

Water Management and Quality with Rice Cultivation



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General Information

- Rice is typically grown in banded fields that are continuously flooded up to 14-21 days before harvest.
- Continuous flooding helps ensure sufficient water and control weeds.
- On average, it takes 1,400 L (370 gal) of water to produce 1 kg (2.2 lb) of rice in an irrigated production system (IRRI).
- Seasonal water input to rice fields varies from as little as 40 cm in heavy clay soils with shallow groundwater tables to more than 200 cm in coarse-textured (sandy or loamy) soils with deep groundwater tables. For muck soils somewhere in between depending on thickness.
- Irrigated rice receives an estimated 34–43% of the total world's irrigation water, or about 24–30% of the entire world's developed fresh water resources (IRRI).

To effectively and efficiently use water and maximize rice yields, the following good water management practices can be followed:

- 1. Construct field channels to control the flow of water to and from your field**



2. Till the land to minimize water loss (or create a hardpan)

prepare land to be laser leveled

retain soil moisture (raise water table)

3. Level the field

avoid ponding, or raised patches

well-leveled field is crucial to good water management

4. Construct bund (levees) and fix any cracks or holes

Rice is extremely sensitive to water shortage (below saturation) at the flowering stage. Drought at flowering results in yield loss from increased spikelet sterility, thus fewer grains.

Different crop establishment methods require different water management practices:

Continuous flooding

- Continuous flooding of water generally provides the best growth environment for rice.
- For direct seeded rice, field should be flooded only once the plants are large enough to withstand shallow flooding (3-4 leaf stage).
- If transplanting, water levels should be around 3 cm initially, and gradually increase to 5–10 cm (with increasing plant height) and remain there until the field is drained before harvest.

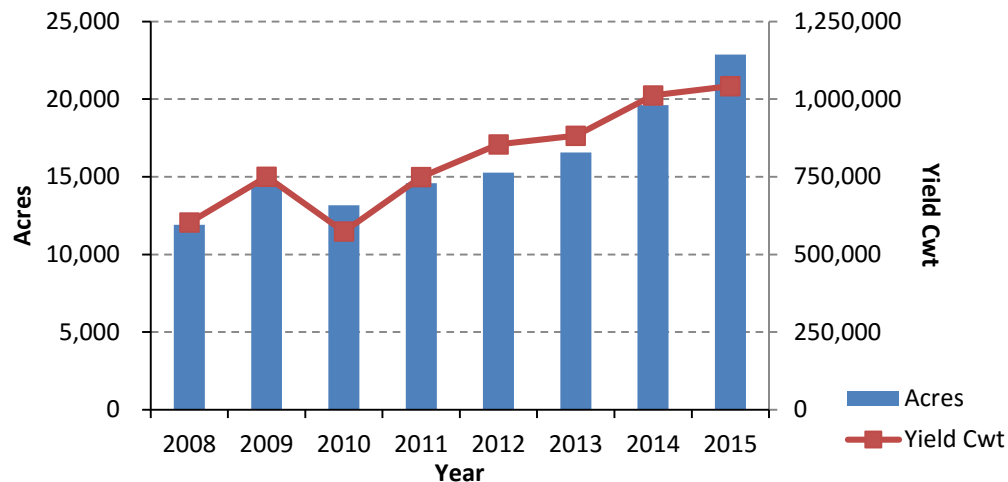
Alternate wetting and drying (AWD)

- For direct seeded rice, keep the soil moist but not saturated, to avoid seeds from rotting in the soil.
- After sowing, apply a flush irrigation to wet the soil, if there is no rainfall.
- Saturate the soil when plants have developed 3-4 leaves.
- AWD can be started a few weeks (1-2) after planting. Irrigate and then allow the water depth to drop to 15 cm below the surface.
- Once the water level has dropped to 15 cm below the surface, re-flood the field to a depth of 5 cm above the surface and repeat.
- NOTE: one week before and one week after flowering the field should be flooded.

Water Management Impact on Rice Yields and Drainage Water Quality in the EAA

Background

- Everglades Forever Act, mandates a 25% P load reduction from the EAA basin when compared to the pre-BMP.
- Effects of mandatory BMPs in the EAA have shown improved water quality from sugarcane farms.
- Discharges from rice farms have not been thoroughly evaluated.
- Rice production has increased by more than 70% since 2008.
- Water quality impacts?
- Production challenges (Rice yield and rice water weevil)?



Experimental Design

- This study was conducted at the Everglades Research and Education Center.
- During summer of 2014 and 2015.
- Two dominant rice varieties in the EAA were selected, Cheniere and Taggart.
- Sowing method was dry-seeding with 112 kg/ha of FeSO_4 at a 2.4 ha field and no other fertilizer was applied (Conventional method).
- Flooding started 20 days after planting.
- Water treatments:
 - 15 cm continuous flood (CF15)
 - 5 cm continuous flood (CF5)
 - 15 cm flood with drawdown (DD15)
 - 5 cm flood with drawdown (DD5)
- With four replications
- Plots were flooded by canal water.



Drainage Water Quality

- Water samples were collected biweekly
- TP (Unfiltered)
- TDP (0.45 μm filters),
- SRP (0.45 μm filters),
- PP= TP-TDP
- DOP= TDP-SRP
- DOC (Total Organic Carbon Analyzer)

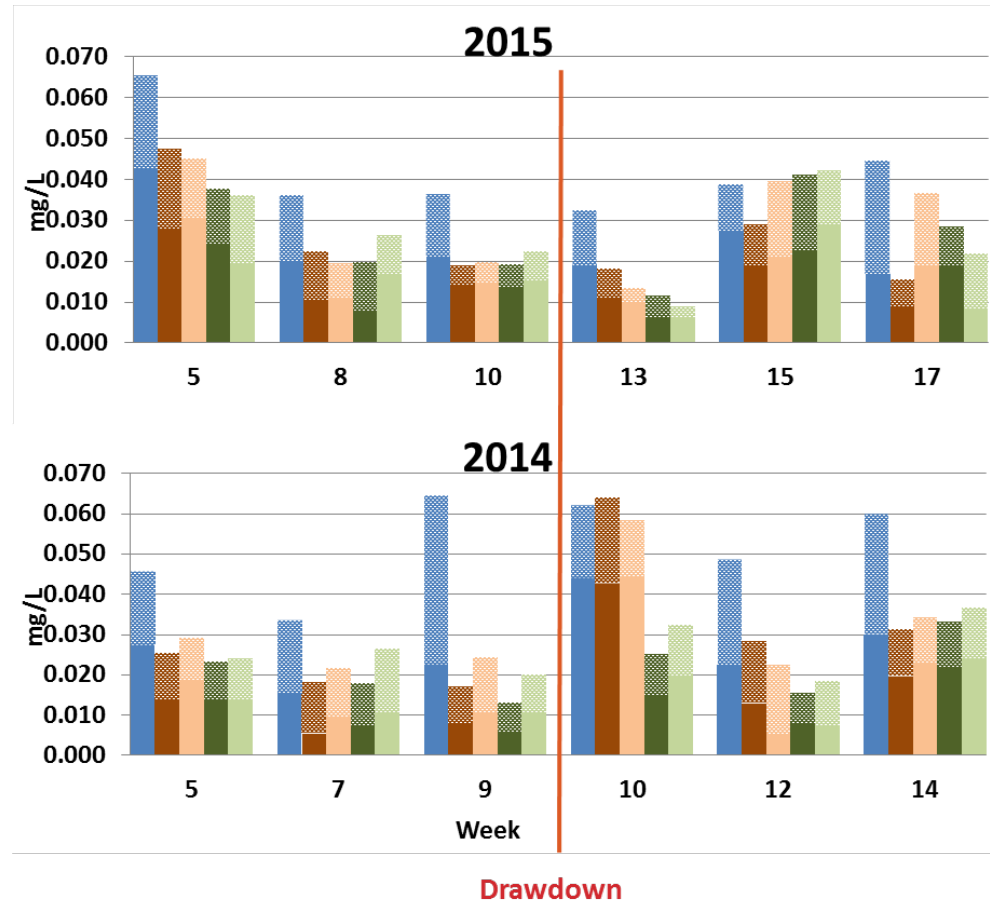


- **Commercial farms** water samples were collected in July and August of 2015.
- **Soil samples** were collected before and after growing season in both years and analyzed for pH, Pm, Pw, K, Ca, Mg, Si and Fe.
- **Aquatic vegetation** were collected 5 weeks after drawdown, rinsed with DI water, oven dried and were analyzed for N and P content.

Results

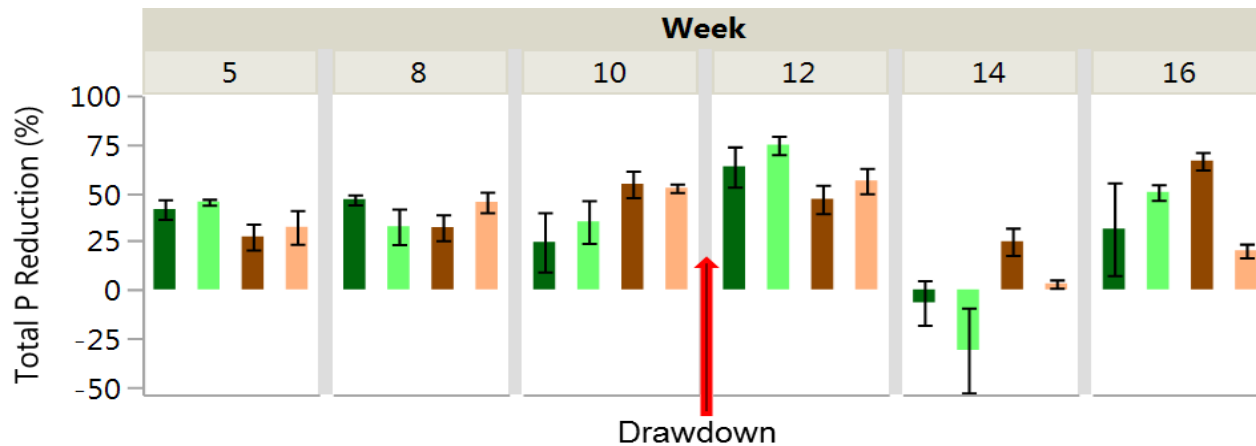
- Total P and total dissolved P concentrations were reduced in both years by 42% and 38%, respectively.
- 15 cm flood always had higher reductions of total P and total dissolved P than 5 cm flood.
- Drawdown did not show any significant effects on water quality parameters.

- Inflow
- 15cm Flood with Drawdown
- 5cm Flood with Drawdown
- 15cm Continuous Flood
- 5cm Continuous Flood
- Particulate Phosphorus (PP)
- Total Dissolved Phosphorus (TDP)



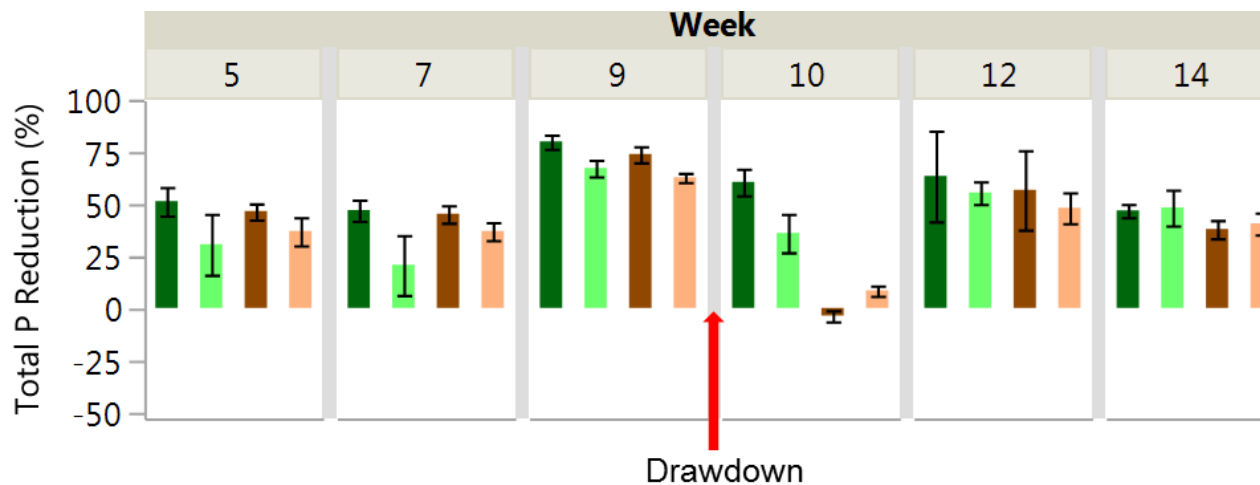
Total P Reduction

2015



Reductions	(%)
DD15	42.0
DD5	34.9
CF15	35.8
CF5	34.4

2014

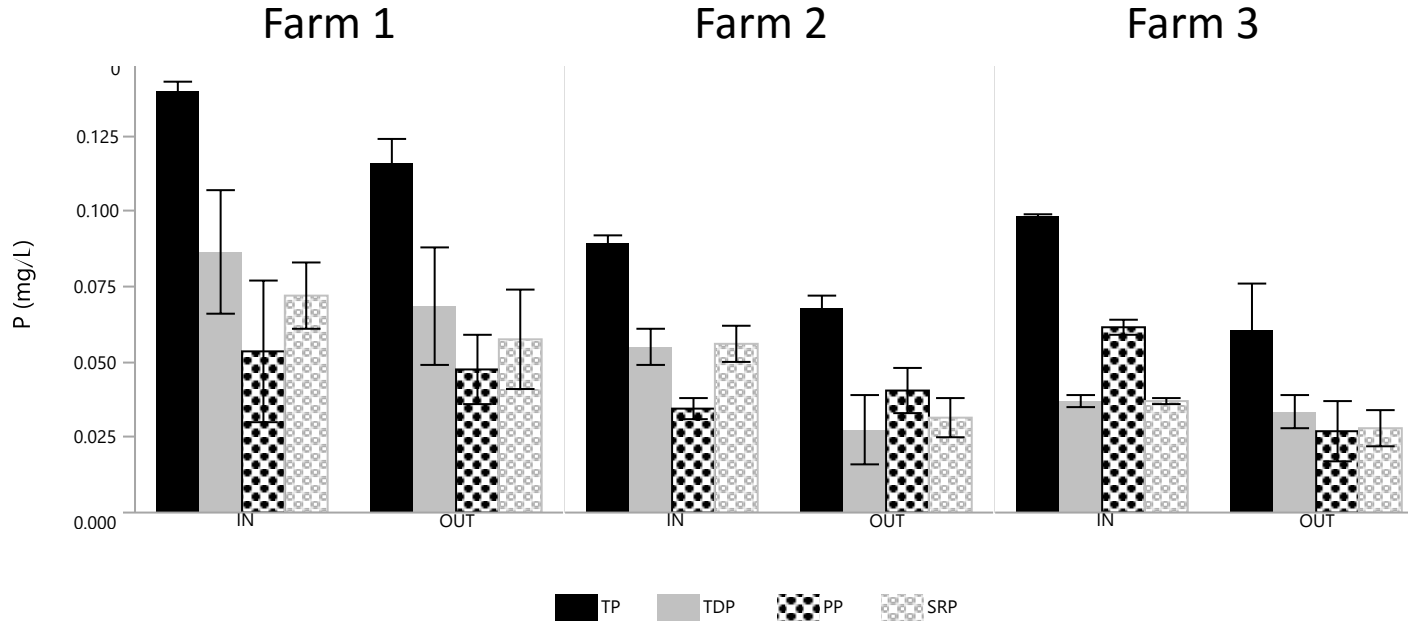


Reductions	(%)
DD15	43.9
DD5	38.7
CF15	58.7
CF5	43.3

Treatment ■ CF15 ■ CF5 ■ DD15 ■ DD5

Commercial Rice Farms

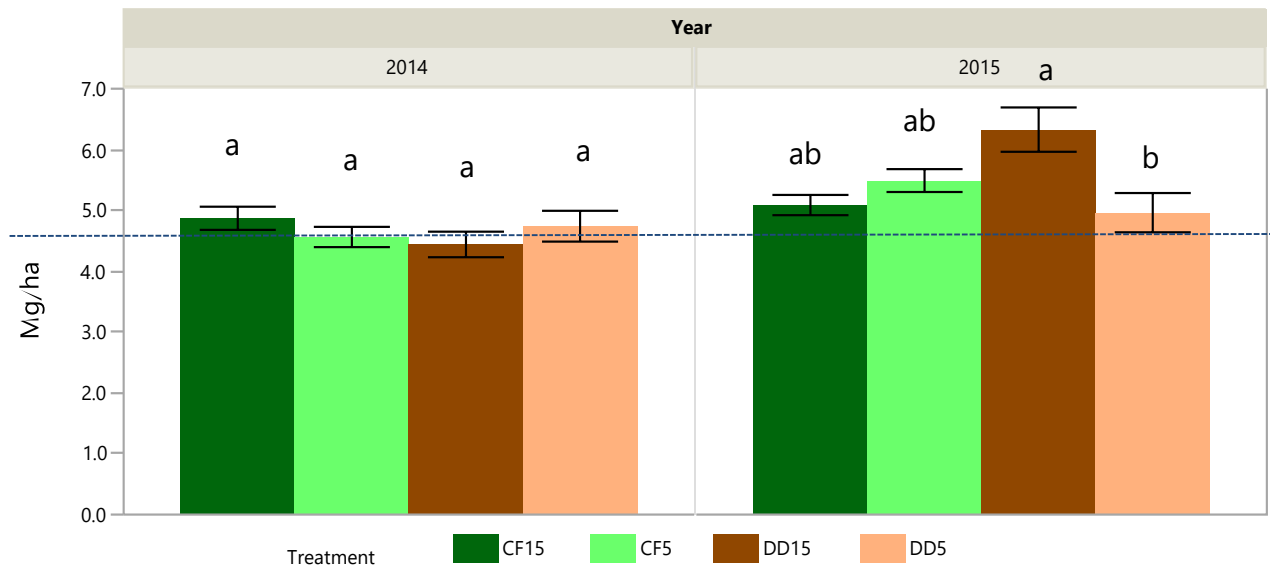
- Similar water quality trends were observed in commercial rice farms.
- Total P was reduced by 17-36% and 26.6% on average.



Rice Yield Results

- Rice yield was not significantly different between water treatments in 2014.
- 15 cm flood with drawdown had significantly higher yields than 5 cm flood with drawdown in 2015.
- Shallow flood depth and midseason drawdown did not negatively impact rice yield.

Average EAA rice yield

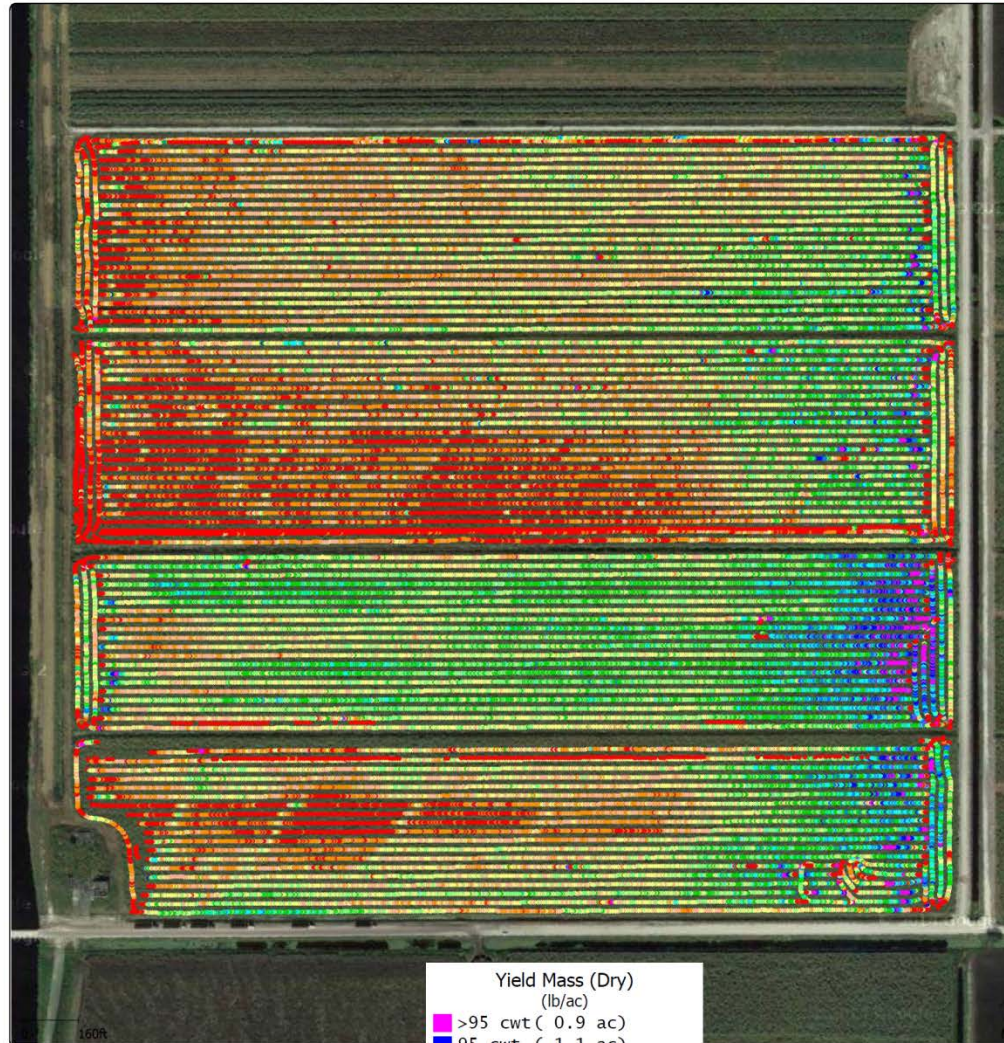


Good water management strategy in the EAA

- Keep water @ about 3-4 inches (7.5-10 cm) deep
- Upwards of 8 inches (20 cm) can cause severe lodging; difficult to harvest; resulting in significant yield loss
- Trying to get moisture early in the season is also very critical; yield maps have shown significant higher yields in area that typically have greater soil moisture.

Grower : Glades Sugar Farm
Farm : Main Farm
Year : 2015-2016

Operation : Grain Harvest
Area : 118.3 ac



Yield Mass (Dry) (lb/ac)	
█	>95 cwt (0.9 ac)
█	95 cwt (1.1 ac)
█	90 cwt (2.0 ac)
█	85 cwt (4.4 ac)
█	80 cwt (10.5 ac)
█	75 cwt (19.4 ac)
█	70 cwt (26.6 ac)
█	65 cwt (23.9 ac)
█	60 cwt (15.4 ac)
█	<55 cwt (14.1 ac)

Acknowledgements

- Florida Rice Growers Inc.
- Mohsen Tootoonchi (graduate student)
- Dr. Tim Lang
- Matt Duchrow

Thank You!