Consideration of a Nitrate Hazard Index (NHI) for Reporting and Tracking

August 28, 2013

Presentation to the CDFA Nitrogen Task Force

Joel Kimmelshue, PhD

LAND IQ
Structure

• Nitrate Hazard Index Approach
• Past Research
• Independent Analysis
• Main Influencing Factors
  – Soil Type
  – Crop Type
  – Irrigation Method
• Conclusions
Accepted Nitrogen Impact Assessment

• Nitrate Hazard Index Approach
  – Published by the Southwestern States and Pacific Islands Regional Water Quality Program and the University of California Center for Water Resources (Universities of Arizona, California, Nevada, etc.)
  – National Academy of Sciences Water Science & Technology Board – Chose Hazard Index as preferred method
  – Includes decades of research/approaches (since the 1970s)
  – “It is consistent with the recommendations of the nutrient Technical Advisory Committee (TAC) appointed by the CA State Water Resources Control Board.”
Nitrate Leaching is Crop & Soil Specific

• “Not all agricultural activities have the same potential to contribute to N pollution” (Hermanson, 2000).
  – Supported by a multitude of studies all across California, US and world:
  – Amount of N accumulated by a crop depends on:
    • Amount of N supplied by fertilizer and soil reserves
    • Genetic potential of crop to take up N
    • Growth and yield potential of crop
    • Environmental variables
    • Ability to retain N in rooting zone (impacted by: soil type, crop type, irrigation method)
Mapping the Risk of Nitrate Leaching from Irrigated Fields by Use of a Nitrate Hazard Index: Case Study in the San Joaquin Valley of California

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Introduction

Nitrogen-enriched runoff to surface water and groundwater can be a source of nitrogen (N) pollution in coastal waters. It can be controlled by reducing nitrogen input and using practices that allow the N to be returned to the soil, such as crop rotations, cover crops, and conservation tillage. A variety of methods have been developed to evaluate the risk of nitrate leaching from irrigated fields. Among these methods, the Nitrate Hazard Index (NHI) was developed to estimate the risk of nitrate leaching from a specific field, taking into account the amount and distribution of irrigation water and the soil properties that influence nitrate leaching.

Methods

- Crop selection
- Irrigation map
- Soil map
- Temperature and precipitation data

Results and Discussion

- One of the most important factors contributing to the risk of nitrate leaching is the amount and distribution of irrigation water. The NHI is a useful tool for predicting the risk of nitrate leaching, and it can be used to identify areas where additional management practices are needed to reduce the risk of nitrate leaching.

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References


Southern San Joaquin Valley Nitrate Hazard Index Approach

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Soil, Crop and Irrigation Methods approach used to create relative Hazard Index

Spatial Data Sources: DWR Crop Mapping - (Fresno Co., 2000; Tulare, 1999; Kings 2003; Kern 2006)

Southern San Joaquin Valley Nitrate Hazard Index Conclusions - Pettygrove, et al, 2012

– 33% of basin has a significant N leaching potential
– That 33% is driven by gravity/surface irrigation practices on various crops and well-drained soils
– Conversion to drip/micro systems would result in a low leaching potential (Nitrate Hazard Index) for certain crops

Significant conversion to these systems has occurred since the DWR 1999-2006 base layers (crop type and irrigation methods) were used.

– Following conversion, a large area remaining at risk is silage corn and other forages, receiving dairy manure applications via furrow or border-check methods.
Independent Analysis

• Focuses on Kern Sub Basin area only
• Uses Kern Sub Basin specific information
  – recent (2011) Kern County crop coverage
  – local climatic conditions
  – local irrigation methods
  – local agronomic knowledge specific to the Kern Sub Basin obtained from Blake Sanden and others
• Performed analysis for representative scenarios in the Kern Sub Basin area
• Our analysis aligns well in approach and enhances conclusions of Pettygrove, et al. 2012 and other researchers
2012 NKWSD Nitrate Hazard Index

NHI

1 - 5
6 - 10
11 - 15
16 - 20
20 - 25
Nitrate Hazard Index
Conclusions/Benefits

• Simple – Does not require numerical data, but can use it if available
• Flexible – Can be used on as large or small scale as desired, or in combination with other assessment methods
• Additional – More parameters (e.g. N applied, effective precipitation, depth to groundwater, applied water, etc.) can be included and weighted to better represent the areas being classified
• Valid – Developed by multidisciplinary group of experts and validated with Central Valley groundwater data
• Temporal – Can show change over time (year to year or growing season to growing season)
• Coverage – Can cover large areas of land with a single spatial resource
• Granular – Field by field, therefore can “roll-up” (or not) for reporting
• Strategic Monitoring – Results in strategic and justified locations for monitoring – thus saving costs and human resources