Upgrow Rwanda Ltd

UPGROW RWANDA LTD

Pilot Data Collection Framework

for MINAGRI Partnership

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Aligned to: PSTA 5 Strategic Plan for Agriculture Transformation

TABLE OF CONTENTS

GLOSSARY OF KEY TERMS

All technical terms, acronyms, and concepts referenced throughout this framework are defined below for clarity and consistency.

Acronym	Full Name	Definition
CEA	**Controlled Environment Agriculture**	Growing food in enclosed, climate-managed facilities with artificial lighting, automated climate control, and precision hydroponic/aeroponic systems.
DTH	**Days to Harvest**	Calendar days from transplanting seedling into growing tower to first harvestable crop ready for market.
EC	**Electrical Conductivity**	Measure of dissolved nutrient concentration in water (unit: mS/cm). High EC indicates high nutrient load; low EC indicates low nutrient availability.
pH	**Potential of Hydrogen**	Acidity/alkalinity scale (0-14); neutral is 7. Most plants need 5.5-6.5 for optimal nutrient uptake.
PPFD	**Photosynthetic Photon Flux Density**	Light energy available for plant growth (measured in µmol/m²/s). Determines supplemental lighting needs for winter or dense planting.
PSTA 5	**Strategic Plan for Agriculture Transformation, Phase 5**	Rwanda's national agriculture strategy and policy framework that guides government investment and priorities through 2030.
MoU	**Memorandum of Understanding**	Formal agreement between Upgrow Rwanda Ltd and MINAGRI defining the pilot partnership, milestones, reporting obligations, and mutual commitments.
MINAGRI	**Ministry of Agriculture and Animal Resources**	Rwanda's agriculture ministry responsible for policy, regulation, and validation of agricultural innovations like this pilot.
CAPEX	**Capital Expenditure**	One-time investment costs: towers, greenhouse structure, pumps, timers, installation labor, and irrigation infrastructure.
OpEx	**Operating Expenses**	Recurring monthly costs: labor wages, nutrients and pH adjusters, seeds and propagation materials, water, electricity, maintenance, and transport.
COGS	**Cost of Goods Sold**	Direct production costs attributable to each harvest cycle (seeds, nutrients, water, electricity, direct labor).
EBITDA	**Earnings Before Interest, Taxes, Depreciation, and Amortization**	Financial metric showing profitability from operations before accounting for financing, taxes, or asset depreciation.

RWF	**Rwandan Franc**	Rwandan currency. Approximate exchange rate: 750 RWF = 1 USD (2024-2026).
HD / LD	**High-Density / Low-Density**	Tower configurations. HD (Agrotonomy): 196 sites/tower. LD (Fronting): 52 sites/tower. HD enables higher yield/m² at lower per-site cost if quality maintained.
LOI	**Letter of Intent**	Preliminary written commitment from a buyer expressing interest to purchase stated crop quantities at specified prices, subject to confirmation.
SOP	**Standard Operating Procedure**	Documented step-by-step work instructions for repeatable tasks (planting, harvesting, nutrient prep, cleaning) to ensure consistency and training.
KPI	**Key Performance Indicator**	Measurable metric tied to strategic objectives. Examples: yield per plant, gross margin %, crop loss rate, tower uptime.
EUCL	**Energy Utility Corporation Limited**	Rwanda's primary electricity provider. Billing used for power consumption tracking and cost modeling.
QC	**Quality Control**	Process of inspecting and assessing crop quality (color, size, firmness, leaf integrity) before harvest to determine market channel.
CoV	**Coefficient of Variation**	Statistical measure of consistency (standard deviation divided by mean). Lower CoV indicates more uniform, predictable crop performance.

1 EXECUTIVE SUMMARY & PURPOSE

This document defines the complete data collection architecture for Upgrow Rwanda Ltd's aeroponic pilot project, operated in partnership with the Ministry of Agriculture and Animal Resources (MINAGRI). It serves as the single source of truth for what data is collected, how, when, by whom, and what decisions each data point enables.

> **DESIGN PRINCIPLE:** This framework is designed to generate investor-grade data from Day 1. Every metric ties directly to a scaling decision, a cost control lever, or a MINAGRI reporting obligation under PSTA 5.

Pilot Infrastructure Summary

Parameter	Value	Strategic Relevance
Total Towers	10	Minimum viable dataset for scaling models
Low-Density Towers (52 sites)	7 towers = 364 sites	Baseline for standard commercial deployment
High-Density Towers (196 sites)	3 towers = 588 sites	Test case for high-density economics
Total Crop Sites	952	Statistical significance for yield analysis
Crop Varieties	~15	Covers local, premium, and export categories
Pilot Duration	6 months	Minimum 3 full growth cycles for most crops
Location	Gasabo District, Kigali	Urban/peri-urban CEA demonstration zone
Environment	Greenhouse-based	Controlled but climate-influenced

2 PILOT INFRASTRUCTURE OVERVIEW

Tower Configuration & Capacity Matrix

Tower Type	Qty	Sites/Tower	Total Sites	% of Capacity	Supplier	Primary Use Case
Low-Density (LD)	7	52	364	38.2%	Fronting Supplier	Leafy greens, herbs, fast-cycle crops
High-Density (HD)	3	196	588	61.8%	Agrotonomy	Volume testing, density economics, export crops
TOTAL	10	—	952	100%	—	Full pilot capacity

SCALING INSIGHT: The HD towers represent 61.8% of total capacity from only 30% of towers. This density ratio (3.77x per tower) is the critical variable for scaling economics — if HD towers demonstrate comparable crop quality at lower per-site cost, the 100-tower expansion should favor HD configurations.

Data Architecture Principle

Every data point collected must serve at least one of four purposes:

Operational Control: Real-time adjustments to growing conditions, nutrient delivery, or workflow

Financial Intelligence: Cost per unit, revenue per site, margin analysis, ROI calculation

Scaling Decision: Go/no-go triggers for expansion, configuration choices, facility design

Ministry Reporting: PSTA 5 output indicators, quarterly reports, compliance documentation

3 DATA COLLECTION CATEGORIES

3.1 Crop Performance Intelligence

Decision this enables: Which crops to scale, which to drop, which to prioritize for commercial production. Directly feeds MINAGRI Output 3.1.1 (demand-driven research) and Output 2.1.1 (export crop validation).

PRIORITY: TOP 3 METRICS FOR INVESTOR READINESS: (1) Yield per Plant — proves production capacity per tower, (2) Gross Margin per Crop — identifies which crops to scale, (3) Crop Loss Rate — validates operational reliability. All other metrics support these three.

Metric	What Is Measured	Why It Matters	Method	Frequency	Owner	Decision Enabled
Germination Rate (%)	Seeds sprouted / seeds planted per variety	First filter for crop viability; <70% signals seed quality or method issue	Count germinated seedlings in nursery trays at Day 5 and Day 10	Per planting cycle	Agronomist	Seed supplier evaluation; variety selection
Days to Harvest (DTH)	Calendar days from transplant to first commercial harvest	Determines crop cycle speed; faster = more revenue cycles/year	Record transplant date and first harvest date per tower section	Per crop cycle	Agronomist	Crop rotation planning; revenue modeling
Yield per Plant (g)	Harvestable weight per individual plant	Core unit economics driver; determines revenue per crop site	Weigh each harvest batch; divide by plant count in that section	Every harvest	Farm Lead	Per-site revenue calculation; variety ranking
Yield per Tower (kg)	Total harvestable output per tower per cycle	Tower-level productivity benchmark for scaling models	Sum all plant yields per tower per complete cycle	Per cycle	Farm Lead	Tower ROI; HD vs LD comparison
Crop Quality Score (1-5)	Visual + tactile assessment: color, firmness, size, leaf integrity	Market price depends on quality grade; premium vs standard	Standardized scorecard: 5=export grade, 4=premium local, 3=standard, 2=below market, 1=reject	Every harvest	Agronomist	Market channel allocation; pricing strategy
Crop Loss Rate (%)	Plants that die, bolt, or fail before harvest / total planted	MINAGRI target: <10% Year 1; direct cost of waste	Count non-harvestable plants per section at harvest time	Per cycle	Agronomist	System reliability; MINAGRI Output 1.1.7 reporting
Bolting / Flowering Rate (%)	Premature bolting before commercial harvest	Indicates heat stress or photoperiod issues in greenhouse	Visual inspection count of bolted plants per variety	Weekly	Agronomist	Environmental control needs; variety climate fit
Regrowth Yield (g)	Weight of	Determines if	Weigh each	Per subsequent	Farm Lead	Multi-cut

	2nd/3rd cuts on cut-and-come-again crops	multi-harvest strategy is viable for lettuce, kale, herbs	subsequent cut separately; track quality degradation	harvest		economics; crop site utilization rate
Pest/Disease Incidence	Type, severity, and spread rate of any pest or disease event	Controlled environment should minimize this; deviations signal system gaps	Log type, affected area (tower/section), severity (1-5), treatment applied	Daily inspection	Agronomist	Biosecurity protocols; treatment cost budgeting
Shelf Life (days)	Days from harvest to visual quality degradation	Determines delivery radius, buyer requirements, storage needs	Store samples at ambient Kigali temp; check quality daily until degradation	Per variety, quarterly test	Agronomist	Cold chain investment decision; buyer matching

3.2 Tower Productivity Metrics

Decision this enables: HD vs LD tower economics; optimal tower configuration for 100-tower expansion; capital allocation per tower type.

Metric	What Is Measured	Why It Matters	Method	Frequency	Owner	Decision Enabled
Occupancy Rate (%)	Active crop sites / total available sites per tower	Empty sites = lost revenue; target >90%	Count planted sites vs total at end of each week	Weekly	Farm Lead	Planting schedule optimization; labor planning
Revenue per Tower (RWF)	Total market value of output per tower per month	Primary profitability metric per capital unit	Sum (yield × market price) for all crops on tower	Monthly	Finance Lead	Tower-level ROI; scaling investment case
Cost per Tower (RWF)	All allocated costs: nutrients, water, electricity, labor, maintenance	Denominator for margin calculation	Allocate shared costs proportionally; track direct costs per tower	Monthly	Finance Lead	Break-even analysis; cost reduction targets
Margin per Tower (%)	(Revenue - Cost) / Revenue per tower	Must be >40% for scaling viability [benchmark]	Calculated from revenue and cost metrics above	Monthly	Finance Lead	Go/no-go for expansion; investor metric
Cycles per Year (projected)	Number of complete crop cycles achievable per tower per year	Higher cycles = more revenue from same capital	DTH × planned varieties × staggering efficiency	Quarterly review	Agronomist	Annual revenue projection; crop mix strategy

HD vs LD Yield Ratio	Yield per site on HD towers / yield per site on LD towers	If HD yields match LD at lower per-site cost, scaling favors HD	Compare matched crops grown simultaneously on both tower types	Per cycle	Agronomist	Tower procurement strategy for expansion
Tower Downtime (hours)	Hours any tower is non-operational due to maintenance or failure	Directly reduces productive capacity; scaling risk	Log start and end time of any tower outage	Per incident	Operations Lead	Maintenance schedule; spare parts inventory
Nutrient Consumption per Tower (L)	Liters of nutrient solution consumed per tower per week	Major variable cost; efficiency gains directly improve margins	Meter or measure nutrient reservoir depletion per tower	Weekly	Farm Lead	Nutrient procurement; cost optimization

3.3 Spatial Efficiency Analytics

Decision this enables: Facility design for 100+ tower expansion; greenhouse sizing; comparative advantage vs conventional farming for MINAGRI Output 1.1.1.

Metric	What Is Measured	Why It Matters	Method	Frequency	Owner	Decision Enabled
Yield per m² (kg/m²/year)	Total production output per square meter of greenhouse floor	Core CEA efficiency metric; target 20-40x conventional [benchmark]	Total yield / greenhouse floor area, annualized	Monthly	Agronomist	Land use efficiency for MINAGRI; facility ROI
Revenue per m² (RWF/m²/year)	Market value of output per square meter annually	Determines real estate ROI and optimal facility size	Total revenue / greenhouse floor area, annualized	Monthly	Finance Lead	Facility expansion investment case
Tower Footprint (m²)	Floor space occupied per tower including access clearance	Determines maximum tower density per facility	Measure base footprint + 0.6m service clearance per side	Once at setup	Operations Lead	Greenhouse layout optimization
Crop Sites per m²	Number of productive crop sites per m² of floor space	Density metric for comparing tower types and facility designs	Total crop sites / total greenhouse floor area	Once at setup, update with layout changes	Operations Lead	Facility design for scaling
Vertical Space Utilization (%)	Productive height used / available greenhouse height	Vertical efficiency is aeroponic's key advantage	Measure tower growing height / greenhouse interior height	Once at setup	Operations Lead	Greenhouse specification for expansion

3.4 Resource Consumption Tracking

Decision this enables: Variable cost control; MINAGRI Output 1.1.5 (90% water reduction target); operational budget accuracy for scaling financial models.

Metric	What Is Measured	Why It Matters	Method	Frequency	Owner	Decision Enabled
Water Consumption (L/day)	Total daily water usage across all towers	MINAGRI target: 90% reduction vs conventional; major cost line	Flow meter reading at main supply line, recorded at same time daily	Daily	Farm Lead	MINAGRI Output 1.1.5 reporting; water cost budgeting
Water per kg Produced (L/kg)	Liters of water used per kilogram of harvested crop	Efficiency benchmark; aeroponic target: 10-20 L/kg vs 200-300 conventional	Total water used in cycle / total harvest weight in cycle	Per cycle	Agronomist	Water efficiency claims for investors; sustainability metrics

Nutrient Solution Cost (RWF/L)	Cost per liter of prepared nutrient solution	Second-largest variable cost after labor	Total nutrient cost / total liters prepared	Monthly	Finance Lead	Supplier negotiation; bulk purchasing decisions
Electricity Consumption (kWh/day)	Total daily electricity for pumps, timers, lighting, ventilation	Third-largest operating cost; critical for margin model	Dedicated meter reading for greenhouse circuit	Daily	Operations Lead	Solar feasibility study; energy cost modeling at scale
Electricity per Tower (kWh/tower/day)	Electricity allocated per tower	Unit cost building block for scaling model	Total kWh / number of active towers	Weekly calculation	Finance Lead	Per-tower operating cost model
Nutrient Solution pH	pH level of nutrient reservoir	Outside 5.5-6.5 range reduces nutrient uptake; crop stress	Digital pH meter, calibrated weekly	2x daily	Farm Lead	Immediate corrective action; system reliability
Nutrient EC (mS/cm)	Electrical conductivity of nutrient solution	Indicates nutrient concentration; too high burns roots, too low starves plants	EC meter reading at reservoir	2x daily	Farm Lead	Nutrient dosing adjustment; crop-specific EC targets
Seed/Seedling Cost per Cycle (RWF)	Total cost of seeds and propagation materials per planting cycle	Input cost baseline for unit economics	Invoice tracking per seed purchase + propagation materials	Per cycle	Finance Lead	Seed sourcing strategy; nursery vs direct seeding economics

3.5 Environmental Conditions Monitoring

Decision this enables: Greenhouse upgrade decisions; climate control investment for scaling; correlation analysis between conditions and crop performance.

Metric	What Is Measured	Why It Matters	Method	Frequency	Owner	Decision Enabled
Temperature — Internal (°C)	Air temp inside greenhouse at canopy level	Most crops need 18-28°C; Kigali can spike to 30°C+	Digital thermometer at 3 points: top, middle, bottom of greenhouse	4x daily (6am, 12pm, 3pm, 6pm)	Farm Lead	Ventilation/ cooling investment; crop variety selection
Temperature — External (°C)	Ambient outside temperature	Delta with internal temp measures greenhouse effectiveness	Weather station or external thermometer, shaded placement	4x daily	Farm Lead	Greenhouse insulation/shading decisions
Humidity — Internal (%RH)	Relative humidity inside greenhouse	Too high (>80%) = fungal risk; too low (<40%) = plant stress	Hygrometer at canopy level	4x daily	Farm Lead	Ventilation strategy; disease prevention
Light Intensity (lux/PPFD)	Photosynthetically active radiation reaching plants	Leafy greens need 200-400 PPFD; fruiting crops need 400-600	Lux meter at top, middle, and bottom tower levels	Weekly mapping	Agronomist	Supplemental lighting decision; tower positioning
Root Zone Temperature (°C)	Temperature of nutrient solution at tower roots	Roots stressed above 25°C; optimal 18-22°C for most crops	Waterproof thermometer in nutrient reservoir	2x daily	Farm Lead	Chiller investment; reservoir insulation decisions
CO2 Levels (ppm)	Carbon dioxide concentration in greenhouse air [if meter available]	Enrichment to 800-1200 ppm can boost yields 20-30%	CO2 meter at canopy level (budget allowing)	Daily if available	Agronomist	CO2 enrichment ROI for scaling
Rainfall (mm)	External rainfall [relevant for water harvesting]	Opportunity to reduce water costs through rainwater collection	Rain gauge at facility or local weather data	Daily	Operations Lead	Rainwater harvesting investment decision

KIGALI CLIMATE NOTE: Kigali has two rainy seasons (March-May, September-November) with average temps of 19-27°C. The greenhouse will moderate extremes but expect internal temps of 25-35°C during dry season peaks. This data directly informs whether passive ventilation is sufficient or active cooling is needed for the 100-tower facility.

3.6 Financial Tracking System

Decision this enables: Unit economics validation; investor-grade financial model; break-even analysis; cost reduction priorities.

Metric	What Is Measured	Why It Matters	Method	Frequency	Owner	Decision Enabled
Cost per Crop Site (RWF/site/cycle)	Total variable cost allocated per active crop site	Fundamental unit economics building block	(Seeds + nutrients + water + electricity + labor) / active sites per cycle	Per cycle	Finance Lead	Break-even yield target per site
Revenue per Crop Site (RWF/site/cycle)	Market value of output per active site	Must exceed cost per site for viability	Harvest weight × market price per kg for that variety	Per cycle	Finance Lead	Crop profitability ranking
Gross Margin per Crop (%)	(Revenue - Variable Cost) / Revenue per crop variety	Identifies highest-margin crops for commercial focus	Calculated per variety using site-level data	Per cycle	Finance Lead	Crop mix optimization for scaling
Total Monthly OpEx (RWF)	All operating expenses: labor, nutrients, water, electricity, maintenance, admin	Must track against ~3,000,000 RWF target	Monthly financial ledger, all categories	Monthly	Finance Lead	Budget discipline; cost overrun detection
Labor Cost per Tower (RWF/tower/month)	Labor hours × wage rate allocated per tower	Labor is typically 30-40% of OpEx; efficiency critical	Time tracking per task × wage rate / towers served	Monthly	Finance Lead	Labor efficiency optimization; automation decisions
CAPEX per Tower (RWF)	Total capital invested per tower including installation	Payback period denominator	Total CAPEX / 10 towers (adjust for HD vs LD cost differences)	One-time, reviewed quarterly	Finance Lead	Scaling CAPEX projection; fundraising targets
Payback Period (months)	Months until cumulative margin covers CAPEX per tower	Investor benchmark: <24 months is strong for agritech	CAPEX per tower / monthly margin per tower	Monthly recalculation	Finance Lead	Investor pitch; scaling timeline
Waste Cost (RWF/month)	Market value of crop losses (dead plants, rejected harvests)	Hidden cost; must minimize to protect margins	Crop loss count × average market value per plant	Monthly	Agronomist	Loss reduction priorities; quality control investment

3.7 Market Validation Intelligence

Decision this enables: Commercial crop selection; pricing strategy; buyer pipeline for scaling; MINAGRI Output 2.1.1 (export crop expansion) and 2.3.1 (food security).

Metric	What Is Measured	Why It Matters	Method	Frequency	Owner	Decision Enabled
Buyer Interest Score (1-5)	Level of confirmed buyer interest per crop variety	No buyer = no revenue regardless of yield	Structured buyer outreach: 5=signed LOI, 4=verbal commit, 3=interested, 2=maybe, 1=no interest	Monthly	Business Dev	Crop prioritization; LOI pipeline for MINAGRI
Market Price Tracking (RWF/kg)	Current wholesale and retail prices per crop in Kigali	Price volatility affects revenue projections; need realistic baseline	Survey 3-5 markets weekly: Kimironko, Kigali Heights, hotels, supermarkets	Weekly	Business Dev	Revenue modeling; pricing strategy
Price Premium Achieved (%)	Upgrow selling price vs average market price	CEA produce should command 15-40% premium for quality/consistency	(Upgrow price - market average) / market average × 100	Per sale	Business Dev	Brand positioning; premium market validation
Sales Volume (kg/month)	Total kilograms sold per month	Revenue realization; demand confirmation	Sales log: date, buyer, crop, weight, price, payment status	Monthly	Finance Lead	Production planning; demand-supply matching
Buyer Repeat Rate (%)	Returning buyers / total unique buyers	Retention signals product-market fit	Track unique buyer IDs and repeat purchases	Monthly	Business Dev	Customer satisfaction; product quality validation
Export Variety Pipeline	Number of varieties being tested for export standards	MINAGRI Output 2.1.1 target: 3 export varieties in Year 1	Track which varieties meet export quality, shelf life, and buyer interest criteria	Quarterly	Agronomist	Export strategy; MINAGRI compliance
Demand Gap Analysis	Orders declined or unfulfilled / total demand expressed	Unmet demand = scaling opportunity	Log all buyer requests including those not fulfilled	Monthly	Business Dev	Production expansion justification; investor opportunity sizing

3.8 Scaling Intelligence Metrics

Decision this enables: Go/no-go decision for 100-tower expansion; facility design; capital requirements; operational model for scaled operations.

Metric	What Is Measured	Why It Matters	Method	Frequency	Owner	Decision Enabled
Labor Hours per Tower (hrs/tower/week)	Total labor time spent per tower weekly	Defines labor scaling: linear vs economies of scale	Time tracking per activity allocated across towers	Weekly	Operations Lead	Staffing model for 100 towers
Task Time Standards	Minutes per standard task: planting, harvesting, nutrient prep, cleaning	SOPs for hiring and training at scale	Stopwatch timing of 10+ repetitions per task, average	Monthly review	Operations Lead	SOP development; hiring criteria
System Failure Rate	Number of equipment failures per month: pumps, timers, tubing	Reliability benchmark for scaling; maintenance budget	Incident log with timestamp, component, cause, resolution time	Per incident	Operations Lead	Spare parts inventory; maintenance schedule at scale
Consumables Burn Rate	Usage rate of nutrients, pH adjusters, growing media, seeds	Procurement planning for 100+ towers	Track consumption per tower per cycle	Per cycle	Farm Lead	Bulk purchasing strategy; supplier negotiations
Tower Startup Time (days)	Days from tower installation to first transplant	Speed of deployment for expansion phases	Log installation date and first planting date per tower	Per tower setup	Operations Lead	Expansion timeline planning
Data Collection Compliance (%)	% of required data points actually recorded on time	If team can't collect data at 10 towers, system fails at 100	Audit data logs weekly: filled vs required	Weekly	Operations Lead	Data system simplification; automation needs
Process Deviation Log	Any instance where SOP was not followed	Identifies training gaps and unrealistic procedures	Deviation report: what, when, why, corrective action	Per incident	Operations Lead	SOP refinement; training priorities

3.9 Risk Tracking Framework

Decision this enables: Proactive risk management; insurance requirements; contingency planning; investor risk disclosure.

Risk Category	Metric	Threshold (Yellow)	Threshold (Red)	Response Protocol	Owner
Crop Failure	Crop loss rate per variety	>10% loss on any variety	>20% or full tower loss	Isolate tower; root cause analysis; replace variety if systemic	Agronomist
Equipment Failure	Tower downtime hours	>4 hours unplanned downtime	>24 hours or pump failure affecting >3 towers	Activate backup pump; emergency supplier contact; incident report	Operations Lead
Water Supply	Daily water availability vs need	<80% of required volume available	<50% or supply interruption >24 hours	Activate water storage reserve; reduce tower cycling; emergency procurement	Operations Lead
Power Outage	Duration of electricity interruption	>2 hours without power	>8 hours or recurring outages (>3/week)	Generator backup; contact EUCL; adjust spray cycle to manual if needed	Operations Lead
Nutrient Imbalance	pH outside 5.5-6.5 or EC deviation >20%	pH at 5.0 or 7.0; EC deviation 15-20%	pH below 4.5 or above 7.5; EC deviation >25%	Immediate reservoir flush and recalibration; test source water	Farm Lead
Market Risk	Unsold inventory as % of harvest	>20% unsold within 48 hours	>40% unsold or price collapse >30%	Emergency pricing; alternative buyer outreach; adjust production volume	Business Dev
Financial Risk	Monthly OpEx vs budget	>10% over budget	>25% over budget or cash runway <2 months	Cost audit; pause non-essential spending; founder escalation	Finance Lead
Data Compliance	Data collection completion rate	<90% of required data points	<75% or >5 consecutive missed days	Team retraining; simplify forms; add redundant collection	Operations Lead

ESCALATION RULE: All RED threshold events must be reported to the Founder within 4 hours and documented in the incident log. Any event affecting MINAGRI reporting metrics must be included in the next quarterly report with root cause analysis and corrective action.

3.10 MINAGRI Reporting Alignment Matrix

This section maps every PSTA 5 output indicator from Annex 2 of the MoU to specific data collected in this framework, ensuring full compliance and credible reporting.

PSTA 5 Output	MoU Indicator	Year 1 Target	Data Source in This Framework	Reporting Frequency	Verification Method
1.1.1: Production models improved	Number of operational aeroponic towers	10	Section 2: Tower Configuration Matrix	Quarterly	Inspection report; site verification
1.1.3: Urban farming promoted	Number of CEA systems demonstrated	1 (Pilot)	Section 2: Pilot as demonstration site	Quarterly	Site inspections; MINAGRI field visits
1.1.5: Water management improved	Water use reduction vs conventional (%)	90%	Section 3.4: Water per kg metric	Quarterly	Sensor data logs; comparative analysis
1.1.7: Plant health enhanced	Crop loss rate (%)	<10%	Section 3.1: Crop Loss Rate metric	Quarterly	Monitoring logs; agronomy reports
2.1.1: Export crops expanded	Number of tested export varieties	3	Section 3.7: Export Variety Pipeline	Quarterly	Production records; sale invoices
2.3.1: Food security improved	Crop production quantity (Tons)	2.5	Section 3.2: Yield per Tower aggregated	Quarterly	Production records
2.3.2: Nutrition-sensitive production	Number of nutritious varieties produced	6	Section 3.1: Crop variety tracking	Quarterly	Crop records; nutritional assessments
3.1.1: Demand-driven research	Number of crop varieties tested	10	Section 3.1: Full crop performance data	Annual	Research reports; trial reports
3.4.1: Knowledge management	Reports and knowledge products	2	Section 4: Consolidated reporting templates	Semi-annual	Quarterly reports submitted to MINAGRI

4 DATA COLLECTION TEMPLATES & LOGGING SYSTEMS

All templates below are designed for paper-first operation with digital backup. The pilot team should use printed sheets daily and enter data into a shared spreadsheet weekly. At scale (100+ towers), migrate to tablet-based digital collection.

Template 4.1: Daily Operations Log

WHEN: Completed every morning (6:00 AM) and evening (5:00 PM) by the Farm Lead. Takes approximately 15 minutes per session.

Field	AM Reading	PM Reading	Notes / Action Taken
Date	____/____/____	—	
Recorded By	_____	_____	
Internal Temp (°C)	_____°C	_____°C	Flag if >32°C or <15°C
External Temp (°C)	_____°C	_____°C	
Internal Humidity (%RH)	_____%	_____%	Flag if >80% or <40%
Nutrient pH (Reservoir 1)	_____	_____	Target: 5.5-6.5
Nutrient EC (Reservoir 1)	_____ mS/cm	_____ mS/cm	Crop-specific targets
Root Zone Temp (°C)	_____°C	_____°C	Flag if >25°C
Water Meter Reading (L)	_____L	_____L	Calculate daily use = PM - AM
Electricity Meter (kWh)	_____kWh	_____kWh	Calculate daily use = PM - AM
All Pumps Operational?	YES / NO	YES / NO	If NO — incident log
All Timers Running?	YES / NO	YES / NO	If NO — incident log
Pest/Disease Observed?	YES / NO	YES / NO	If YES — Section 3.1 log
Unusual Observations	_____	_____	

Template 4.2: Weekly Harvest & Production Log

Tower ID	Crop Variety	Plants Harvested	Total Weight (g)	Quality Score (1-5)	Market Channel	Price/kg (RWF)	Buyer
T-01 (LD)							
T-02 (LD)							
T-03 (LD)							
T-04 (LD)							
T-05 (LD)							
T-06 (LD)							

T-07 (LD)					
T-08 (HD)					
T-09 (HD)					
T-10 (HD)					
WEEKLY TOTAL —		AVG:	—	AVG:	—

Template 4.3: Monthly Financial Summary

FINANCIAL STRATEGY: PILOT PHASE FINANCIAL CONTEXT: The pilot is an R&D investment, not a profit center. Monthly losses during Months 1-3 are expected and budgeted. The goal is to generate validated unit economics data that proves the 100-tower business case. Break-even at pilot scale is targeted by Month 5-6.

Category	Budget (RWF)	Actual (RWF)	Variance (%)	Notes
REVENUE				
Crop Sales — Local Market				
Crop Sales — Premium/Hotels				
Crop Sales — Export				
Other Income				
TOTAL REVENUE				
OPERATING EXPENSES				
Labor (wages + benefits)				Target: <40% of OpEx
Nutrients & pH Adjusters				
Seeds & Propagation				
Water				
Electricity				
Maintenance & Repairs				
Transport & Logistics				
Admin & Communications				
TOTAL OPEX				Target: ~3,000,000 RWF
GROSS MARGIN				= Revenue - OpEx
GROSS MARGIN %				Target: >40%

Template 4.4: Crop Cycle Performance Report

Field	Value
Cycle Number	

Crop Variety	
Tower(s) Used	
Tower Type (HD/LD)	
Planting Date	
Harvest Date	
Days to Harvest	
Total Plants Transplanted	
Total Plants Harvested (survived)	
Survival Rate (%)	
Total Yield (g)	
Average Yield per Plant (g)	
Quality Score (avg 1-5)	
Cost per Site this Cycle (RWF)	
Revenue per Site this Cycle (RWF)	
Margin per Site (RWF)	
Market Channel	
Buyer Feedback	
Key Observations	
Recommendation for Next Cycle	CONTINUE / ADJUST / DROP

5 DATA VALIDATION RULES & ERROR DETECTION

Data integrity is non-negotiable. Poor data at the pilot stage produces flawed scaling models that cost millions at expansion. The following validation system catches errors before they compound.

Rule Category	Validation Rule	Error Type	Detection Method	Corrective Action
Range Check	Internal temp must be 5-50°C	Out of range — likely sensor error or misread	Automated check on data entry	Re-read sensor; recalibrate if persistent
Range Check	pH must be 3.0-9.0	Out of range — transcription error or equipment failure	Entry validation	Re-test immediately; recalibrate meter
Range Check	Yield per plant must be 1g-2000g	Extreme values = data entry error (wrong units or decimal)	Weekly data review	Verify against harvest batch weight
Consistency Check	Daily water use should not vary >30% day-to-day without cause	Possible leak, meter error, or missed reading	Week-over-week comparison	Inspect system for leaks; verify meter accuracy
Consistency Check	Tower yield should correlate with planted site count	Yield without corresponding planting record = data gap	Cross-reference planting log vs harvest log	Reconcile both logs; add missing records
Completeness Check	All 14 fields in Daily Operations Log must be filled	Missing fields — incomplete operational picture	Daily end-of-day review by Farm Lead	Complete before leaving site; escalate if equipment prevents reading
Completeness Check	Every harvest must have quality score + weight + buyer info	Missing = useless data for financial and market analysis	Harvest log audit	No produce leaves site without complete record
Timeliness Check	Daily log must be completed same day	Late entries are unreliable (memory recall errors)	Timestamp check on entries	Farm Lead accountability; backup person if absent
Cross-Validation	Monthly revenue in sales log must match financial summary	Discrepancy = missed sales, incorrect pricing, or data entry error	Monthly reconciliation	Finance Lead reconciles before monthly close
Trend Alert	Any metric deviating >2 standard deviations from 30-day average	Unusual event — could be positive (breakthrough) or negative (failure)	Monthly statistical review	Investigate root cause; document finding

WEEKLY AUDIT PROTOCOL: Assign a weekly 30-minute 'data quality audit' slot (e.g., Friday afternoon). The Operations Lead reviews all logs from the week, flags errors, and ensures corrections are made before weekly data is compiled. This single habit prevents 80% of data integrity issues.

6 SAMPLE DASHBOARDS

These dashboard layouts show how collected data should be aggregated and visualized for different audiences. The team should build these in Google Sheets or Excel during the pilot, migrating to a dedicated platform at scale.

Dashboard 6.1: Weekly Operations Summary (Team Level)

KPI	This Week	Last Week	Trend	Status	Target
Total Harvest (kg)	____	____	UP / DOWN / FLAT	GREEN / YELLOW / RED	>X kg/week
Avg Quality Score	____	____	UP / DOWN / FLAT	GREEN / YELLOW / RED	>3.5
Tower Occupancy Rate	____%	____%	UP / DOWN / FLAT	GREEN / YELLOW / RED	>90%
Water Usage (L/day avg)	____	____	UP / DOWN / FLAT	GREEN / YELLOW / RED	<benchmark
Power Usage (kWh/day avg)	____	____	UP / DOWN / FLAT	GREEN / YELLOW / RED	<benchmark
Crop Loss Events	____	____	UP / DOWN / FLAT	GREEN / YELLOW / RED	0
Equipment Issues	____	____	UP / DOWN / FLAT	GREEN / YELLOW / RED	0
Data Completion Rate	____%	____%	UP / DOWN / FLAT	GREEN / YELLOW / RED	100%

Dashboard 6.2: Monthly Founder Intelligence Brief

Category	Metric	Actual	Target	Status	Scaling Implication
FINANCIAL	Monthly Revenue	____	____	GREEN/YELLOW/RED	Revenue run-rate for 100 towers
FINANCIAL	Monthly OpEx	____	3M RWF	GREEN/YELLOW/RED	OpEx scaling factor
FINANCIAL	Gross Margin %	____	>40%	GREEN/YELLOW/RED	Investor viability threshold
FINANCIAL	Cost per Tower/month	____	____	GREEN/YELLOW/RED	Unit economics for scaling model
PRODUCTION	Total Yield (kg)	____	____	GREEN/YELLOW/RED	Production capacity at scale
PRODUCTION	Top 3 Crops by Margin	____	—	—	Core crop portfolio for expansion
PRODUCTION	Crop Loss Rate	____	<10%	GREEN/YELLOW/RED	MINAGRI compliance; quality

					control
MARKET	Sales Conversion Rate	____	>80%	GREEN/YELLOW/RED	Demand validation
MARKET	Premium Achieved	____	>15%	GREEN/YELLOW/RED	Brand positioning strength
MARKET	Active Buyer Count	____	—	—	Market penetration baseline
OPERATIONS	Avg Labor hrs/tower/wk	____	____	GREEN/YELLOW/RED	Labor model for 100 towers
OPERATIONS	Tower Uptime	____	>98%	GREEN/YELLOW/RED	System reliability at scale
MINAGRI	Quarterly Report Status	____	On Track	GREEN/YELLOW/RED	Partnership compliance

7 ROLES & RESPONSIBILITIES MATRIX

5-person team structure mapped to data collection duties. Each role has clear accountability for specific metrics to prevent gaps and duplication.

Role	Primary Data Responsibilities	Collection Frequency	Reports To	Backup
Agronomist	Crop performance (germination, yield, quality, loss rate, pest/disease); Environmental correlations; Crop variety recommendations; Shelf life testing	Daily inspections; Per-harvest data; Weekly analysis	Founder	Farm Lead
Farm Lead	Daily operations log (temp, humidity, pH, EC, water, power); Nutrient management; Tower occupancy tracking; Harvest weight recording	2x daily (AM/PM log); Weekly harvest compilation	Agronomist	Operations Lead
Operations Lead	Equipment uptime; Maintenance logs; Labor time tracking; Process deviation reports; Data compliance audits; System failure incidents	Per incident; Weekly audit; Monthly summary	Founder	Farm Lead
Finance Lead	All financial metrics; Monthly budget vs actual; Cost per tower/site calculations; Revenue tracking; Payback analysis; Investor-ready financial reports	Daily sales entry; Weekly reconciliation; Monthly close	Founder	Operations Lead
Business Development	Market prices; Buyer pipeline; LOI tracking; Sales volume; Customer feedback; Export variety assessment; Demand gap analysis	Weekly market surveys; Per-sale recording; Monthly pipeline review	Founder	Finance Lead

FOUNDER REPORTING CADENCE: Founder receives: Weekly Operations Summary (every Monday AM), Monthly Founder Intelligence Brief (by 5th of each month), Quarterly MINAGRI Report Draft (15 days before submission deadline), Immediate alerts on any RED threshold event.

8 APPENDIX: ASSUMPTIONS & BENCHMARKS

All assumptions used in this framework are documented below for transparency. These will be validated or revised using actual pilot data.

Assumption	Value Used	Source / Basis	Impact if Wrong	Validation Timeline
Water savings vs conventional	90% reduction	Global aeroponic benchmarks (NASA, Agrotonomy); MoU Annex 2 target	MINAGRI reporting credibility; sustainability narrative	Month 3 — compare actual L/kg to Rwanda conventional benchmarks (200-300 L/kg)
Target gross margin	>40%	Greenhouse/CEA industry standard for viable operations	Below 30% challenges scaling economics	Month 4 — after 2 full production cycles with revenue data
Crop loss rate Year 1	<10%	MoU Annex 2 commitment; CEA best practice for established operations	10-15% realistic for first 2 cycles; higher early is acceptable if trending down	Month 2 — track trend across first 3 cycles
Labor cost as % of OpEx	30-40%	Sub-Saharan Africa CEA operations; Kigali wage benchmarks	Higher labor share compresses margins; signals automation need	Month 2 — actual payroll vs total OpEx
Premium price achievable	15-40% over market	Kigali hotel/supermarket pricing for premium produce	Lower premium reduces revenue model; may need brand investment	Month 3 — after establishing sales channels
Electricity cost	~112 RWF/kWh	Rwanda EUCL commercial tariff 2024/25	Tariff increases directly impact margins; solar consideration	Month 1 — verify actual billing rate
Kigali growing conditions	18-32°C range; 2 rainy seasons	Rwanda Meteorological Agency; local climate data	Extreme events (heat waves, heavy rains) may require greenhouse upgrades	Ongoing — environmental logs will build local dataset
Aeroponic yield potential	20-40x conventional per m^2	Published CEA benchmarks; Agrotonomy specifications	Lower actual yields reduce space efficiency claims	Month 4 — actual yield per m^2 calculation

9 MASTER DATA COLLECTION CHECKLIST

Comprehensive inventory of EVERY data point needed for the pilot. Use this as a master checklist to ensure nothing falls through the cracks. Columns: Priority | Data Point | Unit | Frequency | Source | Decision It Drives | Status.

Priority	Data Point	Unit	Frequency	Source	Decision It Drives	Status
CRITICAL	Yield per Plant	g	Every harvest	Farm Lead / scale	Per-site revenue calculation	
CRITICAL	Crop Loss Rate	%	Per cycle	Agronomist count	Operational reliability; MINAGRI reporting	
CRITICAL	Days to Harvest (DTH)	days	Per crop cycle	Date logs	Crop cycle planning; revenue modeling	
CRITICAL	Total Monthly OpEx	RWF	Monthly	Finance ledger	Budget discipline; margin calculation	
CRITICAL	Total Monthly Revenue	RWF	Monthly	Sales log	Financial viability; investor metric	
CRITICAL	Gross Margin %	%	Per cycle	Revenue - OpEx	Go/no-go for expansion	
HIGH	Tower Occupancy Rate	%	Weekly	Farm Lead count	Planting schedule optimization	
HIGH	Crop Quality Score	1-5	Every harvest	Agronomist assessment	Market channel allocation; pricing	
HIGH	Water per kg Produced	L/kg	Per cycle	Meter reading	MINAGRI 90% reduction target	
HIGH	Cost per Crop Site	RWF/site	Per cycle	Finance allocation	Break-even yield target	
HIGH	Revenue per Crop Site	RWF/site	Per cycle	Sales tracking	Crop profitability ranking	
HIGH	Equipment Downtime	hours	Per incident	Operations log	Maintenance scheduling; reliability	
HIGH	System Failure Rate	failures/month	Monthly	Incident log	Spare parts inventory; budget	
HIGH	Data Collection Compliance	%	Weekly	Operations audit	System scalability validation	
MEDIUM	Germination Rate	%	Per planting cycle	Nursery count	Seed supplier evaluation	
MEDIUM	Temperature Internal	°C	4x daily	Thermometer	Climate control investment decision	
MEDIUM	Temperature External	°C	4x daily	Weather data	Greenhouse effectiveness measurement	
MEDIUM	Humidity Internal	%RH	4x daily	Hygrometer	Ventilation strategy; disease prevention	

MEDIUM	Nutrient Solution pH	pH units	2x daily	pH meter	Immediate corrective action
MEDIUM	Nutrient EC	mS/cm	2x daily	EC meter	Nutrient dosing adjustment
MEDIUM	Light Intensity	PPFD (µmol/m²/s)	Weekly mapping	Lux meter	Supplemental lighting decision
MEDIUM	Root Zone Temperature	°C	2x daily	Thermometer	Chiller investment decision
MEDIUM	Water Consumption Daily	L/day	Daily	Flow meter	Water cost budgeting; efficiency
MEDIUM	Electricity Consumption	kWh/day	Daily	Meter reading	Energy cost modeling; solar ROI
MEDIUM	Labor Hours per Tower	hrs/tower/week	Weekly	Time tracking	Staffing model for scaling
MEDIUM	Buyer Interest Score	1-5	Monthly	Outreach log	Crop prioritization; LOI pipeline
MEDIUM	Market Price Tracking	RWF/kg	Weekly	Market survey	Revenue modeling; pricing strategy
MEDIUM	Sales Volume	kg/month	Monthly	Sales log	Demand validation; production planning

Priority Color Key:

CRITICAL (Red) = Non-negotiable for pilot success and MINAGRI reporting

HIGH (Yellow) = Essential for financial modeling and scaling decisions

MEDIUM (Blue) = Supporting metrics that provide context and optimization opportunities

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Upgrow Rwanda Ltd | Pilot Data Collection Framework | Version 1.0 | Prepared by Sage