

# FUTURE FOODS SMART SUPPLY CHAINS



## WHY THIS INFOSHEET?

Agri-food technology is developing at such a fast pace that it is almost impossible to keep up with all the new knowledge and insights coined by tech pioneers. In a series of three info sheets, Fairfood and CTA aim to identify current challenges and share possible solutions, in order to create a shared learning curve within our [Blockchain for Agri-Food community](#).

## HOW CAN NEW TECHNOLOGIES HELP MAKE SUPPLY CHAINS MORE EFFICIENT?

Blockchain technology has been widely acknowledged as a potential tool for safe and transparent interorganisational information sharing. By cutting out middlemen and automating agreements, the technology offers completely novel ways of smart supply chain management and financing. In this info sheet we will take a look at the most common challenges of international agri-food supply chains and the ways in which blockchain solutions allow us to tackle those challenges by mitigating risks and increasing value for supply chain actors.



## COMMON CHALLENGES IN AGRI-FOOD SUPPLY CHAINS

A lot happens to our food on the journey from farm to plate. Over the past decades, agri-food supply chains have gotten longer and increasingly complicated, forming a cross-border network of producers, collectors, processors, distributors and many more. You might argue that this is inevitable with a vastly growing world population, but it is also the cause of some of the most prominent issues our food system faces today. Some of the most pressing issues and challenges on the journey from farm to plate:

### FOOD LOSS

Today, over 820 million people go to bed hungry.(1) Meanwhile, a third of the world's food is being wasted or lost. Food waste is defined as the decrease in the quantity or quality of food resulting from decisions and actions made by retailers, food service providers and consumers, whereas food loss results from decisions and actions made by food suppliers in the production chain, excluding retailers, food service providers and consumers. According to FAO, 14 percent of the world's food is lost in the process from post-harvest up to (but excluding) retail.(2)

### INEFFICIENCY

Inefficiency is an important driver of food loss. (Consultancy firm Boston Consulting Group identifies four other drivers for the loss and waste of food: lack of consumer awareness, insufficient policy, inadequate supply chain infrastructure and lack of collaboration.)(3) Inefficiency occurs in all stages of a food supply chain; think of a lacking availability of proper harvesting methods, insufficient storage conditions,



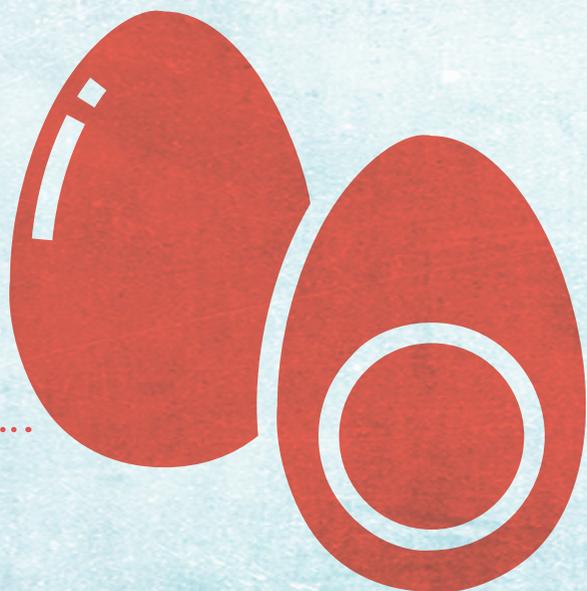
a lacking product quality control and poor factory logistics.(4) The issue of inefficiency can exist in supply chains that are disconnected; there usually is no proper connection between smallholder farmers and the rest of the supply chain.(5) Inefficiency is an overarching issue, which touches upon more of the food supply challenges discussed here.

### POOR LOGISTICS

When talking about food loss and inefficiency, we can't skip over the issue of poor infrastructure networks – something that many low- and middle-income countries deal with.(6) Insufficient infrastructure keeps developing countries from fully profiting from the opportunities that international trade offers. Prominent issues in logistics include inadequate infrastructure and transport links, customs barriers and packaging issues, as local packaging and labelling requirements are often incompatible with international standards.(7)

## FOOD SAFETY

Long and complicated, inefficient food supply chains cause great risks when it comes to the safety of our food. Each year, there are at least 600 million cases of foodborne diseases, resulting in 420 thousand deaths. According to the World Health Organisation, 30 percent of these foodborne deaths occur among children under the age of 5.(8) Another food safety related issue caused by the complexity of supply chains is the size of recalls. In our current food system, products are difficult to trace back to their origins, resulting in bigger recalls of suspected unsafe products than necessary.



## CASE STUDY: FIPRONIL

In 2017, in the wake of a major food safety crisis, 3,5 million chickens were slaughtered, and tens of millions of eggs were destroyed.

Two companies in the Netherlands and Belgium were accused of selling pest control containing the insecticide fipronil, which is not allowed in human food production. The insecticide was found in eggs and egg-based products in 45, mainly European, countries. An anonymous source had already tipped Dutch authorities in 2016 that pest control containing the insecticide was being used to fight red mite in poultry farms, but it wasn't until the summer of 2017 that authorities undertook action. The biggest retailer in The Netherlands, Albert Heijn, ended up pulling fourteen types of eggs from their shelves out of precaution. Later, a list with codes was released that matched codes printed on the sides of eggs, claiming all eggs with codes that were named on the list were unsafe. During what was later named the 'fipronil crisis', 808 stables from 363 poultry companies were closed down. In 2019, Dutch newspaper De Volkskrant wrote that by that time 780 stables and 327 poultry companies were back in business, while the others had remained empty and out of business since the crisis occurred.

## CLIMATE CHANGE

Up to a third of human-caused greenhouse gas emissions is linked to our global food system.(9) This includes everything from fertiliser manufacturing to food storage and packaging. At the same time, climate change has serious implications for our food production. In 2019, IPCC warned that climate change is threatening the world's food supply:

**“CLIMATE CHANGE CAN EXACERBATE LAND DEGRADATION PROCESSES INCLUDING THROUGH INCREASES IN RAINFALL INTENSITY, FLOODING, DROUGHT FREQUENCY AND SEVERITY, HEAT STRESS, DRY SPELLS, WIND, SEA-LEVEL RISE AND WAVE ACTION, AND PERMAFROST THAW WITH OUTCOMES BEING MODULATED BY LAND MANAGEMENT.”(10)**

## POVERTY

Worldwide, about 400 to 500 million smallholder farmers are responsible for the production of 70 percent of our food.(11) Ironically, they are often affected by food insecurity and malnutrition themselves; around 80 percent of people who deal with poverty and food insecurity live in rural areas, where the majority are small-scale family food producers.(12) Incomes are low: in Kenya, an average smallholding family earns a gross income of about \$2,527 a year. In Ethiopia, families with a farm of about 0.9 hectares earn just \$0.80 per day.(13)

## INFORMATION ASYMMETRY

Significant information asymmetry is one of the challenges that smallholder farmers face in escaping poverty. Other stakeholders in the supply chain often are much better informed about prices, policies, regulations and standards. This ultimately leads to unfair prices for the less informed stakeholders, most often smallholder farmers.(14)



## LACK OF TRUST

A general lack of trust in food supply chains is at the root of many issues. As FAO states: "Trust, in the behaviour of other VC [value chain] actors and in the effectiveness of the enabling environment, is an overarching, precious asset driving the performance of the VC. Lack of trust will hinder the performance of the VC. Corruption and extortion, which drain off some of the value added in the VC, undermine the emergence of trust."(15)

About 11 million EU farms sell their products to about 300 thousand food processors, in turn selling their products to 2.8 million food distributors or food services, delivering food to 500 million EU consumers(16)

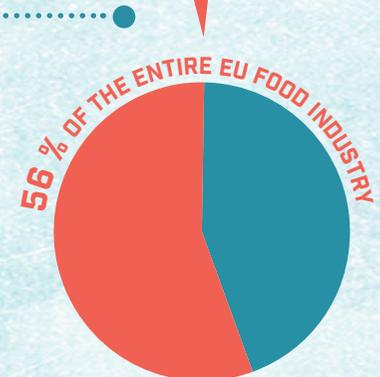


In the EU alone, the agri-food sector provides **44 million jobs**(16) in over **15 million holdings or enterprises** engaged in agriculture, food processing, food retail and food services(17)

**15 MILLION HOLDINGS OR ENTERPRISES ENGAGED IN AGRICULTURE, FOOD PROCESSING, FOOD RETAIL AND FOOD SERVICES**



The five biggest EU food firms make up a market share of **56 percent of the entire EU food industry**(18)



## FROM A PUSH ECONOMY TO A CONSUMER DRIVEN PULL ECONOMY

In 1909, Henry Ford spoke the famous words,

**“YOU CAN HAVE A CAR IN ANY COLOUR, SO LONG AS IT IS BLACK.”**

Ford is the mastermind behind assembly lines as we know them today, which were created for mass production and economies of scale. The assembly line meant the start of a “push economy” in which products are produced at large volumes and pushed down the supply chain right into consumers’ homes. At the time of Henry Ford’s famous quote however, there was less need for customisation as customer expectations were lower and there simply were no sustainability standards.

Today, we are rapidly moving towards the opposite end of the spectrum: a pull economy. Customers are demanding more personalisation possibilities and increasingly demand answers to their sustainability and food safety concerns, while governments are joining in by creating new legislation for sustainability and transparency. In today’s world, competition isn’t won through mass production and economies of scale any longer. Instead, firms must find ways to quickly tailor their products to target customers’ specific needs while minimising waste and environmental impact.

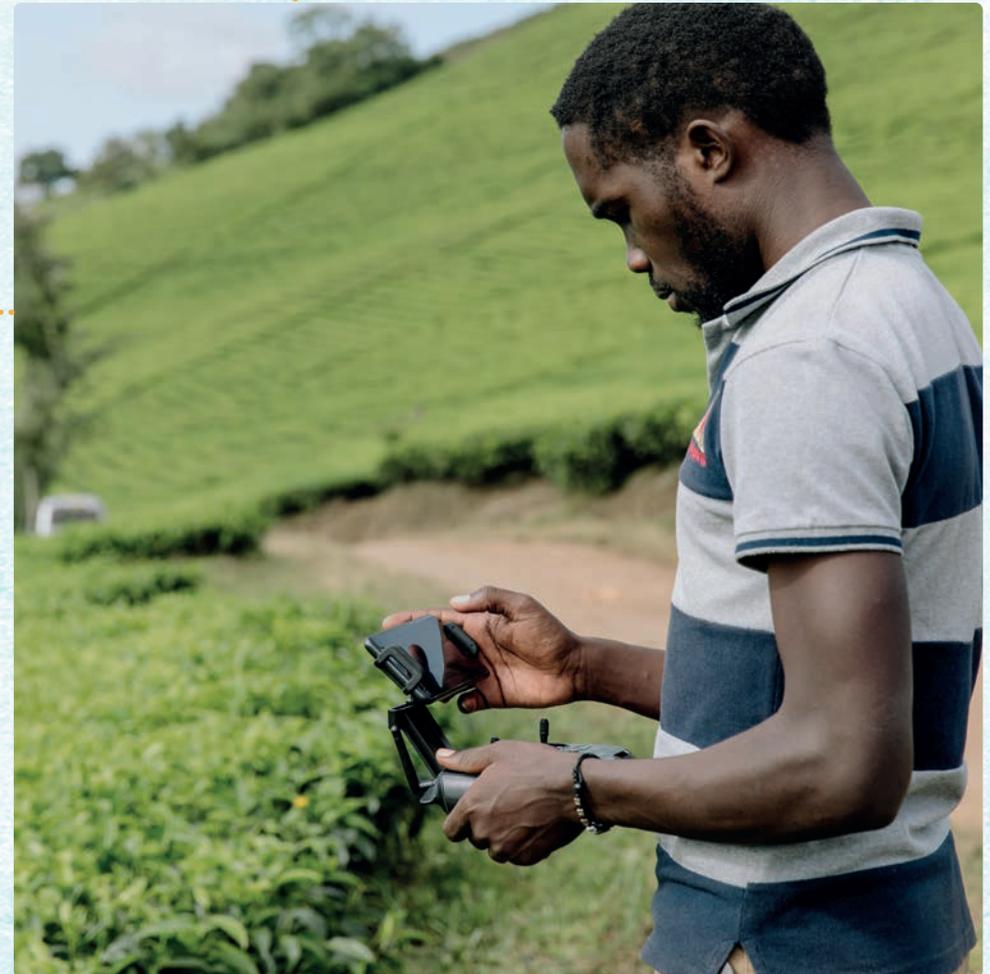
In this new reality, competition no longer takes place at an organisational level, but rather between entire supply chains.<sup>(19)</sup> This amplifies the need for strong supply chain cooperation, efficiency and transparency. It motivates firms to optimise their production processes by using smart systems, and to continuously work together to find new ways to meet customer and government demands.



## USE CASE: MAZIWAPLUS

No less than 8 percent of Kenya's GDP comes from the country's dairy production. Smallholder farmers produce 80 percent of the 3.43 billion litres that Kenya produces annually, yet "they are constrained by low quantity and quality of feeds, lack of reliable statistical information on milk market outlets, poor rural infrastructure, lack of collateral for loans, low technical skills on husbandry practices, reduced access to veterinary and artificial insemination (AI) services".(20)

MaziwaPlus is a start-up specifically aimed at tackling the problem of post-harvest losses. Their integrated software and hardware platforms ensure the safety and traceability of milk between farm and factory. While the hardware keeps the milk chilled and preserved using solar power, the software collects real time data from collection points, which is later used for mobile payments, farmer records, accountability and projection of dynamics in the supply chain.(21)



## 2025: MEET SMART EXPORTER HENDRIK, INDONESIA

Every morning from Monday to Friday, Hendrik wakes up at 7 o'clock to take his scooter to work. He works at a company specialised in exporting nutmeg to the rest of the world, while his wife takes care of the little clove and coconut field they own, right next to their house.



The company Hendrik works for recently switched to a smart system that fully automates agreements by using smart contracts. This has sounded in a whole new era of doing business; Hendrik can now do business internationally under the agreement that he will only be paid once an agreed upon batch of goods arrives at the next doorstep down the supply chain. Automatically, that is: Hendrik no longer has to chase after payments, nor be afraid a payment won't take place at all.



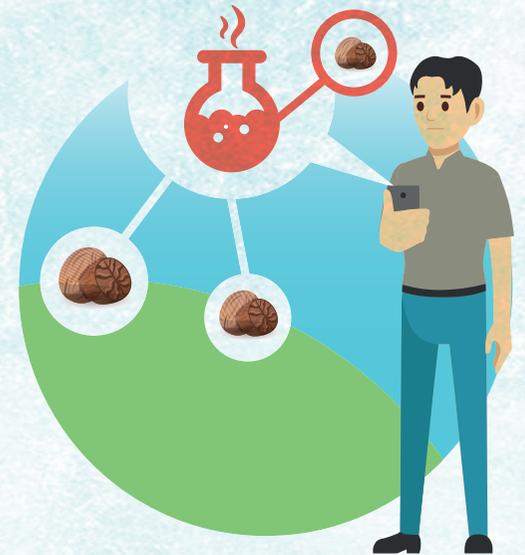
Going beyond trust. That's one need the smart system answers to. Hendrik's company started noticing changes in the relationships they had with their customers. Over the years, there was more and more talk of sustainability and fair trade. Questions were raised about whether or not the farmers producing the nutmeg were paid a decent price for their product and if those farmers' children were able to go to school.





Last year, a major client suggested the company would switch to this smart system, which would allow for more transparent information sharing. Today, all of their nutmeg farmers have joined the system, allowing them to confirm the payment of an agreed upon price. The system even holds a place for third party auditors, who can verify that the nutmeg they are selling is actually organic. In turn, Hendrik learns about the quality of the nutmeg they sell, which is later established by their clients. This allows him to see where there is still room for improvement. The company is planning on rolling out an educational programme for interested farmers.

Something major happened just last week. Hendrik got a call following an automated notification from one of his clients, who's laboratory had discovered the toxic aflatoxin in a batch of nutmeg they had bought from the company. With the new system in place, the source of the contamination could easily be tracked down, after which Hendrik's company decided to also notify another client who had purchased nutmeg from the same batch. A very narrowed down food recall followed. Crisis averted. Hendrik even made it home in time to cook dinner.



## FUTURE-PROOFING SUPPLY CHAINS: SMART INFORMATION SHARING

A future proof agri-food supply chain is a closely interlinked supply chain; one that easily transfers information, products and money back-and-forth. Competitive interorganisational information systems are needed so that supply chain partners can work together more closely to save costs, and to respond to changing laws and customer needs and expectations more quickly.(22)

Also, an interorganisational digital layer can facilitate a collective reduction of inventory costs and allow partners to make their product data transparent, making it easier to respond to growing customer social and sustainability demands, to quickly receive and share customer feedback, and to create better and longer partnerships overall. 5 gains:

### 1 DEMAND BASED PRODUCTION CHAINS

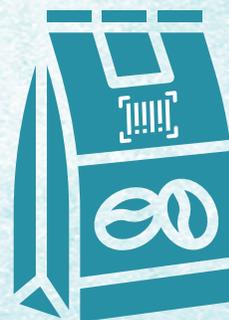
Information sharing allows firms to work together in their resource planning and move from a supply-based production chain towards a demand-based production chain. By collaborating in activities such as sales, production and logistics, firms can enhance their transparency and reduce uncertainties on both sides. In a demand based inter-connected supply chain, activities are digitally coordinated, allowing suppliers to respond to problems in real time.(23) As every company in the chain knows exactly what products the next purchaser down the chain needs, they can supply them with this exact amount, avoiding food waste and minimising inventory costs.

### 2 PRODUCT TRANSPARENCY

Of all the challenges that agri-food supply chains face today, a more demanding consumer might just be the biggest one. Once an interorganisational information system is put in place, actors can begin confirming the chain of custody of a specific product, ultimately making this information available to the end consumer. By sharing information about a product – its origin, journey, and social and environmental sustainability footprint – in a transparent way, its value for the end consumer increases. That’s why many of the largest food brands, including Nestlé, Unilever, Walmart, Ahold, Carrefour and JD.com, are currently working on various blockchain-enabled traceability systems to show their customers exactly where their products come from.

Imagine going through a store and finding two exactly similar products. One provides fully transparent product information and the other provides no information at all about its origins. Which one would you choose? ●

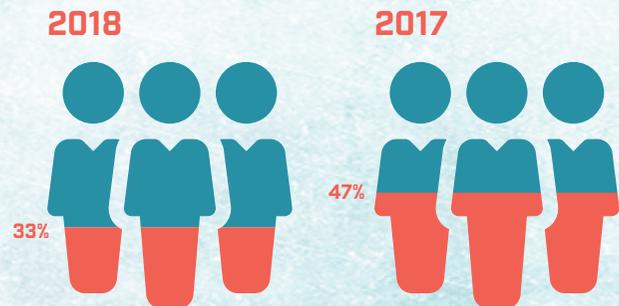
A PRODUCT WITHOUT INFORMATION



OR

A PRODUCT WITH FULL TRANSPARENT INFORMATION





IN 2018, ONLY 33 PERCENT OF SURVEY RESPONDENTS SAID THEY WERE CONFIDENT ABOUT THE SAFETY OF THE FOOD THEY EAT, COMPARED TO 47 PERCENT IN 2017[24]



**94% OF CONSUMERS SAY IT IS IMPORTANT TO THEM THAT THE BRANDS AND MANUFACTURERS THEY BUY FROM ARE TRANSPARENT ABOUT WHAT IS IN THEIR FOOD AND HOW IT IS MADE[25]**

**65% OF CONSUMERS ARE INTERESTED IN LEARNING MORE ABOUT THE FARMING AND FOOD MANUFACTURING PROCESSES BEHIND THEIR FOOD[24]**



**37% OF CONSUMERS SAID THEY WOULD BE WILLING TO SWITCH BRANDS FOR MORE TRANSPARENCY[25]**

### 3 GETTING CUSTOMER FEEDBACK

Without interorganisational connectivity, most suppliers have no idea where their products end up. This makes it difficult for them to receive customer feedback and tailor their products to the needs of the end-consumer. By sharing information within a supply chain, consumers can not only know where their products come from, but suppliers can also find out where their products end up and be notified when customers down the chain have new demands or specific feedback on the production process.

#### USE CASE: RIPE.IO FT. FLAVORWIKI

One example of a platform that facilitates cross chain feedback is Ripe.io, a food traceability platform that runs on blockchain and announced a partnership with Flavorwiki in 2019.(26)

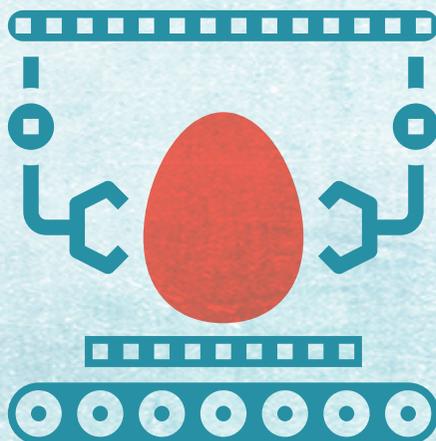
Flavorwiki developed an AI application that offers food brands insights about the flavour, texture, aroma and mouthfeel of their products based on input from a wide consumer database. Ripe.io uses Flavorwiki's software to collect data from consumers about their taste preferences. They then send this information to the producers at the start of the food chain who now have direct access to information about how changes in their production process affect the taste perception at the end of the chain, which they can use to improve their production processes.

#### 4 IMPROVED COLLABORATION AND PARTNERSHIPS

Sharing information within a supply chain requires some form of mutual trust. This is something that often needs to be built up over a period of time. By sharing information and collaborating to create a better product for the end consumer, supply chain actors can build that mutual trust more easily, which results in better cooperation, more sustainable partnerships and better income stability for both parties over time.(22)

#### 5 REDUCING RISK OF RECALLS

It is estimated that a food recall on average costs a company 10 million dollars, excluding loss in sales and brand damage.(27) A large part of those costs come from the lack of a proper chain of custody. Often, companies are unable to trace product batches back to specific suppliers, leading to far bigger recalls than necessary; when a contamination source cannot be located, entire inventories need to be cleared, rather than just a batch. This isn't only a lot more expensive, but it is also a lot more damaging to a company's reputation. And what's more: it leads to more food loss than is actually needed. A smart interorganisational system would reduce most of these risks and costs by helping allowing companies to trace a specific (contaminated) batch back to a specific supplier.



## ● BLOCKCHAIN FOR SUPPLY CHAIN TRANSPARENCY

There appear to be a lot of advantages to sharing data. So why then, you might ask, is not everyone doing this? Why are most agri-food supply chains so fragmented and most food products still not fully traceable? A lot of this has to do with a lack of trust. At the moment, supply chains include a lot of different players that often don't know each other. Sharing valuable and sensitive information on a central platform with complete strangers is a big ask. It potentially puts players at risk of data theft or hacking, data misuse or misrepresentation of their data. What's more, the integrity of a centralised platform can easily be questioned by outside actors such as the end consumer: what if certain actors want to hide certain information or change something to their benefit? In a centralised system there is nothing that stops them from doing this. That's where blockchain comes in.

### BLOCKCHAIN FOR INTEGRITY ●

In the most basic terms, blockchain is a technology that allows information to be recorded and shared within a community. Each member maintains their own copy of the information on the blockchain, and all members must validate any update collectively. Data that has been entered can never be removed, meaning that everyone in the network has access to the same list of data. This allows all actors in the blockchain to share and verify information and to interact with each other online, eliminating the need for a collectively trusted middleman.

As the ledger is maintained by everyone collectively and cannot be altered by a single individual without the approval of at least 51 percent of the network, blockchain provides a secure, democratic, and decentralised single source of truth to log events and interactions between people (or nodes). Since there is no central location for safekeeping and data exists in millions of places simultaneously, the system is nearly impossible to hack.

In supply chains, this single source of truth can help to build consensus on the journey of a specific batch of products within the entire chain. Once individual actors and product batches are identified and connected to a blockchain address, every interaction between supply chain actors or between actors and verifiers, can be confirmed by both sides. This interaction then becomes visible to everyone on the blockchain, since the confirmation can only originate from the involved actors, without any possible tampering or changes by anyone else. In a sense, the blockchain functions as a nonpartisan layer between supply chain actors, so they can safely interact and share data or value.



## BLOCKCHAIN FOR SECURE DATA SHARING

Of course there are situations in which supply chain actors only want to share certain information with certain partners, without making that information visible to everyone in the supply chain. As explained in a [previous info sheet](#) on data ownership and self-sovereign identities for farmers, [smart contracts](#), [decentralised file storage](#) and other encryption technologies offer supply chain actors several possibilities to stay in full control of their data when interacting with applications. Basically, by encrypting their data, they keep control over which information they want to share with other supply chain actors and under which conditions. By using [zero-knowledge proofs](#) (which, unlike smart contracts and decentralised file storage systems, do not rely on blockchain technology to function), actors can even validate the integrity of certain data fields to others, without making their entire data set transparent.

## USE CASE: TE-FOOD

Germany-based tech-company TE-FOOD offers a top-to-bottom traceability solution that aims to benefit all actors in food supply chains. Ultimately, TE-FOOD wants to bring food companies and solution providers together for the contracting, management and clearing of various services regarding the quality and supply of food.

### Their solution covers 5 steps:

- 1 Object identification: physical products are tracked throughout the supply chain
- 2 Data capture: integrity of product information is safeguarded by attaching product information to product ID's throughout the chain
- 3 Data storage: a blockchain is used to store all traceability data in a decentralised and permitted way
- 4 Data processing: TE-FOOD is actively looking at new ways of processing and handling data that benefit supply chain efficiency. Think of harvest notifications and checks on the accuracy of data
- 5 Data presentation: collected data is presented to consumers in an app

One feature of TE-FOOD's data processing system is directly linked to the issue of food safety: TE-FOOD helps identify the source of contaminated products and identifies premises where products stemming from the same source are stored, ultimately allowing in-app contact for the recall of affected products.

## ● FUTURE-PROOFING SUPPLY CHAINS: TOOLBOX

When engaging in international trade, supply chain actors must protect themselves against associated risks, such as currency fluctuations, political instability, non-payment or issues with the creditworthiness of one of the (usually unknown) parties involved in the chain.

To cover at least part of these risks, international trade typically involves multiple third parties being signed under different agreements, which inherently costs a lot of time and money.(28) Smallholder farmers and micro, small and medium sized enterprises (MSME's) are known to struggle with the required paperwork, making it harder for them to (safely) participate in the global economy.(29)

Once supply chain actors are connected to the blockchain and can share data in a secure and transparent way, many solutions to these risks become possible. For example, by giving external financiers better insight into the supply chain cash flow and the credit history of companies, blockchain can facilitate authentication processes and simplify access to affordable financing opportunities.(30) Moreover, through the use of smart contracts and tokenisation, supply chain finance, insurance and international trade agreements can be completely reinvented. 4 possible functionalities of a smart interorganisational information system:

### 1 AUTOMATING AGREEMENTS

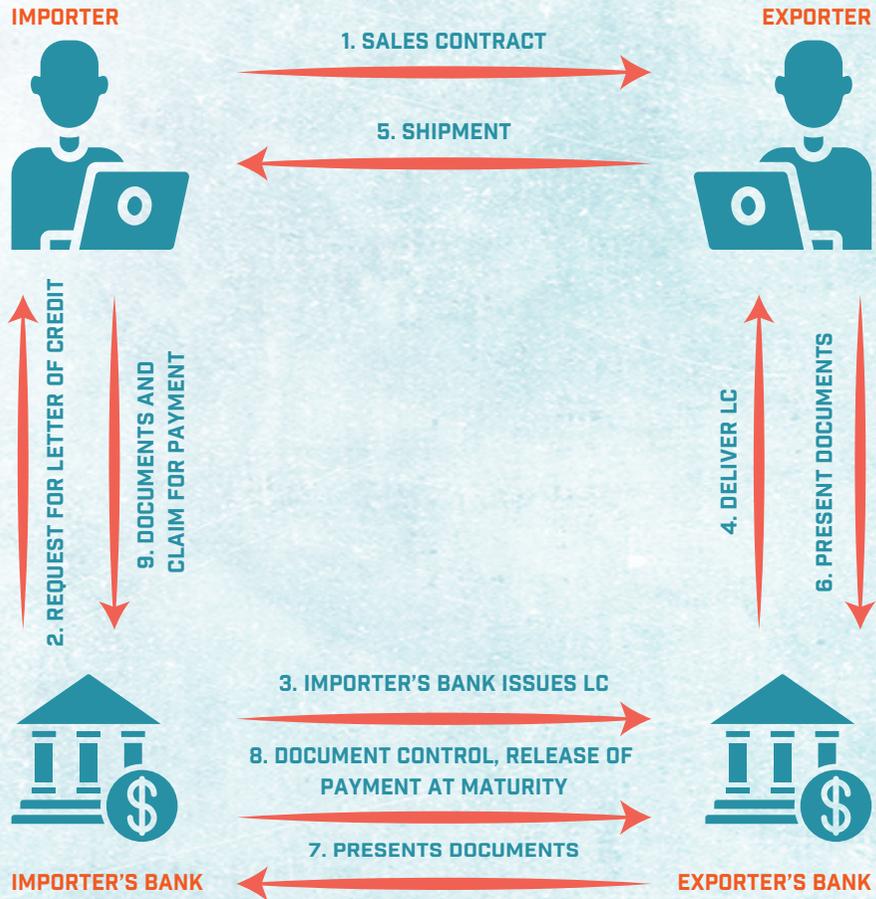
The introduction of smart contracts creates new opportunities to share transactional information – such as, person A sends X amount to person B – but also makes it possible to add specific rules to the blockchain – such as, when Y happens, person A sends X amount to person B, but when Z happens, person B sends X amount

to person A. This means a transaction is only executed when the set criteria are met. Just as with any other transaction on the blockchain, once a smart contract is created, it can never be removed or altered. It can only be overwritten by a new contract, after which the old contract remains archived and accessible in the blockchain. Smart contracts are public, meaning everyone in the chain can verify their validity.

With the use of blockchain technology and smart contracts, a large chunk of the bureaucracy commonly related to international trade can be enforced automatically. (31) This allows supply chain stakeholders to interact with each other without or with much less need for establishing and ensuring mutual trust, therefore lessening the need for paperwork and third parties. For smallholder farmers and MSME's, this means that they can engage in international business much more easily and gain access to loans and insurances that they previously wouldn't be eligible for.

The terms of agreements in processes such as inventory and trade finance, international transactions, insurances and other types of agreements can all be embedded in a smart contract, using cryptocurrencies or tokenised inventory as collateral. The smart contract then acts as an escrow for the payment versus delivery – or whatever is in the agreement – and only executes the agreed upon form of transaction once the set conditions are met, increasing transaction speed and reducing costs and the probability of human error.(32)

## TRADITIONAL MODEL



## BLOCKCHAIN MODEL

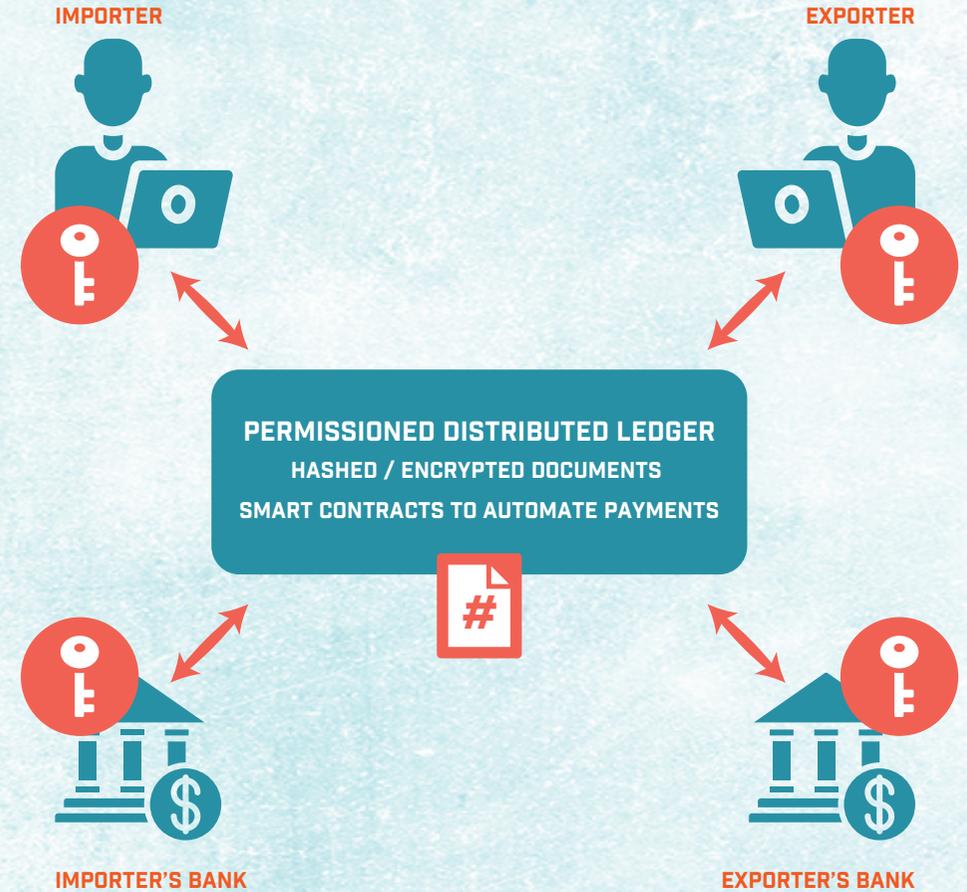


Illustration was based on an illustration by World Trade Organisation(33)

## EXPERT VIEW

CHRIS GEORGEN, CEO AND CHIEF ARCHITECT TOPL

“When talking about using new technologies like blockchain to revolutionise supply chain finance, the first question that should come to mind is: “Why? What is our goal?”

For me, the answer lies in one of the things that blockchain technology is unequivocally best at: providing the infrastructure to transparently make and verify provable claims.

If we consider smallholder farmers, access to a blockchain-powered supply chain gives them the ability to offer verifiable evidence not only of their production history but also of any good farming practices or certifications they might have obtained. In turn, microfinance institutions and other lenders can look to this same blockchain network for proof of these claims, and construct alternative credit scores for the smallholder farmers, many of whom are currently unbanked with no means of building access to credit.

While the ability to provide credit access to previously disenfranchised smallholders seems beneficial at first glance, once we see what can be done with that credit, we realise how revolutionary this can be.

Right now, the average cacao farmer receives only 7 percent of the total value produced in their own value chain. Without access to finance, farmers must harvest and immediately sell their cacao locally, never able to even consider purchasing

processing equipment or, let’s say, covering the cost of a confectioner producing chocolate on their behalf. Excitingly however, this is beginning to change! Already there are projects powered by the Topl blockchain and other technologies where farmers in India and Zambia are moving up their own supply chains through greater transparency and the resulting access to supply chain finance.”



## 2 TOKENISATION

Digital tokens are often used as a currency, acknowledging them as a unit of transaction. They hold another promising functionality however: digital tokens can also be used as a digital version of a real-world asset. As such, digital tokens can represent virtually anything.

One token can correspond with one batch of goods that could be measured in an item's weight, volume or size. When used in this manner, tokens are non-fungible, meaning that each token is unique. This makes it possible to distinguish between batches of the same type of product.(34)

Tokenisation is very similar to the traditional process of securitisation, but with some added features. Tokenisation offers the potential for a more efficient and fairer financial world by greatly reducing the friction involved in the creation, buying, and selling of securities. Deloitte, one of the largest audit and consulting firms in the world, recognises four key advantages of tokenisation for both investors and sellers:

- Greater liquidity
- Increased accessibility
- Greater transparency
- Faster and cheaper transactions(35)

By transferring tokens on a public blockchain, these transactions become visible to all actors and cannot be censored by anyone. When tokens represent real world assets, this can be a great way to make a product's journey transparent and

traceable from farm to plate. As the tokens do not hold any intrinsic value in and of themselves, the main challenge here is making sure that the tokens are always in the hands of the actual owner of the physical goods. This can be partially solved by paying for the goods through a smart contract that exchanges actual valuable cryptocurrencies for the tokenised assets. This secures transparency, as everyone can see that the new owner at least paid for the tokens, which makes it more likely that he or she also owns the corresponding real assets. In turn, this could make it easier for the new owner to use these assets as collateral to gain access to loans.

## 3 DEEP TIER FINANCING

In a complex supply chain, which most agri-food supply chains are, capital providing institutions usually trust the business transactions of the first few tiers of suppliers, making it easy for these suppliers to gain access to capital. However, the weaker accounting practices of small companies at the beginning of the supply chain make it less likely for capital providing institutions to trust them. This makes it difficult for small companies to gain access to loans, which often leads to borrowing rates rising up in double digits.(25)

By both parties confirming each transaction in a supply chain on a public blockchain, deep tier suppliers can prove that they have been supplying on a consistent basis for some years. If a purchaser at the start of the chain already made a commitment to buy another batch of goods from suppliers of T2, T3, and T4, the T4 suppliers know they will automatically get paid after delivering their products. When a commitment like this is recorded in a smart contract, the T4 suppliers could get a loan from the end purchaser or a third-party financier based on the verifiable promise that they will deliver the produce in the near future. This doesn't

just help T4 suppliers gain access to working capital, it also allows supply chain partners to build up longer lasting partnerships. Even if the end purchaser doesn't have the physical product yet, they have a publicly registered commitment by the T4 suppliers to supply the product when it is needed in the future.

#### 4 IOT INTEGRATION

Internet of Things (IoT) sensors make it possible to upload data on for example the physical location, transit temperature and time of arrival directly onto the blockchain. This functionality can be used to generate additional assurances regarding the correct execution of the conditional agreements set in smart contracts. Sensors function as a neutral and reliable source of information, which in turn allows for more complex agreements to be automatically executed, potentially saving costs and time.(30)

For example, a smart contract could be used to automatically pay the seller of goods at the moment a batch arrives in the harbour, but only when the temperature of that specific container remained below a certain threshold during transit. And there are more possibilities. Ibis network, an inclusive insurance solution for smallholder farmers, created a platform that harnesses satellite imagery to automatically pay out farmers when floods or droughts occur in their area.

More modern sensors go beyond monitoring location and temperature. New sensors with the ability to also sense pressure, motion, acceleration and sound have already entered the market. Recent developments even include the use of 'chemical barcodes', in which certain chemicals are used to trace food and pharmaceutical products.(36) All of these developments contribute to solving the 'garbage-in-garbage-out' problem that is often associated with blockchain technology and can help to generate more trust in supply chain automation.



## EXPERT VIEW

MARTEN VAN GILS, TECH LEAD AT FAIRFOOD

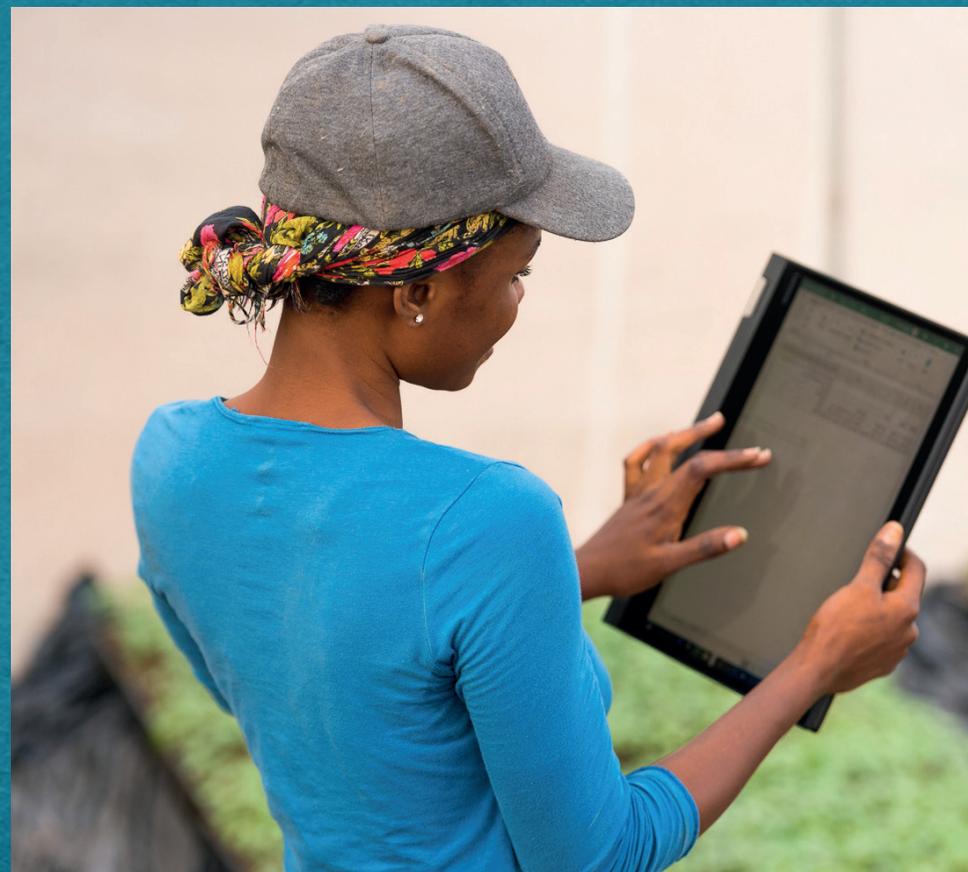
“Three years ago, I predicted that within ten years traceability would become mandatory in food production – for food safety reasons and to meet sustainability requirements linked to the environmental and socio-economic issues we face today.

Yes, blockchain technology holds the potential to help realise farm to fork traceability in food supply chains, but only if farmers are included as full-fledged supply chain actors. That is why Fairfood is working on blockchain-based solutions that truly include the first mile of food production – farmers and food workers.

But let’s not get ahead of ourselves. For solutions to scale they need a business model. That’s why we are currently in the midst of two projects; one with coffee importer Trabocca and one with Verstegen Spices & Sauces, to find out how much value traceability data adds to products. Adding value is key, for consumers, for companies and for farmers and food workers. Ask yourself: what is the value of knowing that no harm was done to people or planet during the production of your food?

Once value is added in the form of trustworthy product stories and social due diligence analytics, it can be captured and shared with the farmers and food workers, be it in the form of actionable farm data, training or cash. This is what we are developing: a blockchain-based traceability platform that shares added value with farmers and food workers.

I expect traceable, transparent products to seriously compete with non-traceable ones soon – if not for the sake of legislation then for the sake of a company’s due diligence or consumer demands.”



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