



Food Traceability Implementation

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Overview

This document provides our experience building a food traceability application in Africa. It is hoped that anyone undertaking a similar endeavor can benefit from our experience. Our traceability application was started around Accra Ghana. Anyone reading this document would need to interpret the results carefully for the region in which they intend to implement similar projects.

The goals of the project were to build a supply chain from bottom and solve some inequities that exist in traditional supply chains. To quote from our project:

“The project is intended to fill the void of supply chain management systems (SCMs) by building systems that address the challenge of providing food provenance while imposing minimal disruption of existing processes and meta-data standards adoption. The project is also a laboratory for testing new ideas and includes risk mitigation for participating farmers so risks are absorbed by us, not the participating small farmers.”

Our solution was to build a supply chain that allowed farmers to enter or at multiple points in particular local spot markets or larger supply chains or organized corporate purchasers - such as superstores.

Supply Chain Management systems are closed systems where sellers sell to a buyers on the system. It is very difficult to leave a Supply Chain Management system because documents and records are kept within the system effectively locking in farmers and forcing them to sell to a limited number of purchasers.

To solve this problem we implemented a DID based system that presents a Self Sovereign Identity philosophy toward trade and farming documents.



Project Initiation

The project was undertaken with the FuixLabs team in Vietnam providing technical support while and Management.

Finding Local Management

A local management team of two individuals was deployed in Accra that monitored the farmers and crops and monitored the progress. We were lucky to find individuals who had agricultural experience and who understood the local agricultural economy and government operations.

The team consisted of an experienced manager familiar with Cardano and a more junior member who visited the farms and held meetings with the farmers weekly.

Lesson 1

It should be noted that individuals should not consider any undertakings without having workers working permanently on the ground.

Recruiting Farmers

Having set up our management we set up meetings with local farmers. Some interesting takeaways is that many farmers don't own their own land but rather purchase vacant land and clear the land to be ready for farming. We consulted with local specialists on how to rehabilitate land that already had been used with chemicals but decided to work with farmers who don't own land.

Lesson 2

Many farmers don't want to use organic farming because it decreases the amount of crops harvested. Using Chemicals is normal way of life.

Farmers were a bit wary at first about not using organic chemicals but were ok when we promised to insure against crop failures,



Farmers hearing our proposition with some skepticism at first

Deciding on a Crop To Plant

We consulted with the farmers on the best crop to grow. During these discussions, we learned that produce prices are very volatile. The price a farmer gets for his crops on the local market can be below the point where buyers will purchase or can be very expensive. The determining factors seem to be amount of crops planted by other farmers, the weather conditions, the quality of the crop and some externalities such as foreign imports.

Lesson 3

Spot agricultural markets can be very volatile. Farmers compensate for the volatility by planting crops with a shorter time to market.



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Each time a farmer plants crops he is taking a large gamble on the market conditions when the crop ripens. Farmers offset the risks by planting crops that ripen quickly and then plant several times a year. Sometimes clearing new land for each crop. We selected a spot of land to clear and made a deal with the owner. We drew up contracts with each farmer and the landowner. The legal contract had a surprising amount of detail.

Lesson 4

Even though many of the farmers had low literacy rates they had a sophisticated understanding of legal contracts. Using legal contracts is useful when working with small landholder farmers so they trust you will pay.



Our Field of Ocra



Working with Ghana Agricultural department

The local agricultural department was sophisticated and very helpful. We retained an agent to visit the farm twice a month and assay for harmful chemicals. The agricultural department charged based on the distance to the local laboratory. The local laboratory was quite sophisticated and the agent was very knowledgeable giving us a broad range of tests on the soil and water and making helpful recommendations. The agent was able to upload images of documents to our DID system using our android App and our web application.

Lesson 5

Government Offices are extremely helpful but short staffed. It is much harder to convince them to travel far from their local office as this could take an entire day for one person. More can be accomplished if the farm is within an hour of the agricultural office.

Lesson 6

Government offices can be very sophisticated on sampling of soil. When asked to certify on the blockchain there were not any concerns they were happy to work with us on putting documents on the blockchain. The agents also had access to android apps and a desktop app.

The Ghana agricultural department was already testing soil for harmful chemical as a matter of course. The farmers observed the testing but did not know what the official was doing.

Lesson 7

A need exists to educate farmers on the documents that are produced by the government and the relevance of the documents to marketing their produce for a higher price.

Clearing and Planting

Land was cleared and planted surprisingly quickly. Most of the farmers were working simultaneously on other plots of land which were far away. It was common for farmers not to be seen for several days and then show up and do an incredible amount of work.

Lesson 8

Farmers keep a schedule that may at first appear disconcerting but it is sometimes necessary for farmers to farm multiple plots and have experience to know when a plot needs their attention.



Finding a Market for Organic Food

We ran a poll on Facebook to see how much locals would pay for Organic Food. The result showed the seriousness of harmful pesticides that are taken. Over half the respondents said they would be willing to pay up to 25% more for organic food.

Lesson 9

The dangers of eating food treated with harmful pesticides is well known and a large concern for locals. Many surveyed users will pay a substantial premium for organically grown food.

As a first attempt at finding a market we visited Restaurants and Hotels and other local spot markets. All the markets said they would be willing and eager to pay for organic food if it was a consistent multi-year supply. None were willing to make any commitments for a single crop.

Lesson 10

Markets may make calculations day to day rather than try to predict a volatile market. Markets are most interested in a consistent and continuous supply of healthy food and much less interested in a single crop.

We were not able to find anyone who would pre-pay a portion for organic food.

Use of Technology

Results of Usability Testing

While further research is required, it is clear from our usability studies that complex problems can be solved on the Metaverse that are impossible for many individuals to solve on Web 2.0 interfaces. Our usability testing was done on a group of 6 farmers in Ghana, Africa. Of these 20 individuals, only 4 had gone beyond primary school. Their ages ranged from 19 to 57.

When these individuals were shown an HTML form on a Web 2.0 interface designed to input data, 5 did not understand the task and 6 of the individuals entered incorrect data.



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We then designed a low-res metaverse that simulated a game requiring baskets of produce to pass guard houses situated along a road to a marketplace. Each guard house was configured to check for a specific item like a certificate of soil management, or type and weight of the produce.

Lesson 11

Skeuomorphism is a valuable tool in bridging the gap created by differences in education, language and culture.

Implementation

We built a framework that included a metaverse builder, a mobile application and a DID implementation Dominion.

An ad hoc metaverse implementation was selected for building a food provenance application for small landholder farmers in Ghana, Africa after performing usability testing on Web 2.0 websites. Our project faced challenges to build an application that small landholder farmers could use due to multiple factors that included:

1. A low education and literacy rate of small landholder farmers.
2. Data such as product description, weights and measures, was specific to the region.
3. Lack of experience using Web 2.0 websites.

Lesson 12

We underestimate the fact that the confidence and facility we have working with websites was developed from working on the internet regularly as we grow up. This facility did not exist anywhere in 2000. In many countries citizens are still where we were more than 2 decades ago and need accelerators

To illustrate the idea, we developed a low-fidelity metaverse creator to manage shipment of fruits and vegetables from the farm to the market. This model was built using only two skeuomorphic images. An Inspection Point and a Transfer Point:



Inspection



Transfer



The trip from the farm-to-table must cross multiple inspection points to assure proper soil management practices were followed, spoilage calculations, proper documentation such as bill-of-lading or packing lists have been completed, etc. On-route to the table, the food undergoes changes of custody from farmer to shipper to warehouse and perhaps to cross border warehouse and international shipper.

Each inspection point checks that certain prerequisites have been met before a change-of-custody can occur; for example, a certificate soil management, or food quality inspection. To complete the trip from farm to table, the produce is required to pass all the inspection points and arrive at transfer points where chain-of-responsibility handoff occurs.



Users were instructed to enter data by selecting a virtual object in the metaverse to open a dialog screen.



5 out of 6 entered data correctly on the first try. All participants entered data correctly after receiving online instruction.

Harvesting

When time came to harvest the Ocro the prices in the market had dropped substantially and the amount of daily crop dwindled to being worth approximately gh30 which is \$3.8. The quality of the Ocro was very poor with many being partially eaten by bugs.

The reasons for the decreased price was a high supply that resulted from a bumper crop from other farmers.

The low harvest rate and poor quality was attributed by the farmers from not using more chemicals. It is very hard to argue against this.

Lesson 13

We should not estimate the wisdom of farmers who have been growing in their country for many years. Organic farming practices may result in the loss of livelihoods or worse famine.

This is a cautionary tale against arrogantly gambling with other livelihoods.



Recoverable crop from a single harvest



Conclusion

The product was a great learning experience and we were able to build a technical framework with feedback from small landholder farmers. We all enjoyed the journey and have lessons that will make the next journey a greater success. Most importantly no farmer was adversely impacted financially from being part of the experiment. FuixLabs paid the amount that would be received from a successful bumper crop.



Payout to Farmers