

# **D.2.1.1.SWOT & PESTLE.**

**Integrated prioritisation of quality preservation in agro-food  
supply chains (NWE)  
Potatoes**

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# SWOT Analysis

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# Strengths

- **Highly productive potato region**

NWE countries benefit from favourable soils, temperate climate conditions and some of the highest potato yields globally.

- **Integrated and specialised value chains**

Strong links exist between breeders, seed producers, growers, traders, processors, storage operators and retailers.

- **Major processing and export capacity**

The region is a European hub for frozen potato products, fresh potatoes, seed potatoes and starch potatoes.

- **Strong technical expertise**

Farmers, agronomists, research institutes and extension services have high levels of potato-specific knowledge.

- **Advanced storage and handling know-how**

Large-scale storage facilities, controlled temperature management and specialised handling systems are already widely used, especially for processing and seed potatoes.

- **Innovation ecosystem**

Precision agriculture, decision-support systems, crop monitoring, storage control and alternative sprout-control technologies are increasingly available.

- **Existing producer and sector organisations**

Grower, processor and trade organisations provide a basis for cooperation, shared standards and market coordination.

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# Weaknesses

- **High environmental footprint compared with cereals**

Potatoes require more soil movement, higher inputs, refrigeration or ventilation in storage, and sometimes irrigation.

- **Dependence on crop protection products**

Late blight, weeds, nematodes, aphids and storage diseases require intensive management, while active substances are being restricted.

- **Storage quality remains sensitive**

Temperature, humidity, sprouting, bruising, reducing sugars and disease development can quickly reduce value, especially for processing potatoes.

- **Fragmented quality data across the chain**

Quality information is often not fully shared from field to storage, transport, processing and retail.

- **High production and storage costs**

Seed, land rental, pesticides, irrigation, energy and storage infrastructure create high fixed and variable costs.

- **Price volatility**

Free-market potato prices can fluctuate strongly, exposing growers to risk when production costs are high.

- **Soil health pressure in intensive production zones**

Short rotations, heavy machinery, soil compaction, erosion, nematodes and declining soil structure can reduce long-term resilience.

- **Uneven storage infrastructure**

Some regions have modern controlled stores, while others still rely on more basic facilities that are harder to adapt to new sprout-control methods.

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# Opportunities

- **Digital quality monitoring**

Sensors for temperature, humidity, CO<sub>2</sub>, sprouting risk, bruising and storage atmosphere can support preventive quality management.

- **AI-based prioritisation tools**

Predictive models can identify high-risk stores, routes, batches, varieties or production areas before losses occur.

- **Alternative sprout-control solutions**

Mint oil, orange oil, ethylene, DMN, refrigeration and variety selection can reduce dependence on legacy chemicals.

- **Precision agriculture and decision-support systems**

Variable-rate fertilisation, irrigation scheduling, late blight forecasting and crop monitoring can reduce inputs while maintaining quality.

- **Breeding and variety innovation**

New varieties can improve resistance to late blight, drought, heat stress, bruising, storage diseases and acrylamide formation.

- **Cross-border harmonisation**

Interreg cooperation can support shared data standards, common quality indicators, demonstration pilots and aligned logistics approaches.

- **Food-loss reduction**

Better harvest timing, storage control, batch segregation and traceability can reduce waste before processing and retail.

- **Sustainable logistics and modal shift**

Optimised routing, consolidation, rail and inland waterway transport can reduce costs and emissions where infrastructure allows.

- **Growing demand for sustainable and organic potatoes**

Consumers and retailers increasingly value lower-residue, lower-carbon and more transparent supply chains.

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# Threats

- **Climate change and extreme weather**

Drought, heatwaves, heavy rainfall and warmer storage seasons increase risks for yield, quality, pests, diseases and storage costs.

- **Higher pest and disease pressure**

Late blight, nematodes, aphids, storage rots and emerging pests may become harder to control under changing climate conditions.

- **Regulatory pressure on pesticides and storage treatments**

Restrictions on active substances increase compliance costs and require fast adoption of alternatives.

- **Energy cost volatility**

Refrigeration, ventilation, drying, storage monitoring and processing are exposed to high and unstable energy prices.

- **Land competition and rising rents**

Expansion of potato processing increases pressure on suitable land, especially in Belgium, the Netherlands and northern France.

- **Market imbalance and overproduction risk**

Rapid expansion of planted area can create pressure on prices if processing demand does not absorb supply.

- **Trade disruptions**

Export barriers, phytosanitary rules and geopolitical tensions can affect flows of seed, fresh and processed potatoes.

- **Public image and social licence risks**

Intensive potato production can attract criticism linked to pesticides, water use, soil degradation, traffic, processing expansion and landscape impacts.

- **Quality failure costs**

A rejected or downgraded batch can generate high costs through reprocessing, disposal, penalties, storage losses or missed processing specifications.

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# **PESTLE,** Quality preservation in potatoes supply chains (NWE).

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# Political

- **Strong alignment with EU and Interreg priorities**

Potato quality preservation fits climate adaptation, circular economy, innovation, food loss reduction and sustainable logistics priorities.

- **Need for cross-border cooperation**

Potato flows, processing capacity, storage, seed trade and logistics are transnational, requiring shared approaches between regions.

- **Public pressure for sustainable farming**

Policy support is increasingly directed toward reduced pesticide use, climate resilience, biodiversity and lower emissions.

- **Strategic importance of food security**

Potatoes remain a high-yield food crop and a key agri-food sector for North-West Europe.

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# Economic

- **High-value but high-cost crop**

Potatoes generate strong economic value, but production costs are high due to seed, land, crop protection, irrigation, storage and energy.

- **Processing industry drives demand**

Frozen fries, crisps and other processed products are major demand drivers, especially in Belgium, the Netherlands, France and Germany.

- **Cost of non-quality is significant**

Bruising, sprouting, rotting, sugar accumulation, contamination or wrong storage conditions can cause downgrading or rejection.

- **Price volatility creates grower risk**

Market prices can swing sharply depending on yield, weather, planted area and processing demand.

- **Investment barriers**

Modern storage, sensors, refrigeration, data platforms and alternative sprout-control systems require capital and uncertain payback periods.

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# Social

- **Growing consumer concern about sustainability**

Consumers and retailers increasingly expect lower pesticide use, less waste, better traceability and reduced carbon footprint.

- **Skills gap in digital and storage management**

Quality preservation requires expertise in agronomy, storage biology, sensors, data interpretation and logistics.

- **Complex stakeholder responsibilities**

Farmers, contractors, store managers, traders, transport operators, processors and retailers all influence quality, but responsibility can be blurred.

- **Resistance to change**

Traditional practices, cost concerns and fear of false alarms can slow adoption of monitoring technologies.

- **Public perception challenges**

Large-scale intensive potato production may face criticism around pesticides, water use, soil health and processing expansion.

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# Technological

- **Emerging storage technologies**

IoT sensors, automated ventilation, refrigeration control, CO<sub>2</sub> monitoring and sprout-risk prediction can improve storage quality.

- **Precision crop management**

Remote sensing, variable-rate fertilisation, irrigation tools and late blight decision-support systems can reduce input use and improve resilience.

- **Alternative sprout-control technologies**

Post-CIPC storage requires new technical combinations, including oils, ethylene, DMN, refrigeration and variety selection.

- **Data integration gap**

Many actors collect data, but systems are not always interoperable across farms, stores, processors and logistics operators.

- **Opportunity for digital twins and risk dashboards**

Integrated platforms could model quality loss risk from field to storage, transport and processing.

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# Legal

- **Strict food safety and quality rules**

Residues, contaminants, traceability, processing quality and phytosanitary standards are key legal constraints.

- **Changing pesticide and sprout suppressant regulations**

The withdrawal or restriction of active substances forces rapid technical adaptation.

- **Residue and MRL compliance**

Historical contamination of potato stores, especially linked to former CIPC use, creates ongoing compliance and monitoring challenges.

- **Liability risks**

Responsibility for quality loss can be disputed when problems emerge after harvest, during storage, in transport or at processing intake.

- **Trade and phytosanitary rules**

Seed and fresh potato trade depends on strict disease-control and certification systems.

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# Environmental

- **Climate change affects both field and storage phases**

Heat, drought, heavy rain and warmer storage periods increase quality risks and energy requirements.

- **Soil health is a critical constraint**

Potatoes disturb soil more than cereals and can increase compaction, erosion, runoff and nematode pressure.

- **Water use pressure**

Irrigation needs are likely to increase in some regions, while water availability may become more restricted.

- **Energy and carbon footprint**

Storage, refrigeration, ventilation, irrigation and processing contribute significantly to emissions.

- **Food loss reduction as an environmental lever**

Preventing quality losses can reduce waste, avoid unnecessary production, and improve resource efficiency.

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# Value chain mapping,

Quality preservation in cereal supply chains (NWE).

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# Step-by-step mapping of risks & levers (1/8)

- **Breeding, variety selection & seed supply**

- Risks:

- Limited availability of varieties combining yield, processing quality, late blight resistance, drought tolerance and storage stability.
- High dependence on certified seed, which represents a major production cost.
- Seed-borne diseases and phytosanitary constraints can affect quality from the start of the chain.
- Trade and certification disruptions can affect seed flows across borders.

- Levers:

- Selection of varieties adapted to final use: fresh market, fries, crisps, starch or seed.
  - Wider use of robust varieties with improved resistance to late blight, nematodes, drought, bruising and storage diseases.
  - Stronger cross-border seed traceability and certification systems.
  - Better integration between breeders, seed producers, growers and processors to anticipate future quality requirements.
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# Step-by-step mapping of risks & levers (2/8)

- **Farm planning, rotation & soil preparation**

- Risks:

- Short rotations increase nematode, pest and disease pressure.
- Heavy soil preparation and ridging increase erosion, runoff and soil structure degradation. Soil compaction from heavy machinery can reduce yield and tuber quality.
- Expansion of potato areas in intensive regions increases pressure on suitable land.

- Levers:

- Longer rotations, ideally 4 to 5 years where possible.
  - Rotation-wide nematode management.
  - Soil health monitoring: compaction, organic matter, erosion risk, drainage and structure.
  - Use of cover crops, contour farming and micro-dams in furrows to reduce runoff and erosion.
  - Traffic-lane management and lighter machinery where feasible.
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# Step-by-step mapping of risks & levers (3/8)

- **Crop growth: fertilisation, irrigation & crop protection**

- Risks:

- High nitrogen input and low nitrogen-use efficiency increase leaching risk.
- Increasing irrigation needs under drought and heat stress.
- Late blight can require many fungicide applications.
- Aphids, nematodes, Colorado beetle, storage diseases and emerging pests can reduce yield and quality.
- Restrictions on crop protection products reduce the toolbox available to growers.

- Levers:

- Decision-support systems for late blight, irrigation and fertilisation.
  - Variable-rate nitrogen application using remote sensing or crop sensors.
  - Water-use efficiency tools and irrigation scheduling.
  - Resistant or tolerant varieties.
  - Biocontrol, biostimulants and integrated pest management.
  - Field-level risk mapping for drought, disease pressure and soil constraints.
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# Step-by-step mapping of risks & levers (4/8)

- **Haulm destruction & harvest timing**

- Risks:

- Poor haulm destruction can increase tuber contamination and reduce skin set.
- Removal of key desiccants creates operational challenges.
- Harvesting too early increases skin damage; harvesting too late increases weather and disease risk.
- Wet harvesting conditions increase soil compaction and bruising.

- Levers:

- Mechanical, electrical or combined haulm destruction alternatives.
  - Use of biomass maps to optimise desiccation where chemical options remain available.
  - Harvest timing based on skin set, dry matter, market destination and storage potential.
  - Avoid harvesting under unsuitable soil moisture conditions.
  - Better coordination between growers, contractors, stores and processors.
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# Step-by-step mapping of risks & levers (5/8)

- **Harvest handling & primary transport**

- Risks:

- Bruising, cuts and mechanical damage create hidden quality losses.
- Damage may only become visible later in storage or processing.
- Mixing batches with different quality profiles reduces traceability.
- Delays between harvest and storage increase deterioration risks.

- Levers:

- Gentle handling at harvest, grading and loading.
  - Monitoring drop heights, harvester settings and conveyor speeds.
  - Batch-level traceability from field to store.
  - Segmentation by variety, field, intended use, dry matter, damage risk and storage duration.
  - Rapid transfer to appropriate curing and storage conditions.
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# Step-by-step mapping of risks & levers (6/8)

- **Curing and intake into storage**

- Risks:

- Poor curing increases vulnerability to rots and storage diseases.
- Inadequate intake checks may allow damaged or diseased lots into long-term storage.
- Quality variation between fields and varieties may be hidden at intake.
- Stores historically treated with CIPC may create residue compliance challenges.

- Levers:

- Systematic intake quality checks: dry matter, damage, rots, soil tare, size, defects and intended use.
  - Dedicated curing protocols adapted to variety and market.
  - Batch isolation for risky lots.
  - Store cleaning, residue monitoring and compliance procedures.
  - Digital intake records linked to field and harvest data.
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# Step-by-step mapping of risks & levers (7/8)

- **Long-term storage**

- Risks:

- Sprouting, weight loss, rots, sugar accumulation and loss of processing quality.
- Warmer autumns and winters increase storage instability and cooling costs.
- Post-CIPC storage requires new sprout-control strategies.
- Fresh, crisp and fry potatoes require different storage temperatures and quality targets.
- Poor ventilation, condensation or humidity control can accelerate losses.

- Levers:

- Continuous monitoring of temperature, humidity, CO<sub>2</sub>, ventilation and sprouting risk.
  - Automated storage control and predictive alerts.
  - Alternative sprout suppressants: mint oil, orange oil, ethylene, DMN and refrigeration strategies.
  - Variety-specific storage protocols.
  - Risk-based store management: high-risk batches processed earlier, stable batches stored longer.
  - Energy optimisation for ventilation and refrigeration.
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# Step-by-step mapping of risks & levers (8/8)

- **Secondary transport, processing intake & final use**

- Risks:

- Temperature fluctuations during transport affect frying quality and sugars.
- Processing rejection due to poor colour, high reducing sugars, bruising, rots, size defects or acrylamide risk.
- Cross-border logistics delays can affect quality and delivery planning.
- Contract penalties, downgrading or disposal can create high costs of non-quality.

- Levers:

- Real-time transport tracking and temperature monitoring.
  - Processor intake data shared back to growers and storage operators.
  - Quality-based routing: fresh, fries, crisps, starch, feed or secondary valorisation.
  - Early warning systems for batches at risk of rejection.
  - Feedback loops between processors, growers and advisers to improve next-season decisions.
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# Prioritisation Matrix,

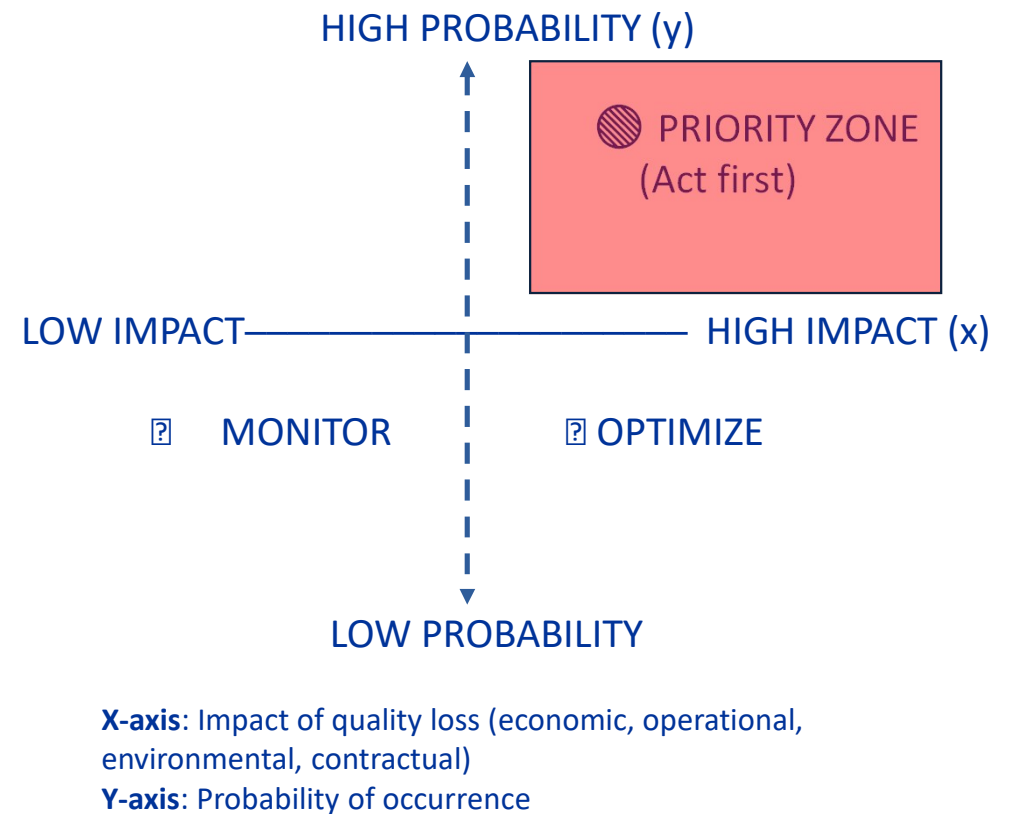
Where should DODILOG focus first?

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# Prioritisation Matrix: High Priority

## Act immediately

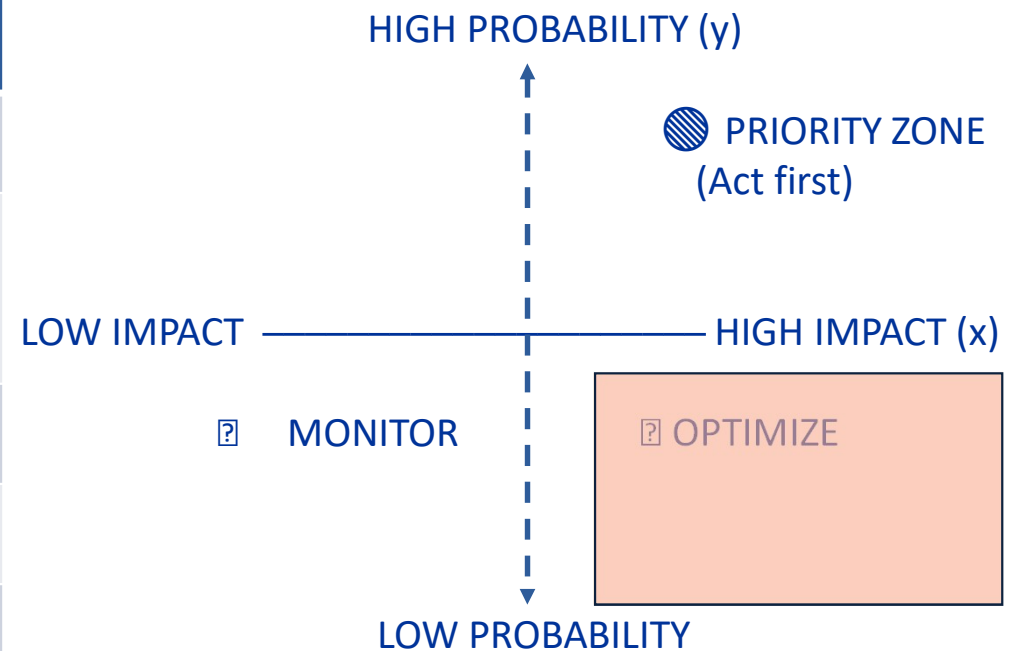
Area	Why it is high priority
Long-term storage	High probability and high impact: sprouting, rots, sugar accumulation, weight loss and processing defects can affect large volumes.
Post-CIPC sprout control	Major regulatory and technical transition; alternative solutions are more costly and require adapted storage management.
Storage monitoring and digital control	Quality losses can develop silently; continuous monitoring can shift management from reactive to preventive.
Harvest damage and bruising	Damage often occurs early but becomes visible later, creating hidden quality losses and processing rejection.
Soil health and rotation management	Long-term production capacity is threatened by compaction, erosion, nematodes and short rotations in intensive potato zones.
Climate and water-risk mapping	Drought, heatwaves, heavy rain and warmer storage seasons affect both field quality and storage stability.



# Prioritisation Matrix: Medium Priority

## Optimize

Area	Why it is medium priority
Crop protection decision-support systems	Important for late blight, pests and pesticide reduction, but many tools already exist and need better integration.
Irrigation scheduling	Increasingly important under climate change, especially in drought-prone regions, but relevance varies by country and water availability.
Batch traceability and segmentation	Strong potential to reduce downgrading, but requires coordination between growers, stores, traders and processors.
Transport conditions	Risk exists through delays and temperature variation, but usually lower than storage and harvest risks.
Processor feedback loops	Intake data can improve upstream decisions, but data-sharing governance is needed.
Alternative valorisation routes	Useful for downgraded batches, but secondary to preventing quality loss in the first place.



**X-axis:** Impact of quality loss (economic, operational, environmental, contractual)  
**Y-axis:** Probability of occurrence

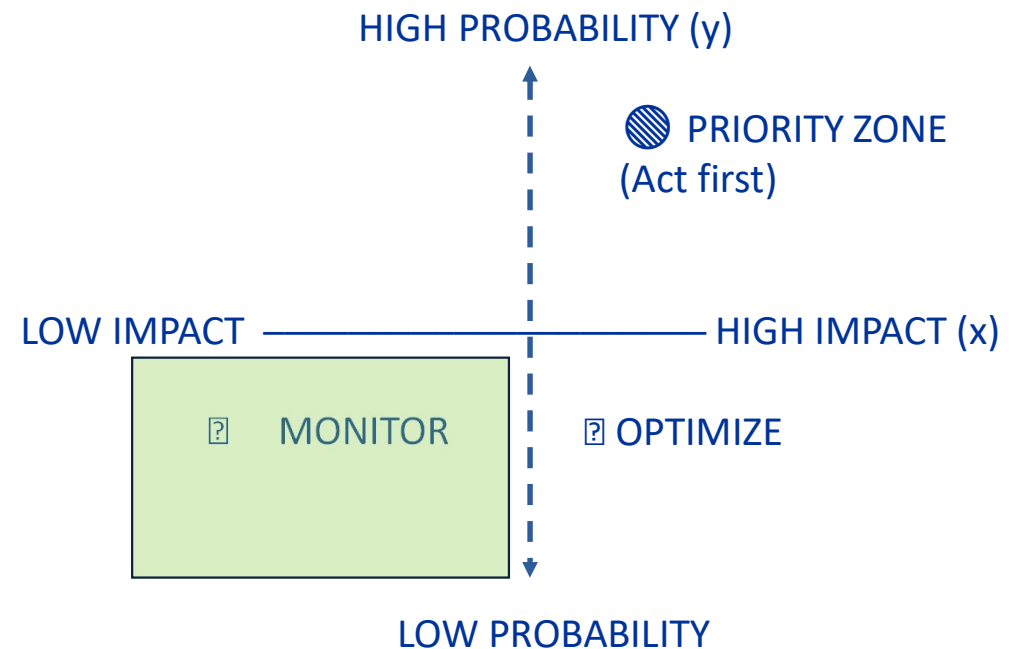
# Prioritisation Matrix: Lower Priority

## Monitor

Area	Why it is lower priority
Final retail and consumer stage	Important for waste, but many potato defects are already determined earlier in the chain.
Mature conventional logistics flows	Potato logistics are already highly organised in many NWE regions; improvements are incremental unless linked to quality monitoring.
General farm-level advisory systems	Agronomic support is already strong; the main gap is linking advisory data to storage and processing outcomes.
Broad market monitoring	Important for strategy, but less directly actionable for DODILOG quality-preservation pilots.

### Priority zones:

-  **High Priority:** Long-term Storage, Post-CIPC Sprout Control, Harvest Damage & Bruising, Soil Health & Rotation, Climate & Water Risk
-  **Medium Priority:** Curing & Storage Intake, Crop Protection Failures, Batch Traceability, Transport Conditions, Processing Intake Rejection
-  **Lower Priority:** Final Retail Stage, Market Monitoring, General Advisory Systems, Mature Logistics Flows



**X-axis:** Impact of quality loss (economic and operational)

**Y-axis:** Probability of occurrence

# Prioritisation scoring model

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## Prioritisation analysis

- **Risk score**= Probability X Impact X Detectability
  - Probability: 1 to 5
  - Impact: 1 to 5
  - Detectability: 1 to 5 (low detectability = higher risk)

Value-chain step	Probability	Impact	Detectability	Score	Priority
Long-term storage	5	5	4	100	High
Post-CIPC sprout control	4	5	4	80	High
Harvest damage and bruising	4	4	5	80	High
Soil health and rotation	4	5	4	80	High
Climate and water stress	4	5	3	60	High
Curing and storage intake	4	4	3	48	Medium-high
Crop protection failures	3	5	3	45	Medium-high
Batch traceability gaps	4	3	3	36	Medium
Transport conditions	3	3	3	27	Medium
Processing intake rejection	3	4	2	24	Medium
Final retail stage	2	3	2	12	Lower

# Results

## For DODILOG, the strongest intervention areas are therefore:

- Continuous storage monitoring and predictive alerts.
- Risk-based batch segmentation from field to store.
- Post-CIPC sprout-control decision support.
- Bruising and harvest-damage detection.
- Soil, climate and water-risk mapping for long-term resilience.
- Data feedback loops between growers, storage operators and processors.

## The central recommendation:

→ to treat the potato supply chain as a **field-to-store-to-processing quality system**, not as separate farm, storage and logistics operations.

## In a nutshell:

For DODILOG, the greatest value lies in focusing first on storage, harvest damage, sprout control and climate-related risks, while monitoring retail, advisory and market-level activities as supporting functions.

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**Interreg**



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**North-West Europe**

**Thank you**

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