

Evolution of P-Loss Risk Assessment Tools

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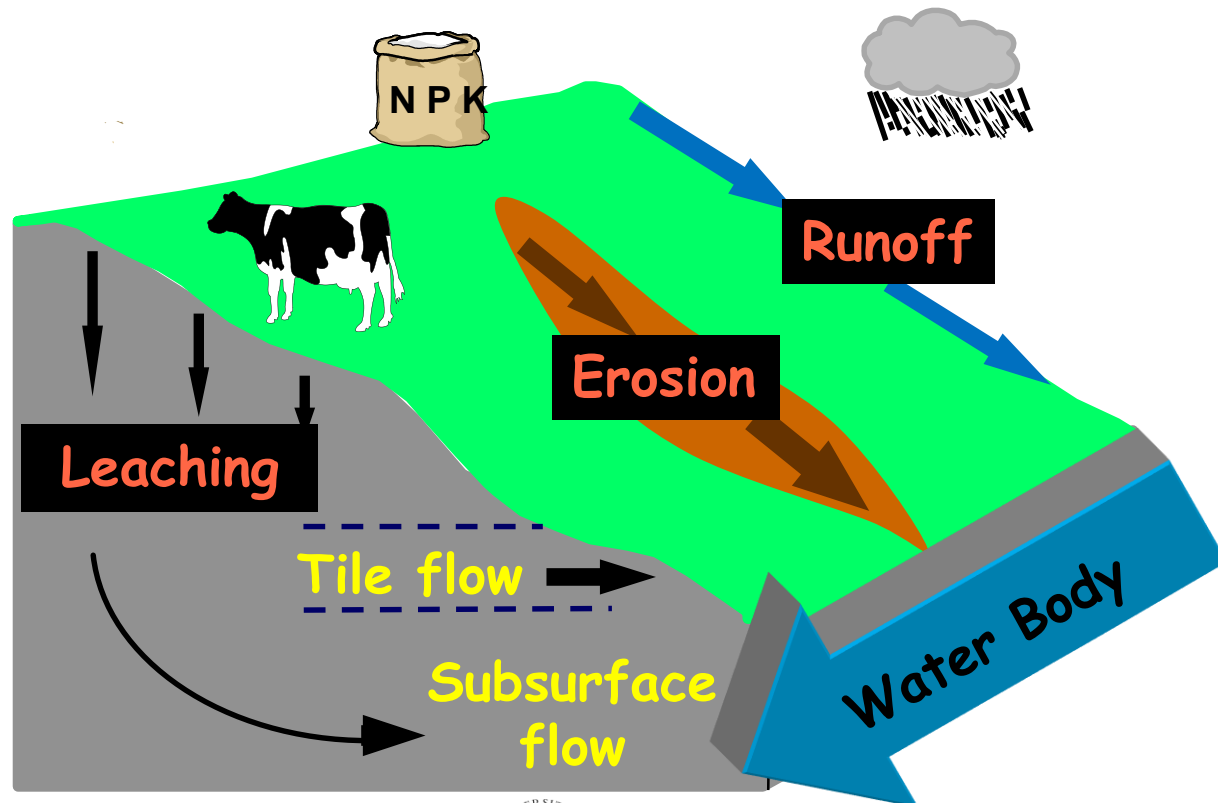


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Eutrophication is a Water Quality Impairment Linked to Agricultural Land Uses

- Nitrogen and/or phosphorus over-enrichment of surface waters
- Results in excessive algal growth
- The limiting nutrient for algal growth
 - Phosphorus in fresh waters
 - Nitrogen in saline waters
- In coastal estuaries like Chesapeake Bay, the limiting nutrient changes with water mixing, depth, location and season

Assessing P Losses: P Sources and Transport Pathways

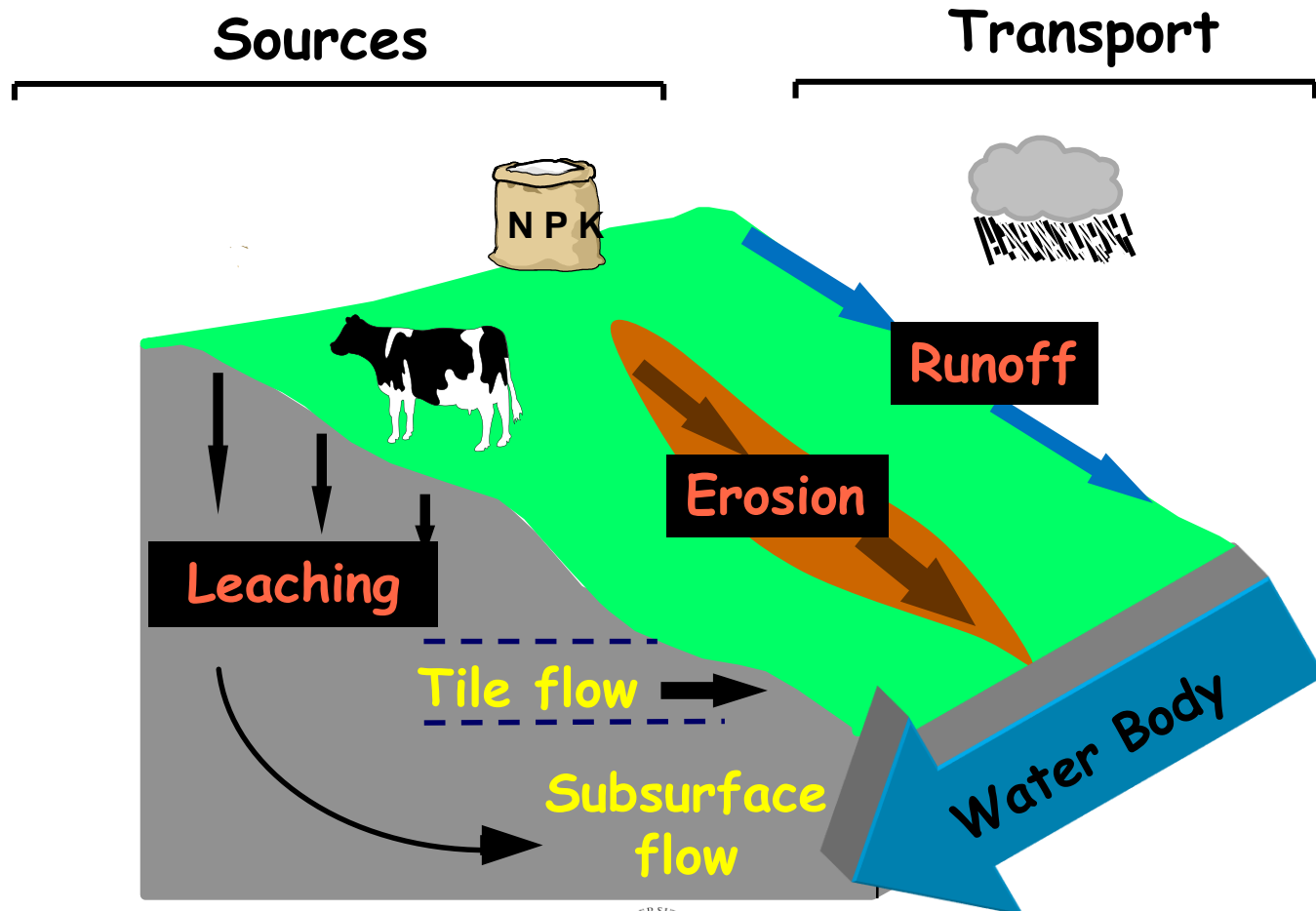


P-loss Risk Assessment Concept

- Lemunyon and Gilbert, 1993.
 - Journal of Production Agriculture, Volume 6, Number 4, pages 483-486
- Phosphorus Index (1993)
 - Based on site-specific landform characteristics and management
 - Each site characteristic assigned a relative P-loss risk rating
 - Scale = None (0), Low (1), Medium (2), High (4), Very High (8)
 - Based on best professional judgement
 - Site characteristics assessed (weighting factors)
 - Soil erosion (1.5)
 - Irrigation erosion (1.5)
 - Runoff class (0.5)
 - Agronomic soil test P level (1.0)
 - Fertilizer P application rate (0.75)
 - Organic P application rate (1.0)
 - Fertilizer P application method (0.5)
 - Organic P application method (1.0)
- Site vulnerability for P loss = sum of weighted risk ratings



Assessing P Losses: P Source Risk and P Transport Risk



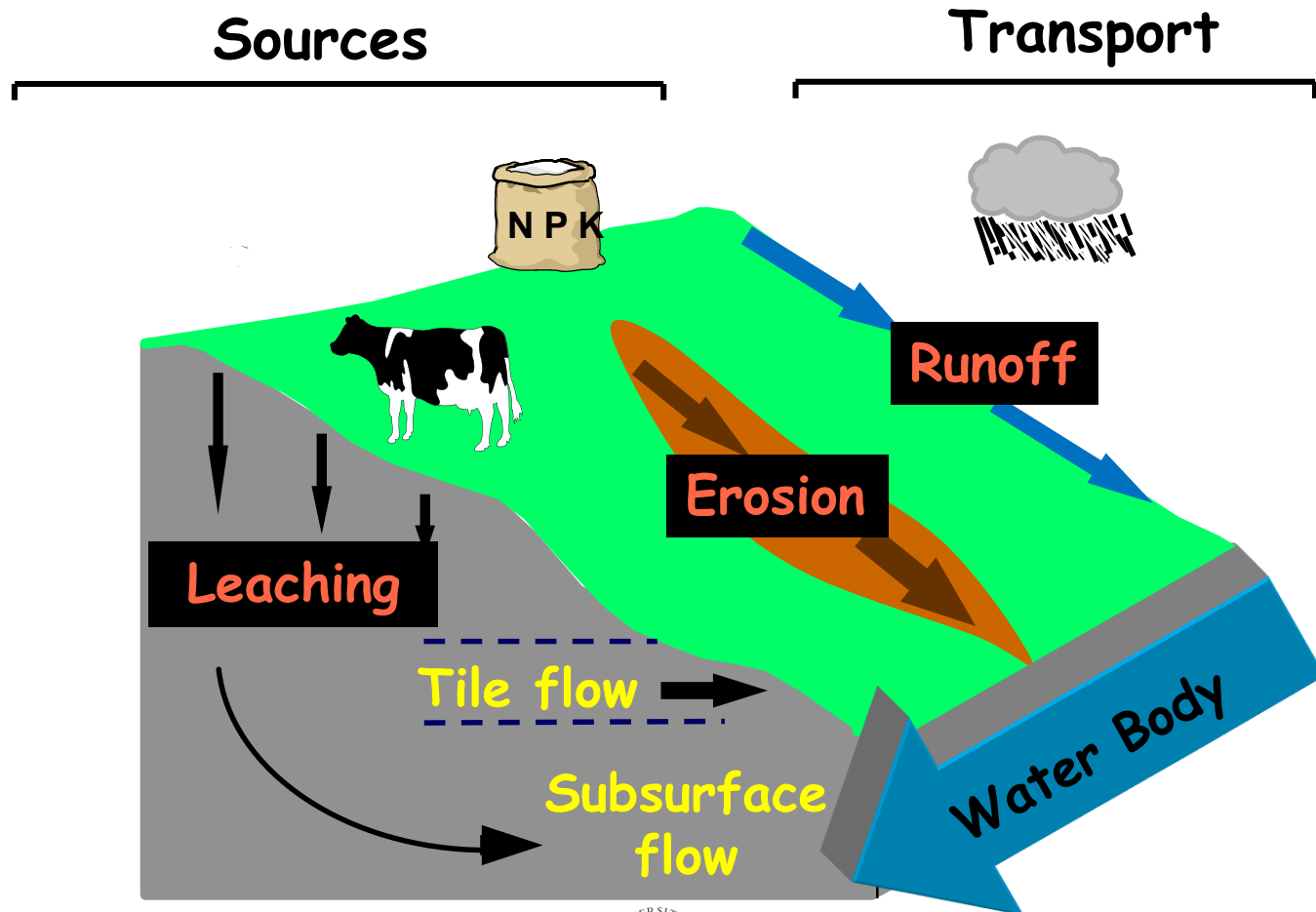
Evolution of P-loss Risk Assessment Tools

- **P Site Index (PSI)**

$$\text{Total P Sources} \times \text{Total P Transport Potential} = \text{P Site Index (PSI)}$$

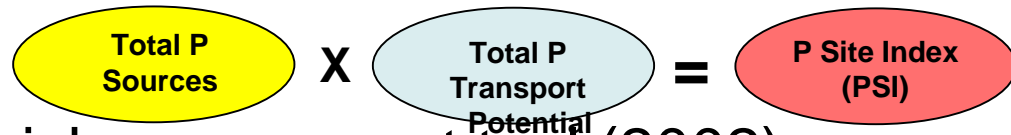
- P Site Index → P loss risk assessment tool (2002)
- Numerical PSI score → Interpretive category
- Largely based on best professional judgment
- Interpretive categories → Adjust farm management

Assessing P Losses: P Source Risk For Each P Transport Pathway



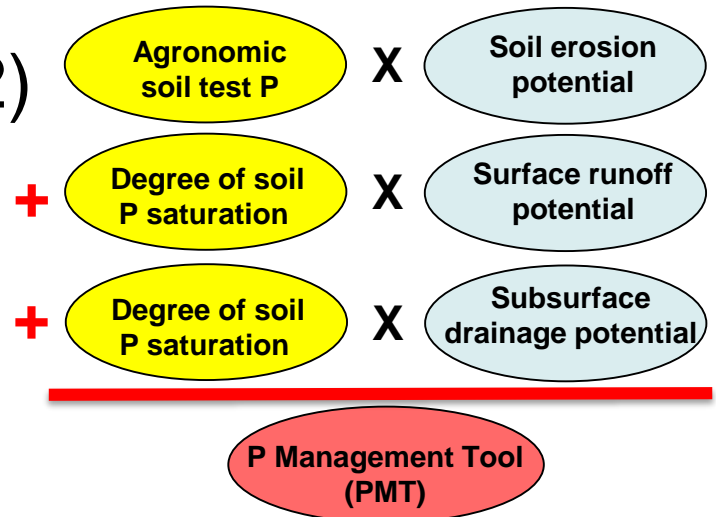
Evolution of P-loss Risk Assessment Tools

- **P Site Index (PSI)**



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- **Transition: PSI → PMT (2012)**



- P Management Tool (PMT)
- Multiplicative → component
- Represents processes of P loss
- More complex



Factors Evaluated in PSI and PMT Assessments

	PSI	PMT
Soil erosion loss estimation	✓	✓
Surface runoff potential of site	✓	✓
Subsurface drainage potential of site	✓	✓
P leaching potential of site	✓	X
Distance from edge of field to surface water	✓	✓
Buffer type and width	✓	✓
Receiving water body priority status	✓	X
Agronomic soil test P level	✓	✓
Soil P saturation ratio	X	✓
P fertilizer application rate	✓	✓
P fertilizer application method, placement, tillage & timing	✓	✓
Manure P application rate and P solubility	✓	✓
Manure P application method, placement, tillage & timing	✓	✓

Phosphorus Management Tool (PMT)

Final Score Interpretation

P Loss Rating	Interpretation
0 – 50	LOW potential for P movement from this site given current management practices and site characteristics. Total phosphorus applications should be limited to no more than one three-year crop removal rate applied over a three year period.
51 – 100	MEDIUM potential for P movement from this site given current management practices and site characteristics. Phosphorus applications should be limited to the amount expected to be removed from the field by crop harvest.
> 100	HIGH potential for P movement from this site given current management practices and site characteristics. No phosphorus should be applied to this site

Evolution of P-loss Risk Assessment Tools

- **Transition: PMT → PMT-2 (2015)**
 - Replace “best professional judgment” calibration with external calibration data
 - Ideal scenario: calibrate PMT to **measured P** loss data
 - 2nd best scenario: calibrate PMT to **modeled P** loss data



Annual P Loss Estimator (APLE)

- Vadas et al., 2013
(<http://www.ars.usda.gov/Services/docs.htm?docid=21763>)
- Annual time step
- Edge-of-field estimation
- Simulates sediment and dissolved P surface losses from soil, manure and fertilizer sources
- Subsurface losses or leaching to groundwater are not simulated

Evolution of P-loss Risk Assessment Tools

- Calibrate PMT-2 using APLE P loss model
 - APLE-estimated P loss from modeled data set (n=10,000)
 - Modified PMT to include coefficients suggested by APLE P loss estimations for each P-loss pathway
 - APLE-modified PMT → PMT-2



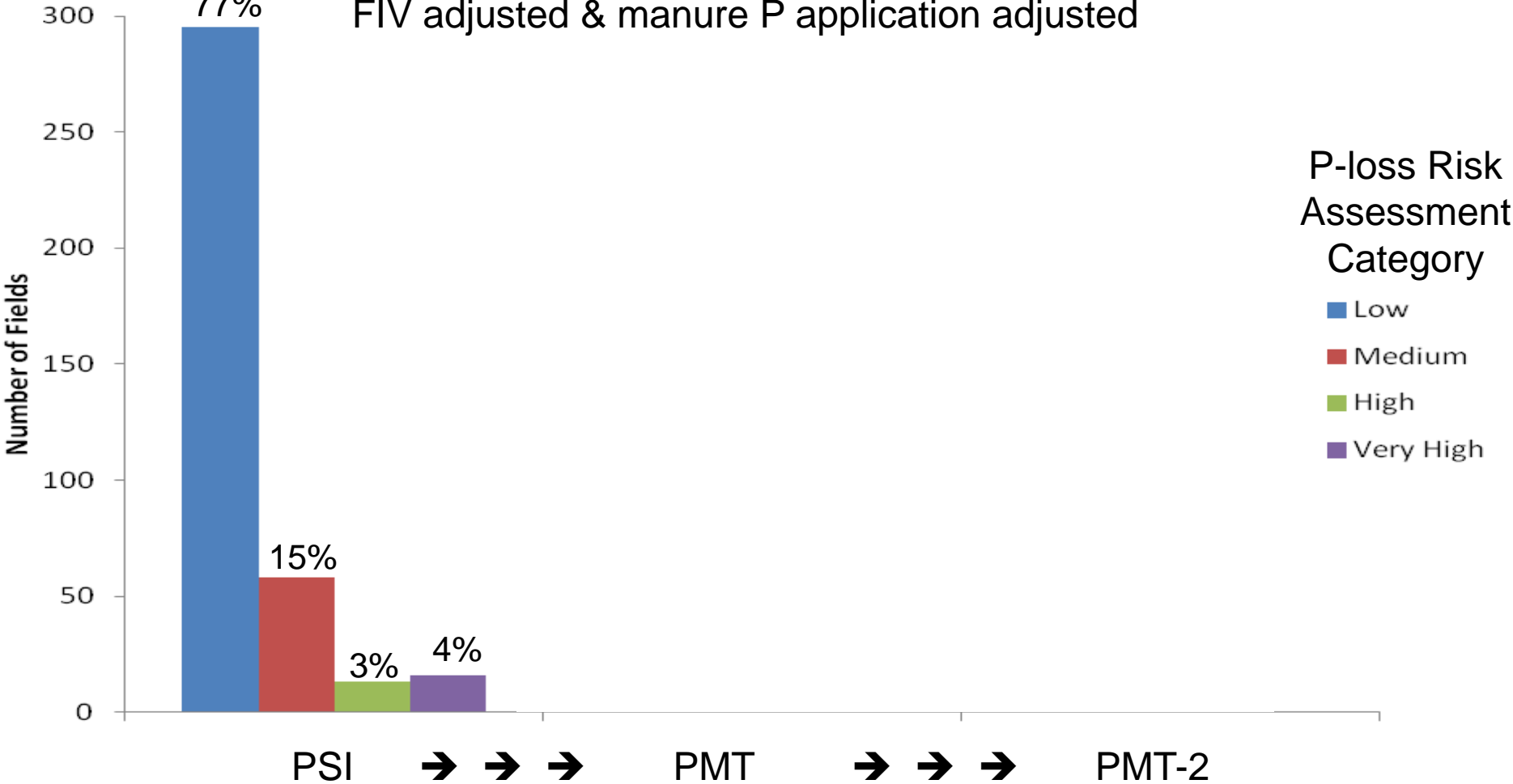
Evolution of P-loss Risk Assessment Tools

- **P Site Index (PSI), 2002**
 - Average transport risk **X** average P source risk
 - Largely based on best professional judgment
- **P Management Tool (PMT), 2012**
 - Represents complex processes of P loss pathways
 - Introduced P-loss risk analysis by pathway components
 - Largely based on best professional judgment
- **P Management Tool – 2 (PMT-2), 2015**
 - PMT calibrated with APLE model derived coefficients
 - Independent calibration with model data
 - Surface pathways only



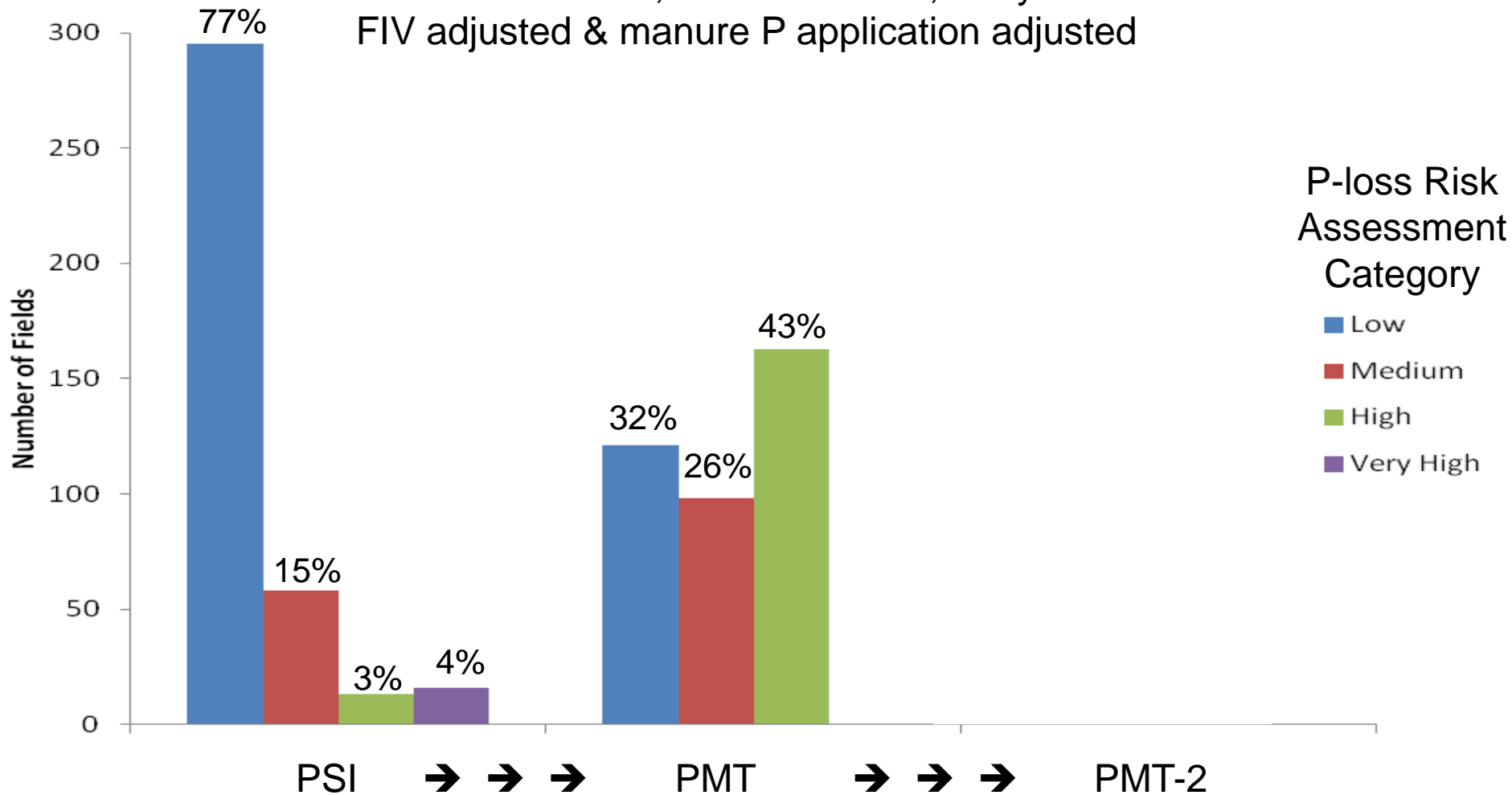
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Field evaluation, 382 farm fields, Maryland
FIV adjusted & manure P application adjusted



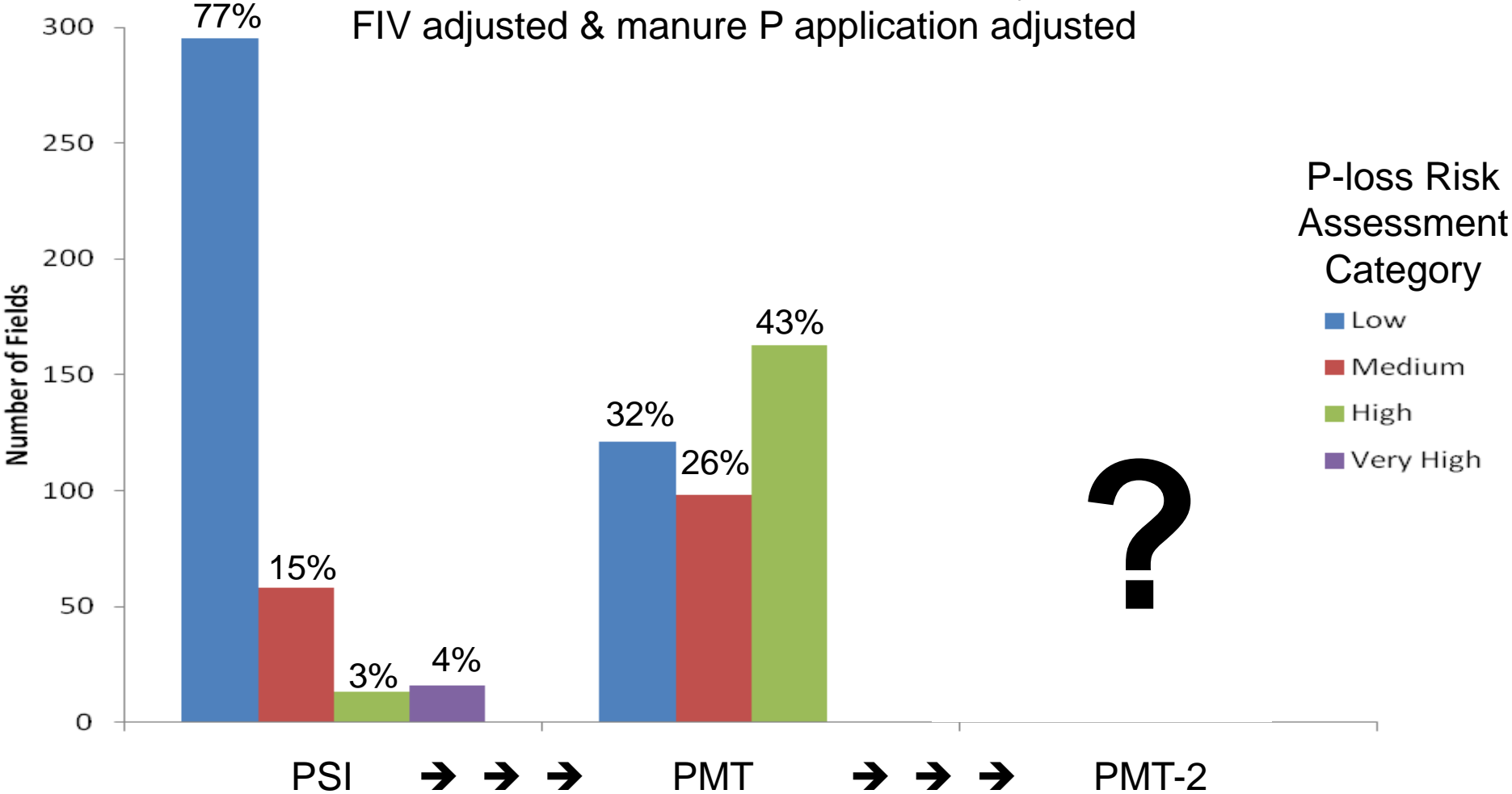
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Evolution of P-loss Risk Assessment Tools

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Evolution of P-loss Risk Assessment Tools

- Science and understanding evolve with long-term continuous research efforts.
- Intuitive, best professional judgment-based P-loss risk assessment can be valuable for guiding management.
- Complex risk assessments that mimic physical processes are reliable representations of real-world conditions but are difficult to calibrate without independent data.
- Independent model output will be utilized to calibrate process-based P-loss risk assessment tools.



Thank you!

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