Re-saturation of Sacramento - San Joaquin Delta Soils through Rice Cultivation

GHG Emissions Modeling Analysis and Recommendation

Credit to Michelle M Leinfelder-Miles 87257_original.jpg (4032×3024) (ucanr.edu)

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Presentation Overview

1. Introduction to New Practice Pathway
2. New Practice Definition
3. GHG Emission Modeling
4. Data Gaps
5. Program Recommendation

1. New Practice Pathway

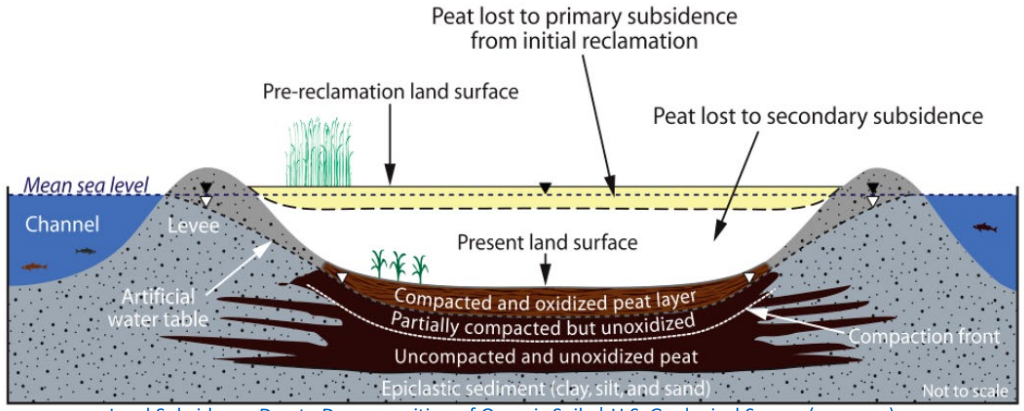
- HSP Call for New Practice Proposals in Summer 2020
  - Proposal for Re-saturation of Highly Organic Peat Soils in the Sacramento-San Joaquin Delta through rice cultivation or construction of managed wetlands
- New practice proposal underwent external review from a technical sub-committee Fall 2020 – Winter 2021
  - Reviewed favorably by external review to be incorporated into HS Incentives Program or HS Demonstration Program Type B, *but noted quantification methodology for GHG emission reductions needed to be developed*
- Quantification Methodology and Practice Guidelines development - 2022
  - Outreach to subject matter experts at NRCS, CA Fish and Wildlife, UCCE, UC Researchers, Delta Conservancy
    - Practice Scoping – *remove construction of managed wetlands from practice*
    - Modeling Scenarios – baseline land use, BMPs
    - Potential practice cost and guidelines

2. Refined Practice Definition

Convert land use in the Sacramento-San Joaquin Delta region from annual, non-rice agriculture (e.g., corn, alfalfa, tomatoes) to rice cultivation to reduce net GHG emissions and stop/slow down land subsidence.

Practice Background

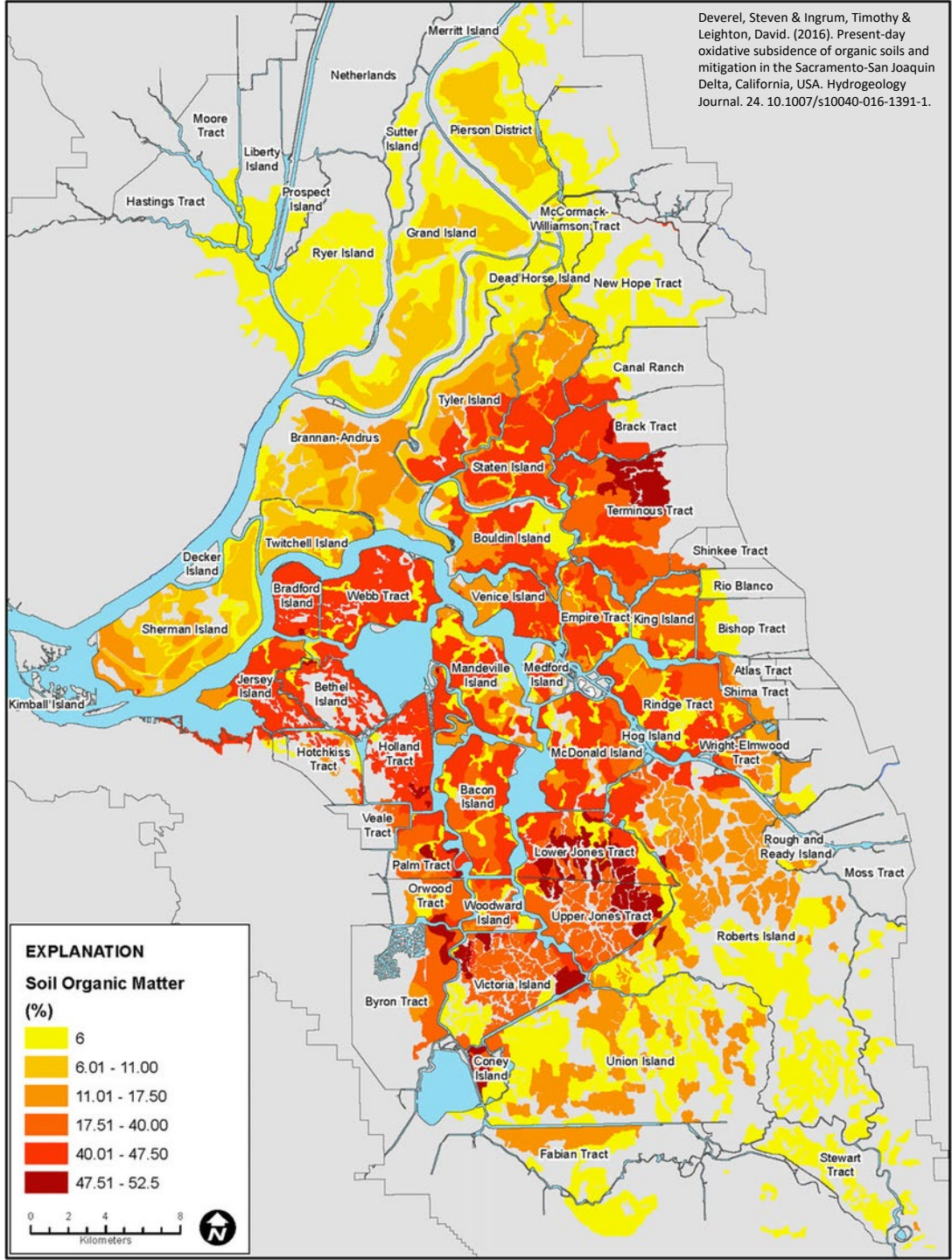
- Draining and farming of organic peat soils in the delta lead to oxidation of the organic matter
  - Emissions of GHGs
  - Organic Matter Loss
  - Land subsidence
- Original proposed solution: Re-saturating the land through rice production slows down or stops organic matter oxidation
  - Decrease Organic Matter Loss
  - Decrease net GHG emissions
  - Slows, reverses land subsidence



Land Subsidence Due to Decomposition of Organic Soils | U.S. Geological Survey (usgs.gov)

3. GHG Emissions Modeling

- This practice is implemented should support the Healthy Soils Program objectives 1) sequester carbon, 2) reduce atmospheric greenhouse gases (GHGs), and 3) improve soil health
- Use DNDC model to estimate new practice carbon sequestration and GHG emissions based on baseline scenarios and best management practice



DNDC Modelling

(Denitrification-Decomposition Model)

Site and soil characteristics

- Twitchell Island (Sacramento County)
- 38.10875°N, -121.6530°W
- Soil type: Silt loam
- pH: 6.2

Depth (cm)	Bd (g cm^{-3})	SOC (%)	C:N ratio
0 -30	0.65	15	14.1
30 -45	0.57	31	15.6

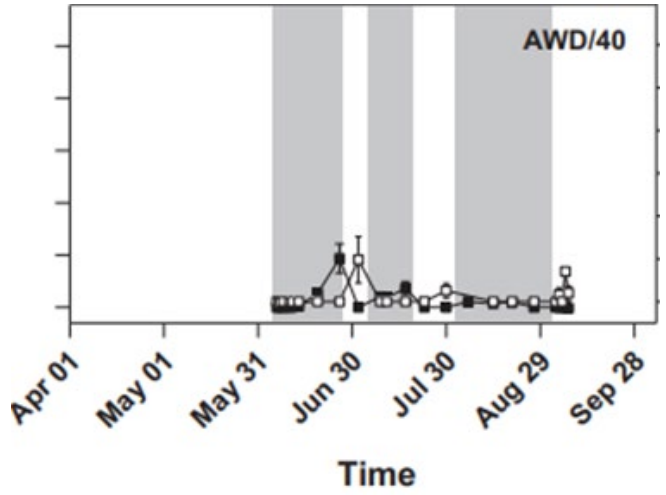
Modeling scenarios

- 24 years (1998 – 2021)
- Crops modeled:
  1. Baseline scenarios cover majority land crop uses: **Silage corn, alfalfa, processing tomato, fallow**
  2. Scenario for interest: **Rice**

DNDC Modelling - Rice management practices

1) **Water management**
   - In-season: Continuous flooding *vs.* Alternate wetting and drying (AWD)
   - Off-season: Continuous flooding *vs.* No flooding

2) **Residue management**
   Retained/removed - 50%



AWD: 7-15 days, once or twice per rice growing season.

Off-season irrigation: From December through February

DNDC Modelling

Net GHG reductions are shown in blue text and represented with negative values

Baseline	Rice growing season	Off-season	SOC	CH_4	N_2O	Net MT CO_2eq
	Residue	Irrigation	MT CO2eq/ha/yr			
Corn						
Rice	Retained	Flooding	-3.7	5.1	-3.6	-2.2
Rice	50% retained	No flooding	-2.2	0.1	2.0	-0.1
Rice	50% Retained	Flooding	-2.7	1.3	-2.6	-4.0
Tomato						
Rice	Retained	Flooding	-1.4	5.1	-1.3	2.4
Rice	50% retained	No flooding	0.2	0.1	-2.2	-1.9
Rice	50% retained	Flooding	-0.3	1.3	-1.4	-0.5
Fallow						
Rice	Retained	Flooding	10.3	5.1	-2.5	12.9
Rice	50% retained	No flooding	11.9	0.1	3.0	15.0
Rice	50% Retained	Flooding	11.3	1.3	-1.5	11.1
Alfalfa						
Rice	Retained	Flooding	7.4	5.1	-4.8	7.8
Rice	50% retained	No flooding	9.0	0.1	-3.5	5.6
Rice	50% Retained	Flooding	8.5	1.3	-4.8	4.9

- Residue management (removal) drives GHG reductions (CH_4).
- Off-season flooding water table depth drives CH_4 emission, therefore GHG reductions.

4. Data Gaps

- Data Gaps for Modeling and Validation
  - Nitrous Oxide and Methane emissions
- Best management practices
  - Straightforward, practical for the region, but set practice up for net GHG emission reductions
  - BMP controls on emission modeling
- Payment Rate per Acre
  - Using USDA NRCS EQIP and CPS to constrain payment rates
    - Land Forming and Smoothing (NRCS CPS 462) or Dike/Levee Construction (NRCS CPS 356)
  - Wide range in potential payment rates

5. Program Recommendation

Proposal to include new practice *Re-saturation of Sacramento - San Joaquin Delta Soils through Rice Cultivation* as a Demonstration Type A Practice for next solicitation to fill data gaps

Type A Demonstration Projects require measurement of in-field GHG emissions and to conduct analysis on cost/benefits for adoption of proposed practice and anticipated barriers