# Zambia Honey Supply Chain and Minimum Viable Ecosystem Report | Palmyra Pro

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## 1. Executive Summary

**Nature's Nectar Zambia (NN)** in partnership with **Palmyra Pro** is advancing a transformative model for honey production by combining a vertically integrated outgrower approach with cutting-edge digital systems to bring unprecedented transparency, traceability, and integrity to the supply chain. Centered around small-scale beekeepers and community-based structures, this model enables decentralized honey production while maintaining high standards for quality and sustainability. The foundation of this **Minimum Viable Ecosystem (MVE)** is rooted in leveraging existing community engagement with more advanced organic certification, and digital tools that provide real-time data validation across the supply chain.

The **Nature's Nectar model** begins with community organization through Zone Lead Farmers, each overseeing local beekeepers who manage **~10 beehives each**. These hives are assembled, distributed, and suspended in nearby forests, allowing for natural bee occupation, honey production, countering deforestation, **in balance with the nature and traditional beekeeping systems of Zambia.**

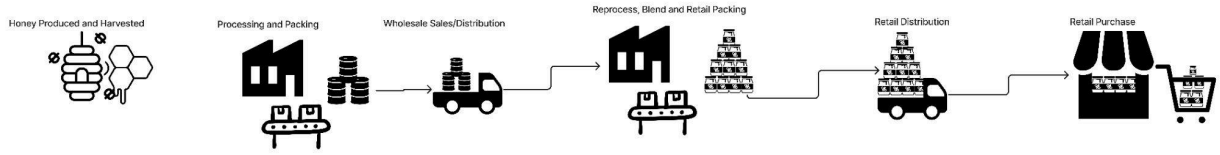
**Key challenges such as adulteration and lack of traceability in global honey markets are directly addressed through Palmyra Pro**, an integrated digital platform enabling secure data capture, credentialing, and auditability. **RFID and NFC** technologies, alongside blockchain-anchored **verifiable credentials**, allow stakeholders to validate honey integrity from hive to consumer. This level of transparency not only increases trust but also creates new market opportunities for **traceable and ethical honey brands.**

To establish the **MVE**, key stakeholders have been identified and prioritized based on their readiness for digital integration. For this project; the MVE is made up of **Nature's Nectar, its Field Supervisors, and organic certification auditors** due to their existing systems, networks, and capacity to support real-time data collection and compliance verification. Other actors—including farmers, government entities, conservation partners, and local buyers—are envisioned for integration in later stages, once barriers such as digital literacy, infrastructure, and market readiness are addressed.

The **MVE pilot will use Palmyra Pro** to capture detailed production data including hive locations, occupation status, and harvest logs, as well as transactional data around honey purchases such as pricing, water content, and farmer identity. Processing metrics, including input/output ratios, waste, and packing information, will also be recorded, along with live audit data flows that can be accessed by certified auditors through credentialed dashboards. With a network of over **3,000 beekeepers and 30,000 hives, Nature's Nectar is uniquely positioned** to pilot this ecosystem, **providing a blueprint for digitizing trust** in agricultural value chains while **delivering measurable impact** for producers and consumers alike.

## 2. Understanding the Honey Supply Chain—--FIGMA:

The honey supply chain consists of several broad steps that apply generally to most agricultural supply chains, ensuring products move from production through to consumers while maintaining required standards.




### 1. Beekeeping & Honey Production

- Beekeepers maintain bee colonies, ensuring their health and productivity.
- Bees collect nectar and other resources, which is transformed into honey and other products within the hive.
- Beekeepers harvest honey  by removing honeycombs from the beehive and this is where processing begins.

### 2. Processing & Packing

- Raw honey is extracted from the combs and filtered to remove wax, pollen, and other impurities.
- Some producers may heat or strain honey for further purification, depending on the type of honey produced, the seasonality or the intended use of the product.
- Honey is stored in bulk containers before transportation.

### 3. Quality Control & Testing

- Samples are tested for purity, moisture content, and contaminants (e.g., pesticides, antibiotics, or adulteration with syrups).
- Compliance with regulatory standards is ensured through 3rd party analysis.

### 4. Bulk Distribution & Transportation

- Large-scale honey producers or cooperatives sell honey in bulk to processors, packagers, or wholesalers.
- Honey is transported via trucks, ships, or air freight, depending on market destinations.

### 5. Re-Processing, Packaging, Wholesale and Retails Distribution

- Honey may undergo further filtration, pasteurization, or blending for consistency.
- It is packaged in bottles, jars, or bulk containers for retail, food service, or industrial use.
- Honey reaches supermarkets, specialty stores, online retailers, or food manufacturers.
- It may be marketed under different brands or as private-label products.

### 6. Consumer Purchase & Consumption

- Consumers buy honey for personal use, cooking, health benefits, or industrial applications (e.g., cosmetics, pharmaceuticals).

Each step in the supply chain impacts quality, price, and sustainability, with variations depending on market regulations, consumer demand, and regional practices.

## 3. Honey Supply Chain Structures and Existing Industry Challenges

Honey production occurs all over the world and different regions have different ways of coordinating their markets. Section 3 provides an overview of the various generalized production systems and supply-chains that exist for honey across the global industry.

| **Beekeeper Types** | **Description**: | **Prevalence**: |
|---|---|---|
| **Independent Beekeepers** | Individual beekeepers manage their own hives, harvesting and selling honey directly to consumers or local markets. | Common in regions with rich beekeeping traditions, such as parts of Europe and Africa. |
| **Cooperatives** | Groups of beekeepers collaborate to process, market, and/or sell honey under a unified brand or structure, sharing resources and profits. | Notable in countries like Mexico and Ethiopia, where collective efforts enhance market access and bargaining power. |
| **Vertically Integrated Honey Companies** | Firms oversee the entire honey production process—from beekeeping to processing and distribution—ensuring consistent quality and supply. | Prominent in major honey-exporting nations such as China and Argentina. |
| **Contract Farming** | Companies contract independent beekeepers to supply honey, often providing resources and guidelines to meet specific standards. | Observed in countries like India, facilitating scalability and quality control. |

**Supply-Chain Preferences via Region:** we have also noticed that various regions have developed preferences on the set up. Much of this is due to the trade-offs in the regions; from quality controls, the need for bargaining power via cooperative structures to scaleability. We have summarised the main honey producing markets and their common models that are used.

| Sample Variations in Regional Supply Chain Models | |
|---|---|
| **China** | As the world's largest honey producer, China predominantly utilizes vertically integrated operations, enabling control over quality and large-scale production. |

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| **European Union** | Features a mix of independent beekeepers and cooperatives. For instance, Greece and Spain have strong traditions of small-scale beekeeping, while countries like France have successful cooperatives. |
| **United States** | Combines large commercial beekeeping enterprises with numerous hobbyist beekeepers, catering to both domestic consumption and pollination services. |
| **Africa** | Relies heavily on traditional beekeeping methods, with cooperatives playing a crucial role in aggregating products for larger markets. |

**Key Challenges in the Honey Industry:** Honey is one of the most adulterated products in the world and continues to face significant challenges around trust. The following table provides an overview of these issues and how solutions leveraging Cardano technology can help improve trust in the markets.

| | **Challenges in Transparency and Auditability** | **Solutions to Address Transparency and Auditability Issues** |
|---|---|---|
| **Adulteration** | The blending of pure honey with cheaper sugar syrups undermines product integrity.<br><br>Recent studies have highlighted widespread fraud, with a significant percentage of honey samples failing authenticity tests. | ● Prior to integrating directly with laboratories for on-chain test results, every effort must be made to ensure and secure honey purity while in processing and inventory stages.<br>● Ensuring all honey is tracked via the traceability solutions such as Palmyra Pro system and batched accordingly will ensure trust in honey purity post harvest through final purchase from NN.<br>● Deploying IoT systems, such as RFID and/or NFC chips, to verify when containers of honey are open, closed, batched or going to processing will be vital in proving NN honey is not adulterated. |
| **Traceability** | Varying and complex supply chains make it difficult to trace the origin of honey, complicating quality control and fraud detection efforts. | ● Utilizing blockchain via verifiable credentials for producers, aggregators, wholesale buyers and retail brands creates opportunities to re-establish trust in the honey we purchase, while also creating new opportunities for fully traceable honey brands to become market leaders. |

# 4. Deep Dive into the Nature's Nectar Supply Chain and Ecosystem

Nature's Nectar's supply chain is a **combination of a vertically integrated model** and **a cooperative model** that creates a unique opportunity to drive transparency in the honey sector as well as set a basis that is highly adaptable for other honey and general agricultural supply chains. The NN model starts with community organization and ends with a final product of liquid honey ready for consumers.

| Step | Process Name | Details |
|---|---|---|
| 1 | Community Engagement, Organization & Initial Beehive Distribution | Nature's Nectar works only with small-scale beekeepers producing forest honey. Communities typically begin with 1,000 beehives, 100 members (10 beehives each). A Zone Lead Farmer is selected as the local manager for each group. NN only collaborates with trusted communities or producers using verified top bar comb honey. |
| 2 | Beehive Occupation & Honey Harvesting | Bees in Zambia naturally occupy hives due to environmental conditions and traditional systems. Beehives are placed strategically to support natural swarming and honey production. First harvest typically occurs 8–12 months after hive distribution. Harvesting is done twice annually by trained teams in each Zone. |
| 3 | Honey Purchasing | After harvest, NN organizes honey purchasing days in each Zone. Honey is collected and transported to Lusaka. Payments are made in cash or mobile money. Each honey bucket is traceable to the specific beekeeper and hive. |
| 4 | Processing, Filtration & Packaging | Honey is processed by Zone, heated to extract from comb, and filtered to remove impurities. It is then stored in labeled containers (tanks, drums, buckets) for inventory. From inventory, honey may be sold in bulk, reprocessed, or bottled for retail. |
| 5 | Quality Control & Testing | Batch samples are retained for up to 2 years. Testing can be done per client request and includes chemical analysis, contamination identification, and pollen analysis. All results are documented and stored for future use. |

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| 6 | Distribution, Transportation & Sales | NN aims to supply high-assurance honey globally. Exports use road and sea freight. Due to export challenges, NN currently sells white-label honey for 5+ Zambian brands. Using Cardano tech (traceability, credentials, oracles), NN is positioned to re-enter premium global markets with authentic, sustainable honey. |

## Nature's Nectar's Supply Chain

### 1. Community Engagement, Organization & Initial Beehive Distribution

Nature's Nectar works solely with small scale beekeepers producing forest honey. NN only works with communities within its network and/or producers with verified top bar comb honey. Communities generally start with 1,000 beehives, 100 community members and 10 beehives per person. A local community member is selected from within the 100 community members as the Zone Lead Farmer. This is the community level manager who is the main point of contact and responsible party for beekeeping operations within that Zone.

### 2. Beehive Occupation & Honey Harvesting

Because of environmental factors and age-old traditional beekeeping systems, Zambia is uniquely positioned to produce honey very similarly to ways bees naturally occupy spaces for their colonies to live. Zambia has a very high bee population in its forests and if beehives are placed in the right location and in the right way, bees naturally occupy and produce honey. With them being able to naturally occupy, they can also leave when they please, allowing for bees to swarm and relocate to areas with food throughout the year.

Once beehives have been distributed, it generally takes between 8-12 months for a first harvest to occur. Honey is harvested by a dedicated and trained team from each Zone and most areas of Zambia have 2 honey harvests a year with variations between regions.

### 3. Honey Purchasing

Once all honey is harvested in that Zone, the NN purchasing team organizes days to come to each Zone, purchase honey from farmers/beekeepers and move the honey to Lusaka for processing. All honey is paid for generally through cash or mobile money payments and each bucket of honey is connected to the exact beekeeper/farmer whose hive produced the honey.

### 4. Processing, Filtration & Packaging

Raw comb honey is batched by zone and extracted from the combs through heating and filtering to remove wax, pollen, and other impurities. Once honey has reached a liquid state and is ready for storage, containers such as tanks, drums, and/or buckets are filled, labeled and placed in inventory. Whence in inventory, the honey can be sold, reprocessed and/or bottled for retail.

### 5. Quality Control & Testing

Each batch of honey processed must have samples retained and sent for testing if requested by potential client. Batch samples are held internally for up to 2 years and, if tested, results recorded and stored locally for suture use. Depending on the requirements of the buyer, different tests can be undertaken to understand the chemical composition of the honey, contamination identification and pollen analysis.

### 6. Distribution, Transportation & Sales

Nature's Nectar's main aim is to provide high assurance honey for markets around the world that want a sustainable, ethical, impactful and organic product. If honey is going to export markets in Africa, generally the product is moved via road freight. If markets are overseas wholesale, generally a combination of road and sea freight are used. Even though these are the intended markets for NN honey, accessing these markets is challenging because of a variety of factors. Because of this, NN in recent years has pivoted to more local white label based sales in Zambia that are good, but most of the market is dictated by price. This honey is bottled and packed for at least 5 brands in the Zambian market. Leveraging Cardano technologies for traceability, credentials and oracles; Natures Nectar is in a strong position to re-enter new markets with authentic, traceable and sustainable premium honey.

## The Nature's Nectar Ecosystem

Nature's Nectar has established its business model around building robust partnerships with communities, stakeholders, regulators, non-governmental organizations and other businesses. These partnerships make the Nature's Nectar model work and without these deep connections, work done by each party involved would not be as impactful as it currently is or could be in the future. Below is an overview of the existing NN network and ecosystem that allows for a robust selection process for the pilot MVE.

## Stakeholder Map - Roles and Responsibilities

| **Stakeholders** | **Roles** | **Responsibilities** |
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| **Nature's Nectar** | Impact First Honey Company | ● Establish beekeeping areas, purchase, process and sell honey to local and international markets.<br>● Provide alternative livelihood opportunities that create benefits for forests and forestry systems. |
| **NN - Field Supervisor (FS)** | Managing multiple Zones of beekeepers and ensuring a smooth process of hive distributions through to the final | ● Field Supervisors are the leading change agent in the field that is employed by Nature's Nectar. These individuals have experience working in communities, are sourced from as close as possible to general beekeeping areas and are the |

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| | dispatch of purchased honey to processing. | responsible party for ZLF oversight, communication and motivation.<br>● Field Supervisors are the leading agent for Zones to verify they understand the organic honey production process and systems. |
| **Conservation Partner(s)** | Provide connections in communities for integrating NN beekeeping operations | ● Conservation organizations in Zambia have long focused on more heavy handed roles and systems for conserving ecosystems, mainly through law enforcement and shifts are occurring to integrate local communities into conservation roles through community engagement. |
| **Beekeeper/Farmer** | Produce top bar honey to sell at the premium NN price while experiencing the value of forest/ecosystem preservation. | ● Beekeepers in Zambia have age-old traditional practices that inform the systems developed at NN. Over the course of receiving beehives, producing honey, and selling it to NN, Farmers are able to have a new/enhanced income source, have more security in meeting basic needs and understand the value forests have in securing honey money. |
| **Zone Lead Farmer (ZLF)** | ZLF are the responsible party at the community level and the point of contact for NN Field Supervisors. | ● Zone Lead Farmers are leaders in their communities. They are often experienced beekeepers and/or dedicated community change agents.<br>● They are elected by their Zone of beekeepers and are responsible for ensuring smooth operations at the Zone level in regards to hive building, distributions, production and final honeycomb sale by farmers.<br>● Zone Lead farmers are incentivized through a commission based system that reduces threat of side-selling honey produced to other honey companies. |
| **Traditional Leadership** | Traditional governance systems are widely used in Zambia for local dispute resolution and land use agreements. | ● Through different levels of traditional governance via Chiefdoms, Chiefs/Chieftainess(‘) , Headmen/Headwomen, and other community leaders, local decisions and disputes are resolved and communicated. |

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| | | • Ensuring NN staff and ZLFs remain in good standing with these systems is vitally important to successful community engagement and long term commitment. |
| **Government Entities** | The Forestry and Veterinary Departments are the 2 most vital government structures for successfully and compliantly producing honey in Zambia. | • Because honey in Zambia is generally a non-timber forest product, there are regulations within the forestry act that dictate means of production, fees and other requirements that must be observed and reported with the Forestry Department.<br>• Beyond a non-timber forest product, honey is also an animal product and thus is controlled by the Veterinary Department with regards to exporting of honey. The Veterinary Department is the designated authority for the export of honey from Zambia and for the declaration of imports abroad.<br>• Currently, there are competing fees, regulations and industry discrepancies between the forestry department and the veterinary department. This overlap has brought issues to the honey sector through competing and varying fees and inconsistent enforcement of them. |
| **Beehive Producer / Sawmill** | NN has established a highly valuable relationship with a dedicated beehive production facility in Zambia that delivers beehives consistently, accurately and on time. | • Nature's Nectar has worked with multiple suppliers of beehives in Zambia with varying levels of success.<br>• Since 2020, Nature's Nectar has worked with a single supplier of beehives. Together, NN worked with this sawmill to understand challenges and solutions that can be implemented to ensure accurate hive delivery.<br>• Integrating sourcing of pine timber for the production of beehive kits to verify sustainability of timber inputs has potential to be developed. |
| **Local- Honey Buyers** | NN has developed sales agreements with many honey companies in Zambia that have direct to consumer | • With these companies being more advanced on the Zambian retail markets, Nature's Nectar works with them to provide a high quality honey ready for bottling and/or retail points through whitelabelling services. |

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| | brands on the shelves locally and in the region. | ● Integrating traceability post sale to honey companies in Zambia has potential to increase the visibility of sustainable honey production locally and inform local consumers.<br>● The main challenge of integrating data with these brands is most don't care where the honey comes from, but solely care about price. This initially creates a challenge for extracting value at this time. |
| **Export Honey BuyersBuyers** | Purchase honey from markets worldwide that is organic and meets international standards. | ● High uncertainty continues to exist for Zambian honey in many of the most valuable honey export markets. Many of these markets, such as Germany, have purchased Zambian honey in the past, but what was received was not what was advertised, meaning buyers and sellers generally lose out on future opportunities and current revenues.<br>● Export markets for NN honey has had its variability since inception and it has been difficult to overcome the bad reputation Zambian honey has with some of the biggest honey buyers worldwide. |
| **Organic Certifier/Auditor** | These organic certifiers and auditors engage with honey companies to ensure their process meet organic standards and issue certificates if systems are in compliance. | ● Organic certification is mainly about following the standard systems and justifying internal processes and results.<br>● Organic bodies generally do annual audits as required by the standards being followed, with the cost of the certification being out of reach for most honey companies.<br>● Ensuring understanding of standards by producers is the most vital piece of information that must be verified and validated by the certifier. |
| **Laboratory** | Independent verification and analysis. | ● Laboratory analysis and results are generally necessary for exporting honey from Zambia, with the most trusted results coming from laboratories in Bremen, Germany. These labs conduct varieties of tests requested by the producer and/or buyer and result in the classification of |

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| | | honey at the batch level. |

## MVE Selection Process and Justification

| Stakeholder | Selected? | Roles, Actions, Reputation. |
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| Nature's Nectar | **YES -** Impact First Honey Company | • Nature's Nectar is the only honey company in Zambia with a 1) robust network of registered producers, 2) is currently organic certified, 3) has existing data collection tools and procedures and 4) one of their co-founders is a Cardano Community Member. |
| NN - Field Supervisor (FS) | **YES -** Managing multiple Zones of beekeepers and ensuring a smooth process of hive distributions through to the final dispatch of purchased honey to processing. | • NN Field Supervisors are the most vital role in ensuring organic certification and production of honey in communities, already use similar data collection tools, have higher levels of education than the average beekeepers or ZLF and are employed by NN. |
| Conservation Partner(s) | **NO -** Provide connections in communities for integrating NN beekeeping operations | • Integrating with Conservation Partners is an integration that can occur in the future as more data flows and correlation occurs. Currently, the correlation of beehives to forest preservation/conservation rates are not available and are costly to access via existing tools. |
| Beekeeper/Farmer | **NO -** Produce top bar honey to sell at the premium NN price while experiencing the value of forest/ecosystem preservation. | • Eventually, a system to incentivize reporting of more data points directly from beekeepers/farmers is envisioned (e.g earning tokens or rewards for confirming location of hives), but limitations of literacy, digital literacy, network access and resources limit such a large number of individuals being onboarded at this time. |
| Zone Lead Farmer | **NO -** ZLF are the | • Zone Lead Farmers are the second |

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| (ZLF) | responsible party at the community level and the point of contact for NN Field Supervisors. | most viable option for integration for individual positions. It is envisioned that over time, some responsibilities of FSs will be reassigned to ZLFs as resources, tools and incentives developed further. |
| Traditional Leadership | **NO -** Traditional governance systems are widely used in Zambia for local dispute resolution and land use agreements. | • Integrating land use agreements between communities, traditional leadership and NN is envisioned, but with many chiefdoms having issues of network access, literacy and digital literacy, this integration will need to occur later in time. |
| Government Entities | **NO -** The Forestry and Veterinary Departments are the 2 most vital government structures for successfully and compliantly producing honey in Zambia. | • Digital systems within the Zambian government are not yet fully available within all departments, with Forestry and Veterinary currently issuing and keeping most records via paper. Changing the entire internal processes for government departments is unachievable at the moment with the current state of the departments, but this is envisioned to be integrated as systems move forward within those departments. |
| Beehive Producer | **NO -** NN has established a highly valuable relationship with a dedicated beehive production facility in Zambia that delivers beehives consistently, accurately and on time. | • Integrating the supply of beehives from the production facility to NN could occur, but again, current digitalization of records is not efficient in Zambian government entities. Most timber sourced by the production facility comes from ZAFFICO, a government para-statal forestry company. To understand the inefficiencies within ZAFFICO, here is one example.<br>○ In 2023, official pricing of timber was not released until March, making the purchase of any timber products unavailable for the first 3 months of the year. |
| Local- Honey Buyers | **NO -** NN has developed sales agreements with many honey companies in | • With many local honey companies with retail brands in Zambia purchasing white label honey from NN for their markets, integration of traceability would be great to have for the industry, |

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| | Zambia that have direct to consumer brands on the shelves locally and in the region. | but with cost of honey being THE limiting factory for these companies, integration is not possible until the market adjusts it value of traceability. |
| Export Honey BuyersBuyers | **NO -** Purchase honey from markets worldwide that is organic and meets international standards. | • With some of the largest export buyers in many markets having low trust in Zambian honey because of past deals gone bad, the best way to redevelop trust is through validating that the NN production system consistently validates their standards, which is meant to be accomplish through the Palmyra Pro application. |
| Organic Certifier/Auditor | **YES -** These organic certifiers and auditors engage with honey companies to ensure their process meet organic standards and issue certificates if systems are in compliance. | • With the organic certification process being a standard issued by governments specifically for their jurisdictions and is the same for all producers, this is one of the easiest wins possible.<br>• Because NN has already achieved organic status, bringing these processes on chain and integrating certifiers/auditors so that they may view data and verify as data streams from communities, higher levels of trust will be achieved. |
| Laboratory | **NO -** Independent verification and analysis. | • Laboratory results being published and verified on chain at the batch level should be a very similar process to integrating with organic standards and a semi-easy win.<br>• It won't be undertaken during this pilot as NN does not currently have purchase orders from buyers demanding these results.<br>• Depending on markets that become available over the near term, this may become a priority post pilot validation. |

## Final MVE Selection Process and Justification

| **Stakeholder** | **Selected** | **Justification Roles in the MVE** |
|---|---|---|
| Nature's Nectar | Impact First Honey | • Nature's Nectar is one of two organic |

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| | Company | certified honey companies in Zambia and by far, the most advanced regarding data collection and robust checks and balances. The only other organic certified honey company does not focus on sustainable beekeeping, does not have digital tools in the field and has been organic certified for many years, meaning change will be resisted.<br>● Working with the NN team, it is clear they are professional, systems focused, motivated and impact driven. Working with Nature's Nectar has been great thus far, as they have created impact systems and incentives throughout their journey that fit directly and applicably into web3 and blockchain solutions. |
| NN - Field Supervisor (FS) | Managing multiple Zones of beekeepers and ensuring a smooth process of hive distributions through to the final dispatch of purchased honey to processing. | ● Field Supervisors are the lifeblood of operating effectively in the field and these individuals are the responsible party for multiple communities of beekeepers. These individuals will be the main point of contact for documenting the organic certification process through survey collections and checks with beekeepers. Data collection and recording is a large portion of this role at NN and by issuing verifiable credentials to this role only, a clear and easy audit trail will be able to be followed internally to rectify issues in a timely manner, as well as by the organic certifying body/auditor who will be enabled with live data flow of the organic survey collection responses. |
| Organic Certifier/Auditor | These organic certifiers and auditors engage with honey companies to ensure their process meet organic standards and issue certificates if systems are in | ● Just over a year ago, Nature's Nectar completed their first organic audit with ECOCERT, an organic auditor/certifier for the United States and EU organic processes. Approval was issued a few months later and the process has continued moving forward with the 2nd audit occurring this year. ECOCERT has the highest reputation in the certification industry in the region and are very well known. Integrating and |

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| | compliance. | showcasing the power of this technology with them will provide for potential growth and adaptation into new organic products and companies. |

## Summary of Targets/Goals for the pilot with Nature's Nectar

**Overview:** We have signed an MOU with Natures Nectar - a honey producer in Zambia that sources from over **3000 small scale honey producers with 30,000 top bar beehives.**

**User Requirements;** Palmyra Pro will be used as the base system for in field data collection regarding organic certification of honey production, purchase records of honey from beekeepers, validated and secure processing and packing data and live data flows for organic certifiers and auditors.

- **Production Data -** data regarding location of beehives, status of beehives, occupation of beehives and harvesting data.
- **Sale of Honey from Farmers to NN -** data regarding price per kilo gram, season, location, farmer, other actors, water content and potentially more.
- **Honey Processing and Secured Packing -** data regarding input of comb honey, processing factors, liquid honey output, beeswax output, waste, packing and securitization via RFD enabled security seals.
- **Live Organic Audit Flow Credentials** - data flow through verified field actors via credentials with read and write functions and external audit view with read only permissions.

# 5. Next Steps and Recommendations | Conclusion

With **core supply chain processes well-documented** and **stakeholder roles clearly defined**, the next stage of development with Nature's Nectar must focus on translating operational workflows into reliable, auditable digital systems. Immediate priorities include **finalizing the structure and logic for verifiable credentials**—starting with **organic certification** surveys—and configuring Palmyra Pro to support secure, **role-based data capture from Field Supervisors**. Integration of **oracles for lab test data**, and anchoring production and processing events to on-chain records, will be essential for end-to-end traceability. Developers should prioritize building lightweight, user-friendly interfaces that **accommodate limited connectivity and digital literacy** in the field, while also designing flexible modules that can evolve to **include Zone Lead Farmers, conservation data, and batch-level identity**

**for white-label partners**. A phased, **modular approach** will ensure system integrity, scalability, and value delivery across NN's honey ecosystem.  As Zambia's honey sector faces challenges in traceability, adulteration, and market perception, Nature's Nectar is positioned to **lead the industry's transformation.**

To move forward, **finalizing the credentialing system for field-based organic audits** and **integrating lab data oracles** are essential. These steps will **ensure end-to-end verification** and unlock premium export markets. Field Supervisors will remain key to maintaining data integrity, while **strategic efforts to engage Zone Lead Farmers** and local buyers will further **expand ecosystem participation**. By scaling these efforts carefully and continuing to build **trust across the value chain**, Nature's Nectar and zenGate can set a new benchmark for **transparent, ethical, and high-assurance agricultural exports from Africa.**