

WQIag

A Tool of Multiple Applications

By

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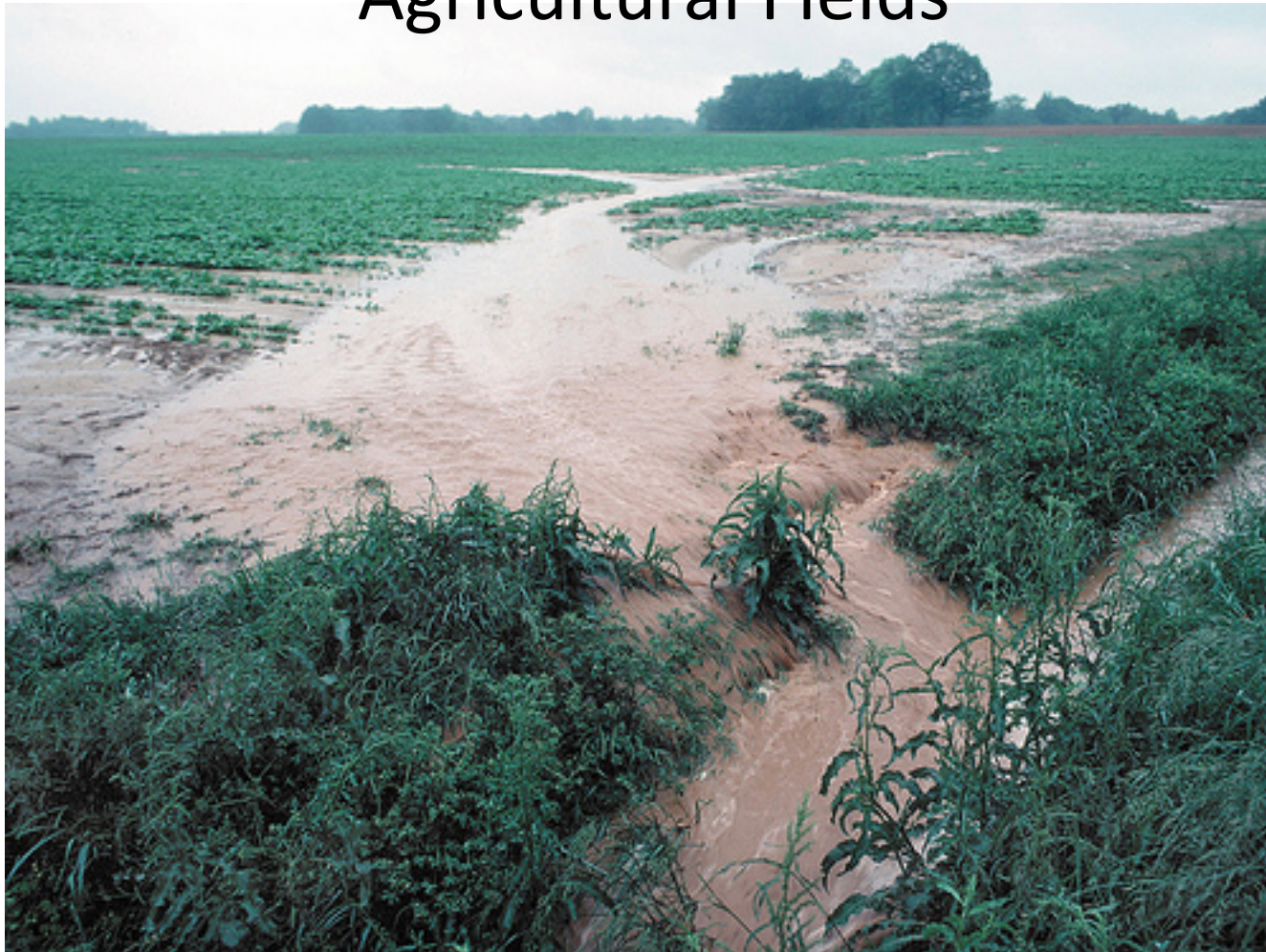
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Runoff – A Common Phenomenon from Agricultural Fields



Outline

Definition of an “Index” & its Common Usages
Water Quality & Water Quality Indices (WQIs)
Agricultural Runoff Water Quality Index(WQI_{ag})

Historical Background

Components

Description & Procedure

Applications and Usages

NRCS

Others (MNDA, WRCAC, Field Stewards, USDOE, etc.)

Concluding Remarks and Future Plans

Defining an “Index”

- A statistical **measure of change** in an economy or a securities market. Each index has its own calculation methodology and is usually expressed in terms of a change from a base value. Thus, the **percentage change is more important than the actual numeric value.**

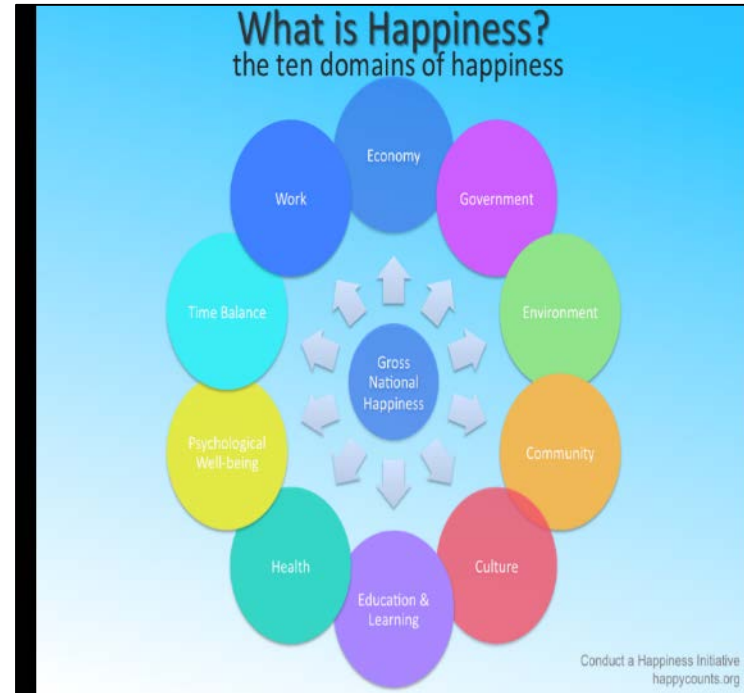
<http://www.investopedia.com/terms/i/index.asp>

- something that directs attention to some fact, condition, etc.; a guiding principle.

<http://dictionary.reference.com/browse/index>

Common Indices

- Dow Jones Industrial Average
- Consumer Price Index
- Soil Health Index
- Watershed Health Index
- Happiness Index
- Farm Irrigation Rating Index
- Many More



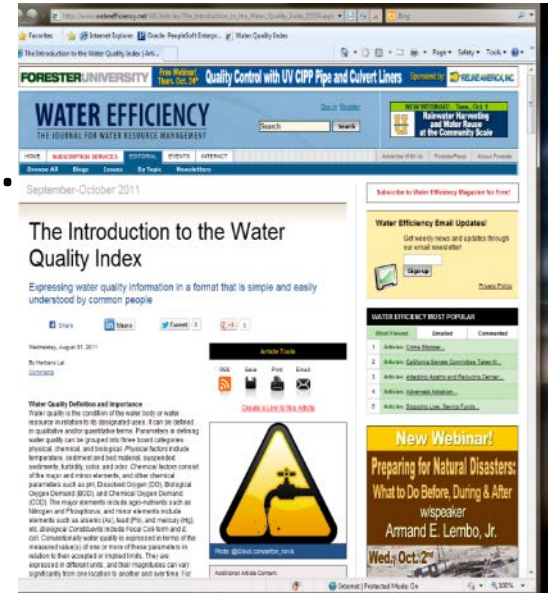
Water Quality (WQ)

- Includes multiple parameters such as DO, pH, Turbidity, BOD, COD, Ecoli, Temp, Nutrients (N & P), and many more
- WQ Parameters expressed in different units (ppm, number, etc.) and measured in different ranges
- Hard to understand and follow by non-professionals

Need for simple tools for expressing WQ

Water Quality Index (WQI)

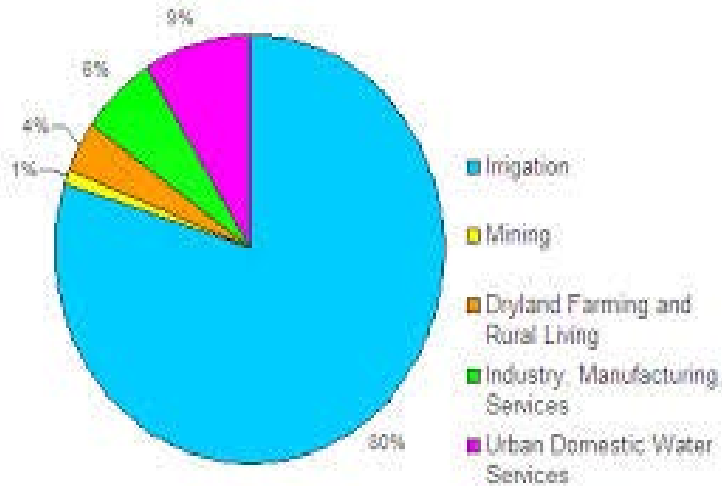
- Combines monitored values of multiple factors such as DO, pH, BOD, COD, Ecoli, Temp, Nutrients (N & P), etc. into a single **dimensionless number** normalized by subjective rating curves
- Primarily used for evaluating the quality of water in rivers, streams and lakes, etc.
- Multiple models ([Review Paper](#))
- No Index for Agricultural Runoff Water



Water in Agriculture & Why WQIag?

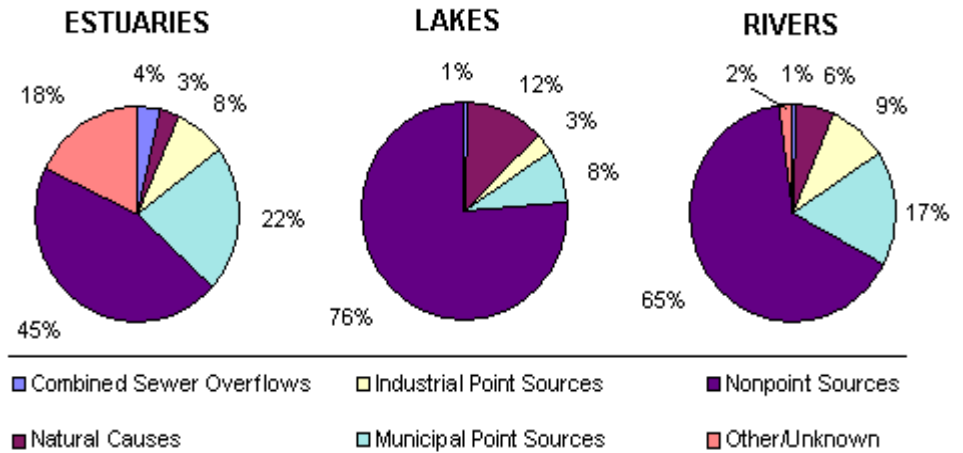
Agriculture

Graph 1: Water use by sector in South Australia



Agriculture Uses Major Portion of Freshwater

RELATIVE IMPACT OF NONPOINT SOURCE POLLUTION PROBLEMS IN IMPAIRED WATERS

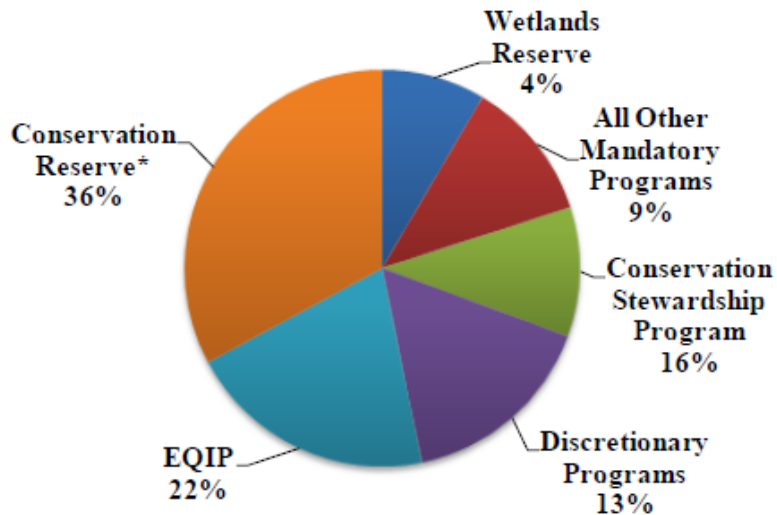


Agriculture is a Major Source of Freshwater Pollution

Need for Evaluation Tools for Conservation Programs

2014 Conservation Budget

Total = \$6.2 Billion



*The Conservation Reserve Program is administered by the Farm Service Agency

- USDA/NRCS spends big moneys on conservation programs for improving water quality from agricultural and forested area
- NRCS always looking for tools for evaluating the effectiveness of its conservation programs

Options for Evaluation Tools for Conservation Programs

Available Tools

- Planning and Assessment Tool (e.g. CPPE)
- Modeling (CEAP, RUSLE2, etc.)
- Edge of Field (EoF) Monitoring

Tools Either too Generic or too Expensive

Need for tools that use site-specific information and multiple factors with least cost

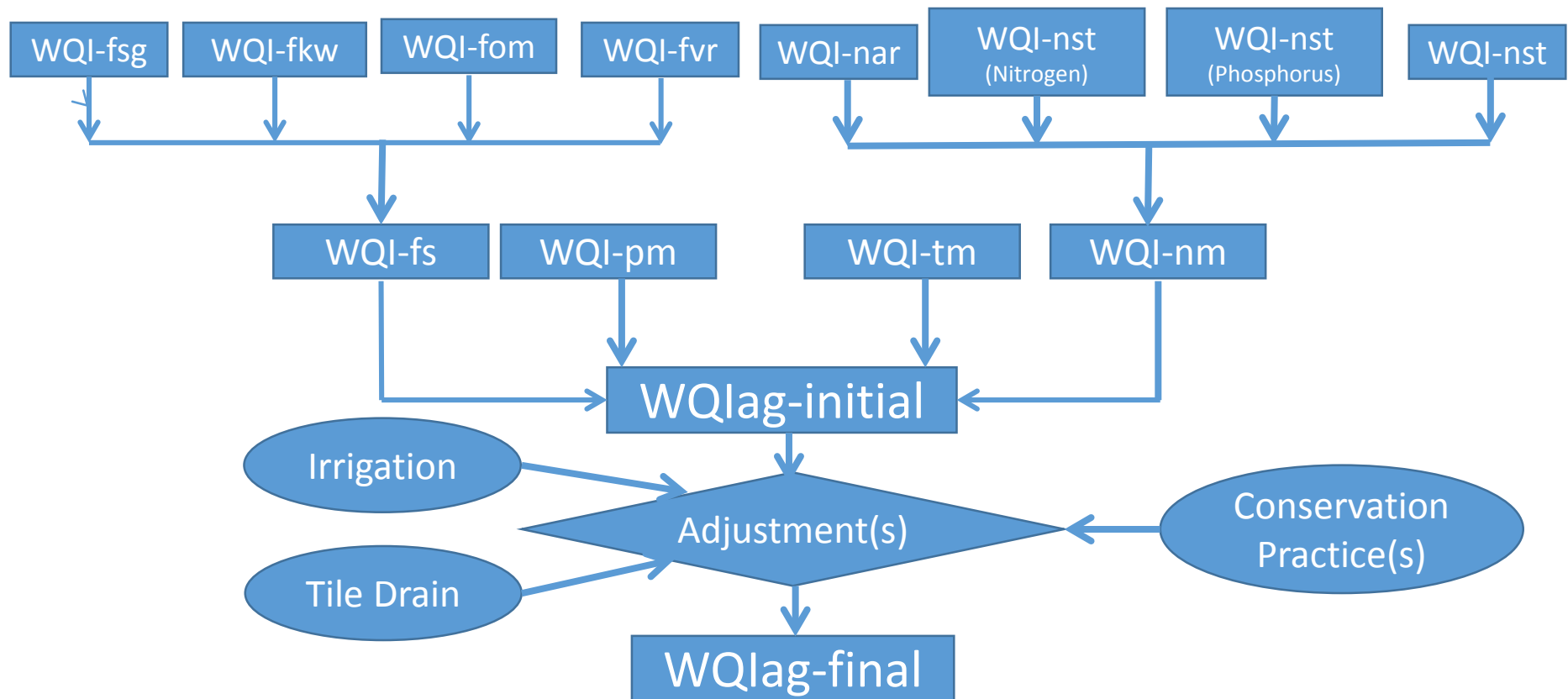
WQIag

- A tool for ranking runoff water from agricultural fields (1 to 10): 10 being the best
- Simple and easy to use web-based system
- Uses multiple field characteristics and management factors
- Weighting for different factors for local preferences
- Site-specific weather data with the possibility of customization

Components

- Field physical /sensitivity factors
- Nutrient management
- Tillage management
- Pest management
- Irrigation / Tile Drain management
- Conservation practices

WQlag Structure



Water Quality Index for Agricultural Runoff (WQIag)

WQIag: Water Quality Index for Runoff Water From Agricultural Fields | Articles | Water Effici... Windows Internet Explorer

http://forester.uade.edu.com/WE/Articles/WQIag_Water_Quality_Index_for_Runoff_Water_From_Ag_13046.aspx

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November-December 2012

WQIAG: Water Quality Index for Runoff Water From Agricultural Fields

Monday, October 22, 2012

By Harbans Lal and Shaun McKinney

Introduction
The water quality index (WQI) is a simple, convenient way to express quality of water in easy-to-understand value. Miller (1986) describes it as a dimensionless number that combines multiple water quality factors into a single number by normalizing values using subjective rating curves. Traditionally, it has been used for evaluating the quality of water for water resources such as rivers, streams and lakes, etc. Factors included in a WQI vary depending upon the designated water uses of the waterbody and local preferences. Some of the factors include dissolved oxygen (DO), pH, biological oxygen demand (BOD), chemical oxygen demand (COD), total coliform bacteria, temperature, nutrients (nitrogen and phosphorus), etc. These parameters are measured in different ranges and expressed in different units. The WQI takes the complex scientific information of these variables and synthesizes them into a single number. Several

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Paul Crabtree, P.E., CNU-A

Additional Article Content
• WQIAG: Water Quality Index for Runoff Water From Agricultural Fields

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http://199.156.165.100/WQIag/

Water Quality Index

USDA United States Department of Agriculture
Natural Resources Conservation Service

Water Quality Index WQIag

About Help Contact Us

Runoff Water Quality Index Version: 1.0.5 Date: 7/05/2012

Site Information * Required

* State: Arizona * County: Greenlee HUC:

* Field #: 2 * Field name: Northside Field * Acres: 100

* Project date: 7/17/2012 * Description: Test Field

FACTORS	DESCRIPTION	WQI RANKING FACTOR	WEIGHTING	WEIGHT
Field Physical Sensitivity Factors				
Slope (%)	Get Slope Interaction (2% to 5%)			
HS group	(B - moderately low runoff potential)	8.00	0.25	2.00
K-factor	(0.21 - 0.32 moderate erodibility)	8.00	0.25	2.00
OM content	2-4%	6.00	0.25	1.50
Rainfall/Veg	Get Rain / Vegetation Interaction	6.00	0.25	1.50
			0.25	1.75
Nutrient Management Factors				
Application rate	LGU recommendations	5.00	0.25	1.25
N-source and timing	Synthetic fertilizer, single, slow release	10.00	0.25	2.50
P-source and timing	Synthetic fertilizer, pre-growing season	2.00	0.25	0.50
Soil condition / application	Dry/well drained, N fertilizer, broadcasted	6.00	0.25	1.50
			0.25	1.44
Tillage Management Factors				
Description / STIR	No Till or STIR Value < 30	10.00	1.00	10.00
			0.25	2.50
Pest Management Factors				
Description	Follow IPM - Suppress using Chemicals and Mitigation	7.00	1.00	7.00
			0.25	1.75
Irrigation Management				
Description	No irrigation (0%)			
Runoff Water Quality Index (WQIag)				7.44
Conservation Practices				

WQlag Applications & Usages

WQ Index: Application in Missouri NRCS Field Offices

Steven G. Hefner, Missouri NRCS Water Quality Specialist

Scott McClure, NRCS District Conservationist

Mark Starnes, NRCS Resource Conservationist (retired)

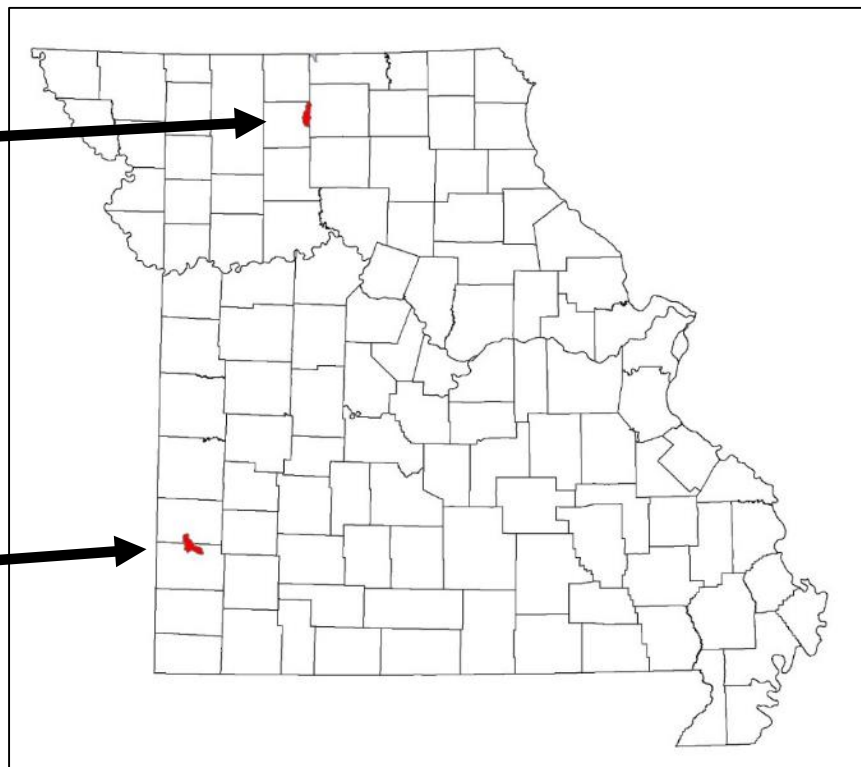
Two 12-digit Pilot Watersheds in Missouri

Lower Little Medicine Creek

- Glacial Till with thin cover of loess
- Grand River Basin feeds the Missouri River
- Cropland on 5-10% slopes
- Non-Irrigated

Opossum Creek – North Fork Spring River

- Transition between Ozarks and Osage Plains
- Spring River Basin drains to KS and OK
- Cropland simulations on 2-5% slopes
- Non-Irrigated



Approach

- Fields simulated in 2013 before EQIP conservation contract activity
- Fields simulated in 2016 following EQIP conservation implementation
- Lower Little Medicine Creek – 51 fields simulated
 - terraces, ugos, critical area planting, wascobs
- Opossum Creek – North Fork Spring River – 22 fields simulated
 - Cover Crops, Interseeding Legumes, Critical Area Planting, Grass Waterways

Initial Perceptions of WQ Index

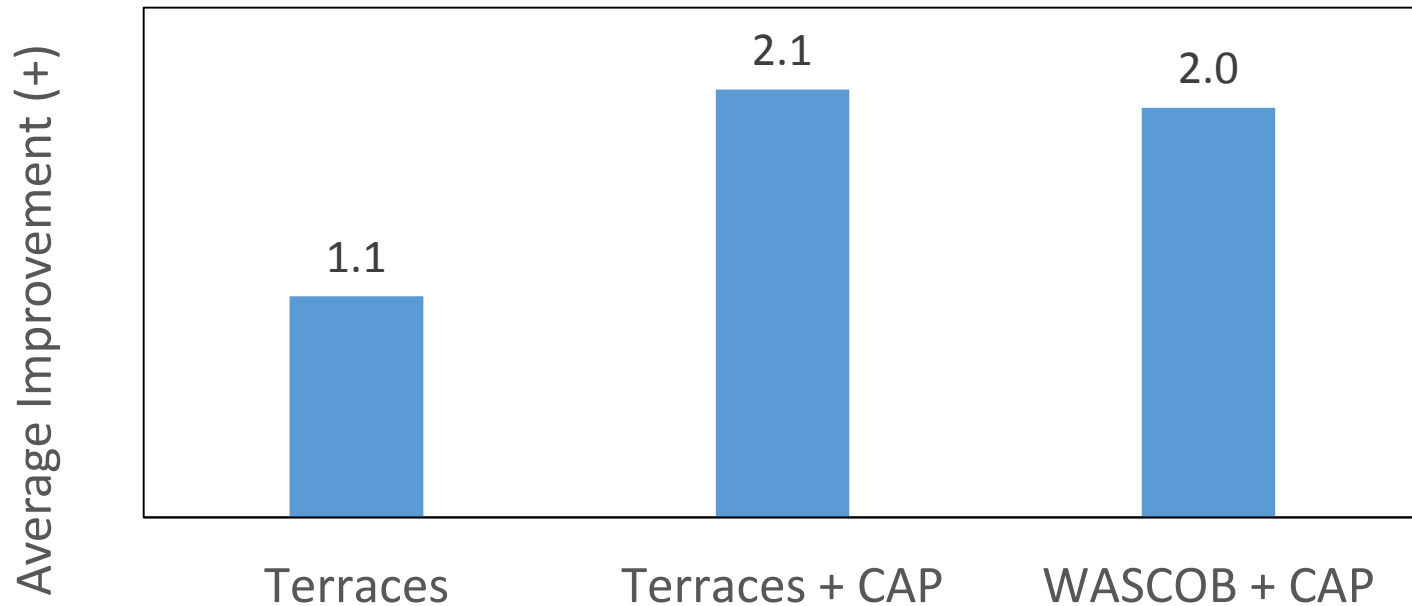
Pros

- Several considerations included in the index
- Often, most information exist in USDA case file (e.g. RUSLE, Nutrient and Pest Management Plans)
- Straightforward approach allows simulations in efficient manner

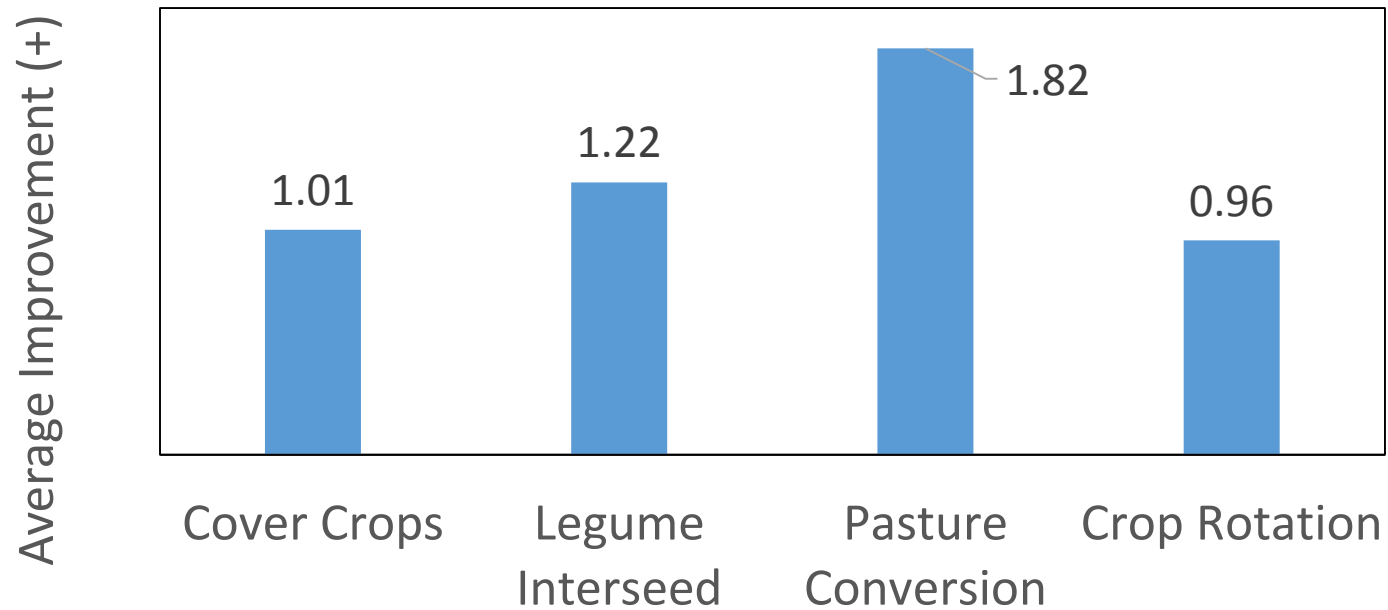
Cons

- Need to conduct two reports to compare pre and post activities
- Need to expanded practice list to show progress

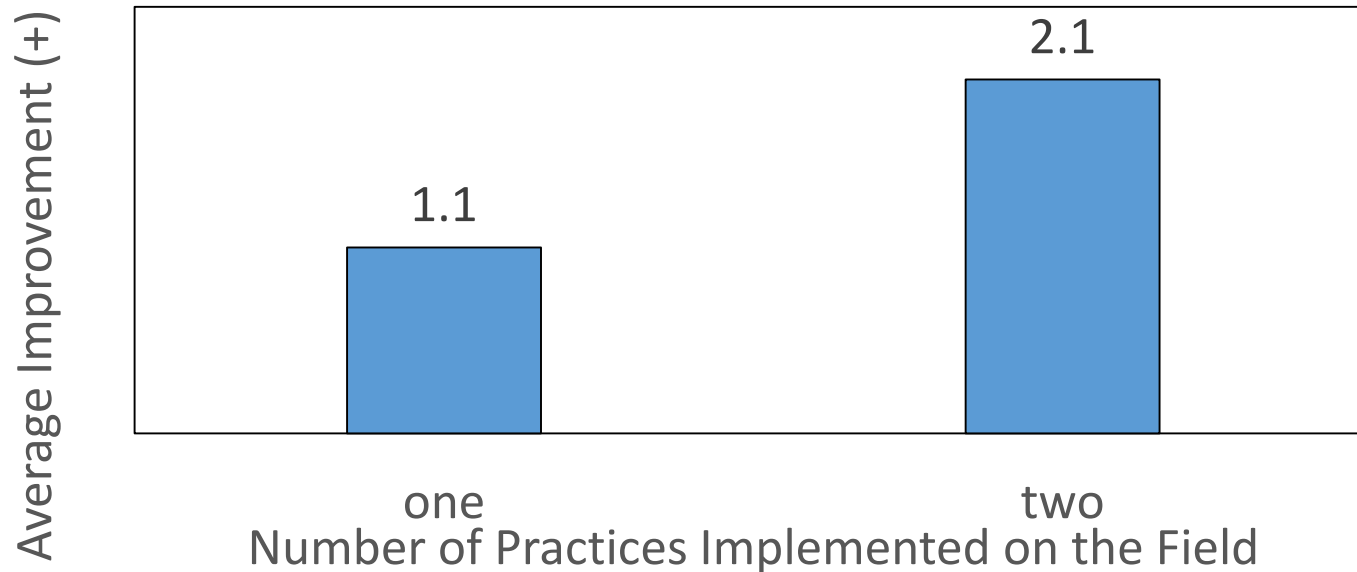
Water Quality Index Improvement from Type of Practice(s) in Little Medicine Creek Watershed, Grundy Co, MO 2013-2016



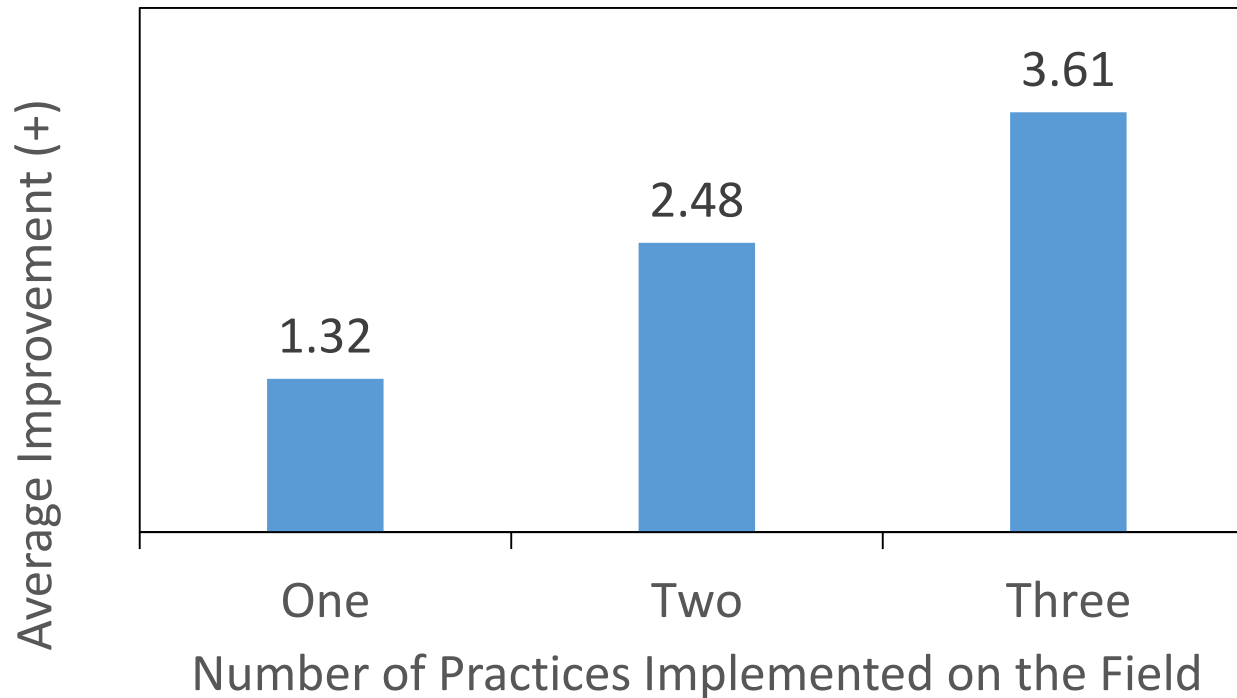
WQ Index Improvement from Type of Practice in Opossum Creek Watershed, Jasper Co, MO 2013-2016



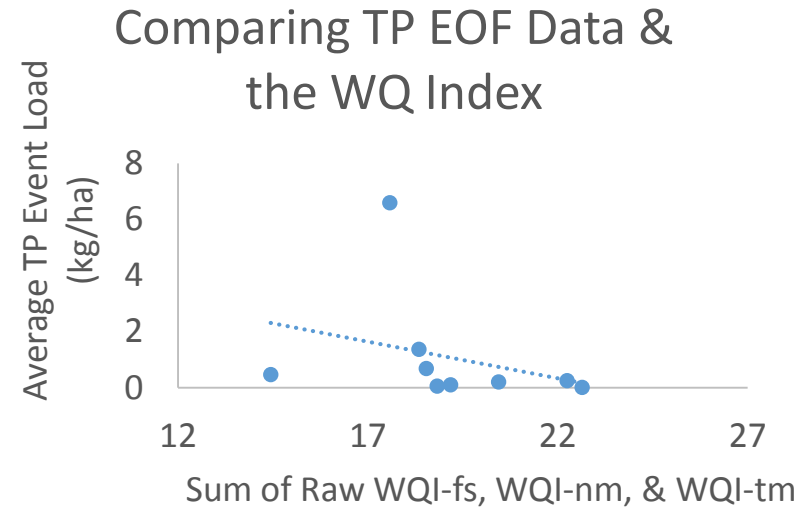
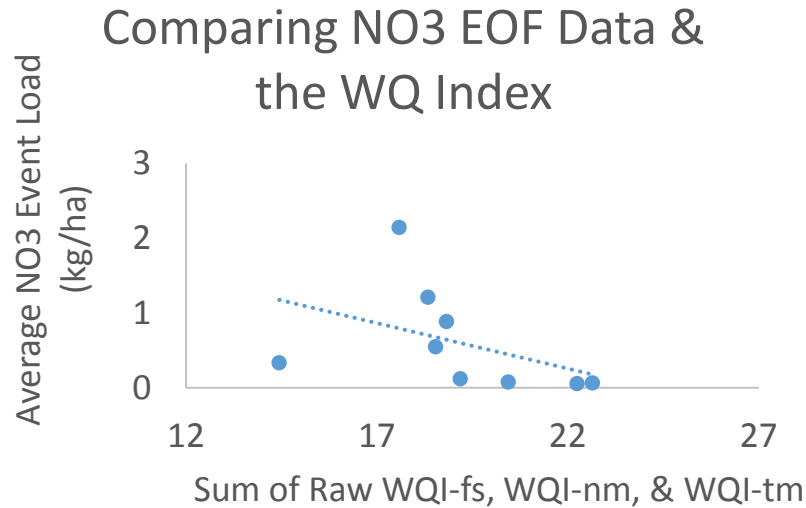
WQ Index from Number of Practices Implemented on the Field Lower Little Medicine Creek, Grundy Co, MO 2013-2016.



WQ Index Improvement from Conservation Practices in Opossum Creek Watershed, Jasper Co, MO 2013-2016



Comparing WQ Index to Missouri EOF Data Sites in Northern Missouri, 2011-2015



WQlag Applications by James Klang

Environmental Market Applications and Flexible Water Quality Regulation

Today's Presentation

- Background & Reasons to Consider Using WQIag
- Three projects that illustrate appropriate use
 1. Minnesota Agricultural Water Quality Certification Program (MAWQCP); Minnesota Department of Agriculture
 2. Field Stewards; a corporate supply chain sustainability program
 3. Proposed compliance metric for the Conditional Waiver for Waste Discharge Requirements for Agricultural Operations in the San Jacinto River Watershed; Western Riverside County Agriculture Coalition
- Summary of WQIag performance to date
- Next steps

[Note: Any opinions, findings, conclusions, or recommendations expressed in this presentation are those of the author and do not necessarily reflect the views and outcomes of the authorized agencies being advised.]

Background & Reasons You Should Consider Using WQIag

WQIag is a metric; an index approach that is easy to use

- Not intended to quantify loading

What WQIag can do:

- Identify an operation's features that have the potential to impact water quality ("Risk Identification")
- Assists in identification of appropriate options to reduce potential risk ("Water Quality Risk Management")
- Educate producers and their service providers
- Provide rankings that respond in parallel to monitoring assessments and/or mechanistic model results

Minnesota Agricultural Water Quality Certification Program

Minnesota Department of Agriculture Contract:
Analysis of the Minnesota Agricultural Water Quality
Certification Analysis Tool

Minnesota Agricultural Water Quality Certification Program (MAWQCP) Background

- Initiated by a January 17, 2012 Memorandum of Understanding between Minnesota Governor Mark Dayton, U.S. Agriculture Secretary Tom Vilsack, and EPA Administrator Lisa Jackson
- Formalizing the state-federal partnership and commitment to develop and implement a regulatory certainty program
- Supporting programs legislation (MN Statute 17.9891) passed in 2013

Further details can be found online at:
<http://www.mda.state.mn.us/awqcp>



The MAWQCP program offers:

- **Regulatory Certainty:** certified producers are deemed to be in compliance with any new water quality rules or laws during the period of certification
- **Recognition:** certified producers may use their status to promote their business as protective of water quality
- **Priority for Technical Assistance:** producers seeking certification can obtain specially designated technical and financial assistance to implement practices that promote water quality
- Minnesota Department of Agriculture is the Delegated Program Administrator

MAWQCP Program Progress & WQlag

MAWQCP Managers are:

- Rolling out the regulatory certainty program in phases
- Using the WQlag tool to determine program compliance
- Using a WQlag ranking of 8.5 as the compliance threshold
- Emphasizing an adaptive management approach

Program progress:

- As of mid 2014 over 656 fields had been evaluated in the pilot phase
- MN Dept. of Ag funded a project team to perform a WQlag performance evaluation as part of their emphasis on adaptive management

MAWQCP WQIag Evaluation Team

Analysis of the Minnesota
Agricultural Water Quality
Certification Program
Assessment Tool



KIESER & ASSOCIATES
ENVIRONMENTAL SCIENCE & ENGINEERING

SENISE

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Stearns County
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Waite Park, MN 56387

Prime:

Stearns County Soil and Water
Conservation District, MN



Subcontractors:

Sense AI **SENISE**

Minneapolis, MN

Kieser & Associates, LLC

Kalamazoo, MI

Final Report:

Analysis of the Minnesota
Agricultural Water Quality
Certification Analysis Tool

MAWQCP WQlag Evaluation Approach

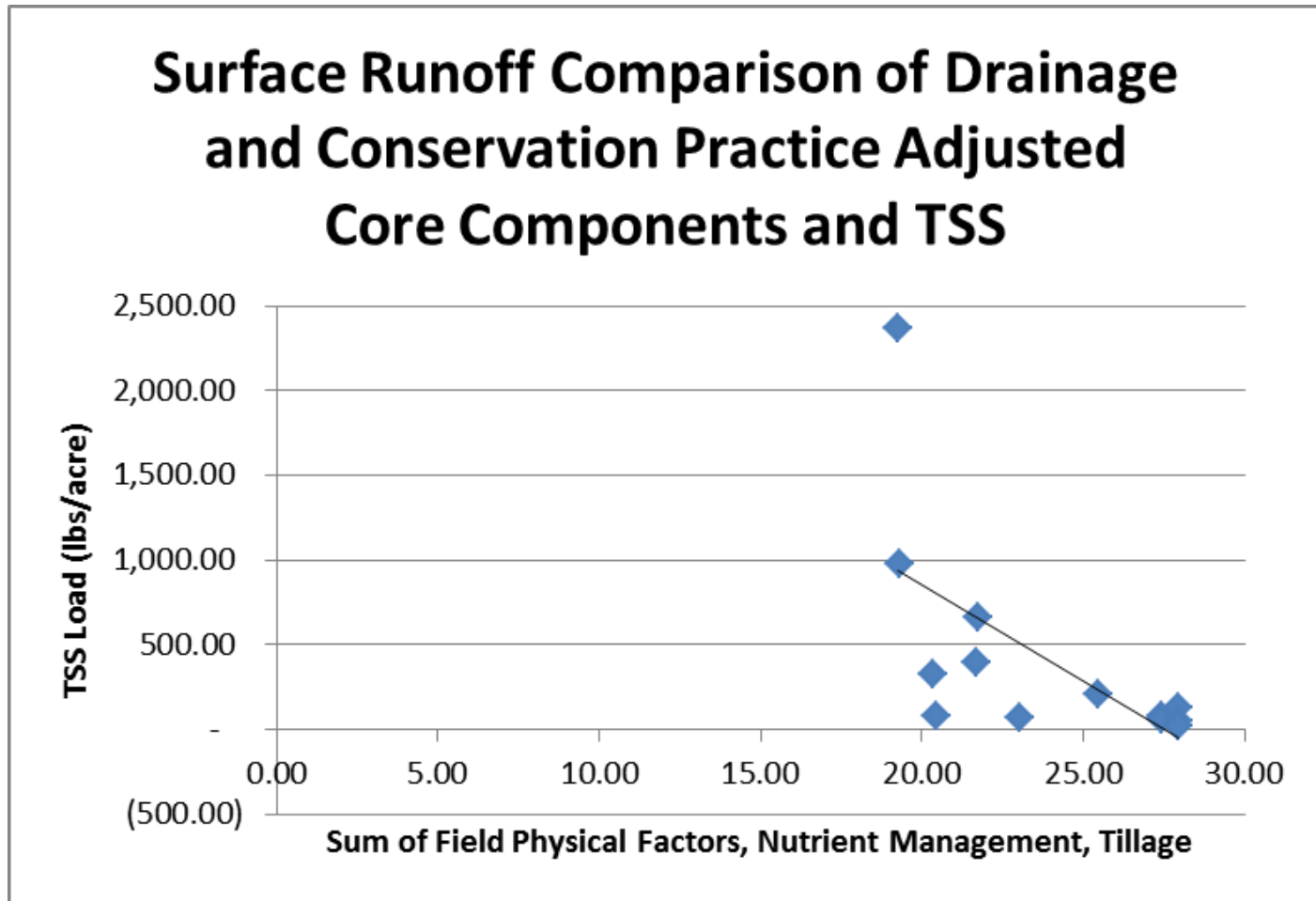
Literature review: evaluating if the list of parameters used, their ranking values, and the WQlag weighting and scoring was appropriately informed by the latest in water quality science

Local sensitivity analysis: informing interested parties regarding the influence of each parameter on interim and final ranking

Farm-field view analysis: identifying which parameters are most influential on the current list of scores, the range of scored values and how much improvement to final scores can be achieved by each parameter

Comparison of edge-of-field monitoring with WQlag scoring: utilizing the Minnesota Discovery Farms network of monitoring stations.

Regression Relationship: WQIag vs TSS Monitoring Data



MAWQCP WQIag Evaluation Summary: Personal Findings

WQIag is:

- A valuable assessment tool for identifying potential water quality risks
- A method to explore producers' options to better benefit water quality; facilitates prioritized technical assistance
- An even balance between transparency and producer confidentiality
- Moderately easy to operate
- Focused on what the farmer can control, while factoring in field conditions
- Very adaptable

Field Stewards

An Emerging Corporate Supply Chain
Sustainability Program

Field Stewards: A Corporate Supply Chain Sustainability Program

Program Development Team & Funding:

- Conservation Marketplace Midwest
- Environmental Initiative
- GNP Company
- Stearns County SWCD
- Kieser & Associates, LLC
- Minnesota Department of Agriculture
- USDA NRCS Conservation Innovation Grant
- McKnight Foundation



Why corporate environmental responsibility programs?

- Growing percent of customers desire product transparency regarding product production impacts
- Consumers' increased understanding of raw materials in the supply chain and their possible impacts
- Corporate response:
 - Growing corporate interest in environmental responsibility
 - A growing number of companies adding programs that address supply chain impacts

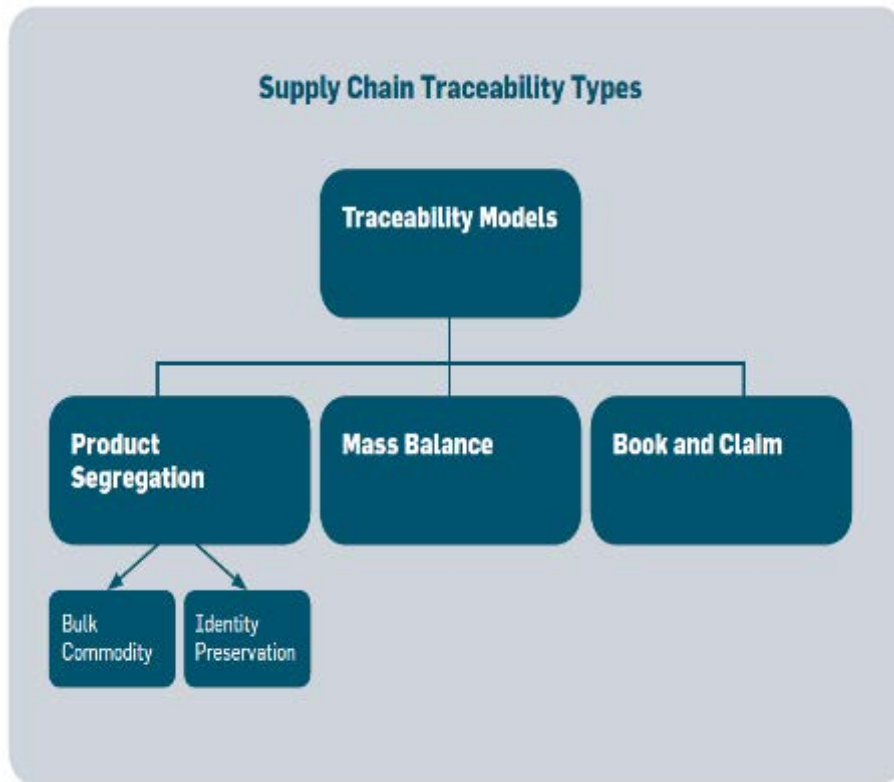


Corporate Environmental Responsibility Programs can...

- Be a continuous improvement process by:
 - Setting a baseline
 - Measuring improvement over time
 - Acknowledge suppliers who are improving according to a evaluation metric
- Be a threshold based approach by:
 - Selecting a compliance value for the evaluation metric that achieves the environmental objective
 - Acknowledging suppliers that meet or exceed the goal



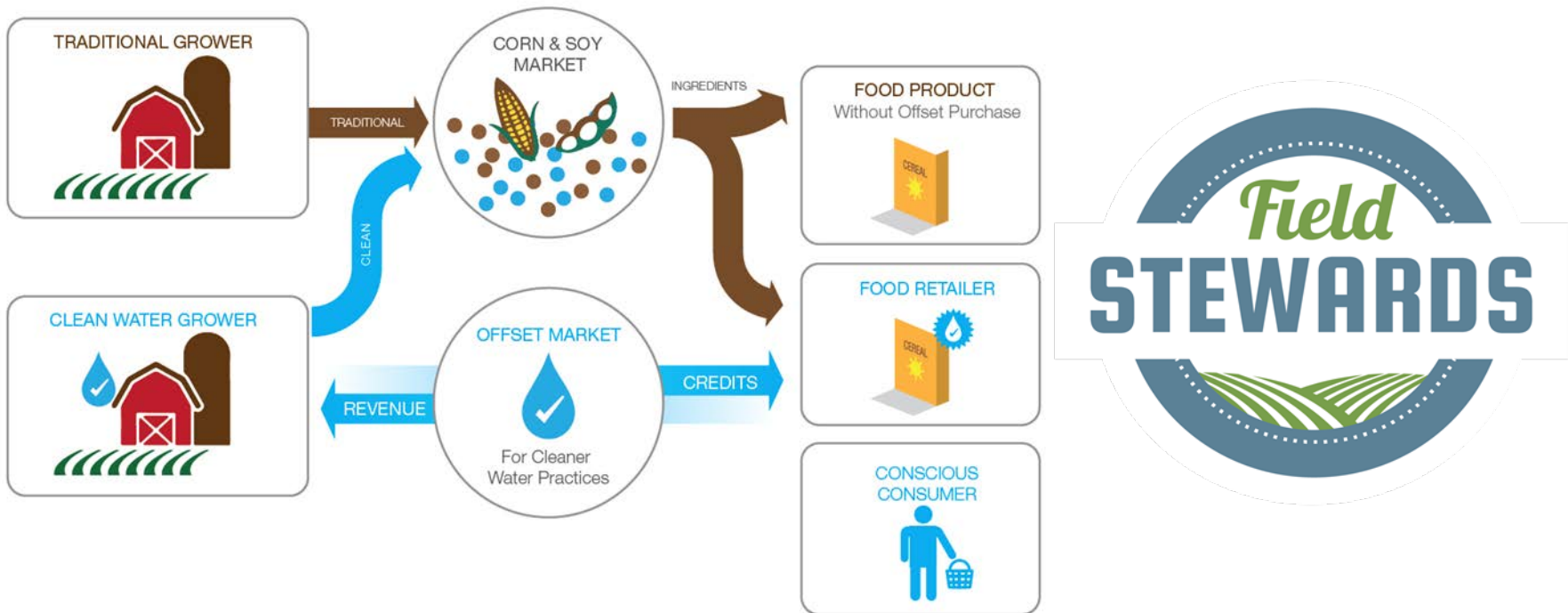
Environmental Responsibility Program Types



A Guide to Traceability: A Practical Approach to Advance Sustainability in Global Supply Chains

United Nations Global Compact

The Field Stewards Team Selected the Book and Claim Approach



Field Stewards WQIag Evaluation Summary: Personal Findings

- A valuable assessment tool for identifying potential water quality risks
- An even balance between transparency and producer confidentiality
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Proposed Compliance Metric for the Waste Discharge Requirements in San Jacinto

**Western Riverside County Agriculture Coalition
NRCS Conservation Innovation Grant
Nonpoint to Nonpoint Source Trading**

Project Team and Purpose

- Western Riverside County Agriculture Coalition (WRCAC); Pat Boldt Executive Director
 - Tetra Tech, Inc.; Jennifer Ferrando, Senior Environmental Scientist & Kellie Dubay, Environmental Scientist
 - Kieser & Associates, LLC; James Klang, Senior Project Engineer
- NRCS CIG grant objective: develop and test a Water Quality Trading program for agricultural dischargers and permitted stormwater entities
- Compliance drivers:
 - A total phosphorus and total nitrogen Total Maximum Daily Load (TMDL) study in the San Jacinto River Watershed
 - Pending state agricultural discharger waste discharge requirements

Water Quality Trading Background

- Water Quality Trading (WQT) is a flexible compliance option for regulated dischargers
- WQT is voluntary option for both the generator and buyer of the traded credits
- Credit units are based on the mass of pollutant discharged or reduced in a given time period (e.g., pounds of TP/year)
- Credits must be:
 - Real, providing further reduction
 - Accountable, trackable and enforceable
 - Equivalent, able to provide an equal reduction offset

WQlag and Water Quality Trading

The credit unit and definition must provide equal environmental protection to what is expected of the discharger buying the offset (Real, Accountable, Equivalent)

- WQlag does not calculate mass, therefore does not define a credit
- Credits must be based on further reductions to what is required of the credit generator (creating a need to determine the Ag producer's baseline)

There is a pending Conditional Waiver for Agricultural Dischargers (CWAD)

- Currently there is not a compliance metric in the CWAD
- The WRCAC CIG team proposes WQlag as the compliance metric

WQIag as a Compliance Metric

The Santa Ana Regional Water Quality Control Board is considering WRCAC's proposal of using the WQIag tool as a compliance metric.

- The tool is recognized as a valuable metric to identify risk
- The tool focuses on Ag operator choices, while factoring in field physical and vegetative attributes
 - Separates legacy loading from current loading impacts
 - Correlating choices with expected loading potential
- The tool can be calibrated to a regional setting
- The tool is very adaptable; able to be adjusted over time as better science emerges

WRCAC's Vision

- Agricultural dischargers under the CWAD need:
 - A compliance metric to forecast the level of effort needed to achieve compliance (Predictability)
 - A moderately easy to use assessment process
- WQIag as a compliance metric option, could facilitate a bubble compliance approach:
 - Ag producers in the same boundary conditions (“bubble”) calculate an acre average score
 - If the “bubble” group’s average is in compliance the whole group is in compliance
 - If the group average is not in compliance, only those fields out of compliance must change

Next Steps in San Jacinto

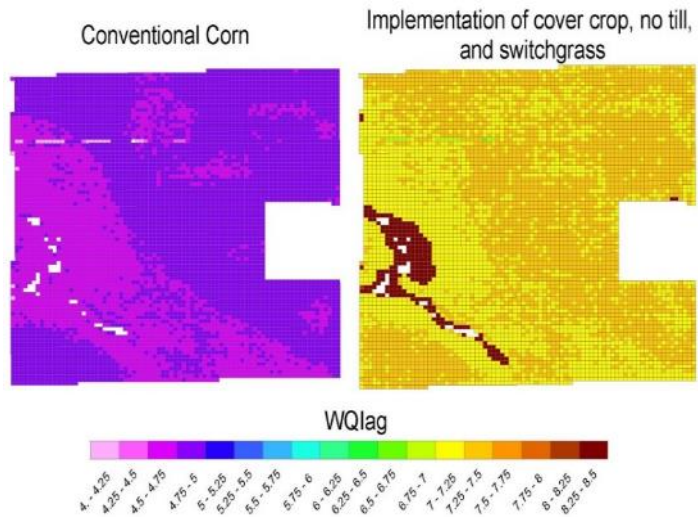
- WRCAC is funding a modeling effort using Hydrus to simulate contaminate runoff to surface waters
- WRCAC has contracted with:
 - Dr. Scott Bradford, USDA ARS
 - Dr. Jiri Simunek, University of California, Riverside
 - PhD student Jing Liang, University of California, Riverside
- A calibrated Hydrus setup exists for the regional setting
- The modeling team will provide hundreds of scenario runs for the purpose of calibrating WQlag ranking values and weighting factors
- The Santa Ana Regional Water Quality Control Board is part of the analysis team comparing WQlag performance against the mechanistic model projections

WQIag Applications by Harbans Lal

WQIag Applications & Usage

(US Dept. of Energy)

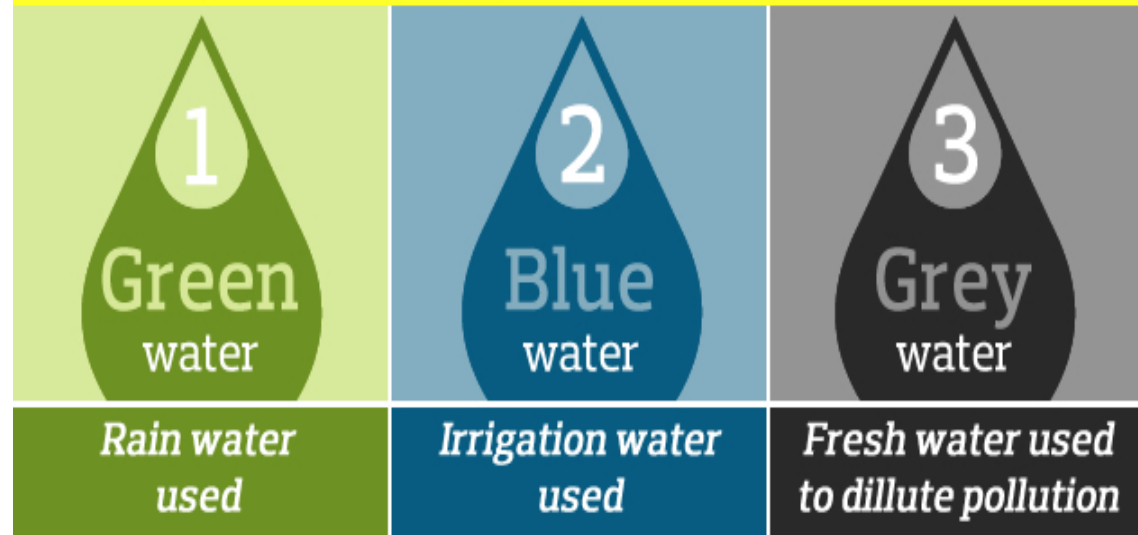
Spatial & Landscape Analysis



Idaho National Lab, Idaho (www.inl.gov)

Estimating Grey Water for Water Footprint

What makes up your water footprint?



Argonne National Lab, Chicago (<http://www.anl.gov/>)

WQIag Applications & Uses

NRCS-National Water Quality Initiative

State	WQI ag	WQIag with Conservation	WQIag Trend
Colorado	6.25	8.85	+2.6
Hawaii	5.08		
Idaho	3.43		
Indiana	5.92		
Minnesota	7.1	8.19	+1.09
Oklahoma	5.26	6.88	+1.62

Integrated into "FieldPrint" Calculator of Field2Market



Many More Applications

www.fieldtomarket.org

www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/eqip/?cid=stelprdb1047761



...Rainwater harvesting...

To be innovative in solving water problems

