



NITROGEN MANAGEMENT PLAN SUMMARY REPORT
GROWER FEEDBACK REPORTS:
MAKING SENSE OF THE NUMBERS

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Presented to:
Dixon-Solano Subwatershed
Sacramento Valley Water Quality Coalition

Stephanie Tillman, MS, CPSS, CPAg, CCA
Cody Fink, MS, CPSS, CCA



PRESENTATION OUTLINE

1. Introduction to Land IQ and our technical disciplines
2. Review of terminology used in the Nitrogen Management Plan (NMP) Summary Report
3. Background/science of information used in N ratios
4. How we analyzed the NMP information from growers
5. What the analysis told us
6. What the results mean to you



LAND IQ TECHNICAL DISCIPLINES

- **Agricultural Scientists**
 - Soil Scientists
 - Crop Production Scientists
 - Ag Water Quality/Quantity Experts
 - Salinity & Nutrient Management
 - Ag Reuse Systems
 - Regulatory Support
- **Remote Sensing and GIS Technologists**
 - Evaluation of large landscapes
 - Focus primarily on irrigated production agriculture
 - Estimation of consumptive use and crop identification



TERMINOLOGY REVIEW

- N efficiency: several terms and meanings
- N removed (R): N removed from the field by harvesting the crop
- Applied nitrogen (A): N applied through fertilizer and/or irrigation water
- A/Y: Applied N (A) divided by yield (Y)
- A/R: Applied N (A) divided by nitrogen removed (R)
- N Removed Index: factor to convert Y to R



N REMOVED INDEX

- USDA NRCS Crop Nutrient Tool
 - Accurate for Midwest crops
 - Likely not representative of California conditions or specialty crops
- CDFA
 - Ongoing compilation of scientific literature on N removed by unit of yield in various crops
 - Requires interpretation
 - Incomplete
 - So many crops in California....
 - Low research priority until recently



TECHNICAL ADVISORY WORK GROUP (TAWG)

1. Develop Y-to-R conversions for crops in the CDFA database.
2. Identify crops *not included* in the CDFA database that are grown on a majority of Central Valley acreage.
 - Crops that occupy the first 95%, and then 99% of the acreage in the Central Valley (exclusive of rice and non-alfalfa hay and silage).
3. Develop Y-to-R conversions for these additional crops.
4. Assess the quality of data AND describe additional work that would be needed to develop usable Y-to-R conversions for crops included in (1) and (2), above.



TAWG – GEISSELER 2016 (GEISSELER REPORT)

- For each commodity
 - Calculated the weighted mean N concentration in harvested yield
 - Reported statistics that tell us something about how conclusive the data is
 - Coefficient of variation (CV) – a measure of relative variability (takes into account how many results there are)
 - Range of the results – difference between largest and smallest values



TAWG – GEISSELER 2016 (GEISSELER REPORT)

- Includes assessment of the relevance of the available data
 - Number of observations
 - Variability
 - Geographic origin
- The amount of data available from California varies considerably among crops.
 - Extensive datasets for some crops but not for others.
 - For many crops, the dataset should be supplemented with additional samples from Central Valley fields



TAWG – GEISSELER 2016 (GEISSELER REPORT)

- Example #1

Crop	N in harvested plant parts	Number of observations		CV(%) (Variability)	Range
		California	Total		
Alfalfa - hay	62.3 lbs N/ton at 12% moisture	49	49	12.5	49.3-82.5

- *While the range is relatively large, with the highest N concentration measured being almost twice as high as the lowest value, the variability is intermediate with a CV of 12.5% of the mean.*
- *In general, alfalfa grown in the Central Valley tends to have a higher N content than alfalfa grown under cooler conditions, such as in the Intermountain area*
 - *To address this issue, the present dataset should be expanded with values from Central Valley fields.*



TAWG – GEISSELER 2016 (GEISSELER REPORT)

- Example #2

Crop	N in harvested plant parts	Number of observations		CV(%)	Range
		California	Total		
Corn - Grain	24.0 lbs N/ton @ 15.5% moisture	0	1775	20.8	6.0-53.6

- *For comparison, the NRCS Crop Nutrient Tool estimates the amount of N removed to be 27.8 lbs/ton.*
 - *No information from California, so not possible to determine how representative values are*
- *Dataset from all over the world*
 - *Corn grain N concentrations vary considerably*
 - *Half the values in their study were between 21.0 and 27.2 lbs N/ton*



N REMOVED INDEX FOR CALIFORNIA

- A number of factors can affect the N concentration in harvested plant parts.
 - For most crops included in this report, these factors seem to affect N concentrations in field crops, vegetables and tree crops equally:
 1. Year of harvest
 2. N availability
 3. Variety
 - Other factors
 - Fruit size
 - Dry matter content of the harvested plant part
 - Percent marketable yield
 - Growth stage when harvested may also be important for some crops



N REMOVED INDEX FOR CALIFORNIA

- Calculating the amount of N removed based on yield and average N concentration has some limitations unrelated to the quality of the data:
 1. The calculated value for N removed is only accurate on a multi-year basis
 2. For most crops where marketable yield is reported and cull or trash is removed in a processing facility, the calculated amount of N removed underestimates the actual amount, the difference being the N in cull or trash.
 3. For perennial crops, N accumulation in perennial tissue (e.g. trunk, roots, or branches) is not included in the value.



NITROGEN MANAGEMENT PLAN INFORMATION – HOW WE ANALYZED IT

- Data Required
 - APN
 - Crop
 - Total N applied (from all sources including irrigation water)
 - Yield (not reported by all subwatersheds)
 - A/Y (calculation performed by grower, checked by Land IQ)
 - Production Unit
- Dixon/Solano had 99% return rate
 - Overall Coalition return rate was 85%

NITROGEN MANAGEMENT PLAN INFORMATION – HOW WE ANALYZED IT

- Records Excluded if:
 - Data incomplete
 - Crop was exempt (rice, non-irrigated wheat, pasture with no N applied)
 - Non-bearing or no yield (A/Y and A/R can't be calculated)
 - Parcel located outside of an HVA
- Data reviewed for errors which commonly included:
 - APN in a different format (i.e. without leading zeros) compared to County database.
 - Amount of N fertilizer applied per acre was much higher than typical application values.
 - Production unit provided by volume instead of by weight (i.e. # of trees, cartons of oranges, etc.)
 - A/Y calculation error
 - Value should be less than 1 (except in young orchards or seed crops)
 - Production unit has to be converted to lbs

NITROGEN MANAGEMENT PLAN INFORMATION – HOW WE ANALYZED IT

- Statistical Analysis
 - Each parcel analyzed separately
 - Min, max, median values and no. of outliers calculated by township and across the whole Coalition for each crop
 - Outliers are any records within the highest 10% or lowest 10% of observations
 - Aggregate results reported to Water Board via boxplots and summary tables – no individual member or parcel information is provided

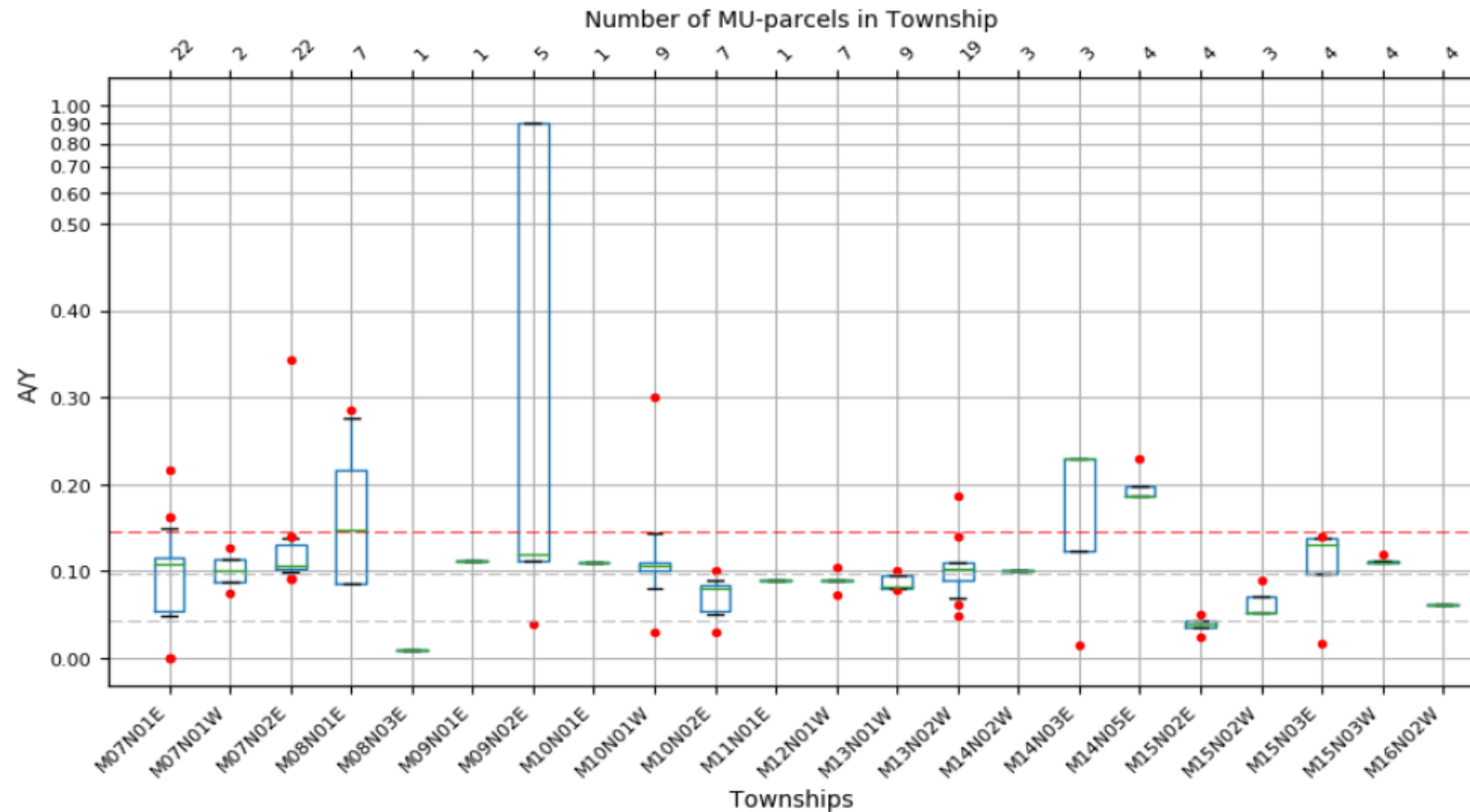


EXAMPLE BOXPLOT FOR ALMONDS

Figure II-1. Box and Whisker plots of A/Y for ALMONDS management units grouped by T-R.

Numbers at the top indicate the number of MU-parcels within each T-R. Red dots are local outliers (A/Y > 90% percentile or < 10% percentile) within each T-R. Horizontal dashed lines represent the 10% and 50% percentiles (grey lines), and 90% percentiles (red line) for all records in the Coalition.

Grouped Boxplots by Township for ALMONDS



EXAMPLE GROWER REPORT

Sacramento Valley Water Quality Coalition 2016 Nitrogen Management Plan Summary Report Results

Member ID:
Grower Name:

Member Name:

Crop: ALFALFA

These results represent information you provided on your 2016 Nitrogen Management Plan Summary Report comparing your Nitrogen *Applied* divided by your *Yield (A/Y)* to other fields of the same crop in your Township(s).

For more detailed information, please refer to the cover letter included with your 2016 Nitrogen Management Plan Summary Results.

The table below includes:

Columns 1 & 2: Your Applied pounds of Nitrogen per acre compared to the average pounds of Nitrogen Applied per acre within your parcel's Township.

Columns 3 & 4: Your A/Y per acre compared to the average A/Y per acre within your parcel's Township.

Columns 5 & 6: Your Nitrogen *Applied* divided by the Nitrogen *Removed (A/R)*⁴ per acre compared to the average A/R per acre within your parcel's Township.

Member ID	Member APN	Member # of Irr. Acres	(1) Member lbs. of N Applied per Acre	(2) Township Average lbs. of N Applied per Acre	(3) Member A/Y per Acre	(4) Township Average A/Y per Acre	(5) Member A/R per Acre ⁴	(6) Township Average A/R per Acre	Township	# of Parcels in Township ²
<input type="text"/>	<input type="text"/>	19	87	60	0.0067	0.0049	0.2142	0.1578	07N02E	75
<input type="text"/>	<input type="text"/>	39	87	60	0.0067	0.0049	0.2142	0.1578	07N02E	75
<input type="text"/>	<input type="text"/>	39	87	60	0.0067	0.0049	0.2142	0.1578	07N02E	75
<input type="text"/>	<input type="text"/>	58	87	60	0.0067	0.0049	0.2142	0.1578	07N02E	75
<input type="text"/>	<input type="text"/>	58	87	60	0.0067	0.0049	0.2142	0.1578	07N02E	75
<input type="text"/>	<input type="text"/>	19	87	60	0.0067	0.0049	0.2142	0.1578	07N02E	75

A/Y and A/R Status Color Key

Outlier³ (>90% of parcels)
 High (>75% of parcels)
 Average (<75% of parcels)
 Not Enough Data

The A/Y and A/R status color shows how your parcels compare to others of the same crop in the same Township. If your A/Y or A/R values are greater than 90% of all parcels in the Township, that is considered to be an "outlier" value. A value is considered "high" if it is greater than 75% of all parcels in the Township and "average" if the value is less than 75% of all parcels in the Township. In some cases, there were not enough data points in the Township to calculate outliers.

If one of your management units (MUs) included parcels in more than one Township, the A/Y and A/R status for that MU could be different for each Township.

Notes:

- Average is calculated using median value
- A Township is typically six by six square miles, 36 Sections, or 23,040 acres. Parcels can be counted more than once in a Township if there are multiple fields of the same crop associated with that parcel.
- Outliers have an Applied Nitrogen over Yield value that is greater than 90% of other high vulnerability parcels of the same crop in that Township.
- A/R Value: The purpose of this value is to estimate the amount of residual Nitrogen (N) available to leach to groundwater. The A/R value (total Applied N divided by N Removed), was calculated using published N removal values from: *Nitrogen concentrations in harvested plant parts - A literature overview (Geisseler, 2016)* (https://apps1.cdfa.ca.gov/FertilizerResearch/docs/Geisseler_Report_2016_12_02.pdf). This publication documents the best available information, but values are expected to be updated and modified as new information becomes available. For many crops, the publication indicates only few if any values could be found, while for others extensive datasets were available.

COALITION WIDE A/Y RESULTS

Crop	A/Y Stats - Coalition-wide			
	No. of Parcels	Median	90th percentile	No. Outliers
Alfalfa	284	0.0025	0.0124	29
Almonds	718	0.0968	0.1532	141
Grape	96	0.0021	0.0041	16
Prunes	171	0.03	0.133	22
Sunflower	249	0.0693	0.141	48
Tomato - Processing	416	0.0021	0.0029	74
Walnuts	1050	0.0299	0.0673	209
Wheat	180	0.02	0.0408	35

COALITION WIDE A-R RESULTS

Crop	A-R Stats - Coalition-wide			
	Number of Parcels	Median	90th percentile	No. Outliers
Alfalfa	284	-334	-2	58
Almonds	718	42	115	133
Grape	96	3	33	12
Prunes	171	66	128	34
Sunflower	249	60	108	42
Tomato - Processing	416	52	128	84
Walnuts	1050	52	150	205
Wheat	180	-8	58	36



WHAT THE ANALYSIS TOLD US

- The highest values within a township are always outliers regardless of how many data points there are or how different they are from each other
- Outliers within a township may not be outliers when compared to the whole Coalition
- Several townships and several of the less common crops did not have enough data points to determine outliers
- Soil type and irrigation method had no effect on outlier status



WHAT THE RESULTS MEAN TO YOU

- One year of data
 - Analysis only provides your results for one year
 - Analysis only provides everyone else's results for one year
 - Comparisons between your results and those of others in the township or coalition represent one year
- Comparisons don't take into account some of the factors that affect N uptake
 - Variety
 - N availability (partly dependent on soil type and management)
 - Fruit size
 - Dry matter content of the harvested plant part
 - Percent marketable yield
 - Growth stage when harvested may also be important for some crops