

Blockchain to restore trust in food supply chains?

A case study in the cacao sector of Costa Rica

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When it comes to food, our demands are high. We want good quality food, sustainably grown, locally sourced, fairly traded and if possible, a bit affordable. But reality is tough: the social and ecological impact of food production remains unabatedly high, while transparency and accountability are clearly insufficient to change course. Blockchain technology is increasingly being proposed to bring about trust and transparency to arrive at a fair and sustainable food system. But does this hypothesis hold? What other options could we imagine to restore trust and design participatory models in the food system? This article dives into the case of Costa Rican cacao to find out.

Chocolate is one of the most desired and popular products in the world, representing a [100 billion dollar](#) global industry. The Netherlands are a key player when it comes to the production of chocolate, but it all starts with the production of cacao — the bean at the base of your chocolate bar. Cacao originates from the Americas, but the main production has shifted to Western Africa, which currently accounts for two thirds of the total production of cacao. The increasing number of cacao-producing countries has resulted in the collapse of the world market price for cacao, a decrease of 30-40% over the past year ([Fountain and Huetz-Adams, 2018](#)). Because of the high demand for cacao and low prices, its production is having a big impact on deforestation and biodiversity loss, while farmers struggle to subsist. A lack of governmental enforcement of protected areas has already caused a total loss of over [90 percent](#) of West Africa's native forests, creating a huge bottleneck for sustainable production. New trade systems must make their entrance in the cacao chain to safeguard forests and ensure that fair shares will be paid to farmers. In this article, I search for new trade systems for food supply chains that operate differently from the conventional systems, in an attempt to ultimately make supply chains more sustainable, transparent and fair. To provide a basis for this examination, I will present a case study on cacao production in the Osa Peninsula of Costa Rica.

Below, both current and emerging trade systems will be examined through the lens of *trust*. At first, trust might seem quite trivial, but trust is essential when we aspire to improve our economic interactions and impacts. How do we trust? And what are the effects of trust and distrust in systems of trade? In supply chains, a range of intermediaries is required to control

the functioning of the system, but due to their huge number it is difficult to keep an overview of the involved actors and their activities. Instead of securing trust, this has resulted in a lack of transparency surrounding the origin of the products we buy. In the last couple of years, blockchain has increasingly been proposed as *the* solution in food supply chains as an immutable system to generate truly fair products. But are we going to put our trust in new technologies, or is it possible to change supply chains by developing a social variant in the form of direct trade?

A brief introduction to trust

Three significant forms of trust can be distinguished in society; interpersonal, institutional, and – this is a technical novelty – distributed trust (Khodyakov, 2007; [Botsman, 2016](#)). Interpersonal or basic trust is built around strong emotional relationships between people, with foundations in familiarity and similarity. Khodyakov also discusses the presence of thin interpersonal trust in which trust is built on weak ties and relies upon reputation. With the arrival of institutions, trust has been shifting to black box systems of authority: large bureaucracies and corporations that do not personally know the individuals in their constituency (Botsman, 2016; Fukuyama, 1995; Giddens, 1990; Khodyakov, 2007), but which have administrative methods to validate claims — a phenomenon known as impersonal trust. According to Rachel Botsman, we now need to shift away from institutional trust, which does not fit the digital age. For her, digitalisation forces us to rethink how trust is built, managed, lost and repaired, by creating a trust shift through technology. This is distributed trust, which focuses on providing transparency, connectivity and accountability, and can, according to Botsman, only accelerate with the

emergence of the blockchain. In her words: "You still have to trust the idea and the platform, but you don't have to trust the other person in the traditional sense."

"Blockchain will transform how we exchange value and whom we trust" - Rachel Botsman

Blockchain explained

In order to appraise the worth of blockchain in giving a new foundation to trust, we need to understand its mechanism. Blockchain can be described as a digital cash book, recording transactions. In contrast to the old cash book system and the newer forms of digital banking via your associated bank, blockchain does not have a central server. It is a decentralized system in which it is possible to record data without it being managed by a higher supervisor or authority (Van de Water, 2018). Each person making use of the system has autonomy over his or her own contributions to the chain. Moreover, blockchains are *immutable*, meaning data cannot be erased, nor be obscured.

To guarantee the safety of the system, all connected computers need to solve an encryption puzzle to check whether the added data meets the requirements before it can get approved to the chain, so-called *hashing*. Each computer independently controls a part of the data; the computers are not required to trust each other. Only if the majority of the computers approve the data will it be bundled in a valid block and connected to previously validated blocks in the system. After this, the data can be transferred. Because all of the computers need to cooperate, it should be impossible to forge data in the blockchain (Van de Water, 2018).

The aim of using blockchain technology in the food supply chain is to fulfil the desire of a traceable, transparent and interoperable system to be able to generate truly fair products. This can be done by synchronizing the flows of resources through the chain of both materials and cash (Hunink, 2018). With the characteristic of a blockchain being immutable and trusted, fewer intermediaries need to be involved in the chain, thereby ensuring that consumer prices will not or hardly rise compared to other systems. In this way, consumers will be able to trace the products they buy from start to finish (Brand, 2018), not only creating consumer awareness about the background of the products they use, but also generating consumer trust in the sense that they are sure the product they buy is produced in a sustainable way and for a fair price. Additionally, blockchain applications could eliminate uncertainty for farmers in a way that they receive faster payment and fair prices for their products

(Jones, 2018), making them more economically independent, and creating stable livelihoods for them and their families.

Blockchain and trust

Blockchain, however, can also be used for other purposes depending on someone's desires. Guido van Staveren van Dijk of Moyee Coffee gives an example of using blockchain for risk analyses. This helps him create a bankable supply chain, which can be useful for small businesses with limited access to funds. [Moyee Coffee](#) is the first *fair chain* blockchain coffee company, with the goal of creating inclusive business models with positive impact. They claim blockchain helps them improve coffee farmers' livelihoods and receive funding to continue their mission. In other words, they generate trust towards the actors in the chain by registering the added value in each stage of the process in the blockchain. By doing this Moyee is able to prove demonstrable impact in the coffee supply chain and provide producers with a fair share of the profits. Without data captured in a blockchain, it would be very difficult for small businesses to overcome the burden of doubt in order to receive funding, Van Staveren van Dijk states.

"With blockchain we go from storytelling, to story doing, to story proving"
- Guido van Staveren van Dijk

But when exactly should one engage in blockchain implementation? According to Nick van Nispen, graduate in the field of blockchain at Rabobank, it is necessary to ask yourself three questions before starting to apply blockchain in supply chains: Is there a need to use a database? Is there a lack of trust between the actors in the supply chain? And lastly, is there a lack of third parties who can create trust between the actors? If all questions are answered with Yes, then blockchain could become applicable. Otherwise there might be other, simpler, technologies that could help out. As mentioned previously, blockchain is a means of automating and storing data, agreements or contracts in a transparent and incorruptible way. This can be useful when dealing with corrupt governments, for example during elections in which blockchain can capture and secure each vote by hashing them into the chain. But this can also be applicable for agricultural supply chains, when there is a need for a database to capture quantities, price agreements and payments, or conduct data collection on product quality and certificates, smart contracts, and so on. When all of these data are stored on a blockchain, it becomes possible to work on chain optimization, restructuring the chain and eliminating superfluous intermediary actors due to the increased transparency in the

supply chain. As a result, each actor can be given a fair price while keeping the end price the same, or so the thinking goes.

Blockchain technology sounds promising, and if it keeps developing in the direction it is right now, experts predict blockchain to become the biggest thing since the introduction of the Internet. But, like with most developments, sceptics have arisen. Some say it is just a hype, and "it will not live longer than a hamster" (Bodó in Van Hall, 2018). And there is the problem of inefficiency. Of Bitcoin, which is built upon blockchain technology, the total energy consumption of the network has been similar to the yearly energy consumption of Austria ([72 TWh in 2017](#)). For all of the flashiness that accompanies blockchain, it actually appears to be very slow and energy-consuming.

"If there is any problem, put a Blockchain on it and suddenly your data will be valid" - Stinchcombe (2018).

And for all of the talk about blockchain being incorruptible and waterproof, any application that deals with real life situations requires additional technologies or protocols to make it work. For example, how can blockchain guarantee the quality of a food product? The blockchain itself is not a quality sensor. Any quality information communicated via a blockchain originates from sources and procedures of which the trustworthiness should be established separately.

We find an example of such a procedure at Moyee Coffee. Moyee is implementing an application to take over data collection and checking before it is put on the blockchain. "Because blockchain is hopeless and very inflexible when mistakes are being made", according to Van Staveren van Dijk. Moyee is going to create digital wallets and IDs for the farmers, which are connected to the blockchain and help to ensure that all human errors are ironed out before information is added to the blockchain, making paperwork superfluous. These wallets and IDs will be linked to mobile payment systems for the farmer so that they can withdraw physical money. While blockchain seems to facilitate demonstrable impact in the fair chain, a significant bundle of additional technologies – sensors, applications and so on –, is needed to make the tool perform and provide the promised trust. Food chains are not only data-driven and blockchain itself is not a quality sensor. Any information communicated via a blockchain originates from sources and procedures of which the trustworthiness should be established separately.

We shift our trust in institutions to trust in technologies, technologies most of us don't even understand.

Perhaps adding to the confusion, blockchain is formally referred to as a *trustless* system since it is based on distributed cryptographic proofs for validity of data, such as transactions and claims. In other words, technology is meant to substitute the bureaucratic security of institutions or the social bonds of local communities, and this is considered a major selling point of blockchain technology. It is doubtful, however, that technology could ever replace human systems for trust and reciprocity. Can we really have faith in technical security, knowing that all encryptions someday can be cracked? If we trust a blockchain, does that mean we also trust the *architect* of the blockchain? There is no need for blockchain to guarantee transparency and security if it is managed by a small group of (influential) people with their own special interests (Tempelhof in [Prisco, 2016](#)). The question then is: Who is controlling the data before it is put into the blockchain mechanism? If false information is added to the chain, the added information remains false regardless of how many computers validate that data. Blockchain cannot make the data accurate or make the people entering the data trustworthy ([Stinchcombe, 2018](#)). As explained by Van Staveren, "One could still put a gun to the farmer's head and tell him to record that they were paid a twenty percent fair share." But he adds to that, "false information can easily be detected, blockchain is the best lie detector." That is because it is impossible to change information in the blockchain after it has been confirmed.

In order to make a system trustworthy, there is a need for trustworthy people. [O'Dwyer \(2017\)](#) adds that there is a need for the inclusion of community organisation, instead of putting all our trust in software. There are many *human* possibilities available which are democratic and provide security. These possibilities rely on collaboration and cooperation as social *glue* between people and organisations. Think of building cooperatives, network organisations and community platforms. These approaches seek to build *high* trust, instead of eliminating trust in society by using a software substitute. From that perspective, I will introduce the concept of the *commons* as an alternative framework to rebuild trust in trade systems, and explore the possibilities of *direct trade* as practical implementation.

The commons and direct trade: a different system to restore trust?

When talking about the [commons](#), we generally refer to shared resources managed by a community for the benefit of all. However, often there are agreed upon rules for use of the resources. Through the concept of the commons, we might be able to create transparent food chains based on high trust models. (Local) food chains can be interpreted as common pool resources being *collectively owned* by its stakeholders ([Laats, 2017](#)). This approach adapts well to the growing trend of producers, entrepreneurs and consumers who want more drastic changes in all parts of the food chain, resulting in new, *direct* food chains in which human relationships and factors such as trust, reciprocity and transparency determine its success. The focus of direct trade is more on the quality of life and collective action instead of merely on economic growth.

In the paradigm of modernization and industrialization, food chains follow Hardin's reasoning of the *tragedy of the commons* and consider collective action as a non-efficient way of production. Also, conventional economics does not consider human contact as one of the major values of the value chain. This economy, however, induced a countermovement of consumers who increasingly wish to know the origin and destination of the products they buy. Most direct food chains refer to regional products, in which consumers know (in person) who the producers and other actors of the food chain are. However, this same transparency is now also being demanded of exotic products like coffee and cacao.

The appreciation regarding the origin of cacao and chocolate has a direct connection with fine favour. In parallel, many customers also increasingly give importance to sustainability and fair incomes for the farmers. There is an increasing movement of cacao producers, chocolate makers, distributors, and retailers who jointly promote this sustainable, fair and fine flavour craft product under the name *bean to bar chocolate*. However, since this term is not always used in the same way, we will refer to *direct trade chocolate*.

Direct trade chocolate is produced on a small scale from farm-specific cacao, as opposed to the industrially produced chocolate from cacao of mixed origins that is bought at the world market. With *direct trade*, we refer to cacao that is directly bought from cacao farmers. Because of this, direct trade goes further than Fairtrade and organic certified systems, who make use of bulk cacao for their products. The ambition of direct

trade is in line with traceability and transparency in the supply chain, but without turning immediately to technological fixes. Together with existing traceability systems, direct trade can demonstrate and communicate the activities in the cacao chain from original resources to end products, and guarantee fair prices for each phase in the supply chain. In this way, it is possible to provide a resilient system with stable incomes for cacao farmers, and it becomes possible for farmers to focus on traceability, sustainable production, and knowledge accumulation through direct sourcing.

Commons in practice: Latin American co-operatives

Considering the promises of blockchain and direct trade – both promoting better livelihood situations for farmers along with sustainability, transparency, and the concept of a fair chain – I have spoken with [Osacoop](#), a farmers' cooperative in the [Osa Peninsula](#) of Costa Rica, who are active in cacao production. Which problems do they face in their current way of organising, and what are their needs and wishes? Can one of these two trade systems support their activities?

The primary problem faced by farmers is that they receive a very low price for their cacao. The price decline of cacao is corroborated by the [2018 Cacao Barometer](#), indicating that "farmers currently bear the risks of a volatile price, and there is no concerted effort by industry or governments to alleviate even a part of the burden of this income shock" ([Fountain and Huetz-Adams, 2018](#)).

Costa Rica is one of the most biodiverse countries in the world, accounting for nearly [6 percent](#) of the world's biodiversity cover. To preserve this, the government established numerous National Parks and Reserves guided by strong conservation policies. The Osa Peninsula in Costa Rica is only recently inhabited by farmers. The first people arriving in the late nineteenth century found rugged nature. There were no trails, no farms, and no institutions to set the rules. It took until the 1950s for a group of farmers to settle there, and a second group followed in the 1970s. They had the opportunity to obtain a large area of land to use for production, which was not possible in the areas where they had lived before. Nevertheless, local communities in the region are still struggling for their subsistence. The agricultural sector in this region has dealt with boom and bust cycles of production, being an unstable source of income (Beggs and Moore, 2013). Agricultural stimulation policies introduced by the government have contributed to the ongoing changes in crops cultivated by farmers, who are trying to respond to fluctuating market prices. However, in the last

decade, farmers' opportunities for agricultural land use activities have been influenced by governmental conservation efforts, including the introduction of multiple protected areas. Even though most of the current arable land in the Osa Peninsula is former farmland (Pacheco, 2012) and its use does not jeopardise the current primary forest cover (Potma, 2016), farmers are facing limitations or are being prevented from setting up cash crop production.

This makes it difficult for farmers who live in forested areas to generate a substantial income out of agricultural activities, while for most of them this is the only means to make a living. The complex relationship between nature and humans on the Osa Peninsula requires care and alternative means of production. The prices paid for crops produced in this region should reflect this situation. However, the opposite is true. A lack of guidance for the specific type of sustainable production required in this area, with respect for both ecology and lifestyle, has led to bad cacao quality and low prices compared to countries who attribute less importance to sparing the environment. To compensate for the low prices, farmers must produce more to receive a substantial income, while the opposite (less and sustainable production) is necessary to keep the natural landscape in balance.

“We need to make clear that we have a different price for our products, that the production is complex and much more care is required. Because otherwise we live in a region with a lot of biodiversity but with many poor people” - Osacoop representative

Osacoop is working to incorporate value in their cacao production. According to the Osacoop board, the co-op needs to improve their understanding of cacao production, but also of the process of chocolate-making, in order to produce high quality cacao and ask higher prices. After harvesting, they want to add value by drying, fermenting and grinding the beans, before selling them to the second actor in the chain. It is thought that in this way, more value can be accrued on the farm, and less actors are needed in the chain, so quality can be better guaranteed while prices for consumers do not have to go up.

“When we receive higher prices for good quality cacao that has been produced under sustainable circumstances, it can be done” - Osacoop representative

The cooperative suggests creating a mechanism for traceability and transparency in the chain,

with barcodes and a locally based brand (or [Geographical Indication](#)), so that they can create a traceable impact and give the consumer the opportunity to buy a product of which they know the source and how it is produced. In addition to these benefits for the consumer, the farmer may create a more efficient production process and receive a fair price for their cacao.

When applying this case in the *blockchain for better trade* discussion, it appears to me that the desires described by the cacao farmers comply more with *interpersonal* trust and direct trade than with the shift Rachel Botsman wants to make towards *distributed* trust with the help of blockchain. A form of direct trade could help the farmers in meeting their needs and be able to produce a local chocolate bar with a fair price.

To support farmers in direct trade, cooperatives can offer a way out – taken the example of Costa Rica. When looking at the three different forms of trust, cooperatives could combine the principles of institutional and interpersonal trust, having close relations with the people active in the chain and providing transparency in their production.

Discussion

It can be said that blockchain technology is not the new big *thing* to save us from all our problems, nor a panacea for restoring trust. Using blockchain requires a network of cooperative systems to make the process credible and to safeguard product quality, prices and social agreements. This solution is too complex to restore our trust, and with that we will be drifting further away from our fellow man in society and impersonal trust.

In most cases, blockchain is used as a traceability mechanism, even though it cannot guarantee 100 percent traceability, and plenty of other technologies exist that can be used for *track & trace*. Blockchain its value does not lie in traceability, nor in quality control or trustworthiness. All of the flashiness around blockchain might make one forget that, in the end, it is just a very complex way of storing and securing data. And by using it, new questions will arise, like: who owns the data? And who controls the data before it is put into the blockchain? As underpinned by Van Staveren van Dijk of Moyee Coffee, blockchain might cover 5 percent of the problem, after which problems like privacy, governance, legal issues, taxation and so on, must still be tackled. It is all about how your supply chain is organised. And then, quality, transparency, trust, and efficiency can be reached without a blockchain.

“Instead of directing resources to the elimination of trust, we should direct our resources to the creation of trust, whether we use a long series of sequentially hashed files as our storage medium or not” - Stinchcombe (2018)

We should not allow ourselves to be blinded by the hype around blockchain. There are better ways to establish trust and transparency in the supply chain. The Bean to Bar initiative is a good example of a new interpretation of current supply chain organisation. When we become good at cooperating, we can build trust and be trustworthy instead of putting all our trust in software. A collaboration of cooperatives in a South-North structure will provide stable and trustworthy relationships that also support ecological and economical sustainability,

guaranteeing high quality products in the most efficient way.

Blockchain might have opened the door to thinking about new systems, or looking at existing systems through a different lens. Blockchain could be used to activate large industries to move towards fair(er) business in their supply chain, if they dare open up their chain. Eventually, closed supply chains are going to increase distrust from consumers, so that businesses will have to redirect their resources to the creation of trust and fair chains in order to stay in the game. To really make a difference in fair supply chains, we need to change the conventional system by moving towards direct trade and short supply chains.

About this research:

Waag, Cacao Museum Amsterdam and Cross-Cultural Bridges work together to develop the concept of a South-North commons in the cacao chain under the title Bean to Bar Co-op. The Bean to Bar Co-op builds on newly formed commons principles, providing improved production- and consumption systems with more authority for, and knowledge accumulation among, small producers and consumers at both ends of the chain. Through a South-North structure equality between actors in the cooperative can be pursued effectively and convincingly. With this co-op, we want to raise awareness for transparency in the cacao chain. Subscribe to the Waag [newsletter](#) to follow its developments.

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