

FOOD SUPPLY CHAIN 2.0

A VISION PAPER ABOUT THE FUNDAMENTAL DEFICIENCIES AND CHALLENGES OF FOOD SUPPLY CHAINS AND FOOD MARKETS TODAY, AND THE TRANSFORMATIVE FORCES THAT CAN BE UNLEASHED BY THE FOODCOIN ECOSYSTEM TOMORROW



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Food is something everyone, everywhere needs at all times. Food provides the necessary nutrition for growth, health and the intellectual abilities of all humans. The quality, safety and origins of food directly influence our physiological and mental wellbeing. And yet despite the vital importance of food, the global system of food production and distribution does not adequately serve the needs of our society. Consumers are in the dark about what they actually eat; farmers are forced to adopt the cheapest agricultural techniques, ones that often pose health risks, and are then squeezed out of profits; large manufacturers are primarily concerned with maintaining market share and are concerned with food safety only to the extent that it protects them from legal liabilities; food scandals with mislabelling, fraud, contamination or unclear origins are increasing every year; supply chain networks are prone to risks of non-payment and malpractice, and are dominated by a small, collusive group of intermediaries who pay minimal prices to suppliers and charge a significant premium to end clients; various ingredients are widely used in food processing that have been linked to increased incidence of cancer, heart disease, diabetes and other potentially terminal diseases, yet due to strong lobbying by the industry and paid research groups these ingredients continue to be used while people remain unaware of their serious risks.

The good news is that the state of technology today allows for a bold rethinking of how global food supply chains and markets could operate. A system of interconnected quality assurance sensors can reliably record the entire history of food from farm to fork; blockchain can protect the integrity and verifiability of sensor data; while smart contracts can enable automatic governance of food supply chains and manage commercial relationships between the different actors within them. Coupled with the dynamic ecosystem of complementing technologies and protocols developed within and around the Ethereum ecosystem, we can envision – and build – a thriving food vertical that will create value for all stakeholders participating in the food sector.

The combination of the maturity of the technology, the brainpower and creativity of participating actors and the clear opportunity to build a bridge between Ethereum and the food sector led to the development of the Food Supply

Chain 2.0 vision. Our cryptocurrency, FoodCoin, is an ERC20-standard token that will serve as the fuel and incentive mechanism for early growth and adoption of the network and will permit creation of the world's first publicly verifiable and community-driven system to assure the quality, safety and origins of food and to create a range of valuable services around this core proposition, such as peer-to-peer marketplaces, smart contract-powered supply chain management tools, a quality-assured commodities exchange platform, consumer-oriented mobile apps to check quality of food, commission-free food delivery platforms, predictive data analytics for food supply chains as well as other solutions whose diversity and scope is limited only by the creativity of the participating actors.

This paper serves as a general introduction to our Food Supply Chain 2.0 vision and will outline the main challenges we need to tackle, the objectives for the FoodCoin ecosystem and the proposed technological solutions. This paper is aimed at the general reader and is therefore non-technical by intention. We will be complementing this paper with a series of in-depth technical documents on hardware, software and protocols, as well as detailed case-study analyses based on projects we have completed in the domain of food quality assurance. More about the team and our partners can be found at the bottom of the document or at www.foodblockchain.xyz/about.

I. BROKEN CHAINS AND DISTORTED MARKETS

The key problems with food supply chains and markets are briefly outlined above. Below, we will attempt to identify the main characteristics whose combination created the many perverse incentives, inefficiencies and malpractices that have been persistently reducing the total value that the global economy could derive from the food sector:

1. **No insights into individual items:** labels and certificates pertain to the whole line of a product developed by a manufacturer; individual items still run the risk of being below standard, for example due to problems during the distribution or sourcing stages.
2. **Reliance on the honesty and competence of a central party:** governments and companies are the only parties enforcing standards today, meaning consumers must trust them to carry out the proper enforcement of these standards. There is no independent verification tool for consumers to assure them of the internal parameters, processing methods or external storage conditions of their food.
3. **Misleading or incomplete labels:** many labels do not provide full information about the product to the consumer (e.g. consumers who buy products marked BIO / Organic may not realise that these labels do not

guarantee that food is pesticide-free, chemical-free or GMO-free). Labels are also regularly abused, for example through ingredients that are added to the final product that do not conform to norms.

4. **Squeezing out of small and quality producers:** many smaller producers and farmers actually do produce better quality products and follow environmentally-friendly and health-benefitting agricultural practices to a far higher degree than large food processing conglomerates. However, they have no way to demonstrate this fact to consumers, and they struggle with finding prospective customers and selling to them. In the absence of a peer-to-peer marketplace with a reputation system, payment mechanisms and enforceable contracts, market forces will continue working against these producers and their practices.
5. **Fragmentation and opacity of supply chains:** supply chains have become complex, opaque and fragmented, making ingredient tracing, origin authentication and identification of chemical contamination, infestation or poor transportation conditions an impossible task. Lack of tokenisation and effective tracing techniques for food products result in chaotic and murky markets, dominated by a small group of large buyers over whom nobody has control or oversight.
6. **Unsustainable resource use:** socio-environmental factors are largely excluded from pricing considerations today and, despite the push from consumers and civil society groups, there is often lack of insight into the sustainability of food supply chains, including such factors as emission of CO₂, use of resources in production and processing, lack of environmental degradation and fair working practices. Due to lack of insight, performance in sustainability indicators does not currently translate into impact on companies' profits, leading them to use sustainability as a marketing tool, rather than adopting it as a true corporate strategy.

All these characteristics together create a low level of trust in the food system amongst consumers, poor living standards for farmers, low satisfaction amongst intermediaries and caterers and market distortion opportunities for the large intermediaries that benefit from complexity, opaqueness and lack of data.

II. ENTER FOODCOIN

Our mission is to align the global food supply chains and markets with the interests of consumers and farmers. Those people who put their labour into making quality food deserve proper rewards, and those people who pay extra money for quality food deserve proper value for the premium paid. Ultimately, all stakeholders can benefit from the higher total value created by the market for

verifiably better-quality food. Retailers and restaurants sourcing quality products can showcase the origins and quality of their food, which any client can easily check from their mobile phone. Governments can assure compliance by the food industry to norms and standards by monitoring public records and processes recorded on the blockchain. Smart contracts can make commercial relationships between different parties seamless as well as mitigate risks and commercial disputes, allowing suppliers and buyers to enter agreements without having to worry about the reputation or solvency of their counterparty.

The core value proposition of assuring quality, safety and origins of food will be built using the following technologies:

1. **Sensor System:** an interconnected system of sensors performing rapid, non-invasive and non-destructive analysis; composition/structure analysis and external environment assessment constitutes the concept of Comprehensive Food Quality Assurance. The system is modular and may include both own, in-house-developed hardware or legacy hardware that is upgraded via embedded software or middleware to interact with our platform. Sensors can be mobile or stationary. The sensor system traces food and captures quality parameters about food throughout the supply chain, recording them on the blockchain. Further technical details and the range of proposed techniques are described in a separate technical paper.
2. **Blockchain:** relevant quality parameters are recorded on the public Ethereum blockchain, assuring immutability of records and preventing disputes on quality and origins as well as manipulation of data. Large datasets can be stored off-chain, on Swarm or on other distributed storage solutions, while hashes or hashes of hashes are recorded on the blockchain, allowing scalability at little extra cost. Security, identity, communication and storage protocols and solutions already available on Ethereum can be integrated into our solution, allowing cross-operability.
3. **Smart Contracts:** active monitoring of data supplied by sensors and execution based on the inputs received permits smart contracts to perform the function of quality assurance controller and make supply chain monitoring and management an automated process to a large degree. With instant settlement of payments and instant discovery of problems, lengthy disputes and costly recalls can become a thing of the past. We will offer a range of different templates to our initial users to allow people to enter different commercial agreements that are guaranteed to be enforced. We also allow users to define the outcome of violation of contract conditions.
4. **Software:** our users do not have to know how the blockchain or smart contracts work; they simply know they can easily and conveniently create, review, enter and manage various commercial agreements regarding the

purchase and sale of food and stipulate the desired quality conditions. Our UI allows simple and intuitive interaction with the blockchain for consumers and farmers. For enterprises or logistics companies, we have advanced platforms that offer supply chain management tools integrated into the Ethereum blockchain.

5. **Developer Tools:** to build additional valuable services around our core proposition of sensor system and blockchain, we are creating developer tools that will allow the community to create distributed apps (dApps), software plugins, new smart contract templates or tools to create additional functionality for the ecosystem or to enable interoperability with other components of the Ethereum ecosystem. The range of services and apps can be driven by the community. Examples of dApps and solutions already in development will be provided below. Demos and alpha versions of these solutions will be released towards Q4 2017.
6. **Token:** FoodCoin largely serves two key functions: firstly, it creates an incentive model for early adoption and growth of the network by allowing early users and developers to earn FoodCoins while using or improving the network; secondly, it serves as the payment method to access the functionality of the platform. Our goal is to provide consumer-level information and services for free and only charge users with high demand on the system. FoodCoin is thus intended to be the cryptocurrency that guarantees the quality of your food.

By offering developer tools and FoodCoin as the instruments and incentives necessary to allow community-driven development of Food Supply Chain 2.0, we aim to create a vibrant ecosystem of useful tools, solutions and applications that can make life better for different stakeholders involved in the food sector. While the variety of possible applications is limitless, below we offer insights into the solutions we are already developing:

1. **P2P Marketplace:** any two or more parties can enter purchase and delivery agreements that stipulate price, quantity and quality conditions. Agreements are deployed on the blockchain and are executed based on conformity to quality requirements. In case of breach of contract, possible outcomes include reimbursement, discount, sale of contract to second-best buyer, insurance claim or human intervention.
2. **Dashboard for Supply Chain Management:** complete overview of orders, contracts on offer and contracts entered; dynamic overview of delivery status and quality parameters; management of staff members and their contracts; multi-currency-supported wallets; profiles for company and users; ability to create invoices and convert data to legacy systems.

3. **Food Checker App:** consumers can scan their food packaging (QR-Code, smart-tag, RFID or unique code) and get a quick overview of the whole history of a particular product, including quality parameters, origins and quality assurance. Users can choose filters or set preferences that enable a traffic light system, with a green light informing them that all of their requirements have been satisfied, and a red one indicating that the minimum safety, quality or sustainability requirements of the user have not been met.
4. **Interactive Reputation System:** if certain farmers or businesses consistently deliver excellent value to consumers they can award them reputation points in recognition of the great quality of the products. This creates better discovery opportunities for quality manufacturers. Consumers can reward producers not only for how tasty their food is, but also how good their health or sustainability indicators are, fostering better practices amongst competing food producers. Consumers can also explore the profile of the farm where the food came from and interact with the producers of their food. This can create a relationship between consumers and their food in ways not imaginable before.
5. **Dynamic Contract Rerouting:** an order book where people place orders for food items with quantity X, price Y and acceptable quality Z. If Client A rejects a contract due to quality falling below $0.9Z$, Client B may automatically purchase food with quality $0.85Z$ for a price of $0.7Y$. A specific example could be a dog food company purchasing meat that was not properly delivered to a shop, resulting in contract rejection. This solution can prevent food waste and allow value recovery for sub-quality food.
6. **Loyalty System for Customers:** people buying quality food verified by FoodBlockchain could receive FoodCoins for their loyalty. They can then redeem FoodCoins for other valuable services delivered by the ecosystem or for rewards offered directly by participating shops and restaurants. This will encourage early adoption amongst food-conscious consumers.
7. **Digital Cooperatives and Matchmaking with Logistics Companies:** this is an extension of the marketplace solution. It allows farmers producing quality food products to discover other producers nearby and create digital cooperatives, whereby they would be able to offer their produce collectively in bulk, allowing them to find larger customers and to have better negotiating power. Once the agreement between a digital cooperative and buyer(s) takes place, the order is then open for bidding by logistics companies who could offer to deliver the order. Selection of the winning bid could be done based on price, quality of delivery or sustainability indicators, allowing dynamic peer-to-peer marketplaces for food.

8. **Food Delivery Platform without the Middle-Man:** restaurants participating in FoodBlockchain that serve meals with quality assured by the blockchain may have customers wishing to order their food for takeaway. Today there are several services that aggregate food orders and then find contractors to deliver the orders on bike or scooter. In the process, these matchmakers take a significant commission for every delivery, while those actually delivering the food get paid a very low hourly rate. With FoodBlockchain, food orders with partner restaurants and cafes could be placed through the decentralised marketplace and customers could pay the delivery people directly without passing through the middle man. FoodBlockchain will provide the necessary infrastructure to make this solution operational and allow workers in the food delivery industry to receive a fairer wage and eliminate profit capturing by the middle man. Everyone else participating in food delivery markets will receive more utility and keep a higher financial value from the transactions. Following the execution of transactions feedback can be left for the restaurant.
9. **Data Visualisation, Data Analytics, Predictive Analytics:** sensors will generate a lot of data pertaining to supply chains, stock, and distribution of food. There is scope to develop software that utilises this data to bring additional value to firms. Examples include visualising data from sensors to allow for better operational decisions, data analytics tools to make supply chain management more efficient and predictive analytics that could automatically order certain products or inform of shortages in advance, allowing smooth operation of the supply chains.
10. **Farmers' Fund:** Farmers' Fund is a smart contract that will contain a certain percentage of the total FoodCoins to which nobody would have access for a certain period of time. The purpose of the Farmers' Fund is for FoodCoins to serve as collateral for micro-loans that could be provided to low-income farmers from developing countries, who normally do not have access to financial programmes. This could involve social lending or ethical financing aspects. Those farmers who repay the loans help maintain or increase the value of Farmers' Fund. If any farmers face difficulties or are otherwise unable to repay, the debt can be restructured, or in completely adverse circumstances (death, disability, natural disaster) completely forgiven. In that case part of the FoodCoins from the Fund will be sold to repay the providers of the financing. Replenishing of the Farmers' Fund can then be at the discretion of the community, which may donate FoodCoins to the Farmers' Fund to enable its continued existence and provision of social benefits.
11. **Quality-assured Commodities Exchange Platform:** we aim to create a new class of assets: agricultural commodities and food contracts with guaranteed quality assurance. Instead of buying and selling one tonne of

wheat with no information about it, participants in the exchange could trade contracts coupled with certificates of assurance issued on the blockchain. One tonne of GMO-free wheat from a protected area and with clear provenance can be priced differently to one tonne of GMO containing wheat coming from a polluted environment. Our exchange will enable trustless exchange of assets without the need to register on the platform or download software. It will support multiple blockchains/cryptocurrencies. Further technical details about the exchange platform will also be released in a separate technical paper.

12. **Integration of Insurance Services:** in any transaction, all parties to a contract wish to be protected against adverse circumstances (e.g. crop sickness, lost shipment, breakdown of production lines, product recalls, etc.). Insurance funds typically function due to significant data and statistical insights. With FoodBlockchain the level of insights into the supply chain and quality data from sensors in a unified system would be significant enough to provide insurance services to farmers or parties to supply chain commercial transactions. Both parties in any transaction can pay a small fee to the Insurance Fund in exchange for protection against adverse circumstances. Similarly, the Insurance Fund could also hedge against changes in commodity prices, giving more certainty to both the buyers and sellers about the expected prices despite the possible adverse shocks to price. The small fees charged as part of transactions will be allocated to the Fund to hedge against changes to commodity prices. We are open to collaboration or integration of services offered by Etherisc.

Countless other applications can be envisioned around the food vertical. Our goal is to create a vibrant, community-driven ecosystem that can make use of the core and modules of Food Supply Chain 2.0 to build a better future for the global food markets. We are very much open to collaboration with interested developers, food enthusiasts, farmers and other parties with a stake in the food sector.

Many parts of our ecosystem are being built for people who may not have heard of the blockchain, e.g. consumers checking quality of food or farmers entering peer-to-peer marketplaces. Our goal will be to educate them about the benefits of using our platform (e.g. higher sales for farmers or assured food quality for consumers) and allow easy onboarding and use of our services.

III. OUR TEAM CAN PULL THIS OFF

Team:

- 1) **Dr Stefan Meyer (CTO)** served as Founding Director of EPFL Integrative Food and Nutrition Center, where he built from scratch the largest research consortium on food in Switzerland. Prior to that he served as R&D Project Lead on food quality at Nestle and earlier he was Founder of MHM Microtechnique, where he created two businesses in the industrial sensors domain that he successfully sold to Maersk Group and Perrot GmbH; he served as Scientific Advisor at Vitargent Biotechnologies. Stefan holds a PhD in Food Science from the University of Leeds and is a Member of the Swiss Federal Office of Agriculture.
- 2) **Angel Versetti (CEO)** worked at the United Nations where he launched a global project and led international workshops on investing in new technologies (at 22), became primary published author of a UN publication (at 21) and wrote a research report on nuclear security (at 20). Previously worked part-time at Bloomberg, World Business Dialogue (at 19) and was a legal case-worker at a refugee aid society in London (at 17). An early crypto-investor and former VC advisory firm owner, Angel has been a speaker at Davos, the Vatican, UNESCO and often appears on TV. He has won many awards and holds a Master's in Public Management from Sciences Po Paris.
- 3) **Prof Jean-Paul Sandoz (Lead Engineer, Network)** is a serial inventor of sensor systems. He has 40+ years of work experience in sensor development and calibration and he formerly served as Professor of Electronics and Signal Processing at Haute Ecole ARC.
- 4) **Professor Malcolm J W Povey (Lead Engineer, Sensors)** is a serial inventor and author of 150+ scientific publications and books on food sensors and quality assurance. He co-invented the Cygnus UVM ultrasound velocity meter, the Acoustiscan scanner and the Ultracane blind aid. He serves as Professor of Food Physics at the University of Leeds.
- 5) **Marek Kirejczyk (Lead Developer, Core)** is a serial entrepreneur and Ethereum enthusiast. He was Vice-President of Daftcode where he led engineering teams of 60+ people working on blockchain and artificial intelligence. Before that he was Co-Founder and CTO of El Passion and Aenima, where he also scaled developer teams to 15-20 people. Earlier he served as Software Engineer at Gadu Gadu and TLS-Technologie. He holds an MSc in Computer Science from Warsaw University and VU Amsterdam and is a Certified Scrum Professional.
- 6) **Matthew Roberts (Lead Developer, Exchange)** is a self-taught blockchain programmer and security expert specialising in trustless agreements and smart contracts. He is the inventor of the concepts of

Timechains, Exploitchains and Atomic Storage Contracts, and has worked as Python Developer at decentralized cloud storage startup Storj and also co-founded Coinbend, the first trustless decentralised exchange for trading cryptocurrencies with strangers.

Advisory Board:

- 7) **Dr Fabiola Dionisi (Scientific Advisor)** is the Global R&D Programme Leader at Nestlé, where she has worked since 1993, mainly in food quality assurance. A globally recognised expert in nutrition, she holds an MSc in Food Science and Medicine from the University of Surrey, a PhD in Biotechnology from the University of Milan and a Certificate from the Institute of Food Technologists.
- 8) **Geoff Finch (Strategic Advisor)** is the former CFO of Lockheed Martin Finance Corp (\$18 billion annual deal flow), Vice-President of Finance for VentureStart (\$5 billion joint venture between Lockheed Martin and NASA) and a Lieutenant Commander in the U.S. Coast Guard. Currently, he is a Resident Adviser in infrastructure finance with the U.S. Treasury's Office of Technical Assistance. Graduate of the University of Arizona and Thunderbird School of Global Management.
- 9) **Nicolas Chaudron (Strategic Advisor)** is a Partner at Idinvest, a top-tier VC Fund with over €7 billion under management, where he leads investments in Energies & Smart Cities. He also founded Electranova Capital. He holds degrees from Ecole Normale Supérieure (ENS), College des Ingenieurs and Beijing University as well as an MBA from the Wharton School, the University of Pennsylvania.
- 10) **Satheesh Sudarsan (Strategic Advisor)** is the Director and Head of Product Management at Samsung. Previously, he was the Global Director at Phoenix Technologies, Head of Product Management at Intel and CEO of Circyl. He holds an EMBA from Columbia Business School, the University of California, Berkeley and Stanford University, as well as Engineering degrees from Purdue University and IIT Bombay.
- 11) **Dr Ajay Sethi (Strategic Advisor)** is a Partner at top-tier VC fund Accel. Ajay is the former Director of Engineering at Oracle, COO of Ezetap and CEO of Zeva Software. He holds a BSc in Computer Science from IIT Bombay, a PhD in Distributed Computing from Rice University and a Certificate in Finance from the University of California Berkeley.

12) **Dr Vlad Trifa (IoT Advisor)** is the Founder of Web of Things and Head of Digital Lab at Swisscom. He has designed and built large-scale IoT platforms used by Fortune 100 companies (Coca Cola, Unilever, LVMH, GE). Previously co-founder at EVERYTHING and Research Associate at MIT and UCLA. He holds a PhD and MSc in Computer Science from ETH Zurich and EPFL.

Supporting Partners:

13) **Tom Lyons (Marketing)** is the Chairman of the Communications Working Group at the Crypto Valley Association and Owner of Lyons Communications, a boutique communications agency focused on emerging technologies. Prior to opening his own business, he had an over 20-year career in marketing and communications in the financial services industry, including at UBS, Credit Suisse and Clariden Bank. Holds a BA in Comparative Literature from Columbia University in New York.

14) **MME (Legal)** is the Swiss law firm that created the legal framework for ICOs in Switzerland.

15) **EPFL Innovation Park (Operations)** is the leading Swiss technology cluster located on campus of EPFL (Swiss Federal Institute of Technology in Lausanne), which is consistently ranked among top-5 engineering schools in Europe.

16) **Department of Economic Development, Government of Canton of Vaud, Switzerland (Financing)** is the branch of the government responsible for support of the businesses with strategic interest for the region.

We are looking forward to public feedback on our proposal and are looking forward to criticisms, suggestions, collaboration offers or any other proposals. You can contact us through our web-page foodblockchain.xyz, where you can find our contact details. Our technical brochures and supplementing documents will be made available throughout the summer of 2017. Interested parties can request to be added to the Google Doc of our technical white paper for the hardware, protocol and software as well as for the exchange platform.

Many thanks for your attention.

FoodBlockchain.XYZ Team