part of what we do here at EIT Food. We're one of those ecosystems that apply open innovations systematically. We have a growing network of different partners from key industry players, agrifood startups, research centres and universities across Europe. We have online and offline spaces — from our events to EIT Food 'marketplaces' and regional innovation hubs — for these different organisations to connect both on pan-European and local level.

Another barrier to open innovation that I should mention is lack of trust between different organisations. A lot of times you have smaller players that could be solution providers for larger ones that are looking for solutions. You need spaces for them to get acquainted with each other so that trust can grow. We all need to work together as allies, as a team, to make our food system better.

Learn more
about EIT Food



Traceability In The Food System



Where has food come from and where is it going? Knowing is crucial to sustaining food supply chains around the world, and as a result, there is a significant global push towards advancing food traceability. But what are the benefits and limitations of this movement, and what does it mean for the future of food?

Food traceability is the ability to trace food along the food supply chain, and as a result, know both its origin and its ultimate destination. This information can be as simple as a customer buying their weekly shop from their local grocer, but when scaled up to include entire food chains the potential advantages of such comprehensive records can be huge: helping to prevent everyday issues in our food system such as the spread of foodborne diseases, economic losses through product recalls, and declines in consumer trust following episodes of food fraud.

Tracing food through technology

But tracking and tracing all our food throughout its journey requires a huge amount of information – and how this information is collected, stored, distributed and analysed is key. Technology will have a major role to play: in July 2020, the US Food and Drug Administration launched ‘The New Era of Smarter Food Safety Blueprint’, focusing on biological and digital traceability through real-time, secure digital transactions. Whole-genome sequencing is being proposed to help identify foodborne diseases at even the tiniest level, as is the use of artificial intelligence, the Internet of Things, sensor technologies and blockchain - but which technologies offer the best path forward to a truly traceable food system?

Is blockchain the answer?

Blockchain technology is one of the most commonly lauded solutions for traceability in the food system. Blockchain is a public, uneditable ledger of digital transactions, which doesn't have to rely on a central trusted authority. Instead, it's an information democracy – made reliable by all parties in the food system reaching a consensus on what is the truth. Blockchain's success as the technology that underpins Bitcoin* has led many to see it as the way forward for rebuilding back the trust that has eroded away from the food industry.

But blockchain alone will not create a trustworthy and traceable food system. One core limitation is that, unlike the fully digital Bitcoin, food is physical. This means that actors in our food system must upload information about food to the blockchain: while this information cannot be changed once uploaded, there is nothing stopping producers, processors or suppliers from making mistakes or deliberately falsifying the information they upload. Alone, blockchain does not solve the issue of trust: it cannot ensure that the story we are told is an accurate reflection of the journey our food has taken in reality.

Blockchain has practical limitations too: setting up a network is expensive, energy-intensive and would require a huge amount of infrastructure and engagement from key players. Lower-income regions could benefit the most from a functioning food traceability system (as they suffer most significantly from foodborne diseases), but generally have weaker internet and digi-

tal infrastructure systems – both of which are essential for blockchain-based solutions to be feasible.

*Bitcoin is a digital currency that doesn't rely on traditional banks.

Alternatives for food tracing

Instead, adaptable and localised digital databases could be a more realistic and affordable solution to food traceability. Farmforce is an example of web-based traceability software which enables smallholder farmers to access new export markets, as it gives international buyers almost instant access to their local product's origins. It was first trialled in Kenya, commercialised in Guatemala and is now working in over 30 countries with 590,000 farmers.

Trust and buy-in

Regardless of the technology we use, the key to creating a traceable food system is getting everyone on board. In order for investment, adoption and new regulations to take hold, we need governments to be able and willing to drive forward development in this area. Solutions must also clearly bring real benefits to both consumers and industry, be tailored to different supply chains and be low-to-no cost for smallholder producers. There is hope yet for a culture-shift away from paper-based records and towards comprehensive digital traceability of our food, but if we build tools that people in our food system aren't able and willing to use, we won't get far.

Policy

Policy governs huge areas of society – and our food system is no exception. Various policies govern the full length of our food chain, covering all aspects from production to consumption: taxes on food, regulations for food safety, working conditions for those involved in food production, and which pesticides (and how much of them) farmers are allowed to use.

Such a raft of rules makes it sound like our food system is pretty fair and well-controlled. But we live in a globally interconnected world, where the food we consume comes from all corners of the planet. Many of the policies governing our food systems are not consistent across international borders, and each country governs their own food production differently. This leads to lar-

ge, and often invisible, discrepancies: for example, imported foods such as tea might be produced under conditions that would never be allowed in the countries we are consuming them in.

Policy is a powerful tool that, if used right, can improve our food system and the lives of many actors across the chain. Policies can be put in place to im-

prove working conditions of the most vulnerable workers, as well as to reduce the impact of food production and to combat climate change. But to really be effective and forge a path towards positive change, these policies must span and act across international borders. Without serious political responsibility, change will be too slow – or may never happen at all.

by Marie Lödige



Carbon Taxes On Food

A proposal from the United Kingdom

Until recently, the vast majority of action targeted towards minimising climate change has focused on decarbonising energy and transportation, but with food production and consumption accounting for around 20 percent of UK emissions, scientists believe our diets deserve more attention and that a carbon tax on food would help mitigate this massive cost to the environment.

What is a carbon tax on food and why should it exist?

Food is responsible for an astonishing 26 percent of global anthropogenic greenhouse gas emissions, with factors including nitrous oxide released from fertilised soils, methane emissions from ruminant animals, rice fields and food waste, as well as carbon dioxide emissions from processes such as land conversion and machinery usage all contributing to the sector's overall emissions. Whilst carbon taxes and/or emission trading schemes (ETS) have already been brought into place in over 40 countries, including all EU states, these account for just a small proportion of food production and consumption-related emissions, and no country has yet introduced a food-specific carbon tax.

It is for this very reason that the UK Health Alliance on Climate Change, a communications and campaign coalition of 21 health organisations including medical and nursing royal colleges, faculties of health, the British Medical Journal and the Lancet, are calling for the implementation of a so-called 'carbon tax' – a levy that will be imposed on food producers according to the carbon footprint of their products.

"It is now widely recognised that it will be impossible to keep global temperatures at safe levels unless there is a transformation in the way the world produces and consumes food, which makes up over a quarter (26 percent) of total global greenhouse gas emissions". Nicky Philpott, the Director of the UK Health Alliance on Climate Change, told me in our email interview.

Is a tax the right measure?

History suggests that fiscal incentives are often highly effective in bringing about change, even when education and other measures have failed. The Soft Drinks Industry Levy (SIDL), or 'sugar-tax', implemented in the UK in April 2018, led to more than half of drinks producers reformulating their products to lower sugar recipes, and an overall 30 percent reduction in sugars consumed from soft drinks alone. Similar benefits are seen when the consumer is the one who pays the premium, leading to a change in purchasing behaviours, as demonstrated with the recent minimum unit pricing on alcohol in Scotland, as well as plastic bag levy in the UK, which led to an 86 percent decrease in single-use plastic bags.

Modelling research from other countries also supports the efficacy of such a policy; a study conducted in Sweden looked at the emissions produced by seven different animal products (beef, pork, chicken and four dairy-based foods), and applied a hypothetical tax on those according to their environmental cost. By just taxing these seven products, the study revealed a potential 12 percent decrease in livestock-related emissions.

What would a carbon tax for food look like?

With the notion only recently being proposed by the UK Health Alliance on Climate Change, and no word yet from the UK government as to whether it is indeed under consider-



ation, exactly how a carbon tax for food would be calculated is currently unclear. One of the more simplistic formulations would be for food types to be taxed according to their average environmental footprint.

Under such a scheme, rather than considering the nuances and differences between different product types or production systems, all dairy products, for example, would be subject to the same level of tax. Another possibility would be for certain tax brackets to be identified such that all foods considered 'high emitters' suffer the same level of tax, those that are considered 'moderate emitters' taxed somewhat less, and those identified as 'low emitters' potentially being exempt.

Potential problems with carbon tax

The environmental impact of food is, however, a highly complex matter. With so many steps in the supply chain as well as various emissions to take into consideration, having one single tax applied across all products of a single type – independent of the individual production systems – risks creating a reductive policy that would likely unfairly discriminate against certain producers whilst also spreading misinformation to the consumer. In accordance with this complexity, the Alliance looks to be proposing perhaps what could be considered the most extensive and fairest of the possible options. All food producers would be subject to the levy, with each food item being taxed according to its own individual footprint, based on existing and in-progress databases. Under this system,

everything ranging from production, processing, packaging and transportation would be taken into consideration and would contribute to the end levy imposed on that food item.


The money: who would pay the price of a carbon tax?

While the Alliance states that the levy should fall onto the producer in the first instance, some producers will likely choose to offset these increased costs, at least partially, by increasing the price that retailers and ultimately customers pay for their products. This sort of trickle-down effect could play an important role in the extent to which the tax could bring about change.

While taxing farmers and producers acts as an incentive to bring about change at the production level, historical evidence indicates that financial incentives at the consumer level are highly effective in bringing about behavioural change, indicating that a rise in prices could lead to consumers, however reluctantly, making more environmentally friendly dietary choices. Whilst maximising this benefit will be key to generating sufficient change, the government must also account for and mitigate any distributional impacts which could affect lower-income individuals disproportionately.

Where would the tax revenue go?

On the other side of the coin, it is important to consider where the revenue from the tax could go, and how it could be used to positively incentivise farmers by encouraging and rewarding change. This could take



With each food item being taxed according to its own individual footprint

the form of the government developing subsidy schemes for climate-positive actions such as tree-planting, as well as putting some of the money towards accelerating existing programs such as the Environmental Land Management scheme which will see farmers financially rewarded for taking action to provide 'public goods' such as clean air, clean water and the protection of wildlife.

When can we expect to see a carbon tax on food?

The call for a carbon tax for food comes as the very last of a series of recommendations made by the Alliance in its recent report 'All Consuming: Building a Healthier Food System for People and Planet'. The changes – which the Alliance deems necessary if we are to meet our commitments to the Paris Agreement – include increasing public information and advice, mandatory environmental labelling, ending the practice of 'buy-one-get-one-free' promotions as a means to reducing household waste, and using state purchasing power in places such as schools and the National Health Service to transform the market. The carbon levy should act as a final option, only to be brought in if the food industry has not enacted the other recommendations by 2025.

by Dr Mirta Alessandrini

Short Food Supply Chains: Limited By Law

Dr Mirta Alessandrini is a lecturer and researcher at Wageningen University & Research working on Food Law, the regulation of Short Food Supply Chains, and the legal frameworks that govern the safety and sustainability of our food systems.

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Short food supply chains represent a great opportunity to support the shift towards more sustainable, inclusive and resilient food systems. Yet, their development is hindered by the presence of demanding and rigid food safety rules designed for supply chains.

What are Short Food Supply Chains?

'Short Food Supply Chain' (SFSC) is an umbrella term that embodies an

alternative to industrialised food production systems. But despite a natural assumption that 'short' infers geographical distance, 'short', in the context of food supply chains, is actually more reflective of the relation between demand and supply and the interpersonal distance between primary producers and us – the consumer. Because of this, a key feature of SFSCs that sets them apart from industrialised food systems is the limited number of intermediaries – a key driver of more value-laden and transparent food supply chains.

**Intermediaries: The economic operators involved in the SFSC that act between the primary producer and the final consumers (e.g. retail shop, home delivery services, processors, etc.)*

What are SFSCs good for?

SFSCs symbolise a way to 're-socialize' and 're-spatialize' food. For instance, initiatives such as farmers'

markets and community-supported agriculture (CSA) focus on the production of high-quality foods and are broadly based on mutual assistance and solidarity principles. By making local food more visible in public spaces or involving the final consumers in the production process, they become a powerful template to build tighter relationships and business incubators for local food networks.

There are also a number of other intrinsic values associated with shorter supply chains: from enhancing food heritage and cultural identities, to re-vitalizing local economies by supporting the re-circulation of community income and the creation of new jobs. At the same time, the sharing of knowledge and agricultural skills is encouraged through the organisation of local events, workshops, professional training, and even online platforms.





With the host of obvious positives, it begs the question —why aren't they more popular?

Limitations of SFSCs

The shortening of supply chains is often considered capable of adjusting some issues generated by the globalization of the agri-food system — such as the intensive exploitation of land and the constant provision of unseasonal food. However, when it comes to food safety, the same principles that aim to reduce the risk of contamination, must apply to any kind of food chain — regardless of its size. For SFSCs, this is a significant challenge hindering their development. The requirement of SFSCs to comply with stringent and often different food safety standards at the international level makes this challenge hard to overcome.

Despite operating under different circumstances to large scale producers, small farmers are still forced to comply with different layers of legislation and stringent requirements. This jeopardises the fundamental role that small farmers play as land keepers, safeguarders of natural resources, key players in the climate change challenges, and boosters of the local economy and social cohesion.

While this is unfortunate, these regulations are not enforced without reason. It is true that some practices being used on small-sized farms may increase the risk of foodborne illness among consumers. Many small facilities do not always have access to enough resources to assure a safe product and they cannot always rely on well-trained employees. The difficulties of this already precarious system are also further aggravated by several factors, like a generalized in-

ability to keep track of and interpret rigid legislation, the lack of resources and knowledge, as well as any tangible help from authorities.

Flexible regulations: learnings from the European Union

Several actions are on the plate in the European Union. From a legislative standpoint, the EU's integrated approach "from farm to fork" is globally recognized as an outstanding example of food safety as it guarantees the safety of foodstuffs from the place of primary production up to the market. The 'principle of flexibility' was introduced in the EU's Food Hygiene Package to help remedy burdens on small domestic producers. Compared to non-EU competitors, farmers in the EU often pay higher costs to be compliant with domestic legislation, while still being burdened by

over-regulation. To lighten such financial burdens, the principle of flexibility ensures the application of hygiene rules is proportionate to the risk posed by particular food operations and establishments. For instance, small farmers in SFSCs will only come into contact with a small number of intermediaries from primary supplier to final consumer, so in the case of direct supply of small quantities of produce to the final consumer, the hygiene rules do not apply.

The need to improve legislation

Despite small farmers' predominance in the agricultural scenario, both policy leadership and legal interventions are not sufficiently fostering their position in today's socio-economic narrative. The "small farmers" involved in SFSCs are those that are usually willing to build a tight relation with

the final consumer, devoted to co-operation and committed to local economic and social development. However, given the heterogeneity of local farming systems, what is considered a "small farm" can vary greatly over time and space. The lack of a general legal definition for "small farmer" sometimes makes it unclear where the dividing line between small and large should be drawn.

Access to different markets is a prerequisite to improve the livelihoods of smallholder farmers. If they are unable to meet food safety challenges, the risk of exclusion will turn into a loss of opportunities. Despite the increasing level of awareness among local food producers of potential issues that could affect the safety of food grown on small farms and then sold through direct channels, it seems there is still a long way to go to bring food safety legislation clos-

er to the local reality. Even with the new emphasis on sustainability, the demand for food safety within SFSCs is increasing — despite lacking institutional support. Yet due to the weak representation in agricultural policy-making, the tendency to become invisible actors is even more exacerbated by the limited political space allotted to small farmers to express their voice. There needs to be greater involvement of small farmers in the decision-making process, as well as finding tools that allow them to easily gain necessary knowledge and expertise to understand and comply with hygiene rules. Rather than focusing only on providing exemptions from stringent legal requirements, legislators should verify whether what they expect from small farmers is something feasible for them and set objectives that are always proportionate to their nature and size.

by Madhura Rao

Black Tea: The Social Cost Of Assam Tea

What it takes to change the system

Its deep, malty flavour makes it popular among tea connoisseurs around the world. Its status as an in-demand and import-worthy agricultural commodity makes it important for the Indian economy.

One sixth of the world's tea comes from Assam, a state in North East India. Often found in various black tea blends, one would imagine that workers engaged in growing and harvesting this valuable tea crop enjoy benefits like attractive wages, employment security, and fair working conditions. But the truth is, those who produce black Assam tea are trapped in a system comparable to modern-day slavery.

Working conditions in Assam's tea plantations

In their early days as a British colonial enterprise, the tea estates of Assam

employed tribal indentured workers from Central and Eastern India. Today, 73 years after India's independence, the tea industry is the country's largest private sector employer and is estimated to be employing around 10 million workers. Globally, India is the second largest producer of tea after China. While plantations have expanded to other parts of the country, Assam remains a key tea growing region and produces more than half of India's tea harvest. Most workers employed in the state's plantations are descendants of the indentured workforce created 150 years ago. One would imagine that the passage of time has seen them integrate into the Assamese society and

Companies downplay the seriousness of the situation or report only about specific initiatives that show their support of workers

enjoy protection of their human rights as promised by independent India's Constitution. However, this is far from what actually occurred.

Civil society organisations working to improve the labourers' situation have reported hazardous working conditions, poor healthcare facilities, gender-based discrimination, and dilapidated housing facilities. The lack of a strong labour union also results in workers getting paid lower wages than the national average. Their identity as tribal migrants and non-native Assamese leaves them without much agency to negotiate their terms of employment. Although Indian public law seeks to ensure fair treatment and socio-economic security, workers continue to be exploited because of inconsistent legal enforcement and lack of access to legal aid.

What can be done to help Assam tea workers?

Traditionally, ensuring labour and human rights is seen as the responsibility of governments. However, several factors, such as the level of economic development, corruption, and legal infrastructure impact the extent to

which governments are able to protect workers. Corporations often maintain the stance that their sole duty is to abide by national laws when it comes to the rights of workers they employ in developing countries, even if those laws do not meet international (or their home countries') human rights standards.

1 Keeping international companies accountable

While these issues deserve government scrutiny, businesses must also play their part if the situation is to improve. Black tea produced in Assam has a global market and is purchased by some of the biggest beverage corporations around the world. For instance, global industry giants such as Unilever and Tata Tetley are known to purchase tea from the state. A growing number of international law practitioners and scholars have been pushing for corporations to be held accountable for the way workers are treated along their supply chains.

2 Report what's really happening

While corporate disclosure on human rights issues remains largely voluntary, some countries such as the UK require large companies to report on the human rights issues in their supply chains via annual Modern Slavery Reports. When modern slavery reports by UK-

based tea companies are analysed, we see that some of them do in fact pay attention to Assam and have supported or devised specific programmes to address human rights-related problems in the region.

However, issues often fail to be tackled in a systematic manner. This means that companies downplay the seriousness of the situation or report only about specific initiatives that show their support of workers (for instance, education initiatives or health camps). While this is more helpful than not reporting at all, it does not address the reality of the situation. For corporate disclosure to be truly meaningful, companies must report on all issues that the workers face — even the ones that they have not yet acted upon.

To make a significant impact on the human rights of plantation workers, businesses need to move away from the window dressing approach of corporate social responsibility (CSR) that allows them to cherry-pick issues that they wish to address. They must instead move to a more consistent and transparent approach — one that places the protection of human rights at its core. Such an approach would entail acknowledging and identifying human rights issues in the supply chain, reporting

about them in a transparent manner, and implementing strategies to ensure that all workers are protected to a degree that is on par with international standards.

Change is possible

The Indian government has promised to allocate a substantial amount from its 2021 annual budget to help improve the working conditions in the tea plantations in Assam. Next to this, several importing countries around the world like the UK, US and members of the EU are currently working towards implementing a human rights due diligence legislation. This means that the law would require companies to not only report but also to act and prevent, mitigate and redress human rights violations throughout their supply chains. As reporting has largely been a voluntary option, this novel approach, embedding the UN Guiding Principles on Business and Human Rights into law, might push companies to take their responsibility to respect the human rights of workers rights more seriously. For the tea plantation workers in Assam, this would mean that international companies purchasing from them will be held accountable by the governments in their home countries.



The quest to hold companies accountable: an example from Germany

Various European countries are introducing laws obliging companies to take responsibility for what happens along their supply chain. Is this an international blueprint to stop human rights and environmental violations?

Modern day slavery, illegal deforestation, theft of water resources, and even child labour. The list of drawbacks related to the way food and other products are manufactured is long. For this reason, in 2011 the UN member states agreed on the United Nations Guiding Principles on Business and Human Rights. This meant requiring companies over a certain size to assess and address human rights risk in their supply chains. It was the first time that the responsibility of companies to upkeep human rights was defined. However, for a long time no compulsory action was required from companies. Instead, many countries implemented voluntary action plans.

After 10 years, the need for stricter rules became increasingly clear. In February 2021, the German government agreed on a draft of a new law called *Lieferkettengesetz* (also called Due Diligence Act), which should come into effect in 2023.

It will require regional companies with more than 3.000 employees to take responsibility over their full supply chain, from raw material to the finished product – even if these materials are produced outside country borders.

Why do we need a law of this kind?

Most products stand at the end of a long and international line of production steps. Take a chocolate bar: The cocoa might come from West Africa, the sugar from Central America, the nuts from North America, and the final assembly might happen in Europe. This is not necessarily bad news. A survey of workers in Mexico, for example, has shown that production for foreign companies can actually enhance labor standards in local markets. However, still too often the outsourced production of raw materials does not meet the standards of

social and environmental sustainability held high within the European Union. Many politicians are therefore arguing that if a company makes profits globally, it should take human rights into account as well.

What are the advantages of the German supply chain law?

When voluntary commitments were in place, the German government found that the goal for compliance was not met by half of the companies. A global supply chain law can transform these voluntary commitments into mandatory ones. This way, companies will be forced to produce in a more sustainable way and to keep up fair working standards. If contractors are found to breach human rights or environmental laws abroad, the law involves hefty fines.

What are the disadvantages?

The law is not about implementing German social standards—which are generally very strict—but about

respecting *basic* human rights. This means that the law could end up just pushing companies to do the bare minimum to protect their workers.

Many companies in the German food sector have less than 3.000 employees. The law is therefore not binding for large parts of the food industry. In 2024, the law is to be extended to also include companies with 1.000 employees and up. But even with this amendment, the majority of the food industry would still be exempt from the law. The law focuses mainly on social aspects, and less on environmental ones. NGOs have therefore criticised the German government for “watering down” the initial proposal - something that is currently discussed according to researcher Melanie Müller.

Could this law be a blueprint?

France has already introduced a similar law. Austria, Denmark, Finland, Luxembourg, and the Netherlands are in different stages of introducing a supply chain law.

Norway, on the other hand, is taking another approach: instead of just checking companies’ suppliers, all citizens can now request information on possible violations along the supply chain. This way, Norway hopes to hold companies accountable through civil action, instead of selective reports by companies. However, what would happen if the companies were not to comply has not been defined.

A law of this sort is also in the making on a European level. The proposed EU bill is said to hold companies accountable not only for their direct suppliers, but for all suppliers that might be indirectly interacting with their products along the supply chain. Companies would not only have to pay fines, but could be held accountable legally. Perhaps most importantly, the European due diligence law aims to hold all companies accountable—no matter their size.

According to Melanie Müller, however, it will be fundamental to increase transparency and flow of information between countries on a global level. Introducing a law is half of the job: the main challenge remains to implement it properly.



Sustainable Agriculture

The Impacts Of Agriculture

25-30%

Global GHG emissions

70%

Freshwater usage

94%

mammal biomass
on earth is livestock
(excluding humans)

80%

All land use change
& habitat destruction
2000-2010

78%

Global ocean and freshwater
eutrophication*

*Eutrophication is an oversaturation of nutrients in marine environments, creating excess algal growth, low oxygen levels and unlivable conditions for other species.

Sources: Our World in Data (2021), Campbell et al. (2017), Poore & Nemecek (2018), FAO (2011), Bar-On, Phillips & Milo (2018)

Around half of the world's habitable land is used for agriculture. Since the dawn of industrialised food production, the most popular approach to growing on that land has been the same across the globe: one species - one process - one product. A monoculture approach catered to a 'cheaper food paradigm' created by our focus to produce calories cheaply and our disregard for the long term impacts of our farming practices.

Over the years we've mechanised, intensified and expanded agricultural land allotments to produce food on gargantuan scales. But the impacts of our decisions to create vast, ecologically ill-considered food systems are now starting to show - from barren soils, to biodiversity loss and polluted watersheds.

Fortunately, these glaring impacts have inspired a new wave of growers and innovators. Some are turning to the past, re-imagining age-old regenerative practices that restore damaged land using an environment-first, soil-centred approach. Others are downsizing to create circular systems where the by-products or waste from one species can be used to help another grow. Innovators are growing upwards instead of outwards, using technology to farm vertically and maximise resources while minimising land use. In cities, urban farms use roofs to create green spaces that act as community hubs and hotspots for passing wildlife.

Wherever we look, it seems that global sentiments around food production are increasingly aligned - bigger isn't better. Land is limited, and if we expect it to continually feed us, it's time we thought more wisely about the ways we use it.

5 Lessons Agriculture Can Learn From Ecology



The agricultural systems that provide us with our food today may seem different from ‘natural’ ecosystems, but they still follow the same basic rules and processes. In the majority of our large-scale agricultural systems, we have ignored these ecological rules and the results have cost the environment plenty. So how can ecology help us transition from a mindset that works against nature, to a mindset that works with it?

What is ecology?

Ecology is the science that studies the relationships between living organisms and their physical surroundings. Although humans have adapted and domesticated ecosystems over thousands of years to maximize harvest from the land, the health and balance of these new agricultural systems is still fundamentally driv-

en by the same relationships between organisms and their surroundings. By overlooking nature’s complex processes and relationships, many of the techniques and practices used in conventional agricultural production have impacted its sustainability and the functioning of ecosystems. Here are 5 lessons that agriculture can learn from ecology:

1 Systems are interconnected

Mass production systems such as monocultures with intensive practices often treat components of an agroecological system, like nutrients or microorganisms in the soil, as completely separate entities. This makes them more manageable in the short term, and to some extent allows land managers to apply the same solutions in every context. But they ignore one key principle: ecological systems are all interconnected. Our agricultural systems do not exist in isolation, but interact with and affect other systems. By under-

standing that moving one piece within an ecological system will invariably affect another, we can be more aware of potential consequences and create stronger and better strategies.

2 Building resilience

Resilience in ecology is defined as the capacity of an ecological system to recover (or maintain) its functions, its composition and its conditions after a change or a disturbance. Resilience is neither good nor bad in itself. For example, a highly resilient system that is damaged or unproductive (like a degraded soil system) would still require a lot of resources and time to return to a productive state. We can call this ‘unhelpful resilience’. On the other hand, a highly productive crop system with low resilience is less stable, as even the slightest change will affect its functions and conditions. Situations like droughts, diseases and floods mean unpredictable and drastic changes to the life

systems on earth — including our food production systems. The best way to prepare, mitigate and adapt is to build productive agricultural systems that are highly resilient with a long-term approach.

3 Biodiversity is key

Increasing biodiversity* plays an important role in making our systems resilient to changes in the environment. In the context of farming, producing different crop species in the same agroecosystem (known as intercropping) is a great strategy for land managers to take advantage of the positive interactions that some species have with one another, while also increasing the variety of products in one field. For example, rotating legumes (like beans) with cereals (like maize) can enhance soil fertility and the overall productivity of the system.

Soil microorganisms are particularly diverse — just one spoonful of soil can contain thousands of species, and they all play their part in different functions like nutrient fixing and absorption, and pest control. Agricultural practices should take care to support soil health to maintain the important role of these microorganisms. Genetic diversity also plays an important role — if there are more genes available in the population, there is a higher likelihood that some genes are more resilient or adaptable to the environment or seasons. Higher genetic diversity in a population promotes the growth of resilient breeds with higher resistance to extreme events and diseases.

*Biodiversity is all the different ways in which life occurs, from genetic diversity within species, to species diversity within an ecosystem, and even ecosystem diversity.

4 Supporting keystone species

Some species have a disproportionate effect on their ecosystem relative to their abundance*. A good example is the case of predators; although they are not abundant in most ecosystems, they play a fundamental role by preying on other animals, which ultimately maintains the number of herbivores at a certain threshold. In ecology, these species are considered 'keystone species'. Keystone species maintain the structure of ecosystems, and recent findings indicate that key species tend to increase the resilience of an ecological system.

In agriculture, pollinators are a key group of animals. Species like bees, moths, and even certain bats, significantly help some plants reproduce by carrying and mixing pollen. By doing so, they contribute to the formation of foods we eat on a daily basis - with an estimated two-thirds of the world's major food crops dependent on pollinators.

Other species are key in providing protection to crops. Species like ladybugs, spiders, and even wasps, prey on other arthropods that would eat and deplete plant leaves, fruits or grains. Even bigger animals like birds, shrews, and bats, provide fundamental protection to crops. Certain colonies of insectivorous bats can even eat thousands of metric tons of insects each year; without them, the crop losses and their economic cost could pile up to billions each year in some countries.

*Relative abundance: How rare or common a species is (measured in number of individuals) in contrast to the other species in the same ecological community.

5 Minimising waste

When we dissect and operate parts of the agricultural system as isolated parts, our systems will tend to be wasteful. Currently, much of our food production practices generate waste, which often causes contamination as a by-product. A clear example is the contamination of water bodies when fertilizers leach from crop fields into the surrounding environment. Problems like the overfertilisation of nitrogen leads to diminishing crop yields in the long term and contribute to gas emissions that impact global warming.

Creating a less wasteful and more efficient agricultural system is also reliant on us acknowledging that different components of our systems use different resources in order to carry out their ecological role. For example, while some crops or animals need inputs like synthetic fertilisers or feed, other organisms like fungi or soil microbes use the waste of other components as their energy source. By promoting the microdiversity of the soil and diversifying the way we manage waste (e.g. using manure from animals as fertilizers), while growing different plants that have stronger dynamic interactions with soil organisms, our systems will be much more

healthy and productive, while using less inputs and minimising waste.

Applying these lessons to agriculture

So what is being done with these ecological lessons in the practice of agriculture? Today, different agricultural frameworks like organic farming already include agroecological practices that incorporate ecological

and social principles in agricultural management. However, much of our food production still needs to take up these ecological lessons and apply them in practice — which can require a lot of time and initial investment in the short-term, but creates long-lasting resilience and productivity. By acknowledging the complex web of interactions and circles that agriculture shares with ecosystems, we are transitioning from a mindset that works against nature, to a mindset that works with nature.



Pollinating Orchards By Hand: Lessons From Sichuan, China

Is hand pollination a long-term solution?

Bees and other pollinators play an invaluable role on our planet — from being an integral part of land-based ecosystems to sustaining human agricultural systems through pollination. But how does agriculture fare when these little miracle workers disappear from a landscape? Read on to learn why farmers in China's Sichuan Province have resorted to pollinating their orchards by hand, and what drove this unusual practice.

Why our plants need pollinators

In 2019, bees were declared the most important species on Earth. They are so important, that without them, the majority of the world's plants would go unpollinated, causing a devastating ripple effect in global ecosystems. But bees aren't just vital components of natural ecosystems, they are crucial to cultivated ones as well. Through pollinating much of the world's crops, bees play an integral role in agricultural systems.

To paint a picture of just how significant that role is, start by imagining a plate of your favourite food. Now mentally throw 1/3 of that food away. This is a small taste of how radically different our lives would be without bees and other pollinators. Approximately one in every three bites of food comes from animal pollinated species. The FAO estimates some 90% of the world's food supply comes from about 100 crops, 71 of which re-

quire animal pollination. And this isn't just true for the fruits and vegetables we eat, but also a number of crops fed to livestock, such as clover, soy and alfalfa, making bees key gatekeepers to meat and dairy industries as well.

Shrinking pollinator numbers

In recent years, news of rapidly declining pollinator numbers has captured the attention of mainstream media, ecologists, climate scientists and agriculturalists worldwide. A recent report from the UN warned that 2 out of 5 species of invertebrate pollinators (bees, but also butterflies and other wild insects) are now endangered. Surveys conducted in North America have also shown evidence of reduced pollinator numbers — between October 2018 and April 2019, U.S. beekeepers lost close to 40% of their honeybee colonies. While it's typical for a proportion of honeybee colonies to die out over winter, this was the

worst recorded winter colony loss since the survey began 13 years ago.

Practices associated with large-scale modern farming, such as land clearing and the use of agrichemicals, have all contributed to a steep decline in pollinators — which only undermines the industries' future. The loss of pollinators threatens not only the health and diversity of Earth's ecosystems, but also global food security and billions of dollars worth of crops each year, not to mention millions of jobs in associated agricultural industries.

Sichuan province's hand pollinated orchards

Agricultural sectors in certain parts of the world are already experiencing the impact of declining pollinator numbers, the most dramatic example coming from China — the world's leading producer of pears and apples. In the apple and pear orchards of Southwest China, a lack of pollinators has left fruit farmers in Sichuan Province with no choice but to pollinate their orchards by hand.

Hand pollination is a painstaking process, one in which farmers individually pollinate each tree's blossoms using a 'pollination stick' — a thin bamboo pole topped with a brush made of either chicken feathers or even cigarette filters. This brush is dipped into a jar of pollen to saturate it, then rubbed against the stigma* of the trees' flowers. Pollinating crops by hand isn't entirely efficient — whereas pollinators get right to the centre of each flower



to deposit pollen, farmers need to repeat this step up to five times to ensure successful pollination.

*Stigma is the female part of a flower which acts as a landing zone for pollen grains. When pollen lands on the stigma, it starts the flower's fertilisation process.

What led farmers to hand pollination?

Sichuanese orchard farmers didn't always rely on hand pollination. Records show the practice first emerged in the 1980s. Before then, most crops were insect-pollinated — in fact, the mountain ranges of Southwest China are said to have been teeming with wildlife, and home to some of the greatest diversity of bumblebee species.

So, what happened? There are several causes at play, but the loss of natural pollinators and the subsequent dependence on hand pollination has been largely driven by two factors:

1 Habitat loss

As land devoted to pear and apple cultivation expands year-on-year, natural land has shrunk considerably, costing pollinators their habitats. Pollinators need surrounding wild spaces where they can nest, breed and forage when seasonal crops, like pears and apples, aren't in bloom. In fact, multiple studies have shown that wild bees are generally only able to travel short distances from the nest, sometimes as little as 100 metres. To sustain themselves while out foraging for nectar and pollen, bees depend on near-by areas of flower-rich land where they can rest and refuel before heading

home. Agricultural expansion has displaced and fragmented wild foraging sites vital to pollinators, severely limiting the amount of food available to wild bees within flying range. The effects of this: sharp declines in the number of pollinators in these agricultural sites.

2 Intensive pesticide use

The second, and possibly leading impact, is the over spraying of pesticides. To protect yields from crop damaging species like pear lice, intensive pesticide use has become common practice in the region. One study found that pear orchards in Si-

chuan Province were often sprayed 12 times before being harvested. In fact, reliance on pesticides isn't just a problem in the Southwest — at a national scale, China consumes 1,763,000 tons of pesticides per year, making it the world's largest consumer, with its application rates far outweighing those of many developed countries. Pesticide use in agriculture is a double-edged sword; while it kills pests, it also kills wild pollinators — insects that are crucial components of agricultural systems. Since heavy pesticide use also discourages local beekeepers from leasing their hives to farmers, orchards

weren't getting sufficient pollination, resulting in low fruit yields. To help struggling farmers, the local government introduced hand pollination in the mid-1980s. Since then, most farmers in the region have turned to the practice to sustain their livelihood.

A long-term alternative or a short-term fix?

While hand pollination seems to have solved the problem of low fruit yields in the short-term, it's a bandaid, rather than a cure. With economic development rising across the region, hired manual labour is be-

coming increasingly expensive, challenging the long-term viability of the practice. If local farmers hope to protect their profits and meet demand in the future, pollinators will need to be coaxed back into the picture.

Preserving our pollinators

When it comes to assessing the health and diversity of an ecosystem, bees have been described as the 'canaries in the coal mine' — in other words, declining bee numbers are a clear warning signal that something in an ecosystem is off-kilter. While many modern farms have become hostile environments for bees,

it doesn't have to be this way. If we want to enjoy the same fruits and vegetables we enjoy today, we need a more sustainable approach and environment to preserve our pollinators.

Fortunately, studies have shown that sustainable farming practices such as planting strips of wildflowers and leaving areas of undisturbed natural land between agricultural plots can greatly boost pollinator numbers. An added bonus of leaving undisturbed natural areas is that it encourages local bird populations, which in turn keep pests down and reduces the need for chemical pesti-

cides. Some experts have even suggested that by devoting a quarter of cropland to flowering cash-crops, such as spices, oil seeds, medicinal and forage plants, farmers could support bees while ensuring sustained economic gains.

Farmers and agriculturalists have a pivotal role to play and vested interest in reversing these alarming declines. The bottom line is: if we want to keep our food choices diverse and affordable in the future, modern farming practices must focus their attention on safeguarding pollinators — and the essential services they provide.





catch crop

noun /kɑtʃ kɹɒp/

plant that grows quickly, whose long roots bind nutrients to ensure soil fertility, aerate the soil and help build up humus. Often grown between rows of main crops

Innovations In Fertilisers & Soil Health /

What methods and applications can help keep our soil healthy?

Ritesh Manjunath Sanu is the Director (R&D) at Samarth Bio-Tech Limited, a research & manufacturing company focused on nature-inspired biological solutions for nutrition management and combating biotic-abiotic stress in agriculture.

Read more about
regenerative agriculture
practices



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Ancient civilizations around the globe fertilised their crops with animal and natural products, maintaining circular agricultural ecosystems. With the onset of industrialisation in the early 1900s, intensive farming and an exponential rise in population and food requirements saw a steep decline in soil potential, leading to the introduction of synthetic fertilisers.

Inadequate education and guidance on applying and managing fertil-

isers from agricultural suppliers and policymakers led farmers to over-use these newly available synthetic fertilisers, resulting in increased desertification and depletion of the health of soils and ecosystems. This excess usage of nitrogenous fertilisers also led to uncontrolled pest infestations, which in turn encouraged farmers to use pesticides - further degrading soil health. Today, every actor in food production is aware of the role 'clean fertilisation' will play in improving the health of our soils, which is a key step towards creating an efficient and sustainable food system.

6 Innovations in clean fertilisation

Innovation has a vital role to play in developing clean fertilisers that can restore the health of our soils and create more productive agroecological systems. Here are 6 new technologies and practices that can con-

tribute to efficient fertilisation and improved soil health.

1. Biofertilisers and biopesticides

Bio-fertilisers are soil microorganisms that naturally transform atmospheric and immobilized nutrients (like nitrogen, phosphate and iron) into forms that plants can use. Examples include various species of bacteria – including nitrogen-fixing, phosphate-solubilizing, and zinc-mobilizing bacteria - as well as 'arbuscular mycorrhizal fungi', which make phosphorus and nitrogen available to plants while sequestering carbon and improving the soil's structure and water-holding capacity.

Widely applying microorganisms like these to depleted soils can help to maintain soil nutrients, leading to a reduced need for synthetic fertilisers. Many of the microorganisms in soil can also help control soil-borne pests and pathogens. Natural 'biopesticides' – including





certain species of fungi, nematodes, bacteria, and viruses — can inhibit and help control insects, diseases and weeds without the need for harmful chemical pesticides.

2. Biostimulants

Biostimulants (extracts from animals, plants or microbes) can help reduce the need for fertilisers and enable plants to achieve their maximum growth potential. Seaweed extracts from aquatic weeds like *Sargassum sp.* or *Achophyllum sp.* are highly regarded for enriching soils and boosting plant health and crop yields. In fact, several kinds of seaweed are now sold as soil enhancers or biostimulants for their nutritional properties, natural hormones and ability to improve the condition of soils while increasing the efficiency of any additional fertilisers used.

3. Slow-release fertilisers

A significant source of environmental pollution is unused fertiliser, either immobilized in the soil or lost to the environment. In fact, researchers have found that anywhere from 50 percent to 95 percent of the nutrients applied to soils through fertilisers are lost to the environment. Nitrogen, in particular, is prone to leach out into watercourses or vaporize into the atmosphere when fertilisers are applied to the land.

Slow-release fertilisers are more efficient than traditional fertilisers as they allow more time for plants to take up nutrients before they are lost to the environment. In India, for example, Urea (a commonly used nitrogenous fertiliser) must now be coated with neem oil to slow the release of the fertiliser within. As an

added advantage, neem oil is also prophylactic against soil-borne insects, nematodes, termites and other pests. Similarly, fertilisers treated with inhibitors (such as nitrification or urease inhibitors) help slow the otherwise rapid breakdown or transformation of nitrogen-containing compounds into less stable forms, improving the efficiency of the fertiliser and reducing pollution (and therefore the contribution of agriculture to climate change).

4. Nano fertilisers

Unlike conventional fertilisers, small quantities of nano fertilisers* can be applied precisely and effectively to the roots and leaves of plants, making it easier for plants to take up the nutrients. Recent studies have shown that nano fertilisers can improve crop productivity by

enhancing the rate of seed germination, seedling growth and photosynthesis. Like slow-release fertilisers, nano fertilisers improve agricultural production by providing balanced nutrition for crops throughout their growth cycle, as nutrient ions are released slowly and steadily over an extended period.

*fertilisers falling within the size range of 1-100nm are called 'nano fertilisers'.

5. Biochar

Similar to activated charcoal, Biochar is used as a soil conditioner for its highly porous, stable and carbon-rich properties. Adding Biochar to soils increases the ability of plants to uptake nutrients and attracts beneficial organisms, as well as improving various physical and chemical properties of soils including their pH and water holding ca-

capacity. Soils can also benefit from Biochar's toxin absorbing qualities and influence on enzyme activity, both of which can positively affect soil nutrition cycles.

6. Satellites and Drones

Mapping technologies, such as drone or satellite imagery, can help improve farm management through precision farming since imaging data can help predict fertiliser requirement, soil moisture, weather conditions, and the incidence of pests. For example, drones use images and heat graphs to locally analyze pest-pathogen infestations, which helps farmers apply pesticides in a more targeted pattern. Many farmers are now also using drones to apply fertilisers and beneficial organisms as well as pesticides in a more precise and efficient way.

These innovations in clean fertilisation and improving soil health not only add value to food production systems but also help address climate change concerns and get us closer to achieving a balanced ecosystem for generations to come. Such technologies are already available to small farmers even in lower-income countries, largely thanks to supportive policies and innovative start-ups. However, some low-resource farmers and nations still need additional research and supply efforts to introduce and adapt these innovations for local use. Continuous interdisciplinary research involving life science, automation and big data, is needed in diverse geographic conditions to help farmers of all scales and beliefs.

Could Forgotten Crops Help Combat Climate Change?

Agriculture is one of the biggest contributors to climate change, with 18.4 percent of global greenhouse emissions produced by agriculture, forestry and land use in 2016. Reducing its impact is a high priority for governments around the world – but how? Could moving away from the norm in food production help combat climate change? Are there existing crops that could already help us change course?

The world's food consumption has become very uniform in recent human history. The four main food sources – wheat, maize, rice and soybean – make up two-thirds of what the world eats, and for good reason. With their nutritional content and high yields, these foods are excellent tools in trying to achieve the UN's Zero Hunger sustainable development goal (SDG).

But climates vary drastically across the globe, and so some parts of the world are naturally better suited to grow these crops en masse than others. Now that these four foods take up such a significant part of our global diet, huge investment is made in importing and exporting these goods all over the world. Trade on such a scale requires transport – and that means emissions.

The benefits of growing 'forgotten crops'

Globalisation has many benefits, but it can also lead us to forget that for generations, people depended on locally available crops for their food – and many still do. There are thousands of other crops that can be just as nutritiously valuable, more hardy to extreme weathers and grown in more varied areas compared to the 'big four', but unfortunately many have become the 'forgotten crops' for many regions around the world.

Also described as 'orphan crops', these foods could help us achieve a number of the SDGs additional to Zero Hunger. Relying more on resilient, local crops would reduce the need for imports, therefore reducing emissions. Increasing the use of nitrogen-fixing crops, such as legumes, which are less reliant on emission-producing artificial fertilisers, would only help this further. The resilience of these orphan crops could make them valuable far beyond their local areas too. African crops such as teff and sorghum have lower water demands than oth-

er staple crops due to the naturally arid environments they come from, which in turn increases their tolerance to drought. Using such crops in other areas of the world could prove useful as a fail-safe if climates were to take a more unpredictable and difficult turn. There are abundant possibilities for us to find climate-resist-

ant, future-proof foods amongst these forgotten orphan crops - we simply need to remember to look beyond the big four. Creating a culture shift in the global diet may seem imposing, but it's worth remembering that quinoa, a now-popular nutrient-rich legume, was not found outside of Peru and Bolivia 30 years ago.

3 Resilient Crops For Changing Climates

by Caroline Wood

1. Pulses - the dry, edible seeds of plants in the legume family (e.g. Beans, Peas, Chickpeas, and Lentils)

Rich in nutrients: Pulses are nutritionally high in protein as well as containing a range of beneficial vitamins and minerals thought to protect against a range of chronic diseases.

Water-efficient: Pulses have a small water footprint (roughly 19 litres per gram of protein, compared with 112 litres for beef) making them well-suited to thrive in challenging environments.

Improve soil quality: Pulses don't require large inputs of chemical fertilisers, due to a symbiotic relationship with nitrogen-fixing bacteria which add nutrients to the soil.

Pulses are already established in many cuisines, but less-known varieties could boost our future food security. For example, Bambara groundnuts (a staple in sub-Saharan Africa) thrive even in acidic soils and are considered a 'complete food' due to their balance of carbohydrates, fibre, micronutrients and essential amino acids.

2. Edible Cacti - Cacti with edible fruits, flowers and/or pads (e.g. Prickly Pear, Barrel, Saguaro and Dragon Fruit Cacti)

Easy to grow: Cacti require very little water to grow, and can be easily cultivated: fallen cacti leaves will often quickly produce roots and start growing entirely on their own.

Rich in nutrients: Cacti fruits, flowers, oil and cladodes (flattened shoots rising from the stem) can be very nutritious, containing a range of vitamins, proteins, fats and fibre.

Versatile to cook with: Cacti fruits, flowers and pads (depending on the species) can be eaten raw or cooked in stews and soups, transformed into pickles, juices or jams - or enjoyed mexican-style with eggs and jalapeños for breakfast!

Their super water-storage abilities make cacti the perfect climate-proof crop, able to grow in arid lands where no other plants can. Nopales (also called prickly pear or cactus pear) are particularly adaptive, and are already farmed and eaten across Central and South America, Africa and the Middle East.

3. Millets - small-grained grasses grown as cereals (e.g. Pearl, Finger, Proso and Foxtail Millet)

Resilient: Finger millet is known as 'famine crop' since it can remain dormant during dry spells, requires little water to grow and its seeds are resistant to pests and spoilage, giving them a long shelf life.

Highly nutritious: Millets are some of the most nutritious cereal crops, with high levels of protein, vitamin B1, fibre and calcium.

Multi-purpose food: Similar in texture to couscous and with a mild flavour, finger millet grains can be eaten as porridge, milled into flour and used in bread or pancakes, or even used to brew beer.

Millets can be grown in areas with very little rainfall. Finger millet in particular is a staple cereal for many of the arid regions of Africa and South Asia, also because it can grow on low-fertility soils, without needing expensive and polluting chemical fertilisers.

by Toon Lambrechts


Regenerative Agriculture: A Portrait In Greece

It all starts with healthy, living soil

Agriculture and nature have always been at odds with each other. Food production puts an enormous strain on the carrying capacity of the environment. Various agricultural systems, such as organic farming, are trying to reconcile the two. Regenerative agriculture takes things one step further, combining food production with ecosystem restoration.

"Look," says Sheila Darnos, as she digs up some loose soil with her hands. "See those white threads? That's mycelium, the root network of fungi, just like in the subsoil of forests. It's an important indicator of soil health. That's where it all starts." We make our way through the tall grass between the fruit trees of

The Southern Lights, Sheila's farm here in Skala, a village not far from Sparta. Like large parts of southern Greece, this rural region is dominated by orange and olive groves. But The Southern Lights, *To Nótio Sélas* in Greek, has more in common with a forest than with the surrounding plantations. Not



**Suddenly the trees
got a lot of sunlight,
and mulberries
and fig trees started
appearing everywhere**

because the farm is being neglected, but because five years ago, Sheila Darnos began to manage the land according to the principles of regenerative agriculture, a philosophy and a system of principles and practices that aims to produce food while restoring the local ecosystem.

Organic farming to regenerative agriculture

The Southern Lights is a place with a long history. Sheila's grandfather bought the land when it was still an olive grove. The oldest olive trees on the farm, with their impressive twisted trunks, were already hundreds of years old back then. "Later, my father

planted orange trees. Then, some 35 years ago, he switched to organic farming. He was really a pioneer at the time."

Five years ago, after the death of her father, Sheila took over the farm. The orange trees had just been cut down to graft a wide variety of other citrus fruits, such as lime, winter oranges and lemons, on the remaining trunks. "Suddenly the trees got a lot of sunlight, and mulberries and fig trees started appearing everywhere. I had just come across the teachings of Masanobu Fukuoka, the founder of 'natural farming' [Robert Rodale coined the term 'regenerative agriculture,' Editor's note]. The idea of transforming the plantation into a

forest full of different types of fruit really spoke to me. Now, five years later, we're reaping the benefits of everything that started growing then.

Polyculture and efficient use of sunlight

Beyond the farm lies the vegetable garden, looking every bit as wild as the fruit forest. Here, too, a tremendous variety of crops all grow together. A self-proclaimed plant connoisseur, Sheila knows them all by their scientific names. "I estimate that there are about a hundred different kinds of fruit growing here at the moment. Of some varieties we only have a few plants, just to

experiment with. That multitude of varieties not only allows us to harvest fruit all year round, it also creates a very high level of biodiversity on this small piece of land."

Indeed, The Southern Lights is a beacon of biodiversity. As we walk among the fruit trees, we can hear the chirping of crickets, that quintessential soundscape of the Mediterranean summer. The high grass is teeming with insects and multi coloured lizards. An owl darts off from the top of one of the olive trees. Close to the farm, most of the trees are still arranged in relatively neat lines, but further away, the plantation looks more and more like a forest. "That's actually intentional," Sheila says. "We're imitating the

ecosystem of a forest, only with trees that bear fruit. That's why the trees are so close together. You won't see that in your typical orchard, but that's how a forest works. Figs and mulberries form the top layer here. Citrus fruits are the middle layer, as they want a little bit of shade, but not too much. The undergrowth is mostly bushy crops, such as berries. It may look messy, but it's actually a very efficient use of sunlight."

Regenerative agriculture: a circular system

Regenerative agriculture is not so much about specific farming methods as it is about the idea that ecolog-

↑ Oranges.
Photo Credit: Toon Lambrechts

ical recovery and food production can go hand-in-hand. In practice, principles from permaculture* and agroforestry** are used. A central figure in all of this is the Japanese farmer and philosopher Masanobu Fukuoka who, in his book *The One-Straw Revolution*, set out the main principles of natural agriculture.

"Conventional agriculture is essentially a system of extraction," Sheila explains. "Organic matter — fruit, vegetables, pruning, and so on — is taken away from the land. By contrast, in circular ecosystems, this is not the case. If you keep taking from the land, the soil will become exhausted and you'll have to start us-

ing fertiliser. Heavily depleted soils, the result of a long history of over-exploitation, are a major problem in our region."

Since her father switched to organic farming 35 years ago, the land Sheila farms today has not seen any pesticides or chemical fertiliser. But regenerative agriculture really takes things to the next level. "Organic farming is just scratching the surface. Many organic farms are still monocultures, with only one crop. That's not a natural situation at all. Regenerative agriculture has a broader perspective, a deep understanding that agriculture operates in a natural cycle."

**Permaculture: The development of agricultural ecosystems intended to be sustainable and self-sufficient.*

***Agroforestry: Agroforestry is the management and integration of trees, crops and/or livestock on the same plot of land.*

How regenerative agriculture helps vulnerable soil

"In regenerative agriculture, the soil is of key importance," Sheila emphasises as we stroll through her fruit forest. She turns over one of the half-decayed pieces of wood scattered around the orange trees. "Our plantation may look messy, but it involves more work than you might think at first glance. For example, we prune more than is customary, in order to imitate the renewal cycle of a natural forest. We do leave all the woody material behind, as it creates habitats for small animals, insects and micro-organisms. This organic material is essential. The more lignin — a component of wood — there is in the soil, the more fungi will thrive. Those fungi and their mycelial net-

works help trees to absorb nutrients." It is precisely this soil that is a sore point in the south of Greece, and in large parts of the Mediterranean. Increasing drought, erosion, wildfires and unsustainable farming methods are taking their toll. In many areas, especially in mountainous regions, the land is now so depleted that it can only be used to have sheep or goats graze on it.

"Regenerative agriculture offers a new outlook for the recovery of these fragile soils," says Sheila Darnos. "There was a major forest fire in the nearby Parnis mountains in 2007. The vegetation there still hasn't recovered. This is largely due to the fact that farmers constantly keep vegetation short in order to make grazing possible. In the long term, this is very destructive, but that's where the money is, so it's still com-

mon practice. But here, trees are sprouting spontaneously."

Soil regeneration: a matter of ethics

There's no fence surrounding the farm here in Skala, but there really is no need for one. It's abundantly clear where The Southern Lights' borders are. High grass and shrubbery on one side, bare dirt on the other. Here, as elsewhere in Greece, it's still customary to keep the ground below olive or citrus trees bare by ploughing, by using pesticides or by burning away all vegetation.

"As a consequence, erosion is a huge problem here," says Sheila. "With the slightest rainfall, the topsoil simply washes away. For me, soil regeneration is not merely an agricultural issue; it's a matter of ethics. Generation after generation, we've exhausted the soil. It is our responsibility to work on recovery. Unfortunately, many people still don't realise this."

Can regenerative agriculture be scaled up?

Working on ecological recovery while producing food is one thing, but is this form of agriculture economically viable? "It's a challenge," Sheila admits. "The fact that we have so many different kinds of fruit means that we can't sell large quantities. Bulk buyers aren't interested in half a tonne of oranges."

"This type of agriculture is struggling on the conventional market. Fortunately, we do have some loyal customers who support our philosophy. But we're definitely faced with the excesses of the market. The limes

in the shop here in Sparta come from Brazil, the lemons from Africa. While we produce fine lemons and limes here in Greece. The irony is that I would get a better price if I sold my fruit in Germany, where there's much greater demand for ecological products. However, for ethical reasons, we strive to sell our fruit locally." Regenerative agriculture is still a very small niche for the time being, but the share of organic farming is growing — albeit slowly. Discussions are raging between organic farmers and conventional farmers on how to feed the growing world population. You'll often hear the argument that organic farming is less productive and therefore requires more land than conventional farming. Indirectly, organic farming thereby puts more strain on the carrying capacity of our planet.

Sheila Darnos disagrees. "In the whole productivity debate, people conveniently overlook the fact that conventional agriculture relies on a huge input of fertiliser and energy. These raw materials have to come from somewhere, and the damage caused by their extraction isn't taken into account. Many elements, such as damage to ecosystems, are also difficult to quantify in our current economic way of thinking. That makes any fair comparison all but impossible."

The future of agriculture

For Sheila Darnos, switching to regenerative agriculture is starting to bear fruit — literally. The citrus trees that were grafted five years ago are producing plenty of fruit today. And she's convinced this is only the be-

ginning. "More than anything, The Southern Lights is a place to experiment, and to learn. Knowledge about regenerative agriculture in the Mediterranean is very limited, which makes me a pioneer. The many interactions between plants and animals here, the layered composition of our fruit forest... it's all uncharted territory. I can only hope that my farm will grow into a place that inspires others, a place that proves that other ways of farming are not just possible in theory, but viable in actual practice. We seem to have lost the ability to dream, and I hope I can help bring it back."

"Regenerative agriculture involves more work than you might think at first glance"

← Sheila Darnos.

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