PrairieSpark Pilot – Field Performance 2019–2024

Business Requirements Document

Dryland Field Performance & Yield Stability Tool for a 3,500-Acre Saskatchewan Grain Farm

Prepared by: **Kahle Salisbury** – Product & Analytics Lead, PrairieSpark

Date: 11/2025

Contents

1 Background & Problem Statement

1.1 Business Context

- Dryland grain farm in Saskatchewan, 3,500 acres, growing wheat, canola, barley, oats across 2019–2024.
- Six seasons of field-level yield and acreage data exist, but are stored in scattered spreadsheets without a unified view.
- Management decisions about crop rotation and input strategy are currently made using experience and gut feel rather than structured field-level KPIs.

1.2 Problem Statement

Dryland grain farms in Saskatchewan operate on thin margins and increasingly volatile weather, yet most decisions about crop rotation and input strategy are still driven by experience and scattered spreadsheets. On our 3,500-acre partner farm, we have six seasons (2019–2024) of field-level yield and acreage data, but no systematic way to see which fields consistently carry the farm, which quietly underperform, or how rotation patterns impact risk and production over time.

Because of this, the farm cannot easily answer basic, high-value questions such as: **Which fields deliver the most stable bushels per acre? Which fields should we deprioritize, rent out, or manage differently? Where should we test new crops or input strategies first?** In practice, most acres are treated roughly the same, yield volatility goes unpriced, and opportunities to reallocate inputs and attention to the highest-return fields are missed.

PrairieSpark's Field Performance Pilot is designed to turn that blind spot into a decision tool. Using real multi-year field data, it quantifies field performance, yield stability, and rotation outcomes at the field-year level, giving owners, agronomists, and future PrairieSpark customers a clear, data-driven basis for deciding **which fields to trust, which to fix, and which to rethink**.

2 Business Objectives & Success Metrics

2.1 Business Objectives

The PrairieSpark Field Performance Pilot will achieve the following business outcomes:

- **Identify** top- and bottom-performing fields by average yield per acre and total production across 2019–2024.
- **Quantify** yield stability and volatility at the field level to support input intensity and risk management decisions.
- **Highlight** opportunities to adjust crop rotation and land use (e.g., test plots, rent-out candidates, de-prioritized fields).

2.2 Success Metrics (High-Level KPIs)

- **Average Yield per Acre (by field)** – How many bushels per acre each field produces on average across 2019–2024.
- **Total Production per Field** – The total bushels each field delivers over the 2019–2024 period.
- **Yield Index vs. Farm Average** – A score showing whether a field is above or below the farm average for that crop and year (example- 1.10 = 10% above average).
- **Field Share of Farm Production** – The percentage of the farm's total bushels that come from each field.
- **Yield Stability** – How consistent a field's yield is from year to year; higher stability means less yield volatility.

3 Stakeholders & Needs

This pilot focuses on three primary decision-makers and one secondary stakeholder group.

3.1 Primary Stakeholders

- **Farm Owner / Managing Partner** – Accountable for overall farm profitability, risk, and long-term land use decisions.
- **Agronomist / Crop Advisor** – Provides field-level recommendations on crop rotation, input strategy, and risk management.
- **PrairieSpark Product & Analytics Lead (Kahle)** – Owns the design and validation of the field performance scoring engine that will be scaled to additional farms.

3.2 Secondary Stakeholders

- **Future PrairieSpark Customers (Dryland Grain Growers)** – Will use the generalized scoring model and dashboards once the pilot is proven on the partner farm.

3.3 Stakeholder Questions

3.3.1 Farm Owner / Managing Partner

- Which fields consistently generate the most profit per acre over 2019–2024, and which ones drag down farm averages?
- If acres need to be cut or rented out, which specific fields should be first on the list based on performance and stability?
- Where should time, cash, and premium inputs be focused next season to get the largest lift in total bushels and profit?

3.3.2 Agronomist / Crop Advisor

- Which fields are most sensitive to crop choice or rotation (large yield swings when crops change) versus fields that remain consistently stable?
- Which rotation sequences on this farm have historically underperformed or overperformed (example, Wheat → Canola vs. Canola → Barley) relative to the farm average?
- Which fields are the best candidates for testing new crops, varieties, or input strategies based on past performance and risk profile?

3.3.3 PrairieSpark Product & Analytics Lead (Kahle)

- Can this farm's multi-year field performance and stability be converted into a simple, repeatable scoring model that works for other dryland farms?
- Which KPIs actually drive owner decisions about which fields to keep, improve, or drop?
- What is the smallest, cleanest set of input columns we need from any new farm to deliver a useful "Field Performance & Risk" dashboard within the first week of onboarding?

4 Scope (In Scope / Out of Scope)

4.1 In Scope

- **Analysis of field-level yield and area data from 2019–2024** for a single 3,500-acre dryland grain farm.
- **Development of a field performance and stability scoring view**, including average yield per acre, total bushels, yield index vs. farm average, and yield stability.
- **Basic rotation analysis** using crop sequence and previous crop to assess how rotation patterns relate to field performance.

4.2 Out of Scope

- **Detailed financial profitability modeling** (input cost data is not included in this phase).
- **Integration of satellite imagery, rainfall, and soil datasets** (planned for future PrairieSpark releases).
- **Multi-farm benchmarking or comparisons** (this pilot covers a single 3,500-acre farm only).

5 Data Sources, Assumptions & Limitations

5.1 Data Sources

- **Primary dataset:** A field–year–crop table with the following columns: field_id_anon, year, crop, yield_bu_ac, area_acres, rm_number, total_bu, farm_year_avg_yield, yield_index, prev_crop.
- **Source:** Compiled from the partner farm's historical yield and acreage spreadsheets for the 2019–2024 seasons.
- **Anonymization:** Raw legal land descriptions and internal field names have been removed; fields are referenced only by field_id_anon in all analysis and outputs.

5.2 Assumptions

- **Yield accuracy:** Yield values recorded in the source spreadsheets are assumed to be accurate within normal farm record-keeping and calibration error.
- **Stable field boundaries:** Field boundaries and field_id_anon mappings are assumed to be consistent across all six seasons.
- **Complete acreage coverage:** Reported area_acres for each field-year are assumed to reflect the full cropped area for that field in that season.

5.3 Limitations

- **No weather or soil data:** Rainfall, temperature, soil type, and soil moisture data are not included in this pilot, so weather- and soil-driven effects are not explicitly modeled.
- **No input cost data:** Fertilizer, chemical, seed, and operational cost data are not available, so the analysis focuses on physical performance (yield and stability), not full profitability.
- **Single-farm, limited crops:** The dataset covers one 3,500-acre dryland grain farm and a limited set of crops over 2019–2024, which constrains generalization until additional farms are onboarded.
- **Potential gaps and noise:** Missing values, recording errors, and calibration differences between years may introduce noise into field-level comparisons, though they are not explicitly corrected in this phase.

6 Functional Requirements

1. The system shall calculate the **multi-year average yield per acre** (2019–2024) for each field_id_anon using yield_bu_ac.

2. The system shall calculate **total bushels per field** as the sum of yield_bu_ac × area_acres across all years in the dataset.
3. The system shall compute a **yield_index** value for each field–year–crop, relative to the **farm average yield** for that crop and year.
4. The system shall provide a **ranked list of fields** by average yield and yield stability (coefficient of variation), with interactive filters for crop and year range.
5. The system shall display a **field-level history view** for a selected field, showing crops grown and yields for each year from 2019–2024.
6. The system shall calculate each field's **share of total farm production** (percentage of total bushels) over the 2019–2024 period.
7. The system shall provide a **summary view of top and bottom fields** (e.g., top 5 and bottom 5) based on average yield, yield stability, and production share.
8. The system shall generate a **rotation performance view** that aggregates by rotation sequence (previous crop → current crop) and reports average yield, count of observations, and over/under-performance versus the farm average.
9. The system shall allow users to **filter** all views and tables by crop, year range, and minimum number of years of data per field.
10. The system shall allow users to **export core tables** (field performance and rotation performance) to Excel/CSV for further analysis or sharing.

7 Non-Functional Requirements

1. The solution shall support data refresh from updated versions of the underlying dataset (e.g., when new years are added) with minimal or no manual rework to calculations or visuals.
2. For typical filter selections, recalculation and rendering of tables and charts shall complete within **5 seconds** on a standard modern laptop.
3. Field identifiers shall remain **anonymized** as field_id_anon in all dashboards, exports, and any shared or public versions of the tool.

8 Detailed KPI Definitions & Reporting

The following KPIs will be computed and displayed in the dashboard to support field performance, risk, and rotation decisions.

KPI Name	Description	How We Calculate It	How a Farmer Would Use It
Average Yield per Acre (by Field)	"On average, how many bushels per acre does this field produce over the years we have data?"	For each field_id_anon: sum all yield_bu_ac across 2019–2024 and divide by the number of years with data for that field.	Spot **consistently strong vs weak** fields. Helps decide which fields are "workhorse" acres vs ones that always seem to lag.
Total Bushels Produced (by Field)	"How many total bushels has this field produced over all years?"	For each field, compute total_bu = yield_bu_ac * area_acres per year and then sum across all years.	See which fields carry the farm in terms of sheer production. Useful when thinking about where to **focus time, capital, and risk management**.
Yield Index vs Farm Average (by Crop & Year)	"How does this field perform compared to the farm average for the same crop in the same year?"	For each crop-year: yield_index = field_yield_bu_ac / farm_avg_yield_bu_ac for that crop and year.	Quickly see fields that are 10–20% **above or below the farm norm for that crop.** Good for deciding where a crop "fits" or doesn't fit**.**
Field's Share of Farm Production	"What percentage of the farm's total bushels comes from this field?"	field_total_bu_2019_24 / farm_total_bu_2019_24 (using total_bu summed over years).	Identify **top contribution fields** and **small-impact fields**. Helps prioritize which fields are worth deep attention vs minimal maintenance.
Yield Stability (Year-to-Year Variability)	"How consistent is this field's yield over time?"	For each field, calculate the standard deviation and/or coefficient of variation (CV) of yield_bu_ac across years: CV = stdev(yield) / avg(yield).	Separate **steady, predictable fields** from **boom-or-bust fields**. Steady fields are better for **trials and reliable production**; volatile fields may need more conservative decisions.
Best / Worst Year Gap (Yield Range)	"How big is the swing between this field's best and worst years?"	For each field: max(yield_bu_ac) – min(yield_bu_ac) across years.	Highlights fields with **huge upside but big downside**. Useful for thinking about **risk tolerance and how aggressively to push inputs** on that field.
High-Yield but High-Volatility Flag	"Is this field a high-yield but risky field?"	Flag fields where avg_yield is above farm average and CV or yield range is also well above average.	Identify "racehorse" fields that can pay off big but are risky. Good candidates for careful management, targeted insurance, or more conservative plans in dry-looking years**.**

Crop Fit Score (Field × Crop)	"Which crops actually like this field, based on history?"	For each field-crop combo, take the average yield_index (field yield ÷ farm average yield for that crop) across all years that crop was grown there.	See **which crops a field is naturally good at**. Helps plan **next season's crop choices by field** and avoid repeating crops that consistently underperform on that field.
Rotation Diversity / Pressure Indicator	"Has this field been rotated well, or has it been pushed too hard with the same crop?"	For each field: count how often high-risk crops (e.g., canola, peas) appear in the 6-year history, and look at runs of the same crop (e.g., canola 3 times in 5 years).	Flag fields with **tight or risky rotations** that could raise disease/weed pressure or yield drag. Supports decisions on **where to give a break** or change the rotation.
Field Role Category (Core / Fix / Question Mark)	"What role does this field play in the farm's portfolio?"	Combine metrics (avg yield, stability, yield index, production share) into 3 buckets: Core = above-average yield & stable; Fix = average yield but unstable or rotation issues; Question Mark = consistently below average or low contribution.	Gives a **simple label** for each field: which ones to **double down on**, which need **management changes**, and which might be **candidates for lower investment, rent-out, or future exit**.

9 Risks & Dependencies

9.1 Key Risks and Mitigations

- **Risk 1 – Incomplete historical data:**
  Some fields may have missing years of yield data, which can distort performance and stability comparisons.
  Mitigation: Clearly display the number_of_years of data per field in the dashboard, allow users to filter by minimum year count, and exclude low-data fields from certain comparisons and summaries.
- **Risk 2 – Misinterpretation of yield volatility:**
  Users may misunderstand volatility metrics (e.g., coefficient of variation) and draw the wrong conclusions about field risk.
  Mitigation: Provide plain-English explanations and examples for each metric (including yield stability) and use hover text/tooltips in visualizations to explain how to read and apply them.

9.2 Dependencies

- **Data availability:** Ongoing access to the partner farm's historical yield and acreage spreadsheets, plus updated data as new seasons close.
- **Stakeholder input:** Periodic feedback from the farm owner and agronomist to validate KPIs, field rankings, and rotation insights.
- **Tooling environment:** Availability of the chosen analytics/BI environment (e.g., Excel/Power BI) with permissions to refresh data, update measures, and publish dashboards.

10 Future PrairieSpark Productization

- **Scale the pilot scoring engine:** Use this pilot's field performance and stability scoring logic as the foundation for a multi-farm PrairieSpark "Field Performance & Risk**"** capability.
- **Enrich with weather and remote sensing:** Add rainfall, soil, and satellite-based indices to evolve the model into a Rain Efficiency and Drought Risk scoring system.
- **Standardize onboarding for new farms:** Define a minimal, standardized input data schema so that any new dryland grain farm can be onboarded and receive a working Field Performance & Risk dashboard within approximately one week.