

GENERATING VALUE WITH MANUFACTURERS AND PROTECTING PRODUCERS AND CONSUMERS: USING BLOCKCHAIN IN THE AUSTRALIAN TEA TREE OIL INDUSTRY.

Australian Tea Tree Industry Association, Down Under Enterprises and Geora.

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The Australian tea tree oil Industry traceability solution deployed on the Geora blockchain protocol aims to solve significant challenges faced by primary producers of tea tree oil using a digital traceability and certification management tool. This industry-first pilot is phase one of a commercial solution, first built for the Australian Tea Tree Industry Association (ATTIA) but intended to champion a pathway toward digital trust for other agri-industries globally.

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TRANSFORMING GLOBAL AGRICULTURE

The World's Least Digitised Industry

Agriculture is one of the world's oldest and most critical industries. It is responsible for feeding and clothing over 7.7 billion people, employing 28% of the world's working population,¹ and producing over US \$2.3 trillion of food products each year.²

¹ International Labour Organization (2017). Employment in agriculture (% of total employment)(modeled ILO estimate). <https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS>, accessed July 2019.

² Food and Agriculture Organisation of the United Nations (2018) World Food and Agriculture 2017 Statistical Pocketbook. Rome.

Yet in many ways, agri-supply chains are failing. Supply chains lose over \$40 billion annually from food fraud,³ and of supply chain participants, 49% do not trust their trading counterparties.⁴ Despite being fundamental to existence, agriculture is often undervalued and primary producers receive a fraction of the value of final products.⁵



At the same time, agriculture is the world’s least digitised industry, having missed out on many of the benefits of the internet due to a lack of connectivity.⁶ It remains an industry based largely on paper records and handshake deals.

Agriculture is under enormous pressure to be more sustainable and secure and to solve critical supply chain challenges. However Agriculture primary producers are often without the resources to do so.

Of the United Nations Sustainable Development Goals (SDGs),⁷ at least nine require immediate action by various participants along agri-supply chains. These include the goals of reducing inequalities, creating sustainable communities and building responsible consumption and production processes.

The Food and Agriculture Organization of the United Nations (FAO) set five principles for food production systems to contribute to the achievement of the SDGs.⁸

FIVE KEY PRINCIPLES

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|---|---|--|--|--|
| <p>1 Increase productivity employment and value addition in food systems</p> | <p>2 Protect and enhance natural resources</p> | <p>3 Improve livelihoods and foster inclusive economic growth</p> | <p>4 Enhance the resilience of people, communities & ecosystems</p> | <p>5 Adapt governance to new challenges</p> |
|---|---|--|--|--|

³ Spink, J (2014) Michigan State University Food Fraud Initiative.

⁴ 3M (2017) Driving Growth and Innovation through Supplier Partnerships. Supplier Survey Whitepaper.

⁵ Van Nieuwkoop, M (2019) “Do the costs of the global food system outweigh its monetary value?”

<https://blogs.worldbank.org/voices/do-costs-global-food-system-outweigh-its-monetary-value> accessed on 20 September 2019.

⁶ International Telecommunication Union (2018) ICT Statistics. <https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>.

⁷ Food and Agriculture Organization of the United Nations (2018). Transforming Food and Agriculture to Achieve the SDGs. Rome.

⁸ UNDP (2012). Sustainable Agriculture Chapter 5 of International Guidebook of Environmental Finance Tools: A Sectoral Approach. <https://www.undp.org/content/dam/aplaws/publication/en/publications/environment-energy/www-ee-library/environmental-finance/International%20Guidebook%20of%20Environmental%20Finance%20Tools/Chapter%205.pdf>.

If United Nations (sovereign) members and UN Global Compact (corporate) participants are to meet these **SDGs**, an enormous injection of funding is needed in agriculture, particularly directed toward primary producers, to allow them to transition to sustainable production methods, adapt to climate change and ensure global food security.⁹ The total investment required is estimated by the FAO to be US \$2.1 trillion annually.¹⁰

Additionally, in order to drive economic value into agri-supply chains, boost our food and other agricultural systems while protecting consumers, global food fraud and counterfeit goods must be addressed. Identifying counterfeit products can be incredibly difficult; supply chains often lack data traceability and transparency, many participants don't trust their counterparties and certificate authorities do not have the capability to protect their marks and make claims as to the validity of certifications on products when in market.

The Opportunity

Throughout history, local, market-based agricultural trade made it easy to know where products came from. Buyers and sellers participated in relatively short supply chains where the provenance of products and trust between counterparties was easily established. However, the globalisation of agri-supply chains increased the distance from production to consumption, introducing a lack of transparency, risks and inefficiencies.

Many agricultural industries have evolved off the back of thin margins, where farmers had little or no access to finance, were geographically dispersed across disconnected rural areas and received minimal market feedback. While individual businesses may have thrived, agriculture as a whole has failed to deliver its potential value, particularly for its primary producers.¹¹

The advent of blockchain technology, along with the rapid increase in internet access across rural and developing communities has provided a unique opportunity to build innovative solutions to trace, trade and finance agri-supply chains.



**OF THE GLOBAL POPULATION
NOW USES THE INTERNET**

⁹ Ibid.

¹⁰ Food and Agriculture Organization of the United Nations (2017) The Future of Food and Agriculture, Trends and Challenges. Rome.

¹¹ Van Nieuwkoop, M (2019) "Do the costs of the global food system outweigh its monetary value?"

<https://blogs.worldbank.org/voices/do-costs-global-food-system-outweigh-its-monetary-value> accessed on 20 September 2019.

WHY BLOCKCHAIN?

Blockchain technology brings together a range of established technologies into a highly novel structure. Being a nascent industry, the range of blockchain protocols can be difficult to navigate, as they are in a state of rapid development and improvement. Many blockchain protocols are working to solve the current challenges presented to commercial adoption and scale.

Blockchain is an inherently risky nascent technology and early adoption is always a risk. There is however a clear sense that Blockchain is a potential game-changer for agriculture. Of many use cases, a large number are still at the idea stage while others are in development but with no output. The bottom line is that despite billions of dollars of investment, evidence of the practical use of blockchain is thin on the ground. Notwithstanding this, there are two facts to indicate that while risky, Blockchain is a technology that can be used successfully by the TTO industry:

1. There are few companies that have the appetite to lead development of a utility that would benefit an entire industry. ATTIA is such an entity and has the vision, mandate and drive to achieve this for the Australian tea tree industry.
2. Blockchain's best demonstrated value is in niche applications with specific use cases. These include elements of data integration for tracking asset ownership and asset status in which distributed ledgers can tackle pain points including inefficiency, process opacity, and fraud. This sums up our use case perfectly; the TTO supply chain is a real niche supply chain that is challenged by both process opacity and fraud.

Agri-supply chains, including those for Australian tea tree oil, are naturally distributed networks, made up of multiple participants needing access to the same set of data relating to a common physical asset. Australian tea tree oil originating at the 'farm gate' is a natural use case for blockchain technology which allows for secure and immutable data sharing across distributed networks.

Technology Snapshot

A blockchain is a form of database that stores information across a distributed network. Unlike traditional hub-and-spoke style databases, blockchains do not have a controlling central party. Each of the individual computers, or nodes, involved in the network run the copy of the ledger and play a role in approving and processing transactions.

Smart contracts are a key component of many blockchain applications. Importantly they aren't legal contracts, instead they are pieces of code that contain instructions for the blockchain to execute transactions. Blockchains are unique in that they use smart contracts to structure and manipulate data in the form of tokens. These tokens can represent any kind of asset, whether a currency, physical commodity or legal contract.

Blockchains are append-only data structures, meaning information can only ever be added to the ledger

and never erased. This is critical in giving blockchains their key feature of being highly immutable.

Consensus mechanisms are the ways in which data is accepted into the shared ledger. When transactions are proposed to the network, a consensus algorithm determines whether or not they will be accepted and processed. If accepted, a group of transactions are bundled together and processed as the next 'block' in the chain.

There have been many pilot applications of blockchain in agriculture over the past five years, revealing that immediate value can be created from applying this technology to agriculture. Three key applications have emerged: traceability, payment security, and real-time finance.

The following use case is built on the Geora Protocol. Geora fills the gap between base technology and its application to agri-supply chains and their various participants. Architecting a solution to meet the specific needs of agriculture means designing for privacy, key management, ease of access and creating applied smart contracts.

There are a growing number of blockchain solutions being used in agriculture. However most of these focus on one specific supply chain. This often means that the technology is highly centralised and forces the user to access it through a single application interface. However every supply chain is different and unique. To this end, Geora allows the user to capture data from any kind of interface, whether it is an email, enterprise solution or IoT device, participants in the Geora network have complete flexibility.

IN PRACTICE: AUSTRALIAN TEA TREE INDUSTRY PILOT

Background

Australia is the home of premium quality tea tree oil, producing over 80% of the total production of tea tree oil worldwide. In Australia, the tea tree industry is highly regulated and controlled for quality with most producers gaining annual certification of their production methods and sites, allowing them to label their products as ATTIA Code of Practice Accredited 100% Pure Australian tea tree oil.

However, nearly all of Australia's tea tree oil (over 90%) is exported.¹² Once beyond the Australian border, Australian tea tree oil faces a growing challenge of counterfeiting and adulteration. Many cases have been identified of high quality 100% pure Australian tea tree Oil being mixed with cheaper non-Australian variants or industrial waste derived from 'normalising' other essential oils and which are falsely labeled in market as pure Australian tea tree oil.

¹² ABS TTO Exports Report 1 Apr 2018 - 31 Mar 2019.

ATTIA (Australian Tea Tree Industry Association) has identified an opportunity to meet growing consumer demand for transparent and traceable products from the grower to the market, and hopefully increase the value of verified Australian tea tree oil. This includes tracking the bulk oil as it is grown on farm, processed, exported and eventually sold and manufactured in various products to the end consumer.

In addition, the industry certifier, ATTIA, aims to identify misuse of their Code of Practice accreditation mark through the implementation of a digital traceability solution.

With the backing of AgriFutures, ATTIA is championing the roll out of an end-to-end supply chain traceability solution leveraging blockchain technology. The initial pilot seeks to test whether and where there is value to be created and captured along the tea tree oil supply chain by creating better traceability of the oil from farm to final products.

Building a Commercial Blockchain Solution

The Minimum Viable Product (MVP) built as part of the pilot delivers a platform for creating trusted and shared digital records of Australian tea tree oil, trading these assets and managing their certification. The objective is to develop a digital solution that provides brand and certificate protection as well as testing the trading efficiencies and value add that can be created for producers along the supply chain.

The ATTIA MVP is a global first for the essential oils industry. The system built out is a generic industry solution which has a simple process of being redeployed as a certificate registry for multiple different industries both across essential oils globally as well as into other commodities and certifying authorities.

Key Objectives

1. Capture critical information about the production, processing, export and packaging of Code of Practice accredited pure Australian tea tree oil (**TTO**).
2. Link the various datasets in the supply chain to a single and secure digital record of the tea tree oil to create a complete digital history of the product from farm into the final manufactured products sold globally.
3. Maintain parity between the digital record and the physical oil as it is transformed along the supply chain, including through production stages and distilling as a bulk oil asset as well as in unique drums, batches and bottles.
4. Allow participants to visualise and inspect the history of the tea tree oil at various stages along the supply chain, in ways that can be shared with both retailers and consumers.
5. Provide ATTIA with a tool to manage the certification of TTO producers, as well as identifying where a certificate has been revoked or fails to meet the required standards.

Solution Requirements

- Blockchain protocol including smart contracts to create, update and trade digital records of tea tree oil.
- Shared dataset which can be interacted with and contributed to by multiple participants.

- A robust permission system to ensure no private or confidential data is shared between parties unknowingly.
- Mobile or web applications, internet of things devices or other applications to capture data along the supply chain including integrations between the various devices and applications with the blockchain protocol.
- Interoperability between the core protocol and external software or protocols to allow users to share data stored within the traceability system with external systems and parties. For example this could be the ability to export data to a retailer’s (e.g. Walmart) IT system.
- An interface to visualise the data and history of the tea tree oil.

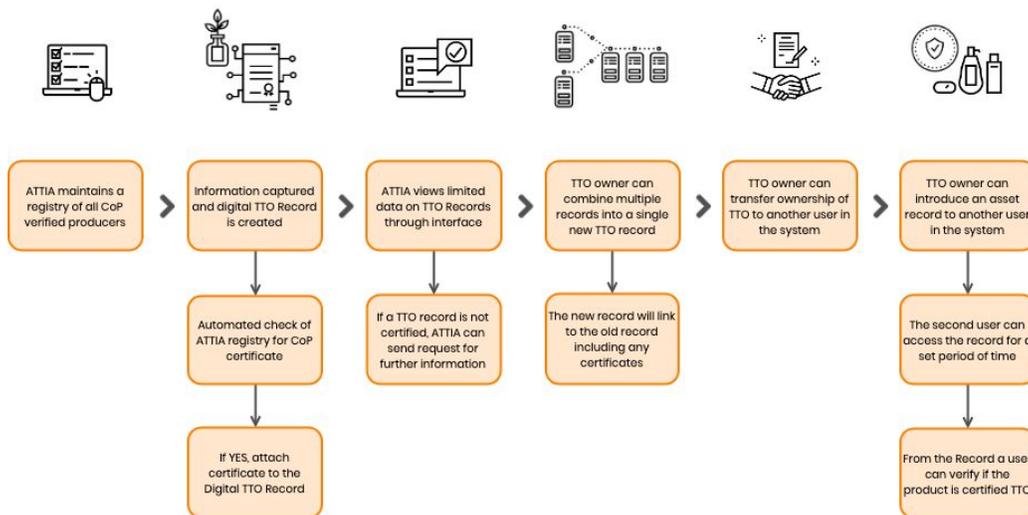
Process

As a first step, the industry regulator (ATTIA) uses a web application to lodge and track the Code of Practice Certification for each producer. Each certificate is created in the blockchain - meaning it is immutable and cannot be removed or changed by any participant along the supply chain.

Next, the distiller creates a record of the bulk tea tree oil as it is produced. This digital record is saved in Geora’s digital asset registry and contains the relevant data about the producer, production area and quantity of oil.

Smart contracts are triggered causing the digital asset record to be automatically sent to the blockchain certificate registry to check if there is a valid Code of Practice accredited certificate. This check-step looks at the asset record and the details in the certificate registry to determine whether the asset is certified. If the asset has a valid certificate, a stamp of the certificate is attached to the asset record.

Tea tree oil producers and traders can then transfer ownership of the tea tree oil between different users in the system using a simple trading application. Each new owner has access to the immutable digital asset record, giving them a complete and trusted dataset relating to the production and certification data of that asset.



Commercial User: Down Under Enterprises

Australian family-owned and operated Down Under Enterprises (DUE) grows, produces, exports, and markets traceable and sustainable native Australian essential oils and botanicals - including tea tree oil - to manufacturers of personal care, home care, and medicinal products globally. DUE sources its product requirements from its own farm, Buhlambar, and also from small growers across Australia. In 2018, DUE received the NSW Premier's Agribusiness Exporter Award and was a national Australian Finalist in the same year.

As a supplier of Australian-produced ingredients directly to manufacturers across the globe, DUE has first hand experience with the rapidly increasing Traceability demands of these manufacturers. Already DUE has adapted and deployed batch tracking functionality across its IT systems and internal processes. But DUE also recognises the natural and essential progression to a more secure and industry-wide solution such as blockchain.

Through extensive discussions with several manufacturers, DUE is working to incorporate blockchain across its entire product portfolio, by developing a built-in API connection directly between its ERP and MRP systems to the blockchain registry, and working with its customers to initiate deployment of this information to their consumer base.

These are exciting times for Australian farmers and exporters working to assure global consumers they are buying products with bonafide Australian components!

Key Learnings

While the blockchain solution offers a great digital structure for tracking data, it is important to ensure the accuracy of data as it is captured, and before it is fed into the blockchain. A blockchain does not provide a complete solution for matching the digital to the physical, and requires robust surrounding digital infrastructure to ensure that parity. Matching the digital to the physical means moving away from human entered data to more integration solutions using smart packaging, GPS location tracking, and Internet of Things devices. By integrating these technologies, data consumers can access more reliable information about the physical product, that is then kept immutable, tracked and shared using the blockchain layer.

Agriculture is an industry often operating off thin margins, facing high risks including the pressure of adverse weather conditions. Prioritising innovation and additional value creation opportunities in the face of very real and competing pressures in the agricultural sector can be challenging. Supporting primary producers by taking an industry wide perspective on innovation is critical. The MVP aimed to create the bones of an industry solution that can be then added on to by individual participants. Industry collaboration is critical, driven by industry bodies who can provide an educational space for primary producers as an access point to the technology.

BEYOND MINIMUM VIABLE PRODUCT (MVP)

Throughout the course of the pilot a number of extension opportunities have been highlighted and form the basis of the next development phases.

1. Identify adulteration or misuse of the Code of Practice mark at a global scale

Using data analytics, create an audit tool for ATTIA to detect where fraudulent transactions or use of the mark are taking place in the system. An 'in protocol' alert system would then allow users to be notified in the web application where these fraudulent events may have occurred. The importance of real time notifications and claims is that it allows traders to avoid entering into a sale where counterfeit products may be involved, and gives ATTIA a tool for identifying and protecting their mark.

Off the back of this system, it is then possible to create a reputation index and the ability to rate counterparties on their use of the mark and any instances of fraud. Good actors in the system then have grounds to increase the value of their product as being both verified and reliable.

2. Finance integration and payments

Blockchain offers many opportunities to develop solutions for secure payments and real time finance. Not only can these payments be between farmers, but integration with Australian Federal Government (Department of Agriculture and Water Resources, DAWR) levy management systems can provide streamlined capture and distribution of levies which link to data around the physical products.

Once an asset registry system is in place, this registry may be opened up to financiers and used to deliver supply chain finance to producers and other supply chain actors. Real-time asset registries secured using blockchain become a powerful source of truth for financiers to deliver cheaper and faster novel finance solutions. Smart contracts can be used to automate these financial products driving additional efficiencies and cost savings for the parties involved.

3. Additional efficiencies and data capture for industry participants.

Integrations with other data sources including ERP systems, shipping and logistics platforms to help create documents and transfer information in streamlined and secure ways particularly as the asset moves cross border. Integrations with smart packaging and other tracking devices to improve the matching of the physical asset to the digital record aims to improve the data quality and reliability of the system.

4. Expansion into other agricultural industries

Finally, the tea tree oil industry use case demonstrates the overall value of an industry wide certificate management and traceability tool. Designed to be industry-agnostic, the opportunity is ripe to launch the traceability solution for other essential oil industries and certificate providers such as organic certifiers.

ABOUT THE PARTIES INVOLVED

The Australian Tea Tree Industry Association

The Australian Tea Tree Industry Association (ATTIA Ltd) is an Australian based not-for-profit organisation formed in 1986 as the peak body to promote and represent the interests of the Australian tea tree industry. From the grower/producers to the manufacturers of off-the-shelf products for public use, ATTIA supports and promotes the responsible use of pure Australian tea tree oil (TTO).

ATTIA's aim is to develop a stable, cohesive, environmentally friendly, and internationally competitive TTO industry producing quality assured 100% pure Australian TTO that meets or exceeds international standards. ATTIA promotes the safe effective use of pure Australian TTO for a wide range of applications.

In 2018 Australia produced 1,008 tonnes of 100% pure Australian tea tree oil (TTO). 97% or 972 tonnes was exported with a value of just over \$43 million (source: ABS). The balance is destined for value-adding largely for export with an estimated total export value for TTO and TTO-containing products of \$45 million. TTO is produced in rural communities providing valuable long-term employment not only for direct employees but also for a wide range of support industries.

Traceability for Australian TTO beyond the farm-gate is currently restricted to voluntary adherence to the ATTIA Code of Practice (COP) (https://teatree.org.au/teatree_about_quality.php) where accredited producers of 100% pure TTO are required maintain audited records of production from the source seed through husbandry, harvest and distillation to the packaging for export to the manufacturer. Manufacturers have begun to adopt COP accreditation, placing the COP logo on their consumer product labelling (https://teatree.org.au/certified_members.php). This is the leading edge of a movement by manufacturers to actively seek proven datasets to confirm the provenance of the TTO they are purchasing. ATTIA producer members equate to 90% of all Australian TTO production; thus the COP system is synonymous to a national TTO production standard.

A significant threat to the Australian tea tree industry is adulteration, a problem that has plagued the industry for decades. The fraudulent dilution of 100% pure TTO with industrial waste allows competitors to severely undercut the market for 100% pure TTO and potentially harm the end-user by allowing contact with a variety of dangerous contaminants including pesticides, endocrine disrupting and skin sensitising compounds.

Evidence collected globally from 2010-14 shows that 50-70% of all TTO sold to consumers was adulterated. This practice has been reduced by a decade long ATTIA campaign of testing and education and we estimate that in 2018/19 less than 33% of all whole TTO sold globally is adulterated. This ongoing campaign, which is anchored by ATTIA's COP, has been instrumental in increasing the production of 100% pure TTO from 350 MT in 2007 to over 1,000 MT in 2018 with a concurrent increase in the farm-gate price of 125% from \$20/kg to a more economically sustainable \$45/kg.

A 2017 market survey showed that up to 50% of the 280 MT of TTO (source: ABS) imported into the EU is destined for the cosmetic market; this is likely to be equally true for the North American market which consumes over 50% of all TTO exports. ATTIA's adulteration education campaign continues to reduce the incidence of adulterated TTO in formulated products, however manufacturers use adulterated material either through ignorance or with impunity as it is almost impossible to reliably and cost-effectively detect adulteration at low (0.5% - 5.0%) TTO formulation concentrations.

To resolve this issue, ATTIA's members are seeking to achieve better traceability along the supply chain, particularly beyond the farmgate where traceability options are reduced to 'trust' and are easily disrupted by unscrupulous downstream participants in the supply chain. There is now real demand from export market manufacturers for proven datasets which detail the history and origin of 100% pure COP accredited Australian TTO.

With the support of AgriFutures Australia (AFA) and funding from the compulsory levy for TTO, ATTIA engaged Geora in late 2019 to develop a pilot Ethereum-based Blockchain solution. Following a two-day industry workshop, a Minimum Viable Product (MVP) is now fully specified with the objective of providing producers, traders and others in the TTO supply chain with a system that facilitates inviolable verification for a buyer or retailer that the product received is 100% pure Australian TTO.

Down Under Enterprises

Australian family-owned and operated Down Under Enterprises (www.downunderenterprises.com) grows, produces, exports, and markets traceable and sustainable native Australian essential oils and botanicals - including tea tree oil - to manufacturers of personal care, home care, and medicinal products globally. DUE sources its product requirements from its own farm, Buhlambar, and also from small growers across Australia.

A signatory to the United Nations Global Compact supporting the UN Sustainable Development Goals, Down Under Enterprises is committed to delivering its customers "Traceable and Sustainable Botanicals" through its direct operations in Australia and North America, and through its network of exclusive Commercial Partners across Asia and Europe.

Geora

Geora builds open source technology designed for global agricultural supply chains, supporting the next generation of digital agriculture. The Geora blockchain protocol provides a simple way for agribusinesses and technology companies to build solutions to better finance and trade along agri-supply chains. Geora has projects active in multiple industries globally including livestock, grain, cotton, horticulture. For more information or to see a demo of the product suite, please head to www.geora.io.

This project is supported by funding from AgriFutures Australia as part of the AgriFutures Tea Tree Oil Program.