# Product Requirements Definition (PRD) Document

## 1. Document Information

- **Product Name**: CattleGuard AI - Modern Cattle Management System
- **Version**: 1.0
- **Date**: February 02, 2026
- **Author**: Grok 4 (xAI)
- **Purpose of Document**: This PRD outlines the requirements for developing a mobile application for scientific cattle management, focusing on Android platforms. It incorporates user-specified features such as photo-based identification, comprehensive animal datasheets, heritage tracking, gestation and calving alerts, AI integrations, analytics, and voice capabilities. Best practice features are proposed based on industry standards for efficiency, animal welfare, and productivity in livestock management.

## 2. Introduction

### 2.1 Product Overview

CattleGuard AI is a mobile-first cattle management system designed for farmers, ranchers, and veterinarians to manage beef and dairy herds scientifically and efficiently. The app leverages Android's native capabilities (e.g., camera for photo recognition, GPS for location tracking, and microphone for voice input) to enable real-time data entry, monitoring, and alerts. It maintains detailed profiles for each animal, tracks biological and operational events, and uses AI to provide predictive insights, analytics, and automated recommendations.

The system emphasizes modern practices such as precision livestock farming (PLF), where AI analyzes data for health monitoring, disease prevention, and resource optimization. It supports offline functionality with cloud sync for data accessibility across devices.

## 2.2 Objectives

- Enable accurate identification and tracking of individual cattle using photos and AI recognition.
- Provide comprehensive datasheets for each cow or bull, including heritage, health, breeding, and performance metrics.
- Automate tracking and alerts for key events like gestation, calving, vaccinations, and health issues.
- Incorporate AI for enhanced decision-making, such as predictive analytics and voice-assisted interactions.
- Promote best practices like real-time monitoring, inventory management, and sustainability to improve herd productivity, animal welfare, and farm profitability.
- Ensure the app is user-friendly, running seamlessly on Android devices (version 10+).

## 2.3 Target Users

- Small to medium-scale cattle farmers and ranchers.
- Dairy and beef producers.
- Veterinarians and farm managers.
- Users in regions like South Africa (e.g., Johannesburg), where mobile tech adoption is high for agriculture.

## 2.4 Business Value

- Reduces manual record-keeping errors by 50-70% through AI automation (based on industry benchmarks from tools like Cattlytics).
- Improves herd health and productivity via early alerts, potentially increasing yields by 10-20% (inspired by AI applications in Cargill CattleView).
- Enhances sustainability by optimizing feed, reducing waste, and minimizing disease outbreaks.

# 3. Scope

## 3.1 In Scope

- Android mobile app with core features for animal management.
- Integration with device hardware (camera, GPS, microphone).
- AI-driven features for recognition, predictions, and analytics.
- Data storage (local database with optional cloud sync).
- Alerts via push notifications, email, or SMS.
- Reporting and analytics dashboards.

## 3.2 Out of Scope

- iOS or web versions (focus on Android).
- Hardware integrations beyond phone capabilities (e.g., no direct drone or sensor support in v1.0; propose as future enhancement).
- Custom AI model training (use pre-trained models via libraries like TensorFlow Lite).
- Payment processing or e-commerce (e.g., for feed orders; suggest as add-on).

# 4. Assumptions and Dependencies

- Users have Android devices with cameras (8MP+ for reliable photo recognition).
- Internet access for cloud sync and AI processing (offline mode for core functions).
- Compliance with data privacy laws (e.g., POPIA in South Africa).
- Dependencies: Android SDK, AI libraries (e.g., ML Kit for image recognition), cloud services (e.g., Firebase for storage).

# 5. Functional Requirements

## 5.1 User Management

- User registration/login via email, phone, or Google.
- Multi-user support for farm teams (roles: admin, manager, worker).
- Profile customization with farm details (location, herd size).

## 5.2 Animal Profiles and Datasheets

- Create/edit profiles for each cow/bull with a complete datasheet including:
    - Basic info: ID/tag number, name, breed, age, sex, weight, color/markings.
    - Identifying photos: Multiple images (front, side, full body) stored for reference.
    - Heritage tracking: Pedigree tree (parents, grandparents, lineage import/export via CSV).
    - Health history: Vaccinations, treatments, illnesses, vet notes.
    - Breeding data: Mating history, AI/embryo transfer records, progeny list.
    - Performance metrics: Milk yield (for dairy), weight gain, feed consumption.
- Best practice: Auto-generate unique IDs using EID (Electronic Identification) if scanned via NFC (Android native support).

## 5.3 Photo Identification and Recognition

- Use Android camera to capture photos for new profiles or identification.
- AI-enhanced recognition: Leverage ML Kit or similar for facial/biometric recognition of cattle (e.g., match photos to profiles with 85-95% accuracy, based on industry tools like Cargill CattleView).
- Features: Auto-crop/enhance photos, search herd by photo upload, alert on duplicates.
- Best practice: Offline recognition for field use; cloud upload for improved accuracy via advanced models.

## 5.4 Breeding and Lifecycle Tracking

- Track gestation: Input mating/AI dates; auto-calculate due dates (e.g., 283 days average for cattle).
- Calving alerts: Push notifications 1-2 weeks before due date, with checklists (e.g., prepare birthing area).
- Event logging: Births, weaning, sales, deaths.
- Best practice: Predictive alerts for heat cycles using AI analysis of behavior data (e.g., from manual inputs or future sensor integration).

## 5.5 Health and Welfare Management

- Record treatments, symptoms, and monitoring (e.g., temperature, activity levels).
- AI disease detection: Analyze photos for signs of illness (e.g., lameness via gait analysis) or use input data for predictions (e.g., early mastitis detection).
- Best practice: Integration with PLF principles – real-time alerts for anomalies, automated reminders for vaccinations/deworming based on schedules.

## 5.6 Alerts and Notifications

- Customizable alerts for gestation milestones, calving, health events, low inventory.
- Delivery: In-app notifications, SMS/email (using Android APIs).
- Best practice: Prioritize critical alerts (e.g., potential disease outbreak) with AI escalation (e.g., notify vet if multiple animals affected).

## 5.7 AI Features

- **Photo Recognition**: As above, for quick ID in the field.
- **Predictive Analytics**: AI models to forecast weight gain, milk yield, or health risks using historical data (inspired by Cattlytics AI predictions).
- **AI Chatbot**: Natural language queries (e.g., "What's the status of Cow #123?") for instant insights on animal data.
- **Voice Integration (AI Speech)**: Use Android Speech-to-Text for hands-free data entry (e.g., "Record weight 450kg for Bull #45") and Text-to-Speech for reading alerts/reports.
- Best practice: AI-driven recommendations (e.g., optimal feed ratios based on performance data, reducing waste by 15-20%).

## 5.8 Analytics and Reporting

- Dashboards: Herd overview (e.g., average weight, breeding success rate), financial summaries (feed costs vs. yield).
- Reports: Exportable PDFs/CSVs for pedigree, health trends, productivity.
- AI Analytics: Trend analysis (e.g., identify underperforming animals), predictive insights (e.g., disease risk based on weather/GPS data).
- Best practice: Visualize data with charts (e.g., growth curves, heat maps for pasture usage via GPS).

## 5.9 Inventory and Resource Management

- Track feed, medications, equipment.
- Best practice: AI-optimized suggestions for reordering, pasture rotation using GPS data.

## 5.10 Offline Mode and Sync

- Full functionality offline; auto-sync when online.
- Best practice: Conflict resolution for multi-device edits.

# 6. Non-Functional Requirements

## 6.1 Performance

- App launch < 2 seconds; photo recognition < 5 seconds offline.
- Handle up to 1,000 animal profiles without lag.

## 6.2 Security

- Data encryption (local and cloud).
- Access controls; biometric login (fingerprint/face ID via Android).
- Best practice: Audit logs for changes to animal records.

## 6.3 Usability

- Intuitive UI with large buttons for field use.
- Multilingual support (English, Afrikaans for ZA users).
- Accessibility: Voice-over for visually impaired.

## 6.4 Reliability and Scalability

- 99% uptime for cloud features.
- Scalable for large herds via modular design.

## 6.5 Compatibility

- Android 10+; support for various screen sizes.
- Best practice: Test on common devices (e.g., Samsung, Huawei in ZA market).

# 7. User Interface and Experience

- Home screen: Dashboard with quick access to herd list, alerts, analytics.
- Navigation: Bottom tabs for Profiles, Breeding, Health, Reports, Settings.
- Photo workflow: Camera integration with guides for optimal angles.
- Voice UI: Microphone icon for inputs; spoken responses for hands-free operation.
- Best practice: Dark mode for outdoor use; gesture-based navigation.

## 8. Data Management

- Local: SQLite database.
- Cloud: Optional Firebase for backup/sync.
- Data Import/Export: CSV, JSON for integration with tools like My Cattle Manager.

## 9. Testing and Quality Assurance

- Unit tests for AI accuracy.
- Field testing for photo recognition in varied lighting.
- Usability testing with farmers.

## 10. Future Enhancements

- IoT integration (e.g., wearables for real-time vitals).
- Drone support for herd monitoring.
- Advanced AI (e.g., satellite imagery for pasture health).

This PRD provides a comprehensive blueprint for CattleGuard AI, drawing from best practices in apps like Cattlytics and My Cattle Manager, and AI innovations from Cargill and Penn State Extension. Development should prioritize user feedback for iterations.