Building a Blockchain-Enabled Honey Traceability System

Problem

Honey is one of the most "faked" foods in the world, depressing honey prices for legitimate honey producers, limiting producers access to markets, defrauding buyers, and putting consumer health at risk. A robust honey traceability system would provide a platform for a verifiable differentiation of honey sources, open new markets, ensure safe access to markets, offer product reliability to buyers, protect consumer health, and facilitate global development of small producers by unlocking the unique qualities of local, organic, fair trade, and varietal honey.

Rationale and Statement of Need

These funds would help build a proof-of-concept honey traceability system by verifying the ability to write and retrieve data from a blockchain-distributed ledger tracing data about bees, beekeepers, and secondary data sources. The data required to track honey production would come from *Apiary Management Software, Sensors (IoT), Secondary Data, Algorithmic Extrapolations,* and *Third Party Verification,* as described below:

● *Apiary Management Software (AMS):* This software records contextual information about a beekeeping operation, including colony counts, locations, management actions, health assessments, queen genetics, and production and survivorship outcomes.

● *Sensors (IoT):* This step involves the collection of automated data, mostly from inside the hive, and includes important bio-markers of hive health such as temperature, humidity, and hive weight. Colony location and colony disturbance would also be monitored.

● *Secondary Data:* This step involves the collection of additional data from secondary data sources outside the hives, including weather, land use, flora taxonomy and density, and bloom periods. These factors all affect apiary suitability measures for a given colony yard placement.

● *Data-Driven Algorithmic Extrapolations:* This process takes the life science data from the sources mentioned above, adds to it secondary data, and uses algorithms to extrapolate the expected honey production for an apiary. It is an important step in the verification and traceability process to ensure production numbers are not inflated.

● *Third Party Verification:* This step importantly ensures honey integrity in the downstream supply chain, ensures the honey is not adulterated after production, and confirms the source of origin. It would be done by honey testing labs with the data written to the blockchain and recorded in a producer rating system.

In order to build a viable honey traceability system, the data needs to be trustworthy, verifiable, and shareable. *Distributed Ledger Technology*, often referred to as *Blockchain Technology,* offers a way to record data that is *immutable*. That is, once it is written to the blockchain, it can never be changed without being detected. This feature makes the data trustworthy from the time of recording.

Additionally, it provides a clear path to transparency as the ledger can be open and shareable. Together this makes the blockchain ledger the ideal place to record the data from the systems noted above in a trustworthy and accessible way.

This grant application is for funds to build a proof-of-concept where we write and retrieve data to the blockchain to show how this can be done to improve the verification process. These funds would critically support this foundational step.

Current Status of Research

Through an existing research partnership with HiveTracks, we have access to data from a software system for commercial beekeepers that is currently being used to manage more than 50,000 hives. In addition to the software, we have been testing a handful of sensors and need to include more for a robust data set. We are also in the process of developing our own sensors with a research partner. The next steps are to write and retrieve this data to the blockchain, add secondary data, expand the algorithmic extrapolations, and add the third party honey verification testing needed to build a complete traceability system. Please note that there are some potential conflicts of interest with PIs and HiveTracks ownership, please see the supplementary material provided for more information.

Tasks/Aims/Timeline

- *June - August:* Work with beekeepers to collect quality data for this proof of concept.
- *September - November:* Write data to a blockchain-distributed ledger to test this process.
- *December - February:* Extract data from the blockchain to show traceability.

Deliverables

- *Milestone 1:* Successfully write data to a blockchain-distributed ledger.
- *Milestone 2:* Retrieve data written to blockchain for honey traceability.

Next Steps

The immediate next step would be to take the data from this proof-of-concept and seek industry partners and investment to build and scale up the system. This includes expansion to a more robust scalable commercial grade platform such as *Amazon Web Services,* continual development of the *Algorithmic Extrapolations,* and statistical modeling for this proper third party verification and testing process.

Roles and Responsibilities

The following personnel from the *Center for Analytics Research and Education (CARE) at Appalachian State University* and select research partners plan to participate.

- *Joseph Cazier, Ph.D. and Executive Director of CARE:* Will direct and coordinate the entire project as the Lead Principal Investigator (PI).

- *Max Rünzel, MS, MA and Associate Research Fellow at CARE:* Will prepare, write and extract key data from the blockchain system to build the proof of concept (Key Personnel - KP).

- *Ed Hassler, Ph.D. and Director of Technology at CARE:* Will serve as technical advisor and oversee the computational and data aspects and serve as a quality control expert (KP).

- *Lewis Alexander, J.D. and Data Privacy Advisor for CARE:* Will serve as legal & ethical advisor and consultant for planned data collection and processing for traceability system (KP).

- *Sullivan Wilkes, Commercial Beekeeper*: Will serve as contract researcher for data collection.

Budget Justification

- *$4,800 for Sensor Acquisition and Preparation:* to acquire, setup, and monitor additional sensors and sensor improvements for needed IoT data.

- *$1,200 for Contract Research in Apiaries*: to manage and administer partnership with commercial beekeepers to collect field data.

- *$12,000 for Data Science Services*: to provide salary support for digital data science services related to writing and extracting information to the blockchain.

- *$3,600 for Technical Advising and Consultations:* to provide salary support for data quality, privacy and advising services.

- *$2,400 for Data Visualizations:* to provide salary support for traceability visualizations.

Conflict of Interest Disclosures

Please note that there are some potential conflict of interest disclosures that come with this proposal. We detail these below.

- *Apiary Management Software* - The Apiary Management Software used for this grant is from HiveTracks.com. The lead PI, Joseph Cazier, is a minority partner in the company that owns the HiveTracks brand and makes the software used for this trail and also likely to be used, at least in part, for future commercial development. Dr, James Wilkes, Computer Science Professor at Appalachian State University, is CEO/Founder of HiveTracks.

- *Commercial Beekeeper -* The commercial beekeeper collecting data for this project who owns "I Know Bob" Beekeeping, is the son of James Wilkes.

- Our University Conflict of Interest Policy will apply to the project.

Note on Letters of Support

The letters of support indicate a willingness work together if we prove the technology works in the proof-of-concept. Other than the disclosure above and the services provided by HiveTracks and Sweetwater Science, there is not currently an existing partnership with any financial or other implications at this time.

Public Information Summary
50 words max

This project helps beekeepers and consumer everywhere by developing a secure honey authentication and traceability system using remote sensors (IoT), Apiary Management Software, Random Lab Testing and writing that data to a Blockchain Ledger. This verification system will help open new markets for authentic honey and safeguard consumers.

Fit Info
please explain why your technology/ discovery applies to either the disruptive category and/or the bridge to translational research category. The maximum allowable length for this summary is approximately 100 words.

This is a new technological solution to a global problem affecting millions of consumers every year who purchase honey they believe to be pure and what is represented on the label when in fact it is not. Consumers are missing out on the product they are paying for and producers are suffering from depressed prices due to a lack of trust in the product. This technology can disrupt the entire industry bringing trustworthy products to market allowing consumers to get the products they pay for and producers to get fair value for them.

On letterhead of partnering organization

2019-04-02
Joseph Cazier, Ph.D. and Executive Director
Center for Analytics, Research and Education
Walker College of Business
1016 Peacock Hall
Boone, NC 28608-2049

Dear Dr Cazier,

I write on behalf of Maya Beekeeping for development in support of the CARE proposal to the North Carolina Biotechnology Center for the NCBiotech's Flash Grant program to fund a Blockchain Enabled Honey Traceability System to provide a platform for a verifiable differentiation of honey sources.

We strongly support this grant application and the focus on honey traceability by implementing beekeeping data on the blockchain. As an organization that currently works with cooperatives of beekeepers in Argentina, Mexico and Belgium, we know of the difficulties to access markets without a tool to verifiably proof the origin, integrity, and features of our beekeepers' honey, significantly limiting the development potential of the rural areas in the stated countries.

Through this letter, we acknowledge specific roles and responsibilities we will fulfill in this partnership. In the event this proposal is funded, we would expect our role in the Blockchain Enabled Honey Traceability System to include:

- *Forming a genuine partnership to increase the traceability of honey to enable rural development. One of our representatives would be designated to work on this effort;*

- *Establishing the contact and starting to work with cooperatives in Mexico and Argentina to test the blockchain-backed traceability system in the field. Tracking the movement of the honey from the hive to the consumer will spike interest among consumers and allow us to learn how the system may be scaled up.*

CARE will take responsibility to lead the Blockchain-Enabled Honey Traceability System's activities regarding preparing, writing, and extracting the data, as well as collecting and analyzing both observational and sensor data to provide verifiable quality honey to consumers.

We look forward to working with you in eliminating trust issues along the honey value chain and facilitating sustainable development for beekeepers in rural areas.

Sincerely,

Benoît Olivier
Coordinator Maya Bees for Development