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Best Practices: Lean Thinking for Corn and Soybean Farms

A Practical Guide to Reduce Waste and Improve Efficiency

Summary

This article presents a practical introduction to lean thinking for corn and soybean farmers. Lean is a proven management approach that helps reduce waste, organize workspaces and improve the use of time, tools, and materials. Although it began in manufacturing, lean has been successfully adapted to agriculture through simple, low-cost tools that focus on improving everyday tasks.

The guide explains six key lean tools — 5S, Kanban, Visual Controls, TPM, Standardization, and Kaizen — with real farm examples and step-by-step recommendations. It also offers advice on how to get started, involve workers and measure improvements using basic indicators.

Lean thinking doesn't require complex systems or big investments. It starts with small changes that make work easier, safer and more efficient week by week, season by season.

Introduction

In farming operations, it is common to face situations such as wasting time searching for tools, keeping excessive inventory with no clear tracking, repeating tasks unnecessarily or working in disorganized spaces. While often seen as part of the job, these issues are forms of waste that reduce efficiency, increase costs and cause daily frustration.

Lean thinking is a management philosophy focused on eliminating waste and improving the flow of work. It originated in the automotive industry and has proven useful in many other sectors, including agriculture. Its strength lies in simplicity: observing the process, identifying what doesn't add value, and applying practical, visual and low-cost solutions.

This article introduces a practical guide to lean tools that can be implemented in corn and soybean farms, especially in contexts like the U.S. Midwest. The goal is

to help farmers and field advisors get started with small improvements in organization, maintenance, material flow and teamwork — without the need for complex systems or large investments.

1. Lean Thinking: Key Concepts and Agricultural Relevance

Lean thinking is a management philosophy developed from the Toyota Production System, built on the idea of maximizing value by eliminating waste and improving process flow. The core principles, as defined by Womack and Jones (2003), are:

1. **Specify value** from the perspective of the end user;
2. **Map the value stream** to identify steps that do and do not add value;
3. **Create continuous flow** to avoid delays and interruptions;
4. **Let the customer pull what they need** when they need it; and
5. **Pursue perfection** through ongoing improvement.

Previous research supports its potential in agriculture. For example, Dora et al. (2015) showed that lean tools helped reduce waste and improve operational control in fresh food supply chains. De Oliveira Martins et al. (2023) documented how visual controls and 5S improved organization and task execution in agro-pastoral systems. While the terminology may sound manufacturing-oriented, the tools are highly adaptable to farm field conditions and can be introduced progressively with minimal investment.

To better understand the range of approaches and results, Table 1 summarizes selected studies that illustrate the versatility and outcomes of lean thinking in agricultural contexts.

While lean tools like 5S, VSM and Kaizen appear frequently across regions, their implementation depth and results vary significantly based on farm structure, data availability and organizational culture. By adapting these principles to farm operations — without requiring advanced technology — producers can gain better control over time, space, resources and labor.

Table 1. *Summary of Key Studies Applying Lean Thinking in Agriculture*

Author(s) & Year	Country / Crop	Lean Tools Used	Main Results	Key Limitations
(Diaz, 2014)	Spain/ Olives	5S, TPM, Visual Management	Reduced downtime, improved space organization	No post-implementation metrics
(Boussauw, 2016)	Belgium/ Mixed farming	Lean readiness index (survey tool)	Identified gaps in leadership and operational readiness	Based on perception, no implementation
(Melin & Barth, 2018)	Sweden/ Mixed (Crops + livestock)	5S, VSM, Kaizen, Standard Work	Improved planning, team autonomy, and internal leadership	Qualitative findings only
(Rodrigues Silva Carrijo, Bortolini Rader, Otávio Batalha, & Godinho Filho, 2023)	Brazil / Coffee	VSM (adapted for agriculture)	Identified bottlenecks, improved seasonal planning	Requires intensive data collection
(Ai Moi & How Sing, 2021)	Malaysia / Pineapple	Kaizen Events, 5S, Kaikaku	Improved productivity, order, and team engagement	Partial implementation, no metrics
(Andreazza de Freitas, Hernandes de Paula e Silva, & Aparecido Lopes Silva, 2025)	Brazil / Citrus	Lean & Green VSM (environmental indicators)	30% faster processes, 28% lower environmental impact	Still conceptual in some phases
(de Oliveira Martins, Vicente dos Anjos, & Oliveira da Silva, 2023)	Brazil / Mixed farming	VSM, 5S, Standardization, JIT, Kaizen	Reduced non-value-added time by 23.2%, improved resource use	No empirical validation

2. Lean Opportunities in Farming Operations

Field observations and interviews conducted in two corn and soybean operations in Indiana revealed that lean thinking may offer practical methods for organizing workspaces, improving input flow, minimizing delays and engaging workers in daily problem-solving. Lean can be a valuable approach to deal with common issues, such as:

- Disorganized work areas
- Excess inventory or materials
- Long waits between operations (due to equipment, labor, or weather)
- Frequent searching for tools or supplies
- Rework or errors caused by inconsistent procedures

2.1 - Lean Waste Identification

A key action item for lean thinking is to identify and eliminate waste in the production process. The common wastes in lean thinking include:

- **Waiting:** Scheduling of planting, spraying and harvesting depends heavily on weather, causing idle time and rescheduling of labor and equipment.
- **Overproduction:** Production regularly exceeds storage capacity, requiring external storage and higher logistical costs.
- **Inventory:** Inputs are often purchased based on price convenience rather than planned usage, leading to overstock and risk of expiration.
- **Motion:** Frequent searches for tools and supplies in multiple buildings slow down daily startup times and generate inefficiencies.
- **Transport:** The layout of buildings and silos leads to unnecessary movement of machinery and materials across the farm.
- **Overprocessing:** Excessive mechanical passes during tillage lack standardized technical criteria. Multiple chemical applications could be optimized.
- **Defects:** No formal inspection systems are in place. Occasional post-harvest handling issues may cause quality degradation.
- **Underutilized talent:** Farms rely on verbal knowledge and informal task assignments, with no structured rotation, documentation or suggestion systems.

Table 2. *Lean Readiness/Maturity Assessment*

Criterion	Definition	Measurement Scale				
		0	1	2	3	4
LEADERSHIP	Evaluation of leadership, visibility, commitment and culture of continuous improvement					
L1: Visibility and Commitment	Are leaders visible and do they provide feedback on the process?					
L2: Support for Continuous Improvement	Is continuous improvement supported, and are appropriate resources available?					
L3: Effective Communication of Objectives	Are long-term objectives clearly established in terms of quality and continuous improvement?					
MEASUREMENT AND PROCESSES	Evaluation of how processes are documented and monitored.					
M1: Main Processes Identified	Are the main processes clearly identified and documented (using flowcharts)?					
M2: Internal and External Indicators	Are internal and external performance indicators clearly identified and defined?					
M3: Use of Basic CI Tools	Are continuous improvement tools used for problem-solving?					
PEOPLE MANAGEMENT	Evaluation of how people are managed concerning their knowledge and skills.					
P1: Employee Knowledge and Skills	Do employees have the necessary skills, and are they related to the work they perform?					
P2: Responsibility and No-Blame Culture	Is an environment of responsibility promoted without blaming employees?					
SYSTEMS AND CONTROL	Evaluation of production control systems.					
S1: Error Control in Production	Are systems established to control errors in basic production?					
S2: Effective Communication System	Is there effective and timely communication about information flow?					
CUSTOMER FOCUS	Evaluation of how customer feedback and satisfaction are integrated.					
C1: Customer Satisfaction	Is customer feedback regularly integrated to improve processes?					

2.2 - Lean Maturity and Readiness

A lean readiness and maturity assessment (see Table 2) of two farms in Indiana in 2025 revealed a low to moderate level of readiness in both farms. While the technical capacity to implement lean exists — given the access to equipment, storage, and operational autonomy — there is limited use of standard procedures, no structured maintenance plans (except for seasonal cleaning) and minimal performance tracking.

The assessment in Table 2 can be used as a starting point to evaluate how ready a farm is to begin implementing lean practices. The scale from 0 to 4 allows teams to score themselves based on real observations. For example, a low score in "Standard Procedures" or "Error Control" suggests that the farm should focus first on 5S, Visual Controls or Standardization.By completing the lean assessment in Table 2 collaboratively with farm staff or advisors, it becomes easier to identify areas that need improvement and prioritize which lean tools to introduce first. This tool is not meant to generate specific direction, but to guide conversations and set realistic expectations for implementation.

3. Lean Thinking Tools Applied in Practice

This section describes how some lean thinking tools could be applied in corn and soybean farms in the United States. The tools are adapted to field conditions and use to address common sources of waste and inefficiency.

3.1 - Value Stream Mapping – A Diagnostic Starting Point

Before introducing specific lean tools, it is essential to understand the process flow of farm operations to identify where waste occurs and where improvements are most needed. One of the most useful diagnostic tools for this purpose is value stream mapping (VSM).

VSM is a visual tool that maps all the steps in a process, from raw material supply to final product delivery, highlighting where value is added and where time, resources, or effort are wasted. In agriculture, VSM can be adapted to represent the crop production cycle, including soil preparation, planting, input application, growth, harvesting and storage.

In this project, VSM was used to visualize the production flow of soybean farming. The map helped identify delays (e.g., waiting time between operations), bottlenecks (e.g., limited storage capacity), and inefficiencies (e.g., overprocessing or unnecessary movement of materials).

Appendix 1 presents an example of a VSM for soybean production. It includes information such as cycle times (C/T), changeover times (C/O), inventory levels, equipment uptime and storage capacity. These data points provide a baseline to evaluate how lean tools like 5S, Kanban, TPM, and Standardization can be strategically applied to improve the flow of operations.

Key uses of VSM in farm settings include:

- **Clarifying** the sequence of operations and their timing;
- **Visualizing** where delays, waste, or excess inventory occur;
- **Setting** priorities for lean implementation based on process data; and
- **Aligning** the team with a shared view of the production system.

By starting with a VSM, farm managers and advisors can better understand where lean thinking can have the most impact and ensure that efforts are focused on the areas with the greatest opportunity for improvement.

3.2 - 5S – Workplace Organization

The 5S tool can be applied to reorganize storage areas, workspaces, and tool management in both farms. Storage zones are often cluttered, lack labeling and have no standardized system for locating commonly used parts, such as electrical fittings or hydraulic accessories.

The application of 5S follows the traditional five-step sequence:

- **Sort** (Seiri): Removal of obsolete or unused tools and materials
- **Set in Order** (Seiton): Definition of fixed locations for tools, including shelving and drawer systems
- **Shine** (Seiso): Cleaning and preparation of the workspace for inspection
- **Standardize** (Seiketsu): Use of labeling and color-coded systems
- **Sustain** (Shitsuke): Weekly checklists and visual reminders for maintenance

On farms, 5S can be applied to:

- Tool sheds or machinery shops
- Chemical storage areas
- Parts bins and containers
- Tractor cabins or mobile toolboxes

See Appendix 2 for a checklist of questions to guide each step of 5S in farm environments.

An example of how this could be applied is in the transformation of a storage wall previously used to hold miscellaneous items. After reorganization, the area could be divided by function and equipped with visual labels for tool categories, enabling faster retrieval and reducing search time.

Figure 1. *Storage area before 5S implementation.*

Figure 2. *Storage area after 5S implementation.*

Benefits:

- Faster access to tools and parts
- Less clutter and cleaner workspaces
- Fewer misplaced or duplicated items
- Safer operations
- Easier onboarding for seasonal workers

Suggested key performance indicators (KPIs):

- Average time to locate tools
- Compliance with cleaning routines
- Number of safety incidents due to disorganization

Figure 3. *Shelf with fluids and tools – previsual control state.*

3.3 - Visual Controls

Visual controls are tools that make information clear and accessible immediately. They help standardize tasks, reduce mistakes, and allow any team member to understand the status of a space, process or material without needing to ask or guess. In a farm context, visual controls can take many forms:

- Color-coded labels for tools, containers and inputs
- Signs and instructions near mixing stations, workbenches or equipment
- Floor markings or shadow boards to show where items belong
- Visual reminders for safety practices or routines

For example, a visual instruction sheet can be posted near the chemical mixing station, clearly outlining the correct proportions for post-emergent herbicide application. This reduces confusion and minimizes the risk of input misuse.

Benefits:

- Fewer errors in preparation or setup
- Safer, more organized work environments
- Less dependency on experienced staff
- Faster training for new workers
- Easier monitoring of compliance

Suggested KPIs:

- Percentage of areas compliant with visual standards
- Error rate in input handling or preparation
- Average time to complete visually guided tasks

3.4 - Kanban – Flow Control

Kanban is a simple visual tool use to manage inventory and ensure that materials are restocked at the right time, in the right quantity. It prevents shortages, overstocking and unnecessary downtime caused by missing supplies.

Instead of relying on memory or verbal reminders, Kanban uses visual signals (cards, labels, bins) to indicate when it's time to reorder or refill a material.

- How it works:
- Each item has a fixed storage location and a defined minimum stock level.
- When the last unit is used, a Kanban card or colored marker is exposed.
- That signal tells the worker to restock or request more.
- Replenishment becomes part of the routine, not a surprise.

On the farm, Kanban can be applied to:

- Lubricants, filters, or grease used in machinery maintenance
- PPE and safety supplies
- Herbicides and commonly used chemical containers
- Tools or spare parts with frequent use

One application could involve hydraulic filters used during regular maintenance. A Kanban card might be attached to each filter box, indicating the reorder point and supplier contact information. When only one unit remains, the card is moved to a "reorder box" as a signal for restocking. An observation guide and questions for identifying other Kanban opportunities are provided in Appendix 3.

Figure 4. *Pre-lean storage of mechanical supplies.*

Benefits:

- Fewer urgent purchases and last-minute trips
- Better control over input inventory
- Less risk of forgotten or misplaced supplies
- Clear responsibilities for replenishment

Suggested KPIs:

- Number of stockouts per month
- Replenishment lead time (signal to refill)
- Inventory turnover for key consumables

3.5 - TPM – Total Productive Maintenance

TPM is a lean tool that promotes shared responsibility for maintaining equipment in good condition. Instead of waiting for something to break, workers take simple daily actions to prevent failures and extend machine life.

In agriculture, where breakdowns during planting or harvesting can cause serious delays, TPM offers a practical way to improve equipment reliability without expensive systems.

How TPM works:

- Operators perform basic daily checks (grease, oil, cleaning, bolts).
- Maintenance is planned based on engine hours or field area covered.
- Tools and parts are kept in dedicated maintenance stations.
- Visual checklists help standardize tasks.

On the farm, TPM can be applied to:

- Tractors, sprayers, planters, or combines
- Seed tender and grain transport equipment
- Any machine with moving parts and seasonal use

Figure 5. *Field execution of TPM checklist on seeding machinery.*

Appendix 4 presents a TPM implementation checklist and Appendices 5 and 6 show sample daily and monthly maintenance checklists. One critical application of this lean tool could be in seeders used for corn and soybean planting. By incorporating pre-operation checklists and organizing maintenance kits near the storage zone, operators could complete basic servicing tasks quickly and consistently.

Benefits:

- Fewer unexpected breakdowns
- Better planning of repairs and downtime
- Increased equipment lifespan
- Greater operator ownership and care

Suggested KPIs:

- Number of unplanned breakdowns per season
- Average downtime per failure
- Preventive maintenance completion rate

3.6 - Standardization + Quality at the Source

Standardization ensures that tasks are done the same way every time — regardless of who does them. Quality at the source means doing things right the first time, by preventing errors instead of correcting them later. When combined, these concepts reduce variability and improve consistency across operations.

In farms, many tasks (e.g., chemical mixing, calibration, maintenance) depend on memory or personal habits. This increases the chance of mistakes, especially with seasonal workers or shared equipment.

How to apply it:

- Create POEs (point of execution instructions) posted near the task.
- Use pictures or diagrams instead of long texts.
- Introduce standard forms to record key settings (e.g., spray pressure, seeding depth).
- Mark fixed locations for materials or equipment used in the task.

One of the most impactful interventions as an example could be an herbicide mixing station equipped with a visual POE showing the correct water-to-product ratio, PPE required, and step-by-step instructions. This reduced confusion and minimized dosage errors.

Benefits:

- Tasks are performed consistently
- Fewer errors or rework
- Easier training and task handover
- Improved safety and accountability

Suggested KPIs:

Figure 6. *Field application of herbicide with tractor sprayer.*

- Procedure compliance rate
- Number of input handling or calibration errors
- Time required to train a new worker

3.7 - Kaizen – Continuous Improvement

Kaizen means “change for better” in Japanese, and in lean it refers to small, ongoing improvements made by the people who do the work. The idea is that workers — who know the problems best — can suggest ways to make tasks safer, faster, or easier, even without major investment.

In a farming context, Kaizen does not require meetings or paperwork. It starts by creating a space for suggestions and acting on small ideas that solve real problems.

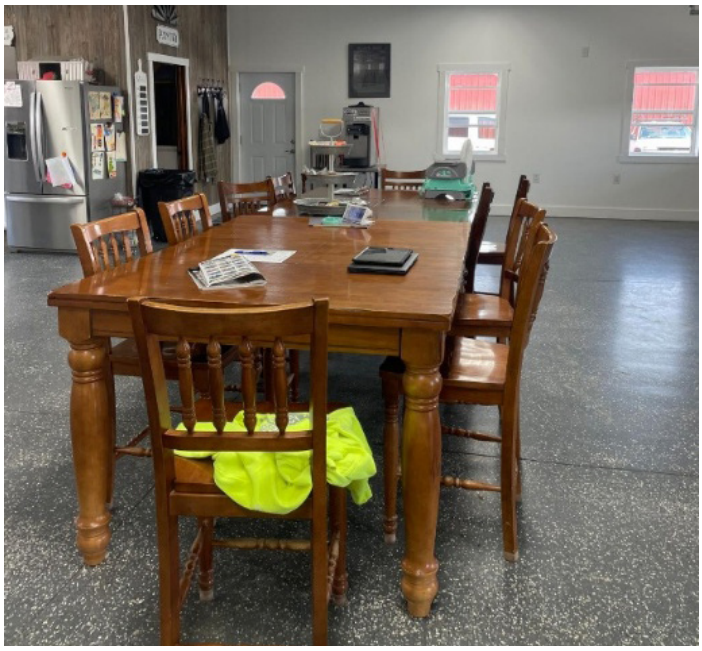

Figure 7. *Farm meeting space used for Kaizen talks.*

How to apply Kaizen on the farm:

- Place a whiteboard or suggestion box in a common area.
- Encourage workers to share ideas weekly.
- Prioritize simple changes that take little time or money.
- Show before-and-after results to motivate others.

For example, a worker suggested relocating a frequently used sprayer hose from a distant shed to a mobile cart near the chemical station. This saved 10-15 minutes per day during spraying season.

Benefits:

- Greater team engagement and ownership
- Practical improvements from direct experience
- Quick results without complex systems
- Foundation for long-term change

Suggested KPIs:

- Number of improvement ideas per month
- Participation rate among staff
- Time from idea to implementation

4. Getting Started: Recommendations for Your Farm

Introducing lean tools doesn't require big investments or major changes. The most important step is to start small, focus on visible improvements, and involve your team in the process. Lean doesn't mean doing more; it means doing better, with less effort and fewer problems. Start simple. Be consistent. Improve a little each week. Based on field experience, here are some practical recommendations to begin applying Lean Thinking on your farm:

4.1 Start with simple and visual tools

Begin with 5S and Visual Controls. These tools improve order, safety and clarity in workspaces, and their results are quickly visible. They also help build momentum and team involvement.

4.2 Choose one area to focus on

Don't try to "lean" the whole farm at once. Select a specific location (e.g., chemical storage, machinery shed, parts wall) or process (e.g., equipment maintenance) and implement one or two tools there.

4.3 Involve your team

Ask workers what slows them down, what tools are hard to find or what tasks cause confusion. Their answers will point directly to where lean can help. Share progress and celebrate small wins.

Figure 8. *Unsorted parts and tools: Opportunity for 5S*

4.4 Use simple indicators

Don't overcomplicate measurement. Track things like time spent looking for tools, number of breakdowns, or errors in input handling. A whiteboard or checklist is enough to start.

4.5 Make it routine

Lean is not a one-time fix. Set up weekly 5-minute checks to clean, reorder, or review a visual board. The goal is to build habits, not perfection.

4.6 Grow from experience

Once your first lean area is working well, apply the same logic elsewhere. You'll begin to see connections between tools — like how 5S supports TPM, or how standardization helps reduce waste.

5. Final Thoughts and Next Steps

Lean thinking offers farmers a clear, simple path to improve their operations. By reducing waste, organizing spaces and engaging workers in small improvements, farms can save time, avoid frustration and gain better control over their daily work.

The tools presented in this article — 5S, Kanban, Visual Controls, TPM, Standardization and Kaizen — have already shown positive results in other agricultural settings and can be adapted to farms of different sizes and styles. Their strength lies in their simplicity and flexibility.

It's worth noting that lean offers even more tools, such as Just in Time, Heijunka (load leveling), or Andon (visual alerts for problems). These were not covered here, as they often require more advanced systems or larger teams. However, with time and adaptation, they may become useful in more structured or high-volume farm environments.

The key is to begin. One improvement leads to another. And over time, a lean approach can help build a farm that is not only more efficient but also more resilient and easier to manage.

Figure 9. *Field treated with herbicide prior to planting.*

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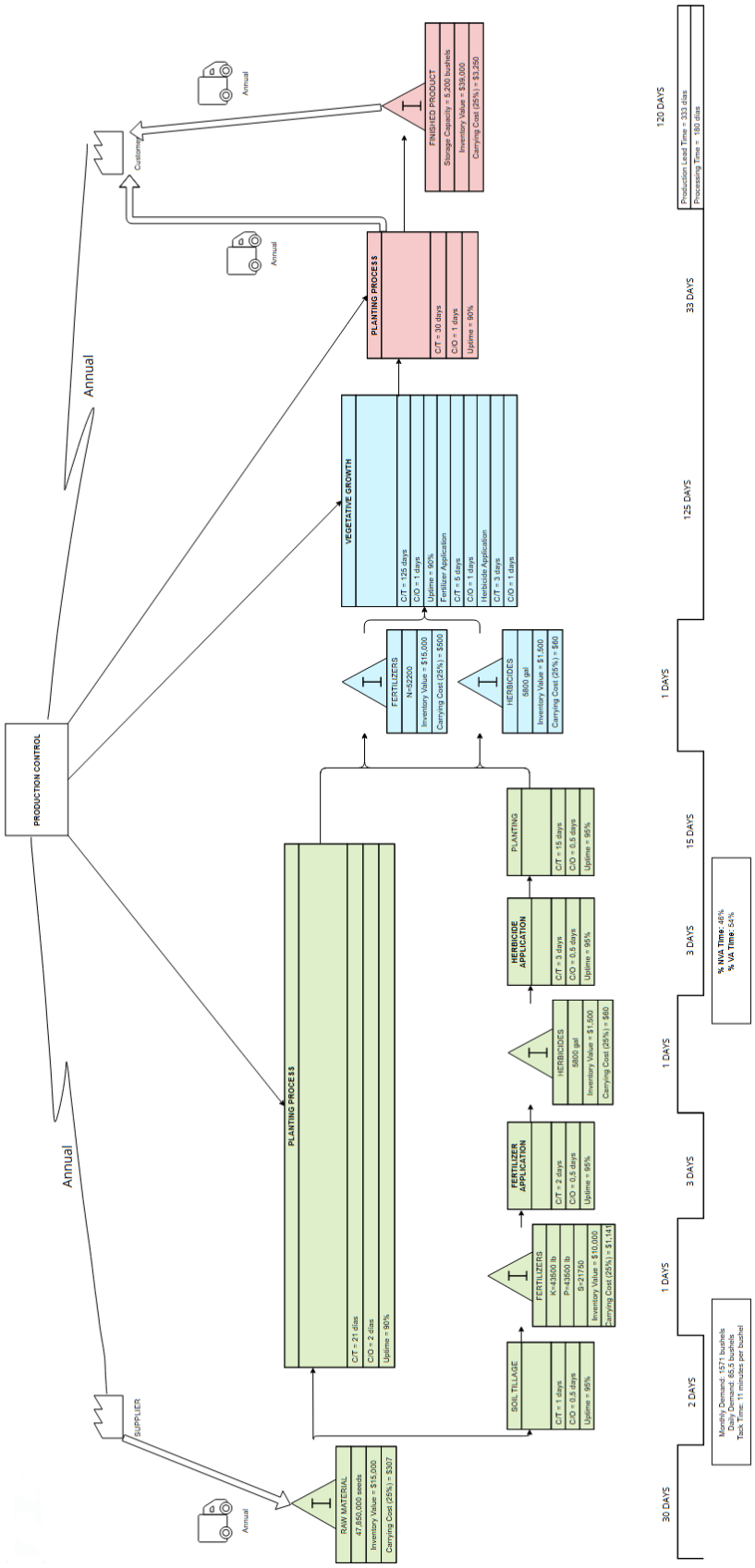
Appendices

1. VSM Soybean



Appendices

2. 5S Checklist

Seiri (Sort)

- What objects, tools, or materials are present in this area?
- What is their frequency of use (high, medium, low)?
- Are there any unnecessary or duplicate items?
- Are there any damaged items stored? Why?
- Could anything be safely discarded or relocated?

Seiton (Set in Order)

- Are the objects organized in a logical and visible manner?
- Are there designated areas for each type of material?
- Is time wasted looking for objects? Which ones?
- Could this area be rearranged for better efficiency? How?

Seiso (Shine)

- Is the area free from dirt, residues, or spills?
- Are there established cleaning routines? Who performs them?
- What equipment or surfaces require frequent cleaning?
- What barriers prevent this area from staying clean?

Seiketsu (Standardize)

- Are there clear and visible rules to maintain order and cleanliness?
- Are signs, labels, colors, or other visual aids used?
- Are there written checklists, routines, or formats? Are they visible and understandable?
- Are defined standards followed, or do they vary between people?

Shitsuke (Sustain)

- How often are order and cleanliness conditions reviewed?
- Who is responsible for verifying compliance?
- Are there any incentives, reminders, or follow-up routines?
- Does the team show discipline in maintaining the 5S? What could be improved?

Appendices

3. Kanban Opportunities Checklist

Observation of Supply and Material Handling

- What types of supplies/materials are currently stored?
- In what physical areas are they stored and how are they organized?
- Are there any supplies that accumulate more than necessary? Which ones?
- Have there been recent stockout situations? How often?
- Is there any visual system (labels, colors, signs) to control inventory?
- Who is currently responsible for inventory control?

Replenishment Flow

- How is it decided when to replenish a supply? Is it by calendar, visually, or when it runs out?
- Are there defined minimum or maximum levels for each type of supply?
- Who requests or purchases the replenishment? How do they do it?
- Which supplies are replenished most frequently? Which ones cause the most delays?

Kanban Opportunities

- What supplies or materials could benefit from a visual replenishment system?
- Would it be feasible to use cards, labels, or marked containers on this farm?
- What areas could work as 'Kanban points' or consumption stations?
- Who could be responsible for reviewing and maintaining these points?

Appendices

4. TPM Implementation Checklist

Machinery and Equipment in Use

- Which machines are considered critical for the operation?
- What is the average usage frequency of these machines?

Current Maintenance

- Are there established maintenance routines? Are they documented?
- Who performs the maintenance tasks? Are these individuals properly trained?
- Are the tasks recorded? How and where?
- Is the maintenance preventive, corrective, or both?
- How often do mechanical failures occur in key machinery?

Cleaning, Inspection, and Order

- How often is agricultural equipment cleaned?
- Where are maintenance tools and spare parts stored?
- Are they organized and labeled? How is access managed?

Opportunities to Implement TPM

- What simple tasks could be performed directly by operators as part of autonomous maintenance?
- Are there recurring failure patterns that could be prevented?
- Would it be feasible to implement a visual checklist per machine?
- Which equipment could be prioritized for a TPM pilot program?
- What benefits would staff expect if the current maintenance system were improved?

Appendices

5. Autonomous Maintenance Checklist

Autonomous Maintenance Checklist – Agricultural Machinery

Frequency: Daily

Equipment Information

Equipment type:	_____
Brand and model:	_____
Serial number or ID:	_____
Location / Area of use:	_____

Daily Checklist

Activity	Completed? ✓	Requires Attention? Yes/No	Comments
General visual inspection of the equipment			
Check oil and fuel levels			
Lubricate moving or critical parts			
Surface cleaning (mud, dust, debris)			
Inspect belts, hoses, and connections			
Check lights and signals (if applicable)			

Final evaluation of equipment condition:

☐ Equipment is in optimal condition

☐ Maintenance or further inspection required

Operator: _____ Date: _____

Appendices

6. Monthly Maintenance Checklist

Monthly Maintenance Checklist – Off-Season Agricultural Machinery

Recommended Frequency: Once per month during inactive periods (e.g., winter)

Equipment Information

Equipment type:	_____
Brand and model:	_____
Serial number or ID:	_____
Storage location:	_____

Monthly Checklist – Inactive Equipment

Inspection Item	Completed? ✓	Requires Attention? Yes/No	Comments
Check the battery charge and terminals			
Inspect fluid levels (oil, coolant, hydraulic)			
Inspect antifreeze protection level (if applicable)			
Clean and remove debris or rodents from equipment			
Look for rust, corrosion or oil leaks			
Check tire pressure and condition			
Inspect storage area for humidity or pests			

Overall equipment condition:

☐ Equipment is properly stored and protected

☐ Maintenance or corrective action needed

Operator: _____ Date: _____