Fairfood
Mauritskade 64
1092 AD Amsterdam
Tel: +31 (0) 6 4157 6980
Email: marten@fairfood.nl

Position Paper: On Blockchains

By Marten van Gils, November 2017

Abstract

Blockchains have great potential to increase sustainability of food supply chains, especially if they include smallholder farmers and consumers as supply chain actors. Fairfood therefore intends to co-develop the ecosystem and technology that will lead to inclusive blockchains for food.

> *This magical, marvellous food on our plate, this sustenance we absorb, has a story to tell. It has a journey. It leaves a footprint. It leaves a legacy.*

1. Issues in our food system

Since the Industrial Revolution, ever more **complex food supply chains** have been created to manage the increasing flow of raw materials and goods needed to feed the rapidly growing world population. In the coming 40 years, we'll consume as much food as in the last 8.000, so the pressure on our food system is only set to increase. Unfortunately, complex chains typically **lack transparency**, leaving room for abuse, fraud and negligence that put our food system at risk and make it difficult to respond to

Fairfood
Mauritskade 64
1092 AD Amsterdam
Tel: +31 (0) 6 4157 6980
Email: marten@fairfood.nl

problems adequately and in time. Recent scandals, such as Fipronil in eggs, horsemeat in IKEA meatballs and paint in baby food, illustrate this. Even though modern-day supply chains feed billions, they can be tremendously **inefficient**, which has great economic, environmental and social consequences. Vital parts of the Amazon rainforest and its inhabitants, for instance, had to make way for food production, while roughly one third of the food produced globally is wasted. Finally, food supply chains that start in developing countries all too often lack **inclusiveness**. The majority of the 570 million smallholder farmers who produce more than 70% of our food live on or below the poverty line and 815 million people suffered from hunger last year . In other words, the global food system is a remarkable feat of human cooperation, but sustainable it is not.

Technological developments that allow for smarter ways of producing food have become more readily available in recent decades, ushering in a new era of food production. As a result, efficiency and productivity have increased in technologically advanced supply chains. Efforts to produce our food more sustainably are increasingly successful, but we're far from there yet. Serious issues remain, especially in the massive, low-tech supply chains that start in developing countries, such as with coffee, cocoa and palm oil. Government regulators are taking steps to address issues and work towards regulating transparency more. Many expect transparency to become obligatory within 5 years. In response, corporations are increasingly making commitments to improve transparency. Recent research among 156 Dutch and Belgian food companies showed that 87% believe they will be obligated to become transparent about the provenance of their raw materials in the years to come. Certifiers, too, are developing ways to increase consumer trust and we're seeing signs of them looking for solutions beyond certification. Finally, consumers are slowly transitioning towards more conscious consumption patterns. However, the process of future-proofing our food system needs to be seriously accelerated if we want to keep feeding the world responsibly in the years to come.

For better and for worse, technology has always been at the basis of developments in food and it is there that we now look for ways to improve our food system, because a new, potentially transformative, technology is has arrived.

> *Imagine all the food mankind has produced over the past 8,000 years. Now consider that we need to produce that same amount again — but in just the next 40 years if we are to feed our growing and hungry world.*

2. An introduction to blockchains

Much of our world is organized by banks, courts and other central authorities. These central authorities have been reasonably successful in generating trust, but they are typically

Fairfood
Mauritskade 64
1092 AD Amsterdam
Tel: +31 (0) 6 4157 6980
Email: marten@fairfood.nl

vulnerable to human error, theft, fraud and other risks. This became painfully clear, once more, during the Financial Crisis of 2007-2008, which sparked the development of a new technology aimed at generating trust without the need for central authorities: blockchains.

A **blockchain** is a distributed database that consists of a continuously growing list of records, called *blocks*, which are linked and secured using cryptography. These records can be transactions, for instance ('John owes Mary amount X'), which is the case with Bitcoin, the oldest and most well-known application of blockchain technology. More recent applications have made it possible to store not only transactions, but also pieces of computer code on blockchains, which allows for automation of processes in ways that maximise reliability and trust like no technology was able to do before. As such, blockchains represent a revolutionary alternative to the current system in which central authorities decide what's true and what isn't. In fact, they have shown they can do much of what banks, accountants and certifiers do, only more efficiently. They are, in essence, a great new way to build **trust**.

Blockchains have several applications that are particularly relevant to our food system:

- **Digital identification** is an application that can be used to enhance traceability of food. Already used to identify people and devices, blockchains can also provide food products with a digital identification, much like a digital product passport to which information about where the product comes from and how it was produced can be permanently added.
- **Smart contracts** are sets of business rules written in code onto the blockchain. Being self-enforcing, smart contracts can help automate and govern food production processes efficiently. The aim with smart contracts is to provide speed, accuracy and security that is superior to traditional ways of governing business processes.
- **Digital currencies** are used to store and transfer value safely and cheaply over the Internet. It is estimated that 10% of all global trade will be done in digital currencies in 2025 and transactions within the global system of supply chains will be no exception to this.
- **Distributed storage** of data is another useful application for supply chains. While supply chain actors now use different systems to store data, blockchains enable them to store and share encrypted versions of that data. This means they can safely share data to comply to modern-day transparency demands without having to fear their data will be made public.

3. Benefits of blockchains

The combination of digital currencies, digital identification, distributed storage and smart contracts could generate immense benefits for food supply chains. Supply chain **transparency** is a key benefit. Recent food-borne illness scandals demonstrated that the current system of different databases controlled by actors with conflicting interests obstructs transparency rather than promoting it. But putting everything under the control of a central authority is not the solution to the transparency

Fairfood
Mauritskade 64
1092 AD Amsterdam
Tel: +31 (0) 6 4157 6980
Email: marten@fairfood.nl

challenge. Who can be trusted with this immense responsibility: a government, a multinational, a certifier? In fact, many regulators forbid centralised control of supply chain data, and rightly so, as this would stimulate data monopolies and abuse thereof. Decentralised systems like blockchains promise better solutions to the transparency challenge.

Chain **efficiency** is another potential benefit. Blockchains can help to streamline many administrative processes such as stock orders, invoicing and payments, dramatically increasing speed and cutting costs at virtually every step in the supply chain. Quicker data retrieval improves response times in the case of an outbreak of foodborne illness, an obvious advantage that could save lives. Reduction of costs could create room for farmers and food workers to earn more without consumers having to pay more. Only actors that add costs without adding value will likely lose, because blockchains can identify them and highlight the cost of the inefficiencies they add to the system.

Supply chain **governance** and **compliance** to regulations can be greatly enhanced by coding business rules and food regulations in self-executing smart contracts. Think about smart contracts that notify supply chain stakeholder when the temperature in a container that transports frozen shrimp rises above a certain temperature, automatically triggering extra quality control steps further down the supply chain to ensure product quality and food safety.

From Fairfood's perspective, **inclusiveness** is of course the ultimate benefit for the millions of smallholder farmers who make our food. As food production starts with farmers, 'blockchaining' supply chains would mean that farmers become active players in a system they were previously marginalized in. Being at the beginning of their food supply (block)chains, farmers not only control the physical products they grow, but also the – valuable – digital products they create on the blockchain. In other words, we expect that inclusion of farmers in blockchain systems empowers them to unlock additional sources of income.

> *"What's more valuable, a plain coconut or a coconut that is produced fair and organic? Who should benefit from that difference, the retailer, the certifier or the farmer?*

4. Blockchains for food

Since their invention in 2008, blockchains have been applied in a variety of **use cases** pertaining to food. Wageningen University & Research applied blockchain tech to manage the certification process of **grapes** more efficiently, Walmart applied it to identify the source of their **mangos** quicker, Provenance used it to prevent double spending of food certificates in **tuna** and Agriledger applied it to give **cocoa** farmers product quality feedback based on market prices. Fairfood itself used a blockchain to prove provenance and fair pay in a **coconut** supply chain. In this pilot Indonesian smallholder farmers were registered as actors on the (Provenance.org) blockchain. On harvest day, they text-messaged the number of

Fairfood
Mauritskade 64
1092 AD Amsterdam
Tel: +31 (0) 6 4157 6980
Email: marten@fairfood.nl

nuts they harvested to the blockchain system. Those SMS's automatically generated corresponding assets (batches of coconuts) on the Ethereum blockchain. Digital proof of fair payment was added to each batch *by the farmer*. All nuts were tagged so that eventually each single nut could be traced back to the farmer along the supply chain, simply by scanning the qr-code on the nut. This way, coconut consumers could see blockchained proof of which farmer produced their specific nut for which price. Interestingly, by including farmers in the verification of fair payment, they were better able than usual to 'ring the alarm' when the payments they received were incomplete. We see this as a small but powerful example of how including farmers on the blockchain can empower them. Each of the above use cases produced improvements in transparency, most of them improved chain efficiency and some of them increased supply chain inclusiveness. All have created better understanding of how blockchains can be used to make our food system more sustainable. We see these results as arguments for further research and development.

With blockchain technology is in its infancy, there's much to do before large-scale impact on our food system can be expected. **Scalability** issues currently prevent deployment of blockchains in complex, large supply chains. Current systems are slow and user interfaces need to be greatly improved to handle supply chains of differing types, volumes and complexities. Communication **infrastructure** is a limitation in underdeveloped sourcing countries. Our coconut case showed that simple Nokia phones work in most cases, but we'll have to wait a few more years before the majority of farmers can fully adopt blockchain technologies themselves. **Energy consumption** of blockchains is a serious concern. To illustrate, a Bitcoin transaction takes 20 times more electricity to complete than it takes Visa to complete a transaction. This issue can and needs to be addressed soon. Ensuring **data quality** is a more permanent challenge that is inherent to blockchains, because however trustworthy a database technology is, if you put trash in, you'll get trash out. In food supply chains this means training users to treat their inputs much like we treat internet banking orders: once you press 'send', it's gone. Here we see a big role for certifiers, who've been working with farmers to generate quality data for decades. As a true network technology, the potential of blockchains depends on how broad its **adoption** is. The more users in the network, the more trustworthy the data is, the more people will use it, et cetera. Ease of use, affordability and the ability to customize functionalities to fit specific supply chains are crucial for the technology to be widely adopted. Simple, low-cost, open-source and interoperable public blockchains are needed for this.

A final, more philosophical, challenge is to embed blockchains in our current **food culture.** A culture in which consumers are used to eating products that are local, seasonal, healthy, organic and fair would give a great boost to the sustainability of our food system. We're not there yet. Large-scale campaigns aimed at the food industry and consumers are needed to change food habits. Results from the first blockchain pilots in food indicate that blockchains can help consumers be better informed and trust the food they eat more. This

Fairfood
Mauritskade 64
1092 AD Amsterdam
Tel: +31 (0) 6 4157 6980
Email: marten@fairfood.nl

will help them make the switch to more sustainable food.

> *Agricultural sustainability doesn't depend on agritechnology. To believe it does is to put the emphasis on the wrong bit of 'agriculture.' What sustainability depends on isn't agri- so much as culture.*

5. The need for inclusive food blockchains

Virtually everyone – from Paris Hilton to small NGOs (…) – is jumping on the blockchain bandwagon these days. Thousands of blockchain start-ups are working hard to develop tools for their new users, most with grand visions and good intentions. But however idealistic the people behind these initiatives are, the explosive valuation of Bitcoin and Initial Coin Offerings (ICOs) have shown that the domain is **vulnerable** to perverse triggers, overvaluation, bubbles and crashes. If they survive the coming 'Trough Of Disillusionment' (Hype Cycle), some initiatives will eventually become businesses that need revenue and investment to survive. This means that as soon as working tools have been developed and paths to cash have been identified, paywalls go up and openness could disappear to the point where this revolutionary technology may well become **unaffordable** to the ones who need its benefits most.

Commercial food supply chain models typically start at the supplier level and end with retail, excluding farmers and consumers. Consequently, we don't expect commercial applications of blockchain technology to include farmers and consumers. But blockchains, more so than other technologies, should be **open and accessible** to all. That's what they represent in their code: decentralisation, disintermediation, openness, trust. We think that the people who make our food, the quality of our food itself, and ultimately the future of our food system as a whole, will be best served by an open, inclusive approach to this vital new technology. In other words, what our food system needs are **inclusive food blockchains.**

Hundreds of millions of **smallholder farmers** will have a stronger position in such an inclusive system, because they'll not only control the creation of (physical) products themselves, but also the (digital) information about products. This strengthens their position to bypass unnecessary middlemen, chose who to sell to and negotiate better prices. Other actors will benefit too. In exchange for sharing product data, **producers** and **retailers** gain the data from other chain participants. By having more – and more reliable – information about products, they can make efficiency gains that are impossible to achieve in opaque supply chains. Finally, **consumers** have a lot to gain from such a system. By checking the digital passports of their food products, they could see entire product histories and verify if they match their consumption preferences. By filtering their food purchases accordingly, consumers can make the switch towards more sustainable food choices more easily.

Although this high-tech **vision** for our food system may seem futuristic, overly

Fairfood
Mauritskade 64
1092 AD Amsterdam
Tel: +31 (0) 6 4157 6980
Email: marten@fairfood.nl

simplistic and even unrealistic to some, a version of this future has already started to take shape. How sustainable that version will end up being is the question.

> *Today we are seeing best practices in action. We know that, if scaled up with speed, these approaches could increase food production and improve livelihoods without damaging the environment. We need to create conditions for **innovation** and then invest so that innovation moves from the lab to the farmer's fields.*

6. Conclusion

Fairfood sees great potential in the application of blockchain technology in food supply chains. The combination of blockchains, mobile phones, sensors and smart tags, presents a **unique opportunity** to make food supply chains more transparent, efficient and inclusive. We think blockchains will fundamentally change the way the food system works, so it is hard to overstate the scale of this opportunity and, as a consequence, the urgency and importance of taking a position and choosing direction now. As an organisation whose mission it is to improve the livelihoods of farmers and food workers at the base of the food pyramid, we believe it is key for us to influence the development of food blockchains so that it will benefit those who need it most. For us that means that farmers and consumers should have access to blockchain tools that help make our food future-proof. Fairfood will work towards this end, **towards inclusive blockchains for food.**

In our product **campaigns**, we will aim to strengthen the stakeholder ecosystem for blockchains in food. We'll help consumers see the potential advantages and will help industry stakeholders decide if and how to apply the technology themselves. With continuous **research** into the subject, we will build and share our knowledge base about this new technology. This way our team's knowledge base will grow and be made available to others outside our team. In our **projects,** we will partner with businesses and other organisations to develop and apply blockchains to more, larger and more complex supply chains, to form a tried and tested idea of how blockchains for food should ideally look.

We think the potential of blockchains is huge. We're seeing the beginning of a new way to generate trust that will innovate and potentially disrupt our food system. We're seeing massive challenges ahead that we can't and don't want to take up alone. Luckily, there's a growing movement here in the Netherlands and abroad. Together with key stakeholders we plan to take up the challenge to build inclusive food blockchains and get them ready for adoption. Time is of the essence though. This technology is developing incredibly fast and to make sure that blockchains will be used to the benefit of all, we need to act now, together.

Marten van Gils, blockchain program manager @ Fairfood