

The Blockchain of Food



ripe.io, a start-up at the forefront of creating a blockchain solution for our food system was a recent participant at The Mixing Bowl's FOOD IT: Fork to Farm and recognized as one of Forbes' Top 25 Most Innovative Ag-Tech Start-ups of 2017. Raja, their CEO, has compiled and written with his team, the following perspective and analysis on how to initiate, gain adoption and run a "Blockchain of Food" in the food supply chain. We would like to share it with you.

Theme 1 - Blockchain Participants' Friction

The actors interested to participate in the "Blockchain of Food" are driven by a need to demonstrate the superior quality of their methods and products. Most of the participants in the supply chain complain about the lack of transparency and trust by other participants. The participants are asking for a better supply-chain collaboration method. The blockchain can provide this... if they are willing to collaborate.

Farmers:

- The lynchpin of the food supply have little visibility to the end-consumer; little to no ability to differentiate product; and have little to no incentive to adopt better but more costly farming methods if the added value cannot be communicated up the chain and monetized. The Blockchain of Food could give a voice and new distribution opportunities to these farmers.
- Produce farmers generally sit on 20% unused land capacity, and they routinely compost about 10% of their output at peak season. The business case for farmers to embrace blockchain is to find a market for their produce. We know there is such a market because new players all along the downstream chain are supply-constrained (consumers, retailers, new wave foodservice or restaurant chains like Sweetgreen, Mixt or delivery services such as HelloFresh or Blue Apron), but neither the selling, nor the buying side has access

to the infrastructure required to make it happen. The blockchain will enable the birth of this new real-time, local produce market by enabling transparency for evidence of quality (freshness, taste, safety) traceability (for risk management and brand integrity), food sustainability with fair incentives from buyer to grower, combating food fraud and regulatory compliance. The blockchain is enabling supply chain transparency and providing access to data that was otherwise not available creating a path to shrink the supply chain to the farmer.

Distributors:

- These entities rely on verbal assertions from farmers while being under pressure from processors and buyers to provide more transparency to the origin of the product (product type, farming practices, harvest date, treatment information, fair-trade, certifications, etc.). Distributors are also exposed to risks related to changing supply or demand.
- Distributors are pressured by their consumers to source more local farm product but are constrained by the farmers' inability to supply them. The blockchain will give them access to new, or in the vernacular of finance, "IPO-ed" produce by farmers. The jury is very much out on whether they want to move into this new, more local and sustainable world. We view distributors and brokers as the predictor of the long-term adoption of our blockchain. We believe that eventually they will have no choice but to adopt, but will be slow and reluctant to do so. For example, in one of ripe.io's recent IOT-blockchain pilot to determine flavor profiles and quality of tomatoes, we had a motivated, regional distributor participating. Their customer, "the buyer", encouraged them to modify certain elements of their workflow practices to support this effort including non-standard farm pick up times, segregated storage and transport of produce, and even discussing transport logs for food mile calculations- and they did. This is an indication of what could drive adoption – supporting their buyers.

Packers:

- Packers could increase their value in the chain through the use of smarter containers with a blockchain identity, product labeling, and with other measurements or assertions about the food at the time of packing, packinghouse location, practices, etc. These are also valuable pieces of information for actors up the chain. The Blockchain of Food provides a communication channel for the packer to document their value to the supply chain, which in turn adds value to the shared data that will ultimately fulfill on transparency goals.
- As with the large distributors, packers who are part of the established high volume food industry, won't adopt until forced to or there are new innovative entrants into this market for a new, local-out blockchain implementations.

Processors:

- Food processors often struggle to validate the origin of their input products (ex: Campbell's with hormone-free chicken). Consumer trust in the quality of a processed product depends on the ability of the processor to communicate not only processing data

but also origin information about the product, which implies robust traceability and transparency to the grower in virtually instances. The economics of this requirement, today, is prohibitive let alone the ability to motivate growers to connect and provide this information to processes. Processors are rightfully very guarded when it comes to sharing their practices and methods; the Blockchain of Food allows the grower and processor to share information with another privately and securely but also have the supply chain validate this information without necessarily violating individual entity trust. An example of this is a vegan hamburger restaurant that buys their buns from a local bakery using the Blockchain of Food. The baker uses the Blockchain of Food to make a public assertion that the buns are vegan. The restaurant posts a smart contract (self executing code uniquely using data on the blockchain) that is programmed to identify non-vegan ingredients. The baker privately exposes their list of ingredients as evidence to the restaurant's smart contract. Seeing the list of ingredients the smart contract can certify the baker's claims, thus reinforcing these assertions in the mind of the consumer. The smart contract continues to monitor this list of ingredients for every order placed.

- Big food manufacturers (Campbell's, ConAgra) and foodservice companies (Sodexo) will likely take a portfolio approach to adopting the Blockchain of Food by placing their bets widely, or diversify their approach. Obviously they all have major food businesses with legacy systems and processes in place and thus their entire processing network cannot accommodate that. We believe their participation comes from a mix of small pilots based on their innovations groups, small, local, sustainable and healthy brands which play by the new rule and can selectively be our partner (e.g., Bon Appetit division of Compass). The other strategic action for them is to slow things down by joining consortiums, blocking rapid adoption via innovators or just piece-mealing implementations internally. In any of those cases, big food manufacturers will have to plan for a new state of workflow and technology to support a more fresh, local, sustainable food production system. Blockchain allows that transition to be done much more cost effectively than revamping enterprise systems through supply chain cost mutualization for participating in a blockchain.

Grocers:

- Grocers are facing increased competition from online food providers, new retail entrants (Amazon); delivery services, coops and so on. Grocers generally want to provide local options (Kroger's new local web supplier site, or Wegman's using Instacart), but they struggle to coordinate a predictable supply. Premium grocery chains are facing difficulties justifying premium prices to customers who demand more and more transparency and information about their food. Grocers would benefit from the ability to further differentiate premium food options (organic, IPM, Local, Fair Trade, etc.). The Blockchain of Food provides a Web-of-Trust system that allows the participants to evaluate and validate assertions made about our food. This in turn binds the information value provided by local farmers to the claims made by grocers and shared in the blockchain of food to effectively created new, distributed, chain wide, self-certifications of quality, transport, freshness. This is a powerful and potentially transformational activity to help solve for the low levels of consumer trust in their foods.

Restaurants:

- Restaurateurs have a direct relationship with the ultimate consumer. The trend to provide more information about the food they serve (local, organic, free-range) continues to increase. Online ordering and restaurant-specific smart-phone apps further magnify the demand for food data. Consumers are willing to pay significant premiums for food they know is good for them. Smart menus could be connected in real-time with the Blockchain of Food to provide the actual history of specific produce being used on a particular day in the store. This could lead to a potential “holy grail” of food personalization.
- The high-end restaurants certainly are going the farm-to-fork route, but they are probably too small, or have enough influence to “cause” large-scale adoption. The intermediate-sized, fast-growing chains like Sweetgreen, or Boloco and the numerous millennial-centric chains that pop up in major US urban centers are extracting a premium from their consumers for the quality and sustainability of their food, and sooner or later, they will be challenged in authenticating their claims that their food is better. This is what historically happened to Whole Foods.

Traders:

- Traders (Cargill, Bunge, Louis-Dreyfus, etc.) are powerful players that move grain and commodity product across the world, manage vast amounts of data, and are principals in the institutional trading and risk management of all these elements. They have a vested interest in retaining hegemony in managing the commodity business. This means their trading know-how and infrastructure of ports, vessels and predatory pricing relationships with producers can remain the dominant competitive advantage. These entities will likely be first in line to try to coopt the blockchain, as individual enterprises, for their purposes and add it to their infrastructure. Their strategy will likely be one of forcing adoption or leveraging large infrastructure company efforts like SAP or IBM to enable others to connect to their chains. The other aspect that trading houses will be able to implement are their connections into traditional financial exchanges, brokerages and institutional trading markets. There are several large consortium efforts for distributed ledgers and blockchains (R3, Hyperledger, Digital Assets) to engage in derivatives and exchange trading on new, distributed ledger systems, connecting financial risk management in real time to crop and or proteins yield management. This will create new “alpha” trading opportunities for these trading houses based on new shared information on disparate blockchain functions (trading and settlements chains versus food chains.)

Theme 2 - Everything is complex

A food supply chain is indeed very complex. The numerous producers, harvesters, processors, consultants, agents, temporary workers, retailers, who participate in the production of food often only impact a very little portion of the food journey. Such a decentralized process calls for a decentralized solution. The Blockchain of Food simplifies the challenging task of aggregating information from a multitude of actors by providing for one-to-many data integration and process orchestration among participants.

The Blockchain of Food also provides a lexicon and ontology for describing attributes of our food as it moves through the supply chain. This common grammar provides a data structure that is used by smart contracts to automate assertions, certifications, and market operations on the Blockchain of Food.

Any organization can run a blockchain node and become a guardian of the information exchanged on the Blockchain of Food. Indeed, we expect there will be multiple blockchains that will inter-operate with one another. These are drivers that will help the food supply chain organize into more local pods of real time functioning food generation, distribution and efficiency.

Theme 3 - Why share the data?

Sharing data in varying vertical marketplaces, including food, will happen if there is ample evidence of data sharing control and is proportional to a new benefit that results from sharing. In our work with farmers, there is plenty of excitement around data sharing in a blockchain if we enable them to increase their sales through profitable business practices such as increased use of their land and absorption of their end-of-season overflow. Distributors will join for the same reason that they now might have more local produce to sell. Retailers and food service companies would also be able to increase their sales if they have access to more local quality output that come digitized with the lifecycle of that food. The critical element that blockchains must do is to create monetization opportunities with newly, unattained data (i.e. how much fertilizer was used, was there plant disease, excess yield, distributor optimized a delivery route, precision ag practices) that is now available via a blockchain. This is a profound change in current business practices.

An interesting element to the ripe.io blockchain is that when connected to an array of sensors it can capture live growing conditions, transport data and even capture the chemistry make up of produce to determine flavor profiles and ultimately taste. We believe that sensor companies will continue to provide their hardware, cloud hosting, and software analytics solutions to farmers, suppliers, and others along the chain. Their willingness to integrate with the Blockchain of Food comes from their clients wanting to post evidence of the quality of the food produced. For example, if an almond farmer wants to demonstrate to their consumers that their water reduction methods are effective, they will have an interest in posting water meter usage as evidence of their product quality and sustainability assertions. There is untapped value in sharing this information all the way to the producer or buyer.

The value of the Blockchain of Food will only be truly realized if the data collected by the sensors is made available to all across the supply chain and associated ecosystem in its most readable and insightful way. The sensor vendors (Analog Devices, Tek Mahindra, Bosch, Bluestream, Verigo, to name a few) want to deploy their existing relevant sensors into this market and also learn how to optimize them for scalability and reliability. They also want to understand what new sensors are needed for the multitude of different farms, retailers, crop varieties, etc. The quality of the sensors will ultimately dictate the quality/value of the blockchain and the quality of the food we consume. The Blockchain will provide not only a compelling market opportunity for sensors vendors but also an environment where the other

supply chain actors will value those sensors vendors who deliver the sensors that enrich the Blockchain.

Theme 4 - Partial supply chain adoption

The Blockchain of Food does not expect adoption by all participants in a supply chain. That is an unrealistic expectation. It is important that the Blockchain infrastructure is built around the concept of a web-of-trust (described below) which can tolerate visibility gaps in the supply chain. Of course, these gaps also hide information that would be made more valuable if it was exposed and traded on the blockchain.

Example: In this very simple example, a local farmer and restaurant owner are connected with one another on the Blockchain of Food; however, the trucking company is not a member of the Blockchain of Food. At the time of harvest, the farmer makes some assertions about the food (cultivar, practices, harvest date, etc.), and the trucking company picks up the crates. The next visibility point on the blockchain occurs when the produce is received at the restaurant. The restaurant's smart contract, seeing that the shipment was accepted, sends an assertion to the farmer that the delivery is complete. The lack of visibility during transport is a blind spot, but it does not prevent the supply-chain as a whole from benefiting from the system.

Theme 5 - Why a blockchain?

- **Value Proposition #1: Facilitate Communication of Quality.** The Blockchain of Food's number one value proposition is to facilitate the exchange of information, create a digital twin of it and its workflow and validate the quality of food as it moves along the chain. This is accomplished by allowing each participant to share assertions, evidence, and evaluations of each other's assertions about the food. The food's journey across the supply chain is captured in a blockchain object that we call a Food Bundle. This Food Bundle, at the end of the journey, is the sum of all the information contributed by disparate actors and agents over the lifetime of the food item. This information can then be used to establish the provenance, quality, sustainability, flavor and taste profiles, and many other attributes of the food.
- **Value Proposition #2: Evaluation of Quality Assertions.** Another important role for the Blockchain of Food is the evaluation by network participants of the assertions made by other network participants. For example, a food processor may want to assert that a particular product contains hormone-free chicken. This information is of interest and value to the consumer. By making this assertion on the Blockchain of Food, this company goes beyond traditional product labeling and digitizes this data, which can now be used in other automates systems like a smart-menu, diet planning software, grocery purchasing manager requirements, etc. The food processor can go a step further and ask a certification agency to review their assertions about hormone-free chicken. The certification agency might possibly schedule site visits or sampling tests of the product. If compliant with the assertion, the agency can post a certification on the blockchain of food, further reinforcing the processor's assertions.
- **Value Proposition #3: Information Exchange.** The Blockchain of Food is data hungry. As we have seen, the supply chain already has the need to publish assertions about the

quality of the food produced. However, not all information on the Blockchain of Food is available to the public. Proprietary information, methods, measures, recipes, and other sensitive data can be shared securely with selected participants. In an earlier example, the vegan restaurant's Smart Contract was given momentary access to the bun baker's list of ingredients in order to certify its compliance with vegan requirements. No human ever needs to be given access to the recipe, only a smart contract, coded with instructions that can be reviewed by all parties involved to ensure no duplication is made. Blockchains are, by necessity given their distributed nature, extremely secure systems that always assume the need to protect the ledger against bad actors.

- **Value Proposition #4: Crypto-Tokens.** The Blockchain of Food can also be used to issue and manage the creation of unique cryptographic tokens. These tokens could be made to represent value in escrow between two participants; they could represent future production to be farmed in a particular field lot; or many other possibilities. In fact, we believe that tokens don't need to take the form of value exchange for financial settlements of invoices and contracts. Rather, they represent a license to publish the information that becomes uniquely valued proportional to the needs of others in the chain. For example, the cost of in-field sensors, or drones, or precision spraying equipment is expensive for farmers. Perhaps a token strategy would incentivize growers to publish information generated from these devices and machines with tokens to help defray the cost of buying and implementing them. The strategy around the issuance of these crypto-tokens is still being defined and does not necessarily need to be implemented in the initial system.
- **Value Proposition #5: Smart Contracts and Smart Libraries.** Smart contracts are instructions that interface with the blockchain protocol in order to automatically evaluate and possibly post transactions on the blockchain. In a previous example, a smart contract was used to evaluate the assertion that a particular bread bun is vegan using the list of ingredients as evidence. Other Smart Contracts on the blockchain can use the output of this evaluation as triggers for other actions. Similarly, Smart Libraries are specialized sets of blockchain-aware functionality that can be used locally and privately or shared and licensed to other blockchain participants and agents.
- **Value Proposition #6: Smart Marketplace.** Once again, because of their distributed nature, blockchains are excellent platforms for marketplaces. The biggest application we see is a dynamic, data driven marketplace with a live RFP mechanism to engage participants. The underlying asset could merely be the information itself. This is fundamentally how Google works, bidding against words. The difference here is that buyers and sellers are matched by a shared, but trusted need for that data which then can be combined and used later by either party. This way traceability doesn't have to wait for Walmart and or large company consortiums to employ standards and or semi-mandatory, or concentrated business practices to get to the information. Participants do not need to know or trust one another in order to come together on the Blockchain of Food, smart contracts can evaluate the assertions made on the Blockchain and notify their account holders when matches in quality, timing, quantity, etc. are made.

Even though ecosystem thinking has increasingly become recognized as the foundation of corporate strategy, the transformation process has remained largely artisanal, mostly comprised

of facilitators with flipcharts and markers. The cost of those human interventions is so high that most ecosystem initiatives have tended to collapse under their own weight.

The beauty of blockchain is that it has a chance to be that piece of infrastructure enabling new transactions between players that do not know or trust each other (yet).

About the Author: Raja had a long, successful foreign exchange trading career at the likes of Bank of Boston (BAML), Citi, Silicon Valley Bank and Wells Fargo. In addition, Raja co-founded two venture-funded start-ups to exit. Raja recently was part of the early founding team at the ground breaking financial distributed ledger consortium, R3. Raja had a personal desire to examine how blockchains could help solve for major global problems around food and sustainability and was blessed with co-founding ripe.io with a world class and awesome team!