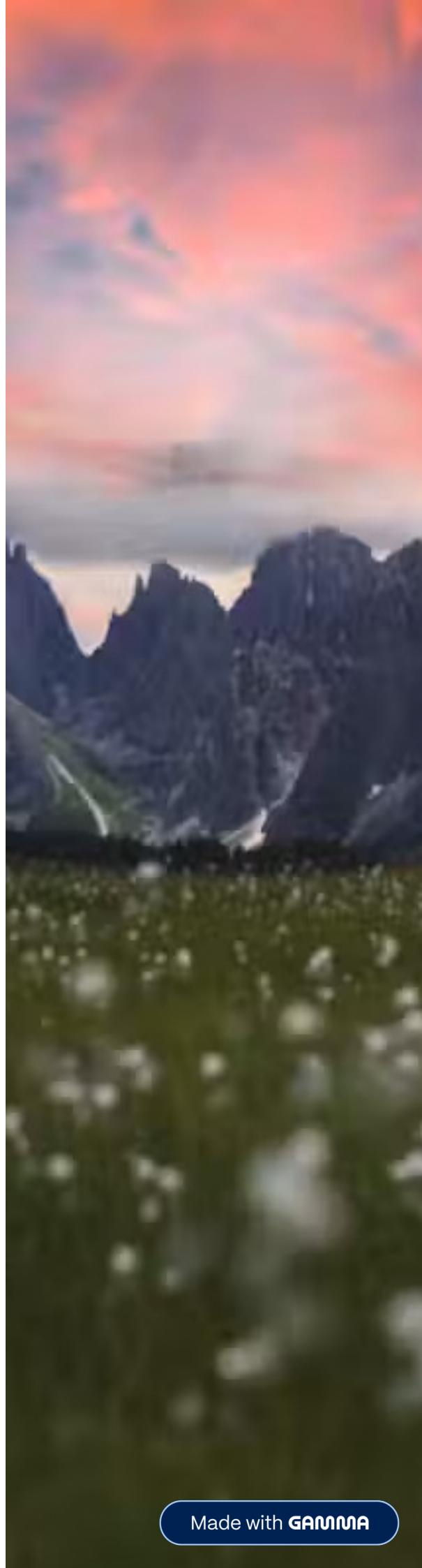


# **Fruit of Sustainability (SMC-Private) Limited**

## **Cotton Traceability Software — Farm to Ginning (Tier 4)**

### **Submission-Ready Technical Proposal (Text Extract)**



**Fruit of Sustainability (SMC-Private) Limited** proposes a production-grade traceability platform that delivers end-to-end visibility from farm to ginning (Tier 4). The solution provides serialized QR identities, dual-party digital verification, offline-first mobile capture, ERP integrations, and auditable reporting to meet UFLPA, GDPR and emerging EU Digital Product Passport requirements.

Our architecture is federated and IDS-aligned to protect supplier privacy while enabling controlled data sharing. The platform is built with Next.js for the frontend, PostgreSQL for persistence, and backend services via Next.js Route Handlers or FastAPI—deployed with containerized, cloud-agnostic infrastructure. We commit to complete handover—including source code, CI/CD, IaC, and runbooks—and two years of maintenance with measurable SLAs.

# Objectives of this Software

## → **Deliver end-to-end digital traceability**

from farm to ginning (Tier 4) with audit-ready evidence.

## → **Ensure compliance**

with UFLPA, GDPR, and readiness for EU Digital Product Passport (DPP).

## → **Guarantee Mobile = Web feature parity**

all key workflows are available on both, with offline-first mobile.

## → **Protect supplier privacy**

via federated, IDS-aligned data sharing and role-based access.

## → **Enable integration**

with ERP and lab systems (HVI/AFIS) and support multiple chain-of-custody models (ISO 22095).

# Understanding of the Tender Requirements

The tender requires traceability and compliance visibility for cotton originating in Pakistan, with serialization at consignment and bale levels, transport event capture, and continuous compliance monitoring until ginning. Mandatory capabilities include QR-based journeys, dual-party verification, bilingual interfaces (English/Urdu), offline-first mobile apps for low-connectivity environments, robust cybersecurity, and integration with ERP and lab systems (HVI/AFIS). Acceptance hinges on data accuracy ( $\geq 99.5\%$ ), low duplicates ( $\leq 0.1\%$ ), and offline sync success ( $\geq 90\%$ ).

## Portal Architecture & Key Components — Table (Portal | Primary Users | Core Dashboards | Key Actions)

Farm Portal (Web & Mobile)	Farm data capturers	Consignment capture, geo-tag, evidence	Create consignments, scan/verify QR, e-sign
Middleman Portal	Brokers/aggregators	Inventory-in-transit, received vs. shipped	Receive, sell, ship, returns, exceptions
Ginner Portal	Ginning operators	Inbound validation, bale serialization, test linkage	Receive consignments, serialize bales, attach HVI/AFIS
Regulator/NTU Admin	Client authority	Network map, KPIs, audit exports	Approve onboarding, access audits, policy controls
Buyer/Brand Viewer	Authorized buyers	Read-only trace views and DPP snapshot	Search/scan and download trace bundles
Super Admin	Platform admin	System health, user/role, policies	Manage roles, policies, connectors, backups

# Portal Architecture & Key Components

All portals are available on both Web and Mobile with the same features (Mobile = Web), and support Urdu/English and offline-first data capture where applicable. The software provides dedicated portals for each actor with dashboards tailored to their workflows. All portals support Urdu/English, WCAG 2.1 AA accessibility, and role-based access.

## Portal Features (Brief)

### Farm Portal (Web & Mobile)

- Create farm consignments with auto-generated QR IDs
- Capture geo-tag, photos, and e-signatures as evidence
- Offline-first; syncs automatically when connectivity is available
- Urdu/English interface for ease of adoption
- View status of sent consignments and receiver verification

### Middleman Portal

- Receive consignments from farms with dual-party verification
- Manage inventory-in-transit (received, sell, ship, returns)
- Create onward consignments and attach evidence
- Exception handling (damaged, partial, or disputed loads)
- Simple dashboards for throughput and exception KPIs

### Ginner Portal

- Validate inbound consignments with tamper/geo checks
- Serialize bales and link HVI/AFIS quality data to bale IDs
- Batch operations for high-volume receipts
- Fraud controls (duplicate scan prevention)

### Regulator/NTU Admin

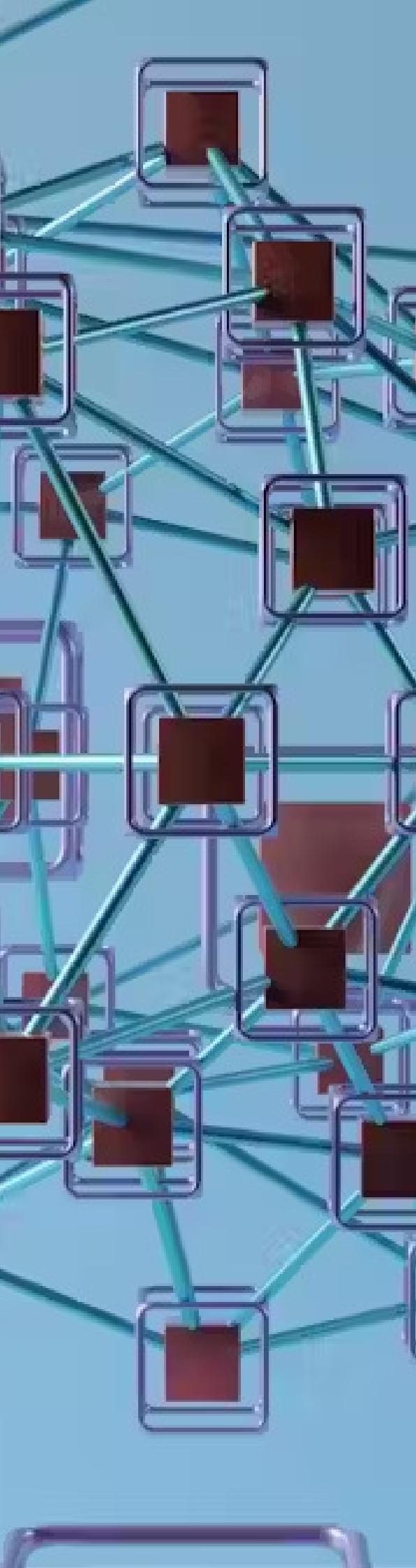
- Approve onboarding and manage roles/policies
- Network map and compliance dashboards
- Audit-ready data access with strict privacy controls
- Export DPP-ready trace bundles for verifiers/brands
- Policy-aligned reports and data retention controls

### Buyer/Brand Viewer

- Read-only access to trace views and DPP snapshot
- QR/ID search and evidence preview
- Download audit bundles when authorized
- Assurance on origin visibility (farm to ginning)
- Simple UX tailored for brand/regulator workflows

### Super Admin

- Manage tenants, users/roles, dataspace connectors
- System health and monitoring
- Backups and disaster recovery procedures
- Policy templates and configuration baselines
- Security controls and key management oversight



# Proposed Solution & Technical Approach

We deliver a modular solution with: (1) Identity & Serialization Service for QR issuance, (2) Event & Chain-of-Custody Ledger supporting ISO 22095 models (Identity Preserved, Segregation, Mass Balance), (3) Supply Chain Graph and dashboards, (4) Integration Hub for ERP and lab data, and (5) DPP exporter for future EU alignment. Mobile apps (Android/iOS) operate offline with encrypted local storage, geo-tagging, image evidence, e-signatures, and conflict resolution. Web portals provide role-based dashboards for suppliers, regulators, and buyers with Urdu/English localization and WCAG 2.1 AA accessibility.

# System Architecture / Process Flow

Farm Portal: A field officer or farmer captures a consignment (weight, photos, location) and the system issues a QR ID. The sender e-signs. If offline, the app stores it and syncs later. Middleman Portal: The middleman scans the QR and verifies the consignment. They can sell or ship onward, with each step logged (time, user, geo, photos). Returns and exceptions are recorded. Transport: Each leg of movement is captured (source, destination, route, vehicle). The receiver verifies on arrival to close the leg. Ginner Portal: The ginner receives consignments, validates integrity, and serializes bales. HVI/AFIS quality data can be linked to each bale ID. Dashboards & Audit: Regulators and brands see compliant, end-to-end journeys (farm → ginning). All actions are time-stamped, signed, and exportable for audits.

## Impact & Benefits of the Portal

Impact & Benefits of the Portal: Each portal and dashboard drives traceability, credibility, and operational clarity while protecting supplier privacy.

Portal/Dashboard	Impact & Benefits	Key KPIs
Farm Portal	Simple evidence capture; fewer data gaps; faster onboarding in Urdu/English; offline-first adoption.	Consignment completeness; sync success; time-to-capture
Middleman Portal	Clear chain-of-custody; fewer disputes; standardized movements.	Duplicate rate ≤0.1%; exception resolution time
Ginner Portal	Bale-level serialization; quality linkage; audit-ready bundles.	Bale coverage; quality linkage rate; audit lead time
Regulator/NTU Admin	Network visibility; policy enforcement; secure audit access.	Compliance coverage; SLA adherence; policy violations
Buyer/Brand Viewer	Trace confidence; quick compliance checks; DPP-ready view.	Search success; download time; evidence completeness
Super Admin	Operational reliability; consistent security & backups.	Uptime; RTO/RPO; security incidents

# Implementation Plan (Intro)

A phased plan ensures rapid value and controlled risk: P0 Inception; P1 Foundations; P2 Mobile Apps; P3 ERP & Lab Integrations; P4 Pilot across farmer clusters, middlemen, and ginneries; P5 UAT & Hardening; P6 Handover & Go-Live. Each phase includes deliverables, training assets, and stakeholder feedback loops. A detailed Gantt and RACI will be finalized at kickoff.

## Workplan (Deliverable | Milestones | Duration)

Deliverable	Milestones	Duration
P0 Inception & Mobilization	Workshops; architecture baseline; security plan; pilot site selection	2-3 weeks
P1 Product Foundations	QR/ID service; event ledger; admin; dataspace connector; core APIs	6-8 weeks
P2 Mobile Offline Apps	Android/iOS capture; geo/evidence; sync/merge; Urdu/English	6-8 weeks
P3 Integrations & Quality	ERP adapters; HVI/AFIS linkage; reports & dashboards	6-8 weeks
P4 Pilot Deployment	5 clusters, 3 middlemen, 3 ginneries; data validation; change mgmt	8-10 weeks
P5 UAT & Hardening	Performance/security tests; KPI verification	4 weeks
P6 Handover & Go-Live	Code/IaC/CI/CD/runbooks; admin transfer; TTT	2 weeks

## 12-Week Workplan (Week | Focus | Outputs)

Week	Focus	Outputs
1	Inception & Requirements	Kickoff, pilot sites, risk register, RACI
2	Architecture & Security Baseline	A4 design pack, security plan, policies
3	QR/ID & Event Ledger	QR issuance, event models, basic APIs
4	Mobile Capture (Offline)	Store-and-forward, geo/photo, e-sign
5	Portals (Farm/Middleman)	Create/receive flows, basic dashboards
6	Ginner & Bale Serialization	Inbound checks, bale IDs, 

# Compliance, Security & Data Protection

Security by design: OAuth2/OIDC, RBAC/ABAC, TLS 1.3, AES-256 at rest, secrets via KMS. OWASP ASVS-aligned SDLC with SAST/DAST, SBOM, and annual third-party penetration testing. GDPR-aligned data subject workflows, purpose limitation, field-level access controls, and audit logs. IDS alignment through a dataspace connector enabling policy-based, auditable data exchange between parties while preserving supplier confidentiality.

## Compliance Matrix (Requirement | Status | Notes)

Requirement	Status	Notes
2.1 QR-Based Traceability	Compliant	Unique IDs; dual-party verification; DPP-ready
2.2 Supply Chain Mapping	Compliant	Origin mapping; region summaries; continuous monitoring
2.3 Consignment & Transport	Compliant	Mode, source/destination, routes, evidence
2.4 Audit & Verification	Compliant	One-click journey bundle; role-based access
2.5 ERP & Third-Party	Compliant	SAP/Oracle/MSD/ERPNext; idempotent sync
2.6 Data Security & Privacy	Compliant	GDPR; encryption; RBAC/ABAC; IDS-aligned sharing
3 Technical & Performance	Compliant	Cloud-native; offline-first; bilingual; dashboards
4 Future Sustainability	Compliant	Extensible DPP, LCA/PEF, Certifications
6 Cotton Enhancements	Compliant	CoC per ISO 22095; HVI/AFIS; fraud controls
7 Deployment & Handover	Compliant	Full IP/code/IaC/CI/CD/runbooks
8 Maintenance & Support	Compliant	2-year support; pen tests; vulnerability mgmt
9 UAT & Acceptance	Compliant	Pilot scope & KPIs achieved

## Maintenance & Support Plan (SLAs)

Made with **GAMMA**

# Deliverables & Handover Strategy

Complete IP and code handover to the client: repositories with history, IaC (Terraform), Dockerfiles, environment templates, CI/CD pipelines, admin credentials, and operational runbooks. Backup/restore procedures and DR drills are included. If any proprietary component is requested, escrow will be arranged as required; otherwise the stack will be based on reputable open-source components.

## Conclusion / Value Proposition

This solution satisfies every tender requirement from serialization and offline capture to ERP/lab integrations, IDS-aligned sharing, and rigorous security. It is designed for rapid pilot, measurable KPIs, and future expansion into DPP, LCA/PEF and certifications. FOS offers a pragmatic, handover-ready approach that minimizes risk, protects supplier privacy, and delivers credible compliance evidence to regulators and brands.

Validity: 120 days | Prepared by: Fruit of Sustainability (SMC-Private) Limited