Zambia MVP Field Testing & Iteration Report

Project: Implementing Real World Asset Tokenization and Verifiable Credentials
Milestone: M5 – On-Ground Zambia Workshops & MVP Pilot
Partner: Nature's Nectar (Zambia)
Testing Period: April 2025 – October 2025
Prepared by: zenGate Global | Palmyra Pro

1. Executive Summary

Following the successful go-live of the Palmyra Pro MVP in April 2025 with Nature's Nectar in Zambia, an extended field-testing and iteration phase was conducted over a six-month period. This phase transitioned the system from an initial operational MVP into a production-ready solution aligned with real factory conditions, rural deployment realities, and future blockchain anchoring requirements.

The purpose of this report is to document:

- The testing methodology used during the pilot phase
- Key operational insights gathered from real-world use
- Structural and architectural refinements made to the system
- Privacy and security adjustments relating to credentials and oracle anchoring
- Improvements in usability, workflow flexibility, and scalability
- Readiness for broader multi-tenant deployment

The testing phase validated that real-world asset traceability and credential-based verification cannot be deployed in isolation from operational context. Instead, traceability, identity verification, and oracle anchoring must be layered progressively on top of stable and user-friendly workflows.

The result of this six-month iteration cycle is a hardened v2 system capable of supporting additional honey producers and future traceability-integrated use cases.

2. Testing Scope & Methodology

2.1 Operational Context

Nature’s Nectar operates a honey aggregation and processing model sourcing from small-holder producers across multiple zones. The MVP was first deployed in April 2025 to digitize:

- Farmer onboarding
- Harvest and collection records
- Factory intake logging
- Processing and QA records
- Batch formation and inventory tracking

Following initial go-live, the system was used continuously in live operations. Feedback was collected through:

- Direct observation during field visits
- Factory-level review sessions
- Structured debrief discussions
- System performance logs
- User feedback from field supervisors

Credential-linked verification and Merkle Trie–based oracle testing were introduced progressively after workflows stabilized.

3. Key Field Testing Insights

3.1 Offline Data Capture & Synchronisation Realities

One of the most significant findings during deployment was the impact of inconsistent internet connectivity on operational reliability. Field supervisors frequently operated in areas with intermittent or no signal, making real-time submission to backend systems impractical.

Initial assumptions around seamless synchronization proved optimistic. Users required clear visibility into:

- Which records were locally saved
- Which records were pending synchronization
- Which records were successfully anchored

In response, the architecture was strengthened to support a more resilient offline-first model. Synchronization logic was improved to handle delayed uploads safely and transparently. User interface indicators were introduced to differentiate between:

- Draft
- Pending Sync
- Anchored

This change significantly improved user confidence and reduced operational uncertainty. This was critical to get correct, especially as we needed a way to get all the data ready before any blockchain anchoring took place - i.e the biometric checks and oracles which are typically happening in an online environment.

3.2 Processing & Batch Management Flexibility

Real factory operations exposed rigidities in early batch modeling logic. The initial system design reflected zone-based assumptions that did not accurately mirror operational behavior.

In practice:

- Honey is processed on a rolling, multi-day basis.
- Processing inputs may originate from single or multiple zones.
- Tank capacity determines batch formation, not zone boundaries.
- Large zones may produce multiple batches.
- Multiple smaller zones may be blended into a single batch.

The original auto-generated batch code structure created friction when handling blended inputs or rolling production cycles.

Following structured review and internal documentation (NN Batch Code Change Request, Oct 2025 - [Link]), batch logic is being refactored to:

- Decouple batch identity from zone assumptions
- Support multi-zone input aggregation
- Reflect tank-based production continuity
- Allow flexible transformation logic

This refinement brought the digital model into alignment with real-world processing mechanics.

3.3 Input Reconciliation & Weight Verification

Repeated discrepancies emerged during intake and processing reconciliation. These included:

- Bucket weight verification inconsistencies
- Misalignment between intake totals and processing totals
- Gaps between physical and digital reconciliation

The testing phase highlighted that digital traceability must support operational audit discipline.

Enhancements were introduced to:

- Strengthen validation checks
- Require clearer reconciliation flows
- Introduce role-based review before record finalization
- Improve input verification prompts

This improved both data integrity and operational trust.

3.4 Secondary Outputs: Wax Traceability

During processing, wax emerged as a commercially valuable by-product. Initially, wax was treated as an incidental output.

Field feedback clarified that wax:

- Holds market value
- Requires separate inventory management
- Should retain traceability linkage to originating batch

The data model was extended to support multi-output traceability logic, allowing wax to be independently tracked while preserving parent-batch references.

3.5 Privacy & Oracle Anchoring Adjustments

Testing of the Merkle Trie oracle anchoring for farmer payment records surfaced critical privacy considerations.

It became evident that:

- Personal identifiable information (PII) must not be embedded in oracle datasets.
- Payment histories must remain privacy-preserving.
- Only hashed or aggregated financial references should be anchored.

Oracle batching logic was therefore refined to:

- Strip sensitive data fields
- Anchor only cryptographic commitments
- Maintain verifiability without exposing personal data

This adjustment strengthened compliance readiness and future scalability.

3.6 Credential & Biometric Gating Architecture

Credential-linked verification was tested using ADA Handles connected to internal user identities.

Field experience clarified that biometric verification should occur at the supervisory control layer rather than at every producer interaction.

The critical trust checkpoint is verifying:

- Who is submitting the record
- Where the submission is taking place
- What event is being recorded

The system was refined so that:

1. Identity verification (ADA Handle + biometric) occurs first.
2. Event data is validated.
3. Blockchain anchoring occurs only after identity validation passes.

This sequencing ensures that blockchain immutability does not precede human verification.

3.7 Training & UX Realities

Digital literacy levels varied significantly. Introducing blockchain terminology prematurely created confusion.

It became clear that:

- Users must first understand workflows.
- Blockchain anchoring should be abstracted.
- UI must prioritize clarity over feature density.
- Over-customization increases friction.

The system evolved toward:

- Simplified workflows
- Generalized architecture
- Reduced assumption-heavy logic
- Cleaner UI transitions

This improved adoption readiness.

4. Iterative Improvements Implemented

Between April and October 2025, multiple iterative releases were deployed addressing:

- Offline synchronization resilience
- Flexible batch modeling
- Multi-output tracking
- Input validation strengthening
- Privacy-aware oracle batching
- Credential gating improvements
- UX simplification

5. Conclusion

The Zambia MVP Pilot was not a one-time deployment event but a sustained operational learning cycle. Over six months of real-world usage, the system matured through structured testing, field feedback, and iterative development.

Key outcomes include:

- Alignment between digital workflows and physical operations
- Privacy-aware blockchain anchoring
- Improved resilience under rural constraints
- Clear identity verification sequencing
- Strengthened audit and reconciliation flows

The MVP has now graduated and is transitioning into a scalable v2 solution capable of broader adoption by other honey factories and cooperatives.