



Florida State Technical Advisory Committee

Juan Hernandez, State Conservationist



Housekeeping

- Please sign in by name & email in the Chat
- Attending in Person- please sign in at the back of the room





Background

NRCS depends on our local knowledge and expertise to implement Farm Bill Programs to ensure the process remains locally-led.

The role of the State Technical Committees is to serve primarily as a source of information, analysis, and recommendations to the leadership members who are charged with implementing the conservation provisions of the Farm Bill.



Financial Assistance Programs

**Amber Till, ASTC-Financial Assistance
Programs**

FY 2025 Financial Assistance Programs

Conservation Program Allocations	
CSP Classic (Farm Bill)	\$ 8,870,000
CSP Initiative (Long Leaf Pine)	\$ 1,000,000
CSP IRA	\$ 10,000,000
Total CSP	\$ 19,870,000
EQIP Classic (Farm Bill)	\$ 12,136,280
EQIP Classic (Disaster Assistance - 6.5M NHQ, 6M NRCS-Florida)	\$ 12,500,000
EQIP Initiatives (Long Leaf Pine, Gopher Tortoise, Northern Bobwhite)	\$ 4,633,717
Non-IRA EQIP	\$ 29,269,997
EQIP IRA	\$ 40,130,770
Total EQIP	\$ 69,400,767
Total Allocation	\$ 89,270,767

FY 2025 Contract Obligations To-Date

Conservation Stewardship Program (CSP)	Agreement (No.)	Contract Cost (\$)
Farm Bill	127	\$ 9,661,317
CSP Ag Land	56	\$ 4,871,780
FY2025 Florida CSP Classic Ag Land	48	\$ 4,124,330
FY2025 Florida CSP Renewals Ag Land	8	\$ 747,450
CSP Non-Industrial Private Forestland (NIPF)	60	\$ 3,833,975
FY2025 Florida CSP Classic NIPF	55	\$ 3,433,092
FY2025 Florida CSP Renewals NIPF	5	\$ 400,883
CSP Longleaf Pine Initiative (LLPI)	11	\$ 955,562
FY2025 Florida CSP Classic Longleaf Pine Initiative (LLPI)	9	\$ 555,568
FY2025 Florida CSP Renewals Longleaf Pine Initiative (LLPI)	2	\$ 399,994
IRA	4	\$ 643,291
CSP IRA Ag Land	4	\$ 643,291
FY2025 Florida CSP Renewals IRA Ag Land	4	\$ 643,291
Grand Total	131	\$ 10,304,608

FY 2025 Contract Obligations To-Date

Environmental Quality Incentives Program (EQIP)	Agreement (No.)	Contract Cost (\$)
Farm Bill	404	\$ 27,850,324
Disaster Assistance	163	\$ 12,219,780
Locally-led (Field Office)	102	\$ 5,568,703
Locally-led (Regional)	25	\$ 2,031,703
Longleaf Pine Initiative	22	\$ 1,600,492
WLFW Gopher Tortoise	24	\$ 1,775,934
WLFW Northern Bobwhite	9	\$ 896,858
Historically Underserved	18	\$ 1,685,484
National Initiative (Urban, NOFEI, NOI)	7	\$ 513,398
State Initiative (Tribal)	1	\$ 592,580
Conservation Planning Activities	20	\$ 77,210
Incentive Contracts (CSP-like)	13	\$ 888,180
IRA	49	\$2,109,728
Disaster Assistance	49	\$2,109,728
Grand Total	453	\$29,960,051

FY 2025 Disaster Assistance Contract Obligations To-Date

Environmental Quality Incentives Program (EQIP)	Agreement (No.)	Contract Cost (\$)	Initial Allocation (\$)
Farm Bill	163	\$ 12,219,780	\$ 12,000,000
Bivalves (\$60,000 payment cap)	52	\$ 2,025,224	\$ 1,000,000
Sprinkler System - Center Pivots	51	\$ 8,330,675	\$ 8,500,000
Mulching (\$50,000 payment cap)	46	\$ 1,347,059	\$ 1,000,000
High Tunnel System (\$50,000 payment cap)	13	\$ 505,358	\$ 1,000,000
Animal Mortality	1	\$ 11,464	\$ 500,000
IRA	49	\$ 2,109,728	\$ 14,000,000
Woody Residue Treatment (Pasturelands/Rangelands)	14	\$ 904,184	\$ 10,000,000
Woody Residue Treatment (Forestlands)	9	\$ 594,281	\$ 2,000,000
Citrus Orchards	26	\$ 611,263	\$ 2,000,000
Grand Total	212	\$ 14,329,507	\$ 26,000,000

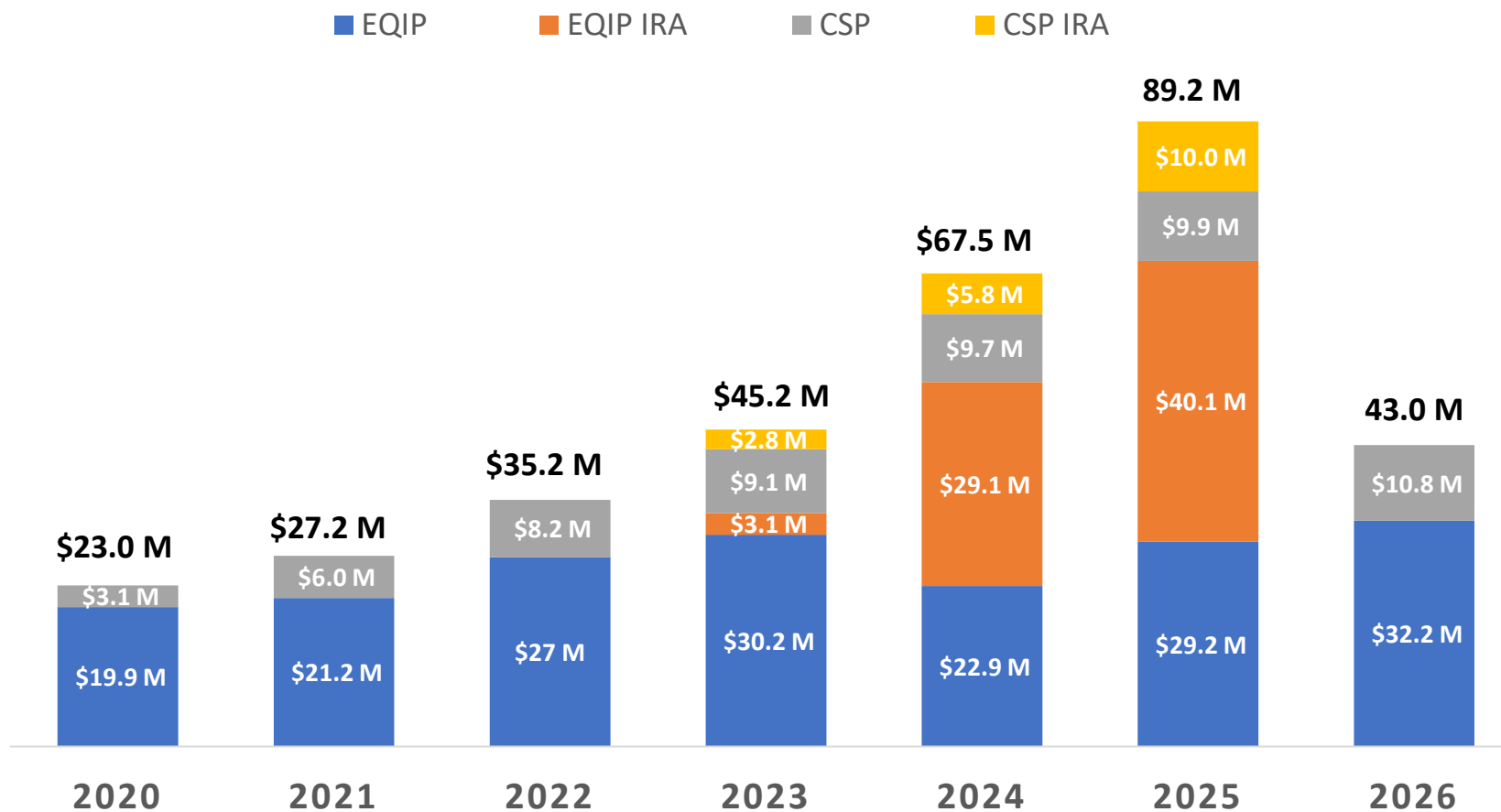
FY 2025 Disaster Assistance Additional Funds Requested

- **105** applications preapproved with IRA funds were not obligated prior to the Jan 27, 2025, funding pause
- **12.5M** in additional Farm Bill funds has been requested

Environmental Quality Incentives Program (EQIP)	Agreement (No.)	Contract Cost (\$)
Woody Residue Treatment (Pasturelands/Rangelands)	16	\$ 1,622,085
Woody Residue Treatment (Forestlands)	78	\$ 10,434,817
Citrus Orchards	11	\$ 479,073
Grand Total	105	\$ 12,535,975

EQIP/CSP TRENDS

FLORIDA NRCS PROGRAM FUNDING FY 2020-2026



FY 2026 EQIP/CSP

- **Proposed Application Sign-Up – October 1, 2025**
- **CSP** will shift from statewide to area-level pools and allocations will be proportional to demand
- **Workload Prioritization Tool (screening)**
 - Timeline for the applicant to provide NRCS with information needed to rank their application
 - Non-responsive applicants will be screened 'Low' for planning and funding consideration

FY 2025 Partnership Projects – Producer Contracts

Regional Conservation Partnership Program Land Management/Rentals (RCPP-LMR)	Agreement (No.)	Contract Cost (\$)
1924 – Ocala to Osceola Wildlife Corridor	6	\$ 506,779
1960 – Red Hills to the Coast	7	\$ 93,691
2290 – Surface to Springs	12	\$ 307,768
2817 – Forest to Gulf	10	\$ 661,117
Grand Total	35	\$ 1,569,356

FY 2026 RCPP Partnership Projects – Producer Contracts

➤ **Application Sign-Up – July 31, 2025**



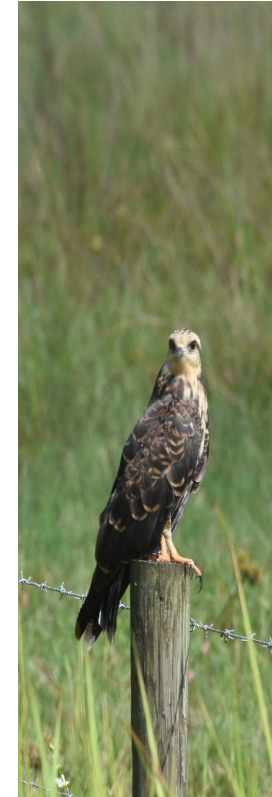


Conservation Easements

**Marcus Shorter, ASTC- Conservation
Easements**

FY2025 ALE Applications

- 14 Applications Ranked
- 2 Obligated – Hardee County (FDAC/RFLPP)
 - \$4,301,555
- 9 Unfunded Eligible
 - \$11,522,300 (June Funds Assessment/rolled into FY26)
- FY26 ACEP-ALE batching period will be open on October 1st, 2025 and close on December 31st, 2025.



FY2025 WRE Applications

- **16 Applications**
 - 1- Eligible
- **3 Easements Closed**
 - **2,555 acres**

Restoration/Engineering

	FY25			
	Projects	Acres	Cost	Partnerships
Restoration	4	4632	\$ 2,269,578	LOA, ESA, TFT
Additional Restoration	8	16470	\$ 4,305,203	LOA, ESA, DU, TFT
Stewardship	11	12012	\$ 2,466,103	USACE, Area 3 ACES, ESA
	FY26			
	Projects	Acres	Cost	Partnerships
Restoration	4	7422	\$ 7,788,206	LOA, TFT
Additional Restoration	3	464	\$ 1,694,572	LOA, ESA
Stewardship	6	8973	\$ 2,902,609	LOA, ESA, USACE
Design/Planning	4	4478		DU, Area 3-ACES, ACES

RCPP-Easements

- **6 – Deed Review**
- **1- Preobligation**
- **7 Easements projected to close FY25**
 - **4,241 acres**
 - **\$5,771,460** Estimated NRCS Contribution



Natural
Resources
Conservation
Service

nrcs.usda.gov

RCPP Fall signup

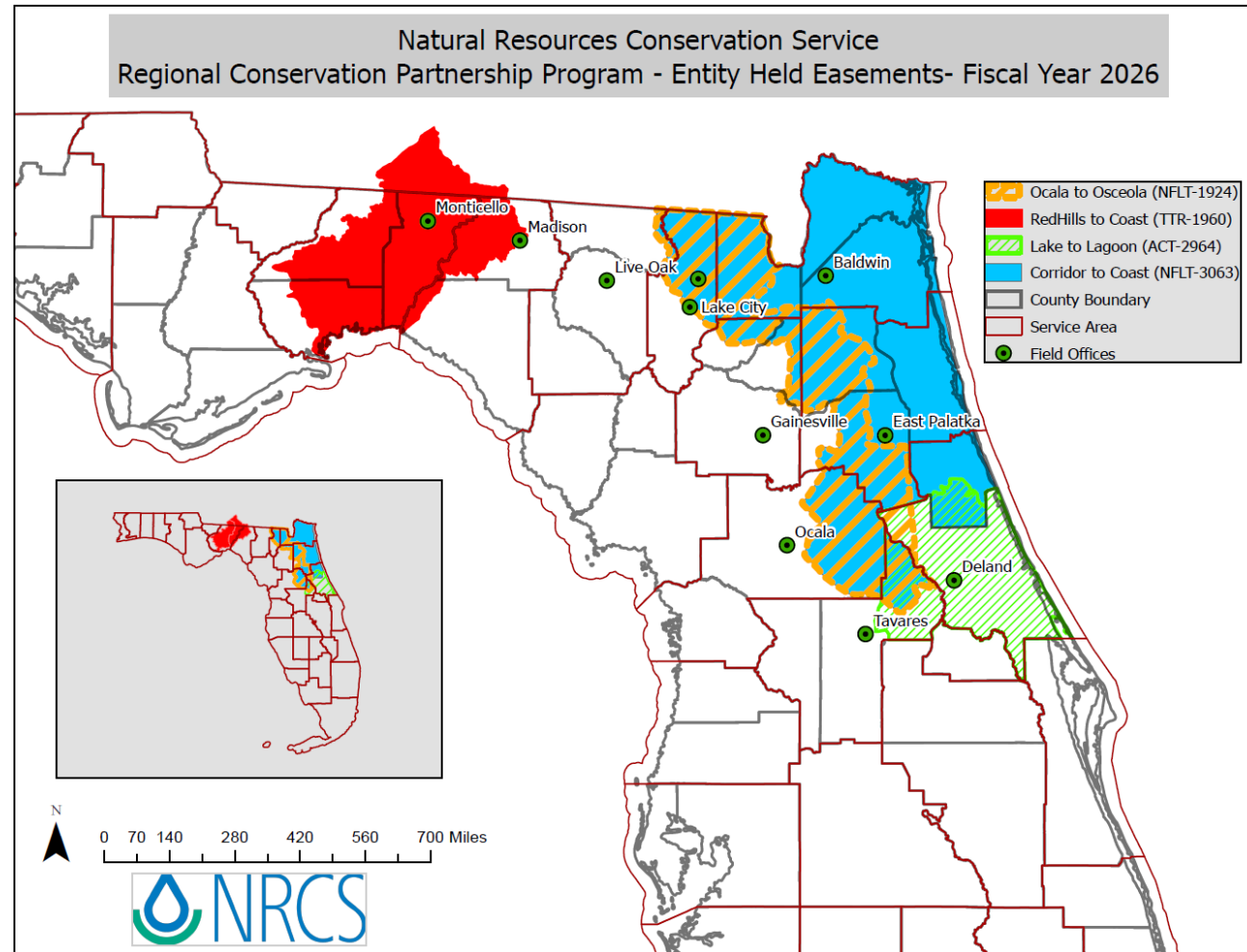
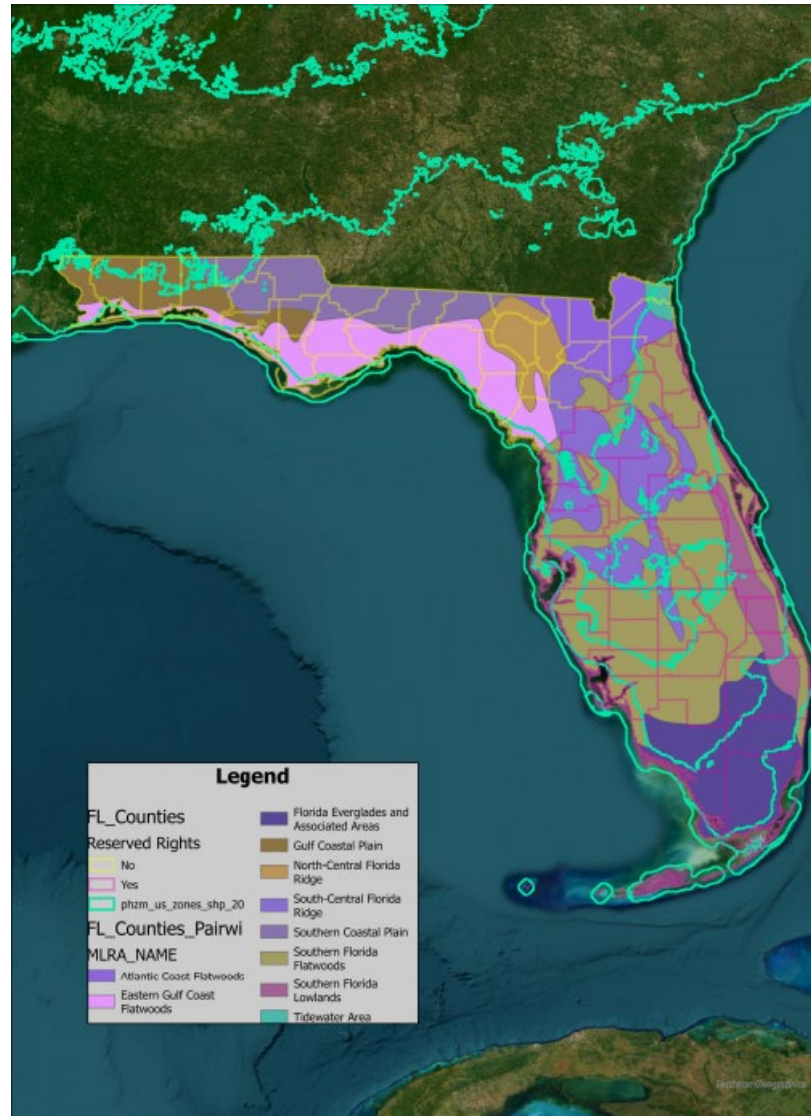


EXHIBIT E – RESERVATION OF GRAZING RIGHTS

- **This exhibit authorizes the Landowner to reserve grazing rights provided the Natural Resources Conservation Service (NRCS) determines that the reservation of the grazing right is—**
 - Compatible with the land subject to the ACEP-WRE easement
 - Consistent with the long-term wetland protection and enhancement goals for which the easement is being established.
- **All Counties south Citrus, Marion, Putnam, and St. John's Counties**

PENINSULAR FLORIDA UPLAND/WETLAND COMPLEXES



Preliminary Compensation Package

**We will continue to request funding at
80% of the appraisal value.**



Ranking Updates

**For FY26 we would like to keep ranking
procedures the same as FY25.**



United States
Department of
Agriculture

Questions?



Natural
Resources
Conservation
Service

nrcs.usda.gov



Emergency Watershed Protection (EWP) Program Updates



Jason Strenth

State Conservation Engineer

EWP Program Manager

USDA-Natural Resources Conservation Service

Gainesville, Florida



Recap - Program Purpose

- Assist Sponsors with implementation of emergency recovery measures to relieve imminent hazards to life or property caused by a natural disaster that creates a sudden impairment of a watershed. Assistance is through a locally led cooperative agreement where NRCS provides financial and technical assistance.
- EWP is disaster recovery and Not disaster response.
- In Florida, mainly consists of removing debris from waterways and addressing erosion along waterways after tropical systems



Hurricane Ian

- Funded 71 Damage survey reports (DSR's) for 23 sponsors – total of \$137.8 million (construction)
- 1 sponsor (8 DSR's) declined participation
- 1 sponsor (1 DSR) withdrew
- Total obligation for 21 sponsors is \$103.4 million
- 14 sponsors have completed work
- Total paid to sponsors currently is \$59.7 million (not all 14 completed have had final payment made)
- Damage was both debris and erosion
- All work should be completed by end of September 2025



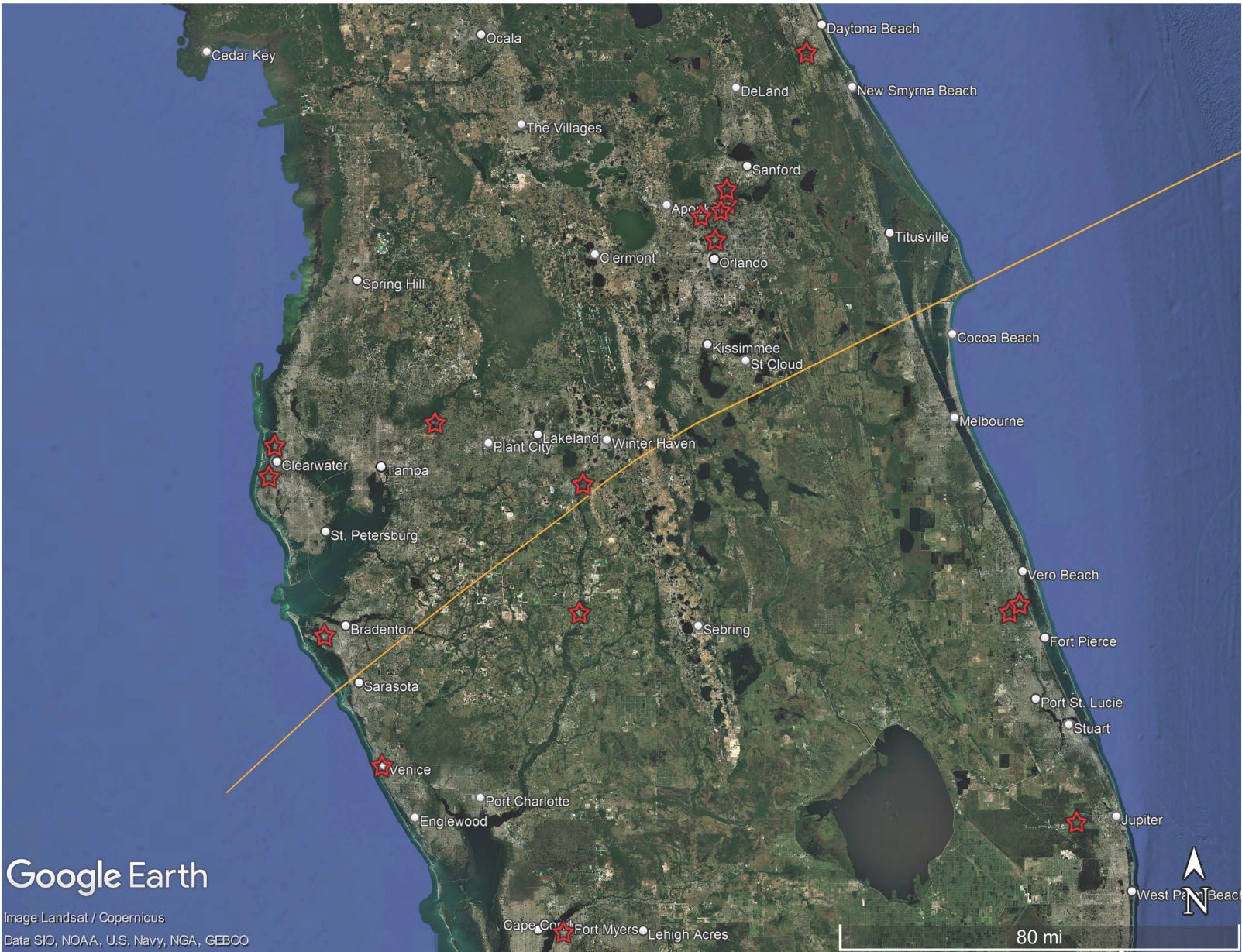
Hurricane Helene

- No requests for assistance received



Hurricane Milton

- Received requests for assistance from 19 sponsors; includes cities, counties, water control districts, and water management district
- 2 sponsors withdrew request and 1 sponsor had no eligible work
- Florida NRCS was able to secure 100% cost share for Hurricane Milton EWP
- Submitted 29 DSR's so far for 16 sponsors and all have been funded
- Total construction cost is \$46.3 million
- Still finalizing DSR's for 2 sponsors
- To date, executed 8 agreements for total obligation of \$28.3 million









Florida NRCS EWP Contact

- Jason Strenth, Program Manager
352-338-9559
jason.strenth@usda.gov





Partnerships & Initiatives

**Hilary Barnhart, ASTC-Partnerships &
Initiatives & Denise Liggett, RCPP
Coordinator**



Florida Agreements & Conservation Innovation Grants FY 2026

- Inflation Reduction Act Agreements are now able to move forward
- Conservation Innovation Grants Notice of Funding Opportunity FY2026 will not be held in Florida due to lack of funding.



Local Working Groups FY 2026

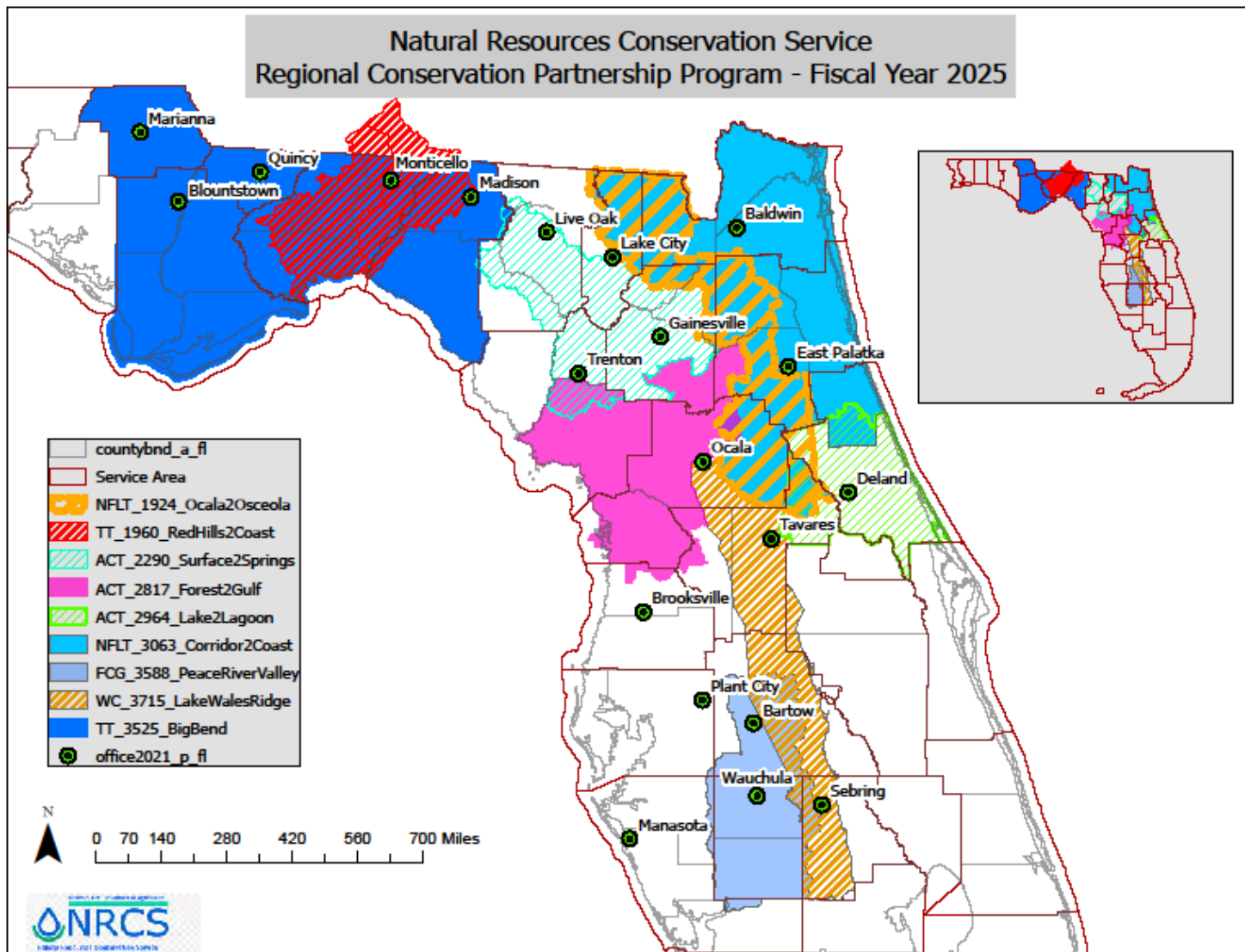
- Local Workgroup Meetings have been held and submitted their input.
- The Leadership Team will review and use to prioritize ranking, funding pools, and local priorities.

Regional Conservation Partnership Program

UPDATES

Existing RCPP Projects are continuing to progress.

There will be both Land Management and Easement sign ups on some projects.





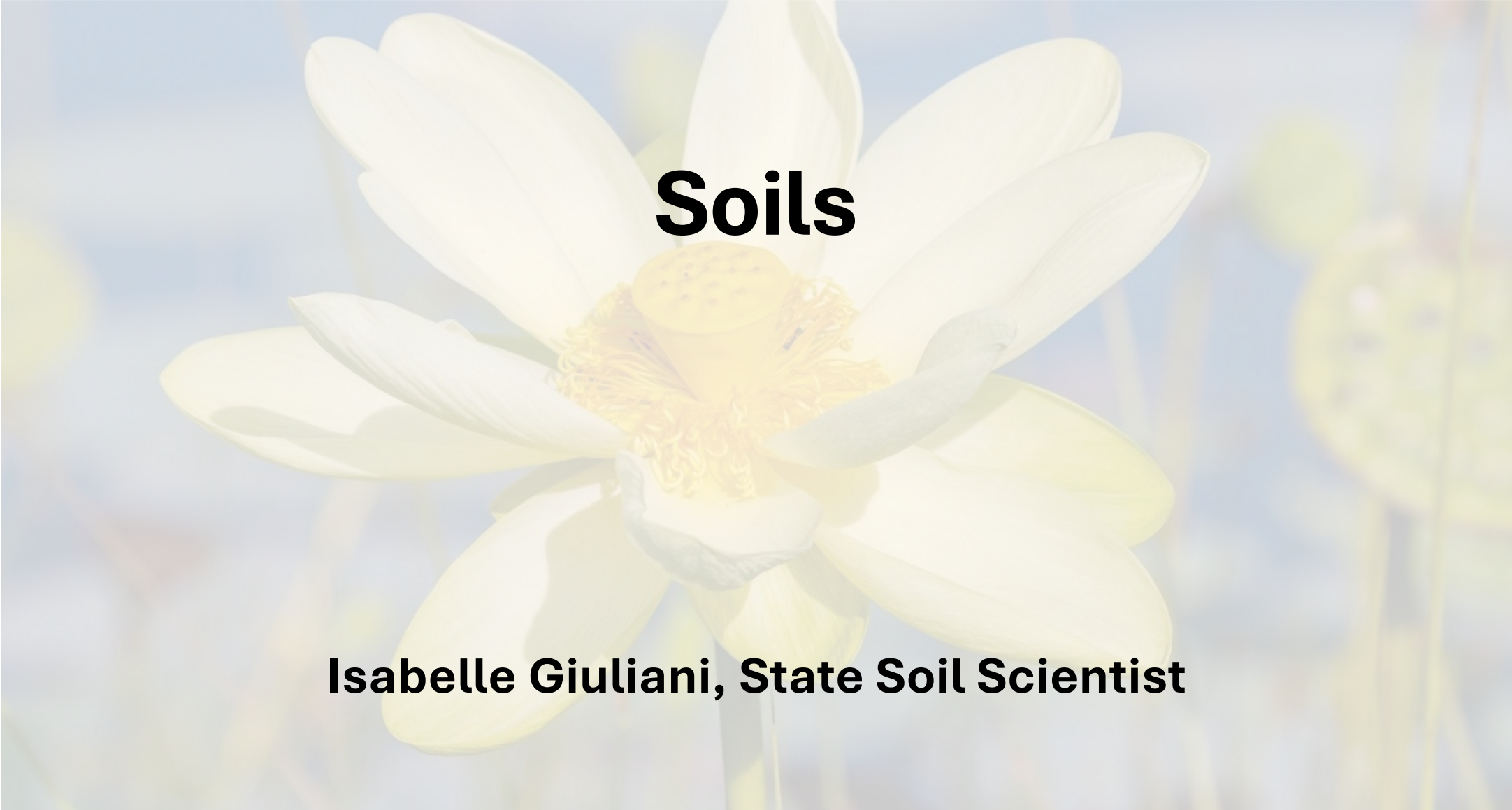
Regional Conservation Partnership Program

- 2023 Inflation Reduction Act (IRA) Funded RCPP Projects just received the go ahead to continue!
 - Alachua Conservation Trust (L2L) and North Florida Land Trust (C2C)
- 2024 IRA Funded RPPP Projects are still under review.
 - Tall Timbers, Florida Conservation Group, Wildlands Conservation and the Intertribal Buffalo Council



The Good News!

- We may have a new Notice of Funding Opportunity for calendar year 2025!
- If the NOFO does come out this year, it will be funded with Farm Bill funding and each project will most likely be no more than \$10 million.

A large, white lotus flower in full bloom, centered in the background. The petals are numerous and layered, with a yellow center. The background is a soft, out-of-focus blue and green, suggesting a pond or garden setting.

Soils

Isabelle Giuliani, State Soil Scientist



Ecological Sciences

**Bianca Diaz, State Resource
Conservationist**



Conservation Innovation Grants

Florida Gulf Coast University, Dr. Derek Lura

**Florida International University, Dr. Maruthi Sridhar
Balaji Bhaskar**

Food, Water, & Energy

Agricultural engineering for the future.

Dr. Derek Lura

U.A. Whitaker College of Engineering

2025



Overview

01

Global
consumption
and trends

02

Systems
integrations
and
optimization

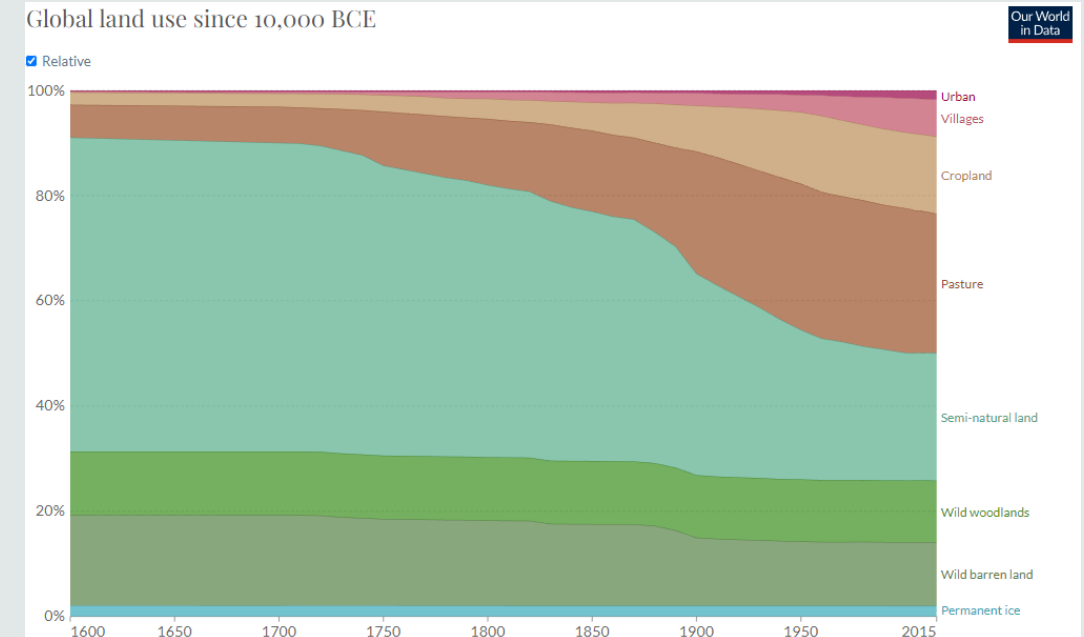
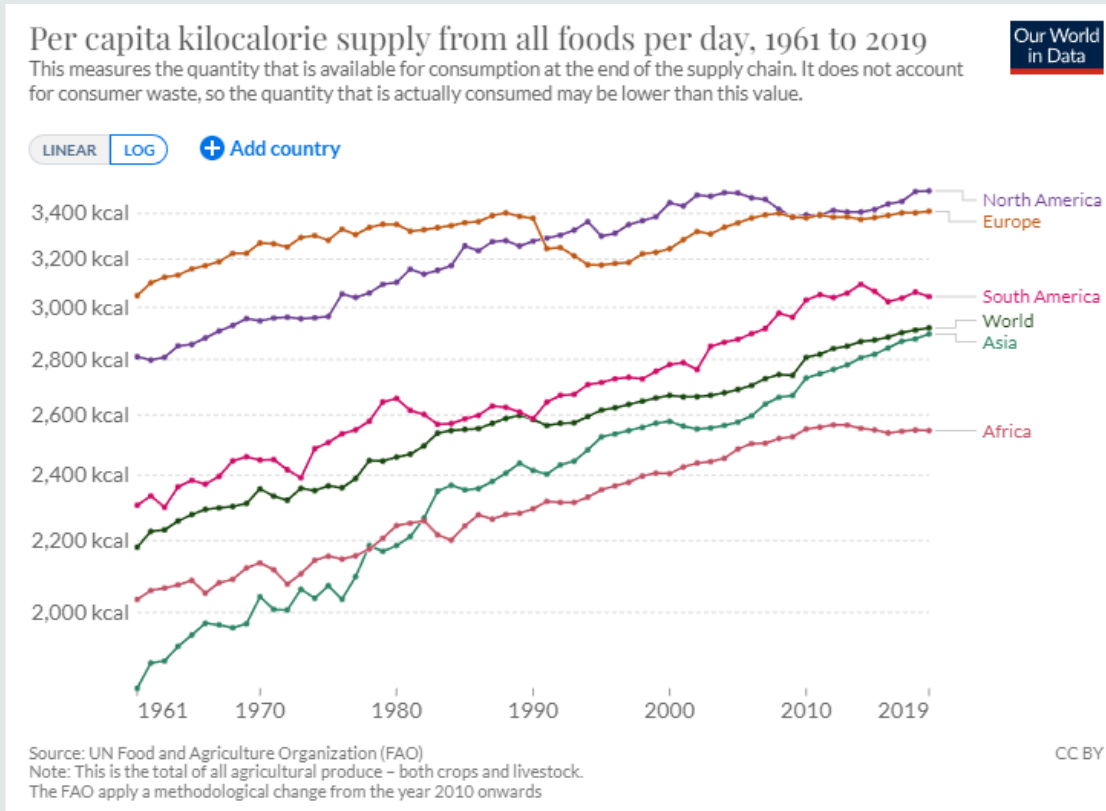
03

Technology
and the future

04

Undergraduate
Research

Global Consumption - Food



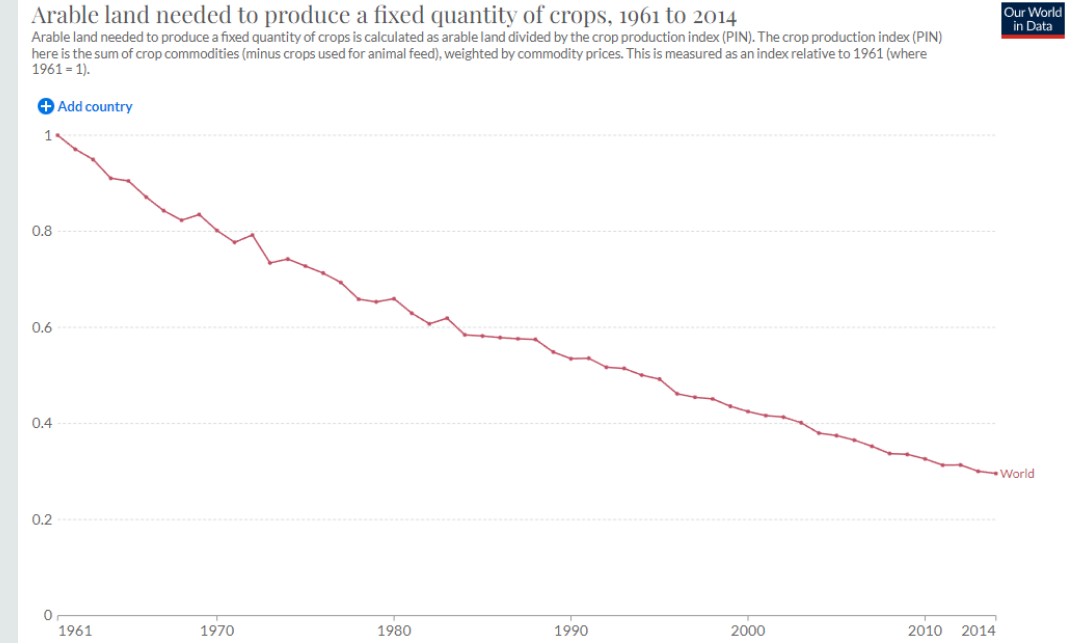
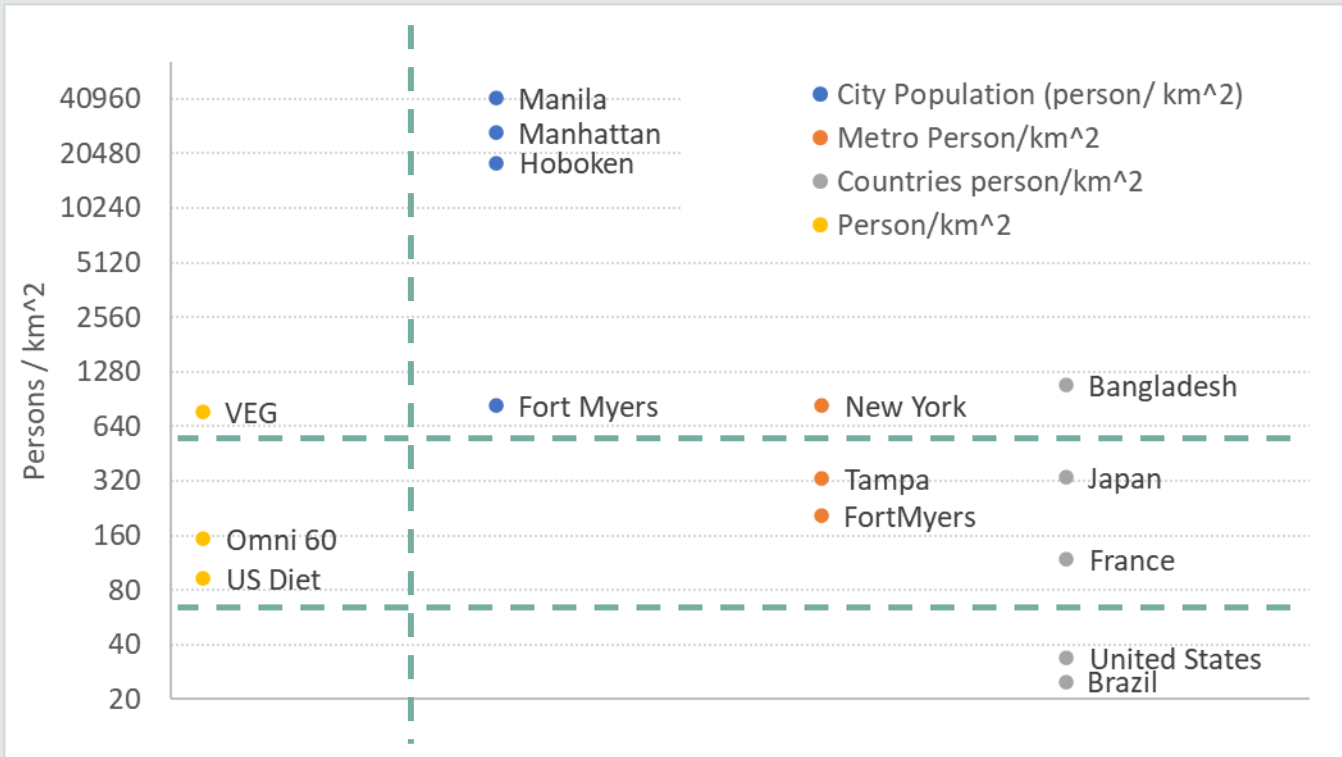
Agriculture Accounts for:

- **70%** of Global **Water** Use, &
- **38%** of **Land** Area, and
- **30%** of Global **Energy** Use.

<https://ourworldindata.org/food-supply> * Using Data from US FAO

<https://www.fao.org/sustainability/news/detail/en/c/1274219/> * United Nations – Food and Agriculture

Global Consumption - Food



Over the past 80 years, our primary growth has been in productivity of croplands. More intensive agriculture, with higher yields across a variety of crops.

Diet matters, you can feed approximately 10x the number of people on a vegetarian diet than you can on the diet of the average US consumer.

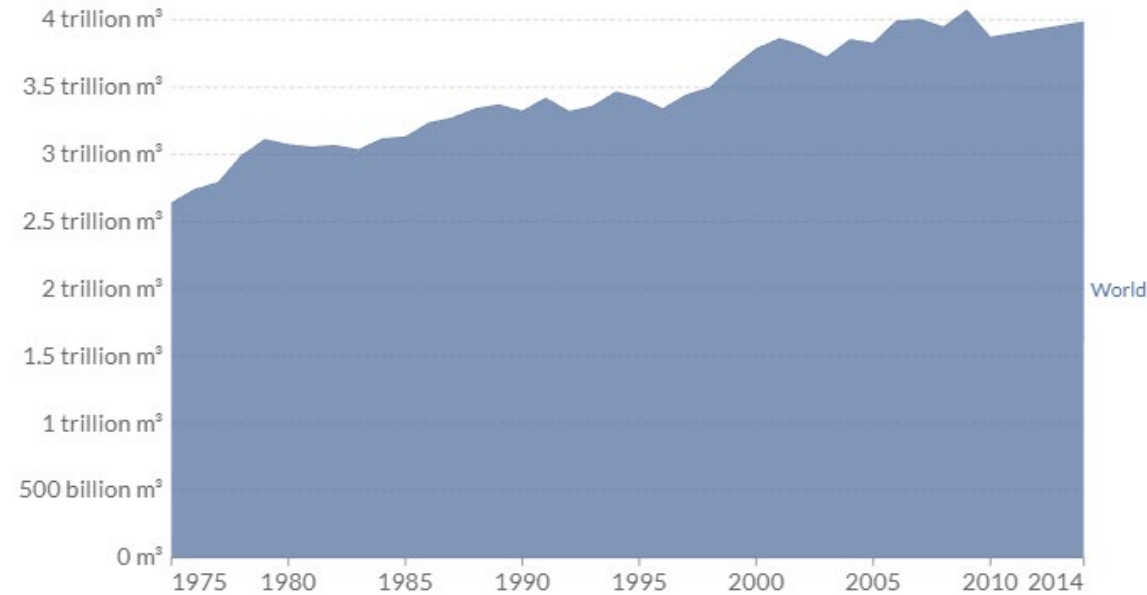
<https://online.ucpress.edu/elementa/article/doi/10.12952/journal.elementa.000116/112904/Carrying-capacity-of-U-S-agricultural-land-Ten> & <https://ourworldindata.org/grapher/arable-land-pin>

Global Consumption – Water

Global freshwater use over the long-run

Global freshwater withdrawals for agriculture, industry and domestic uses since 1900, measured in cubic metres (m³) per year.

□ Relative

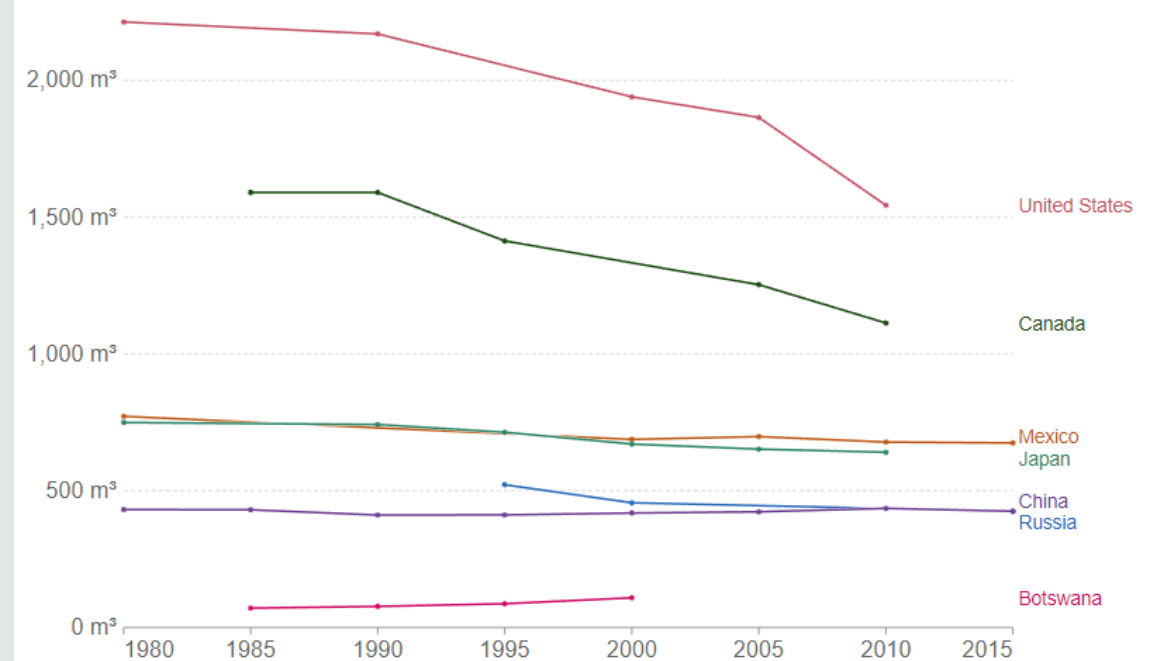


As population growth slows, and water and energy efficacy improve, we may see global freshwater use start to decline.

<https://ourworldindata.org/water-use-stress>

Water withdrawals per capita, 1980 to 2015

Total water withdrawals from agricultural, industrial and municipal purposes per capita, measured in cubic metres (m³) per year.

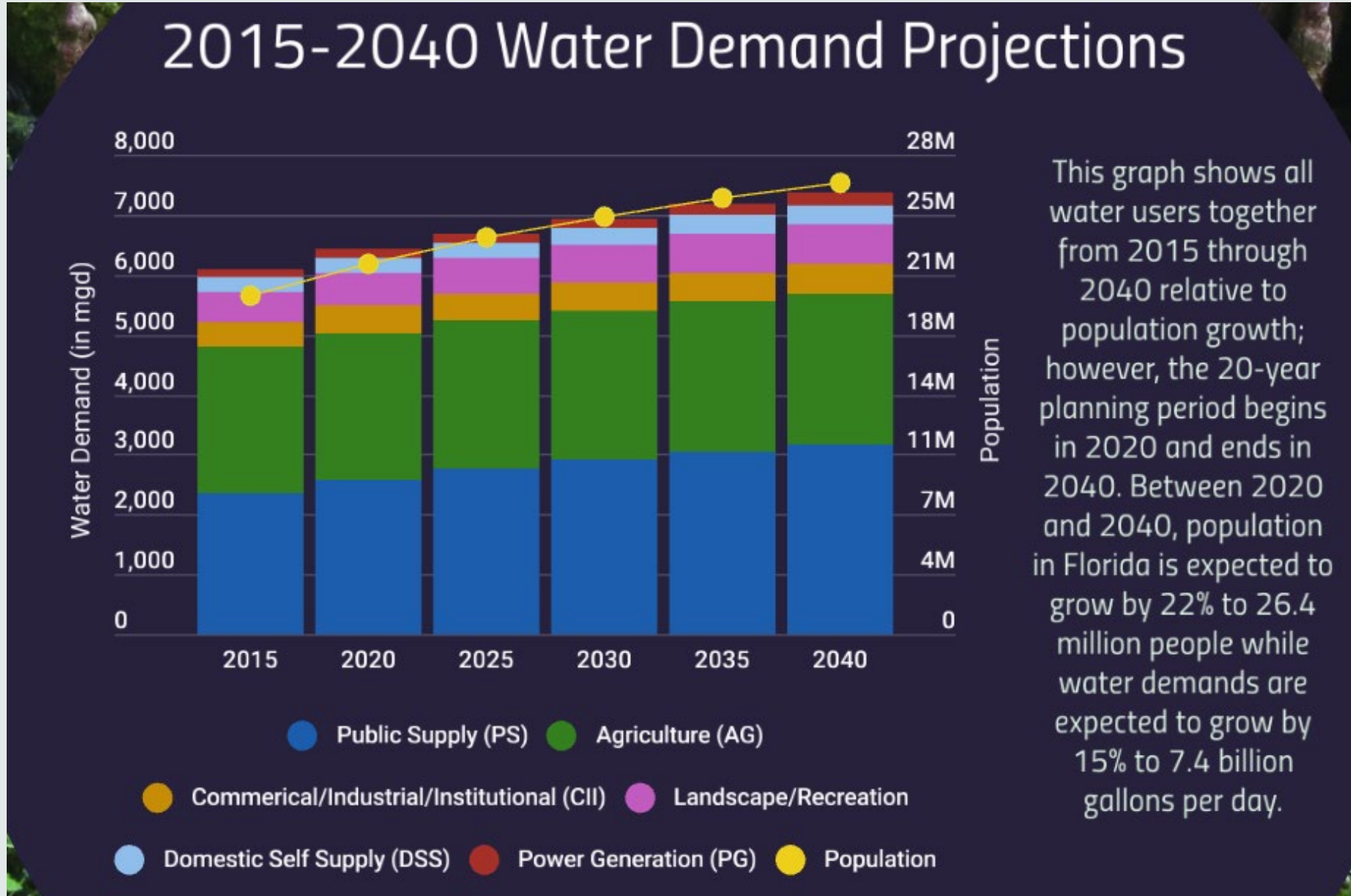


Source: UN Food and Agricultural Organization (FAO) AQUASTAT

OurWorldInData.org/water-use-stress • CC BY

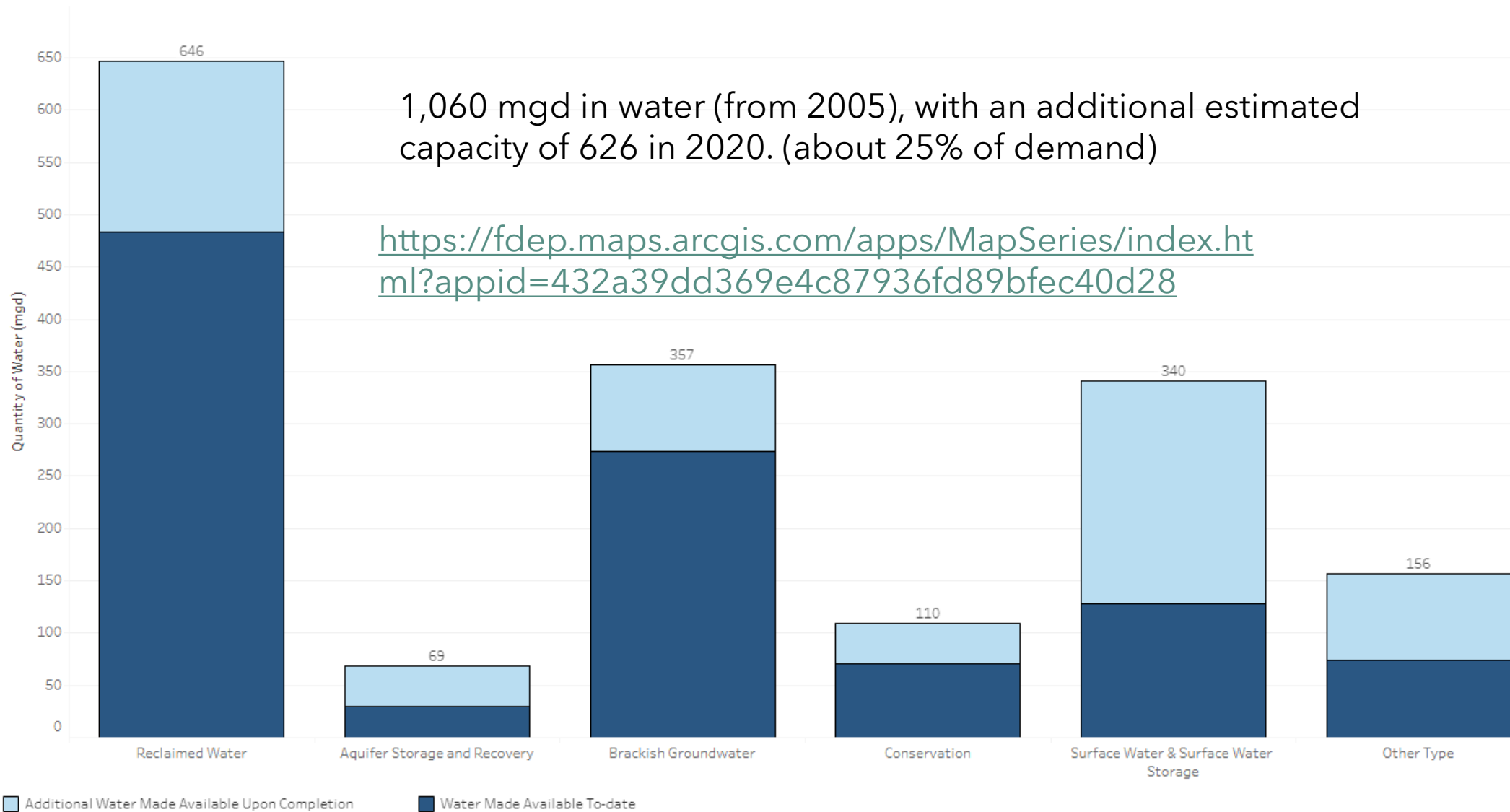
Note the significant decline in per capita water used in the US.

Florida State Consumption – Water



Sate Production – Water

Quantity of Water Made Available

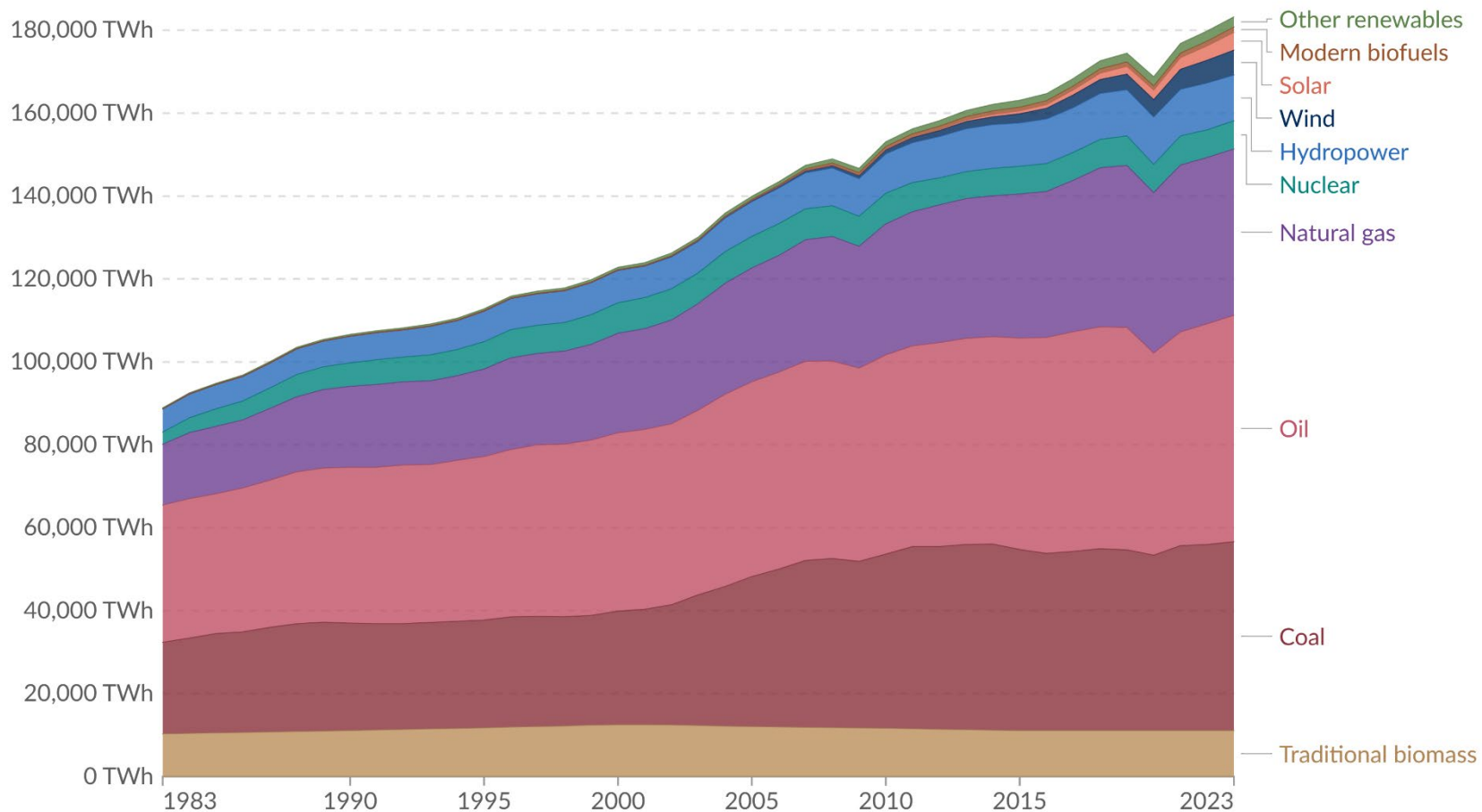


Global Consumption - Energy

Global primary energy consumption by source

Primary energy¹ is based on the substitution method² and measured in terawatt-hours³.

Our World
in Data

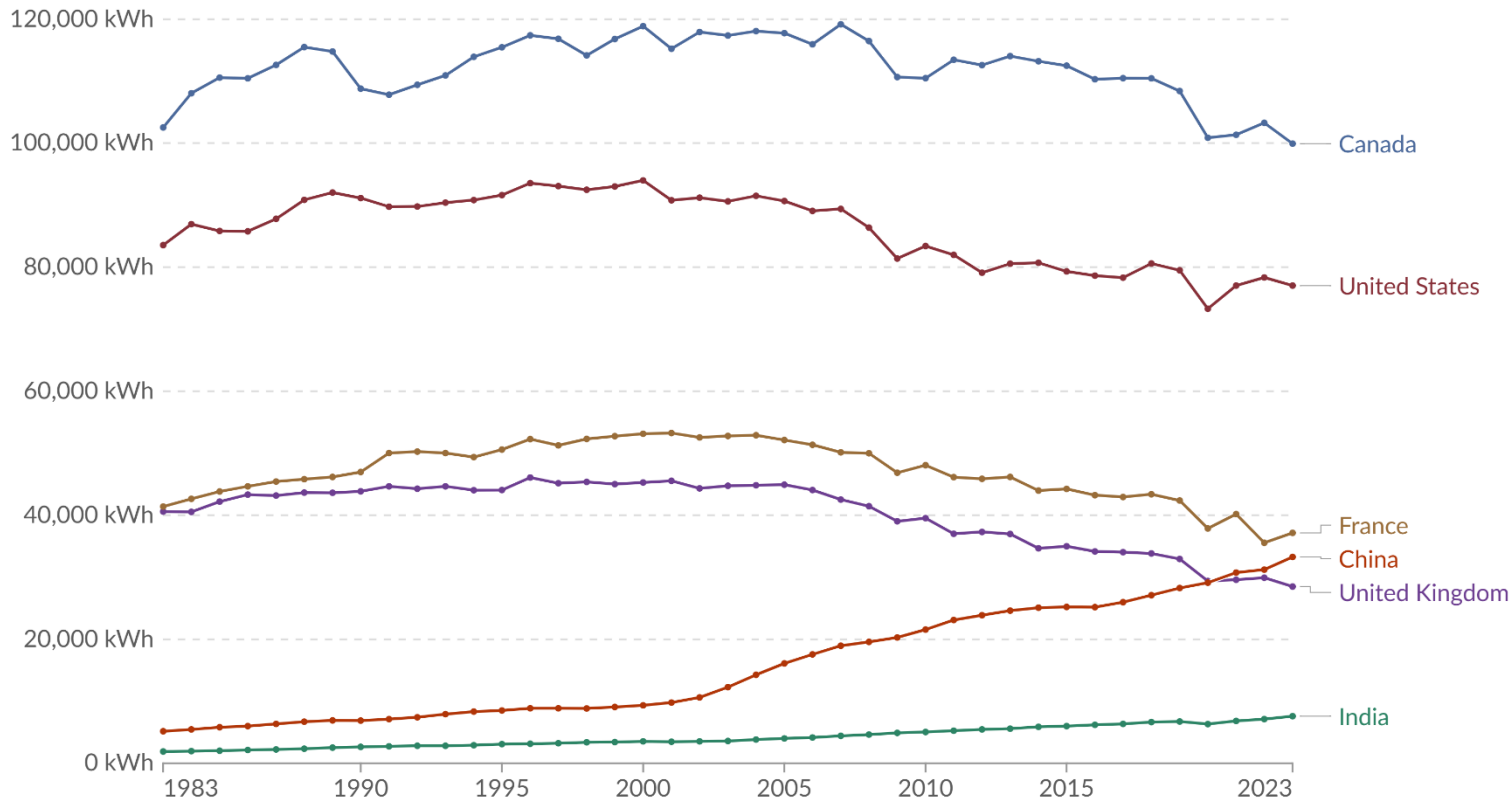


Global Consumption – Per Capita Energy

Energy use per person

Measured in kilowatt-hours¹ per person. Here, energy refers to primary energy² using the substitution method³.

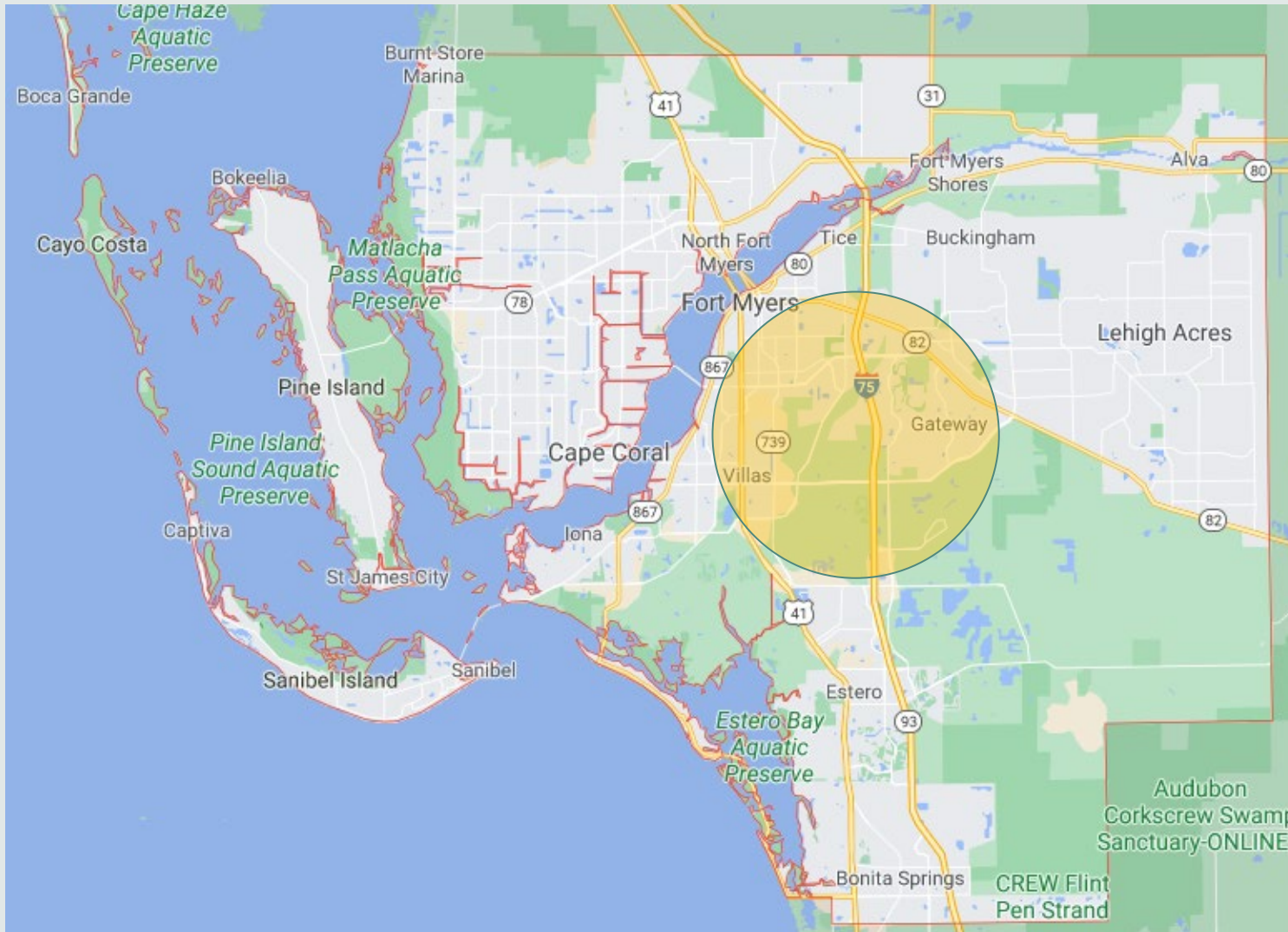
Our World
in Data



Data source: U.S. Energy Information Administration (2023); Energy Institute - Statistical Review of World Energy (2024); Population based on various sources (2023)

OurWorldinData.org/energy | CC BY

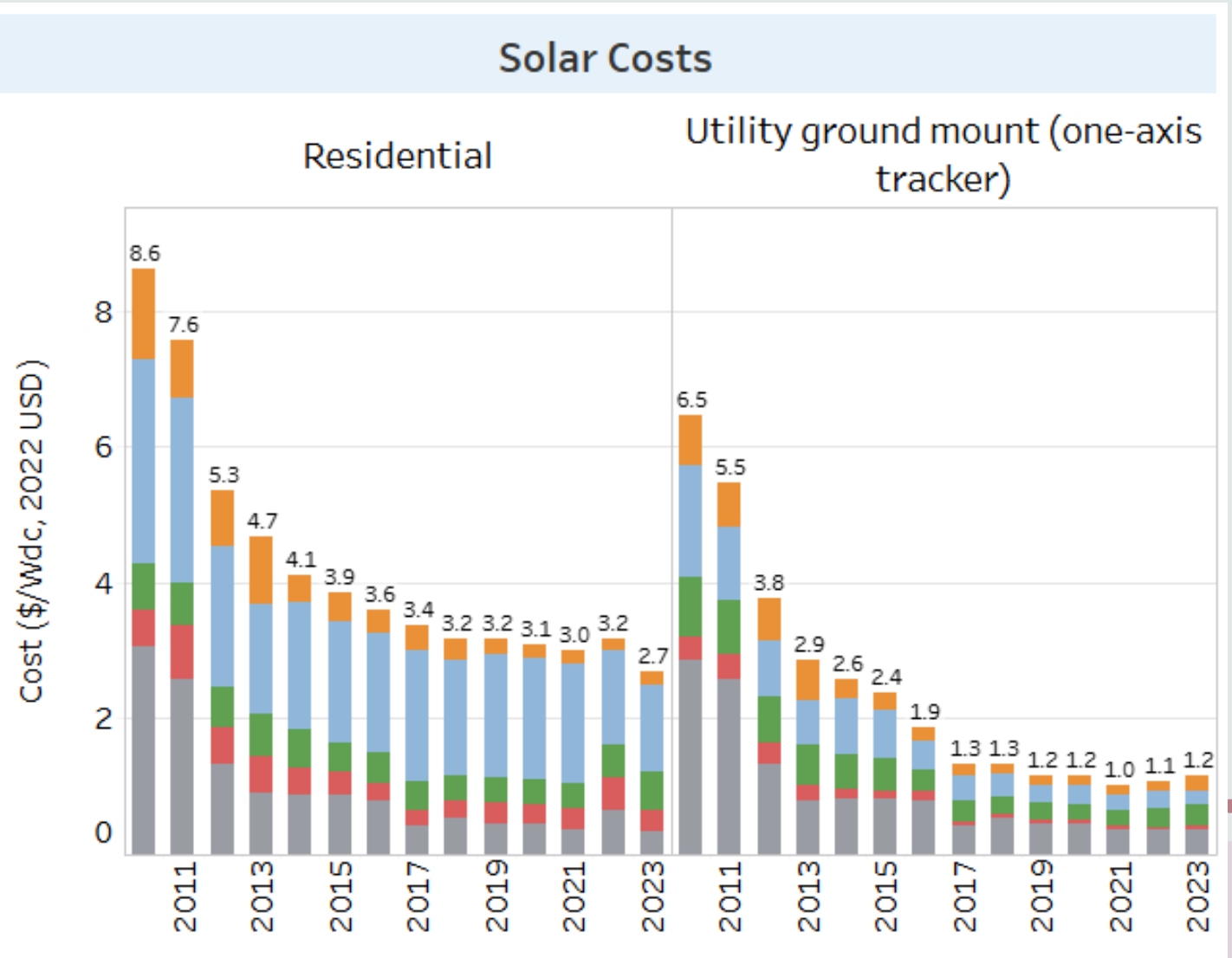
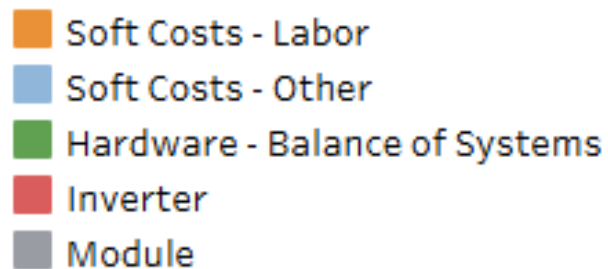
Fort Myers – Pure Solar



The Cape Coral & Fort Myers metro area:

- Population of 770,577 in 2019 (US Census Bureau, 2021).
- Total per capita energy expenditures for Florida (Including Residential, Commercial, Industrial, and Transportation) was ~59 MWh. (US Energy Information Administration, 2018).
- According to PVWatts (National Renewable Energy Laboratory, 2021):
 - 1km² area fits a about 150MW_p (panel capacity) and produces ~212,615 MWh per year.
- If we estimate a total of 32,100 MW_p PV with area of 214 km² (a circle with a radius of 8.25 km). Too meet all energy needs.
- This array would likely cost around \$32 billion with an installation cost of \$1/watt.
 - \$41,527 per person.
 - ~2x larger than the Talatan Solar Park (current biggest)

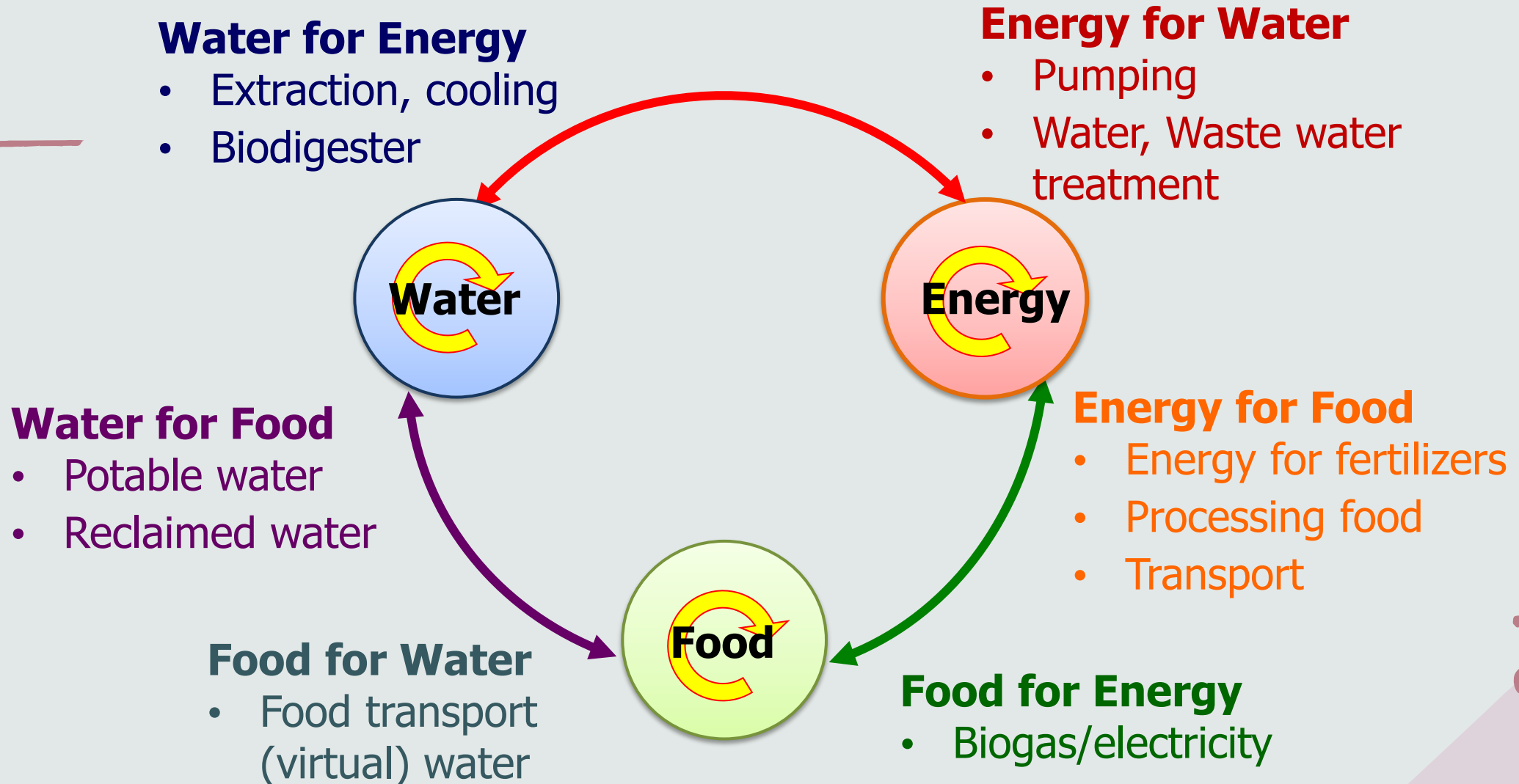
Cost of Solar



<https://www.nrel.gov/solar/market-research-analysis/solar-installed-system-cost>

Part 2 – Systems Integration & Optimization

We Need a Paradigm Shift - System Integration and Optimization



The Water-Energy-Food (WEF) Research at FGCU



Community-scale Water-Energy-Food System

Solar Modeling & Design

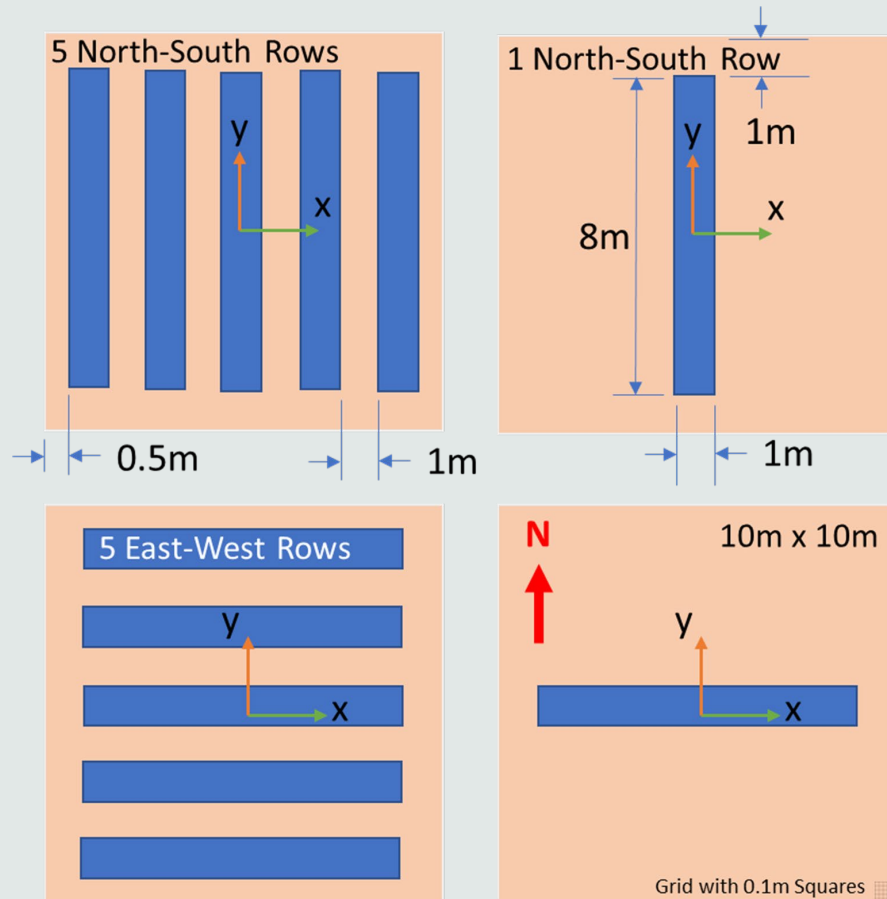
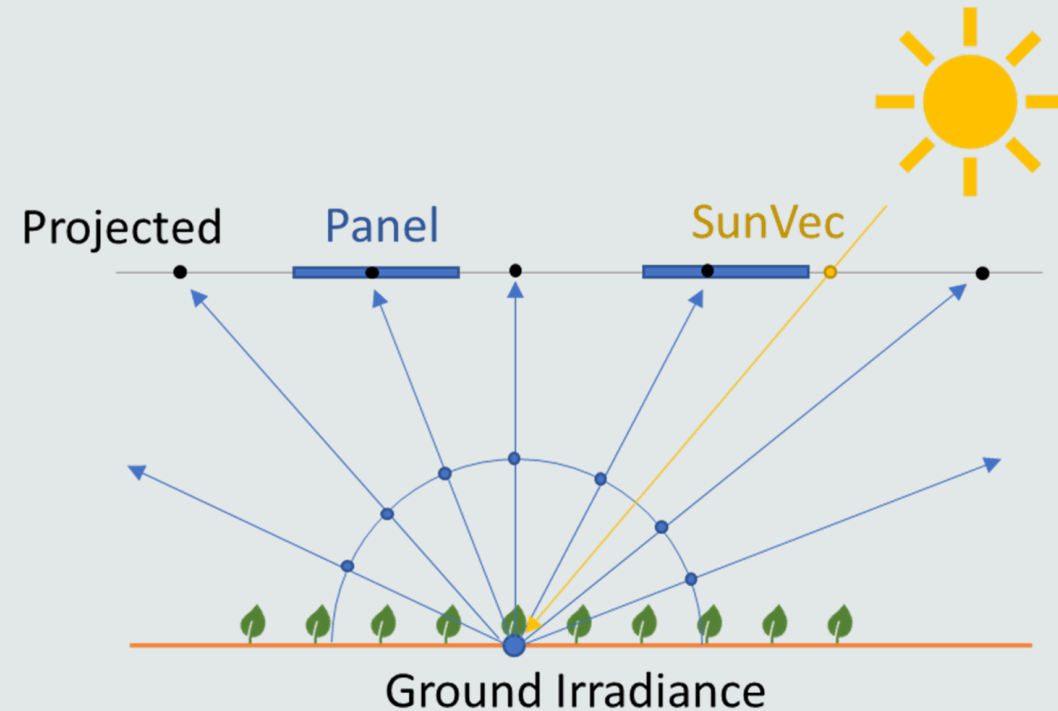
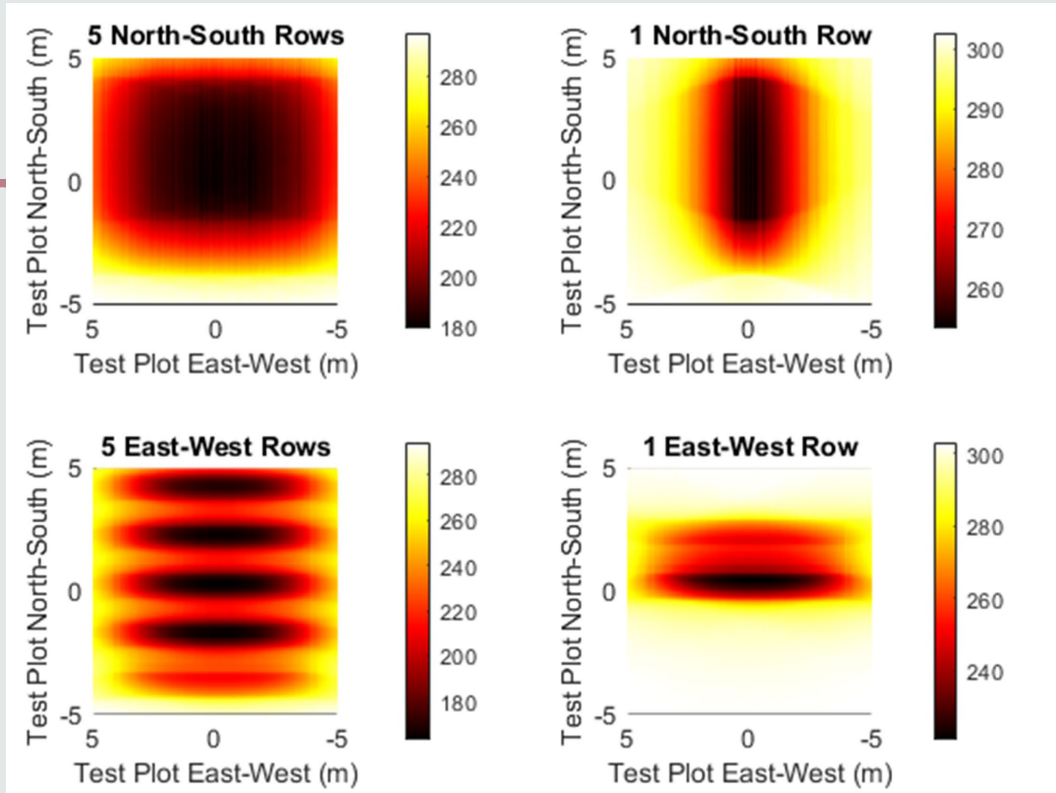


Figure 1. Arrangement and dimensions of the study area and solar panels.

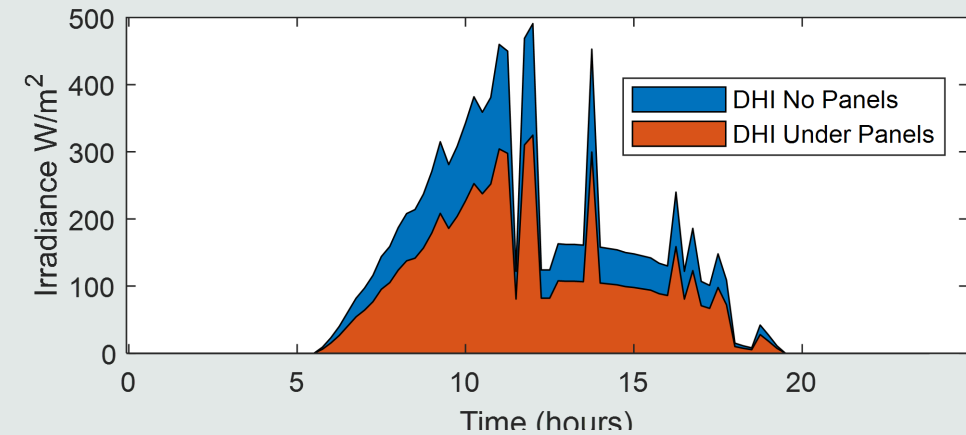
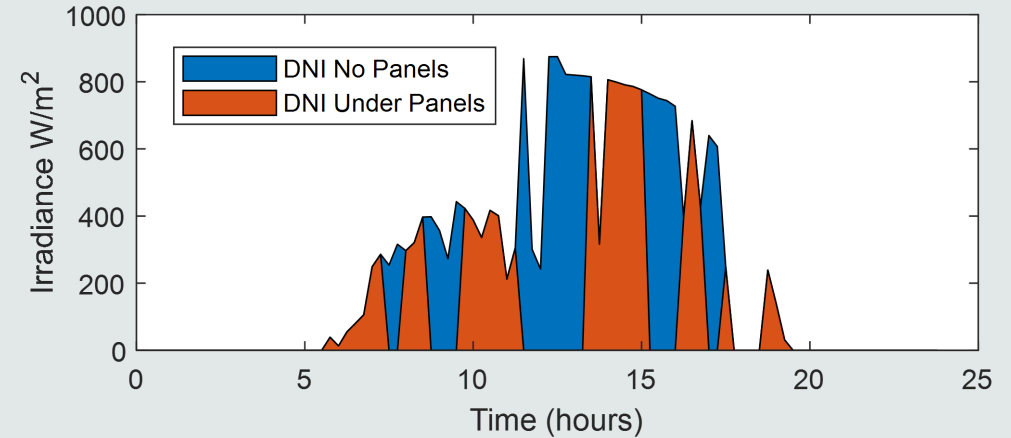


Detailed historical Irradiance data can be obtained from the US National Renewable Energy Laboratory (NREL), National Solar Radiation Database (NSRDB), this includes weather-based shading (clouds).

Solar Modeling & Design



Mean annual solar irradiance for each panel configuration.



Example of irradiation for the middle of the plot (0,0,0) with time-series data for one day (June 30th 2019) in the 5 vertical rows configuration

The Water-Energy-Food (WEF) Research at FGCU

Just after start of construction on June 6th

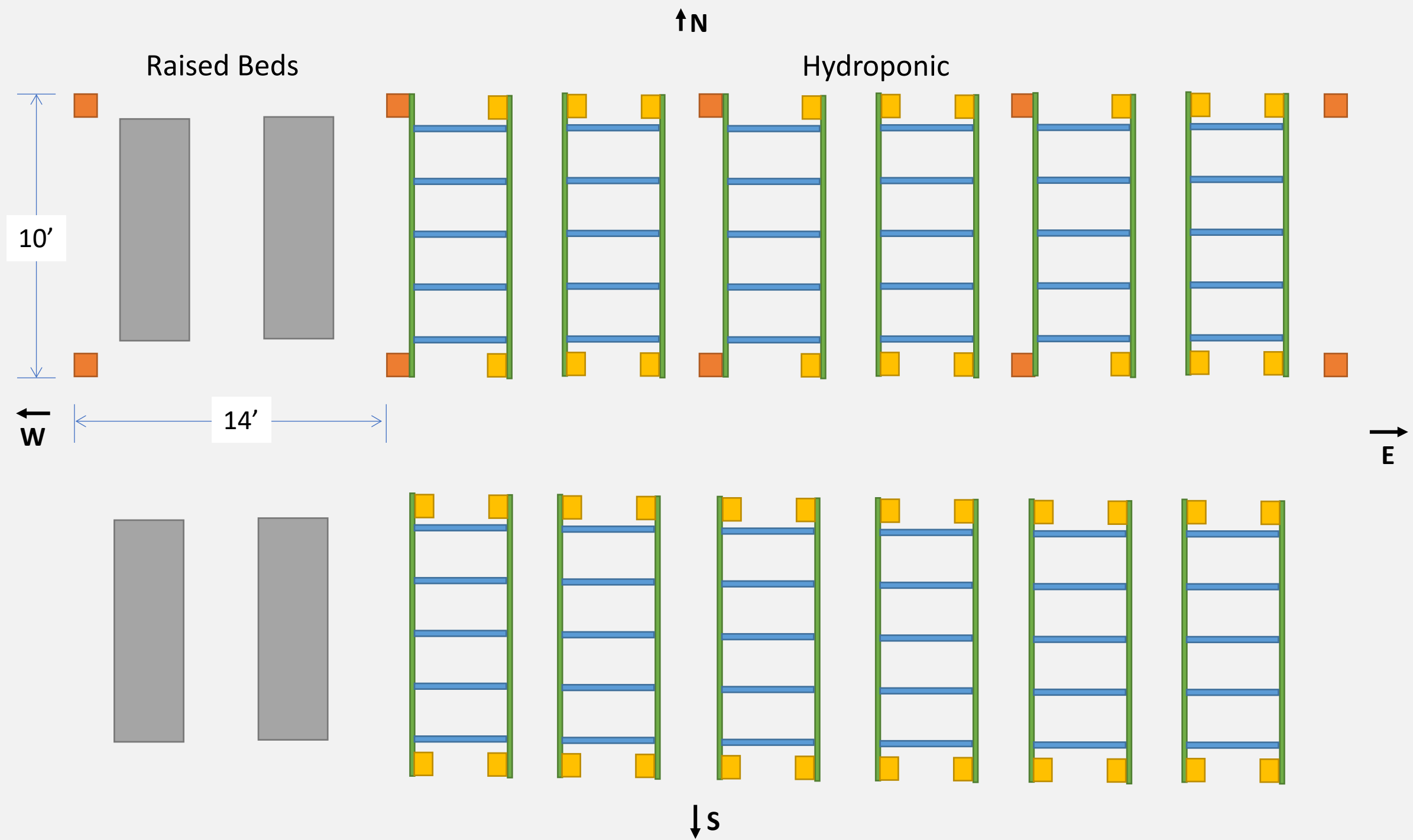


Status as of July 12th



Progress Summer 2022

Precision Systems for Waste Mediation and Agrivoltaic Production



Actual Table Placement / Notes

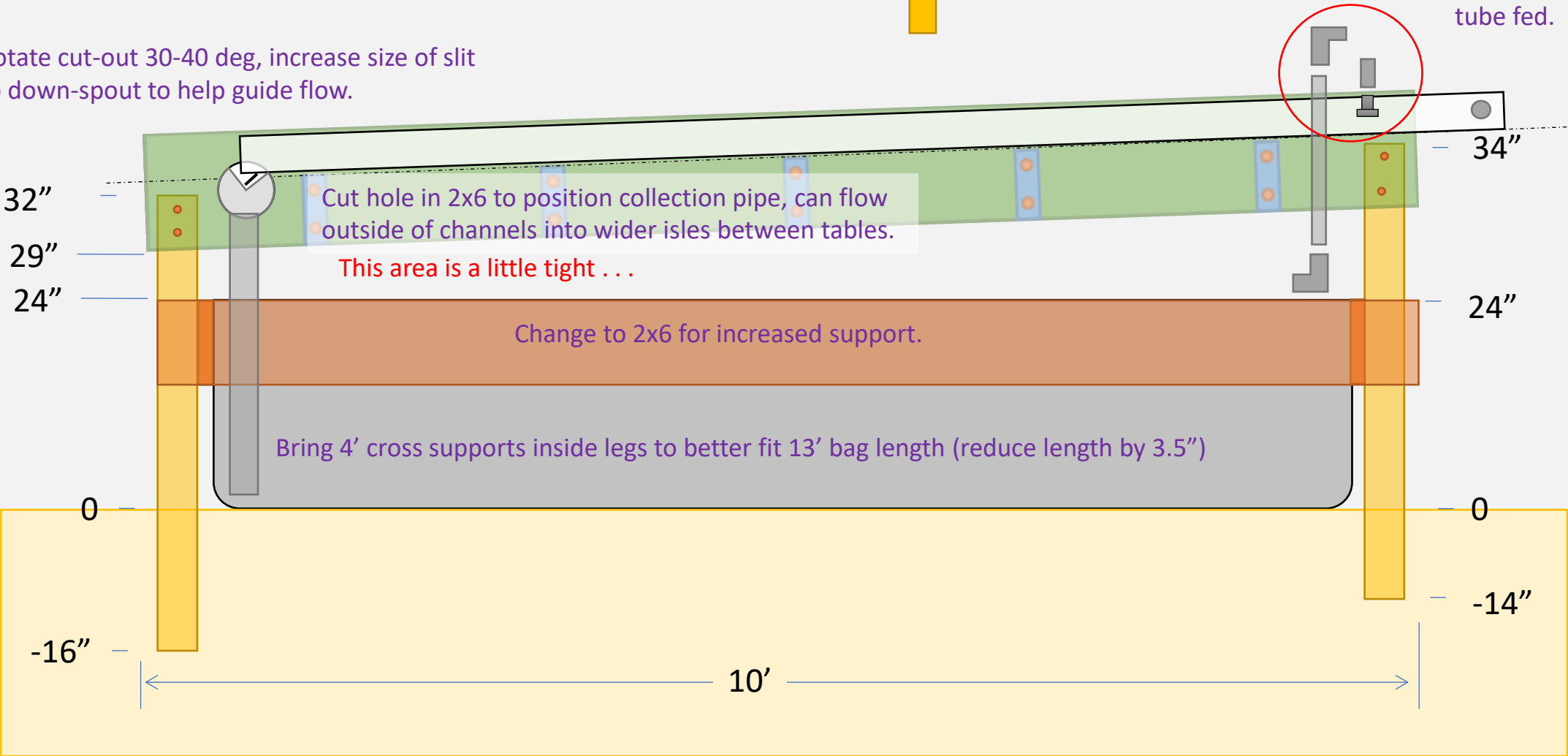
Maintaining a slight / consistent slope is VERY important!

Rotate cut-out 30-40 deg, increase size of slit to down-spout to help guide flow.

4" x 4" by 4ft

4x4s should not go "above" 2x4s

Side-cut continuous tube fed.

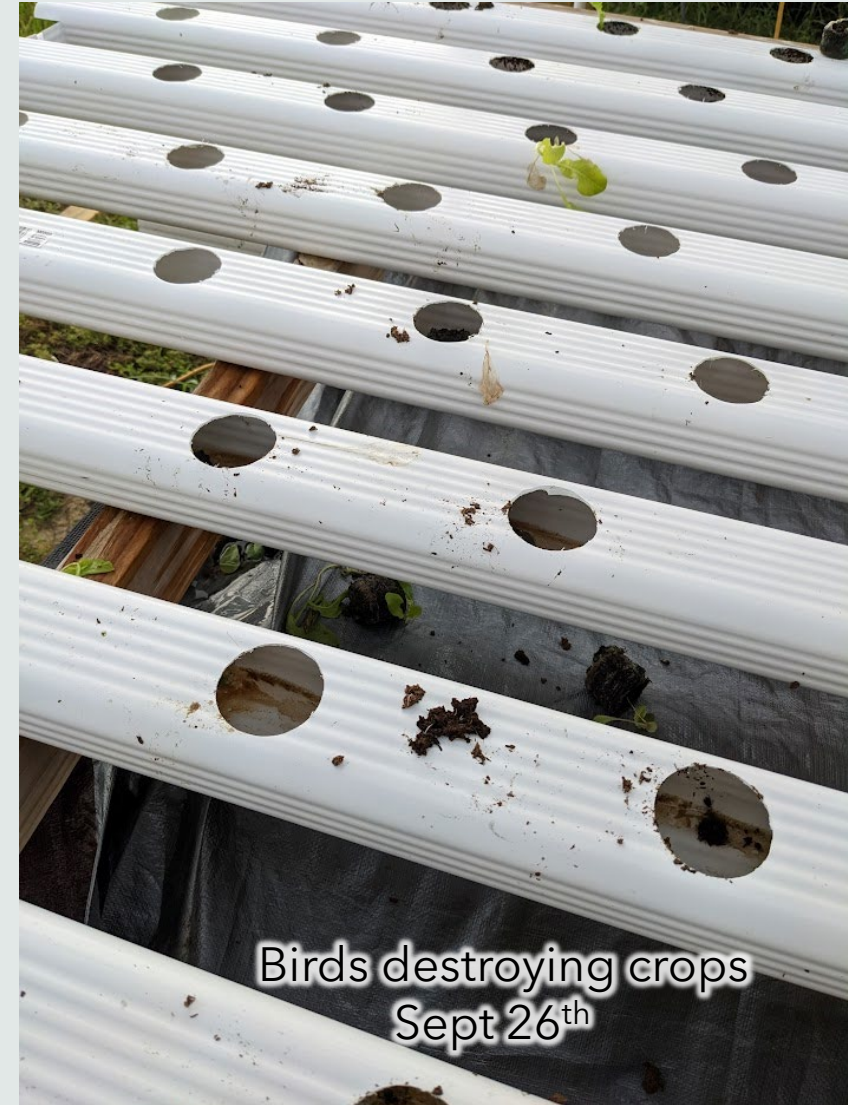


The Water-Energy-Food (WEF) Research at FGCU

8/11/22

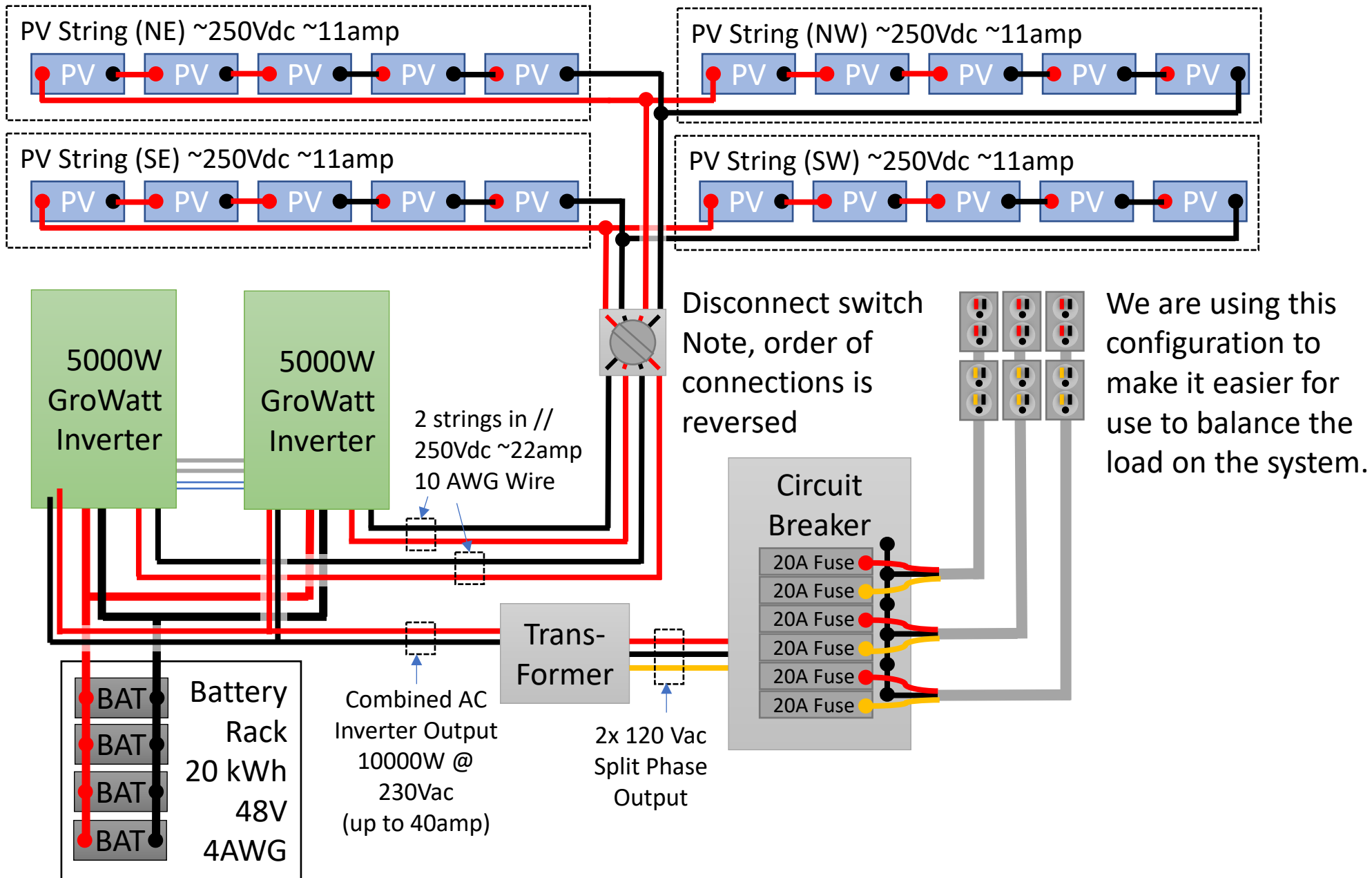
Flow Testing August 11th

	P1	P2	P3	P4	P5	P6	P7	P8
8/11/22	P1	P2	P3	P4	P5	P6	P7	P8
Flow 2 Holes @ 30 sec	440	460	440	420	420	420	460	460
w/3 Holes	600	560	520	520	540	520	540	600
# Water still streaming out in a laminar flow								
w/4 Holes	640	640	620	620	620	600	620	660
# Water Flow out still laminar								



Birds destroying crops
Sept 26th

Precision Systems for Waste Mediation and Agrivoltaic Production



The Water-Energy-Food (WEF) Research at FGCU



Panel Delivery August 30th



Panel Installed Sept 20th

Precision Systems for Waste Mediation and Agrivoltaic Production

System didn't suffer any major damage due to Ian, Milton, or any other hurricane

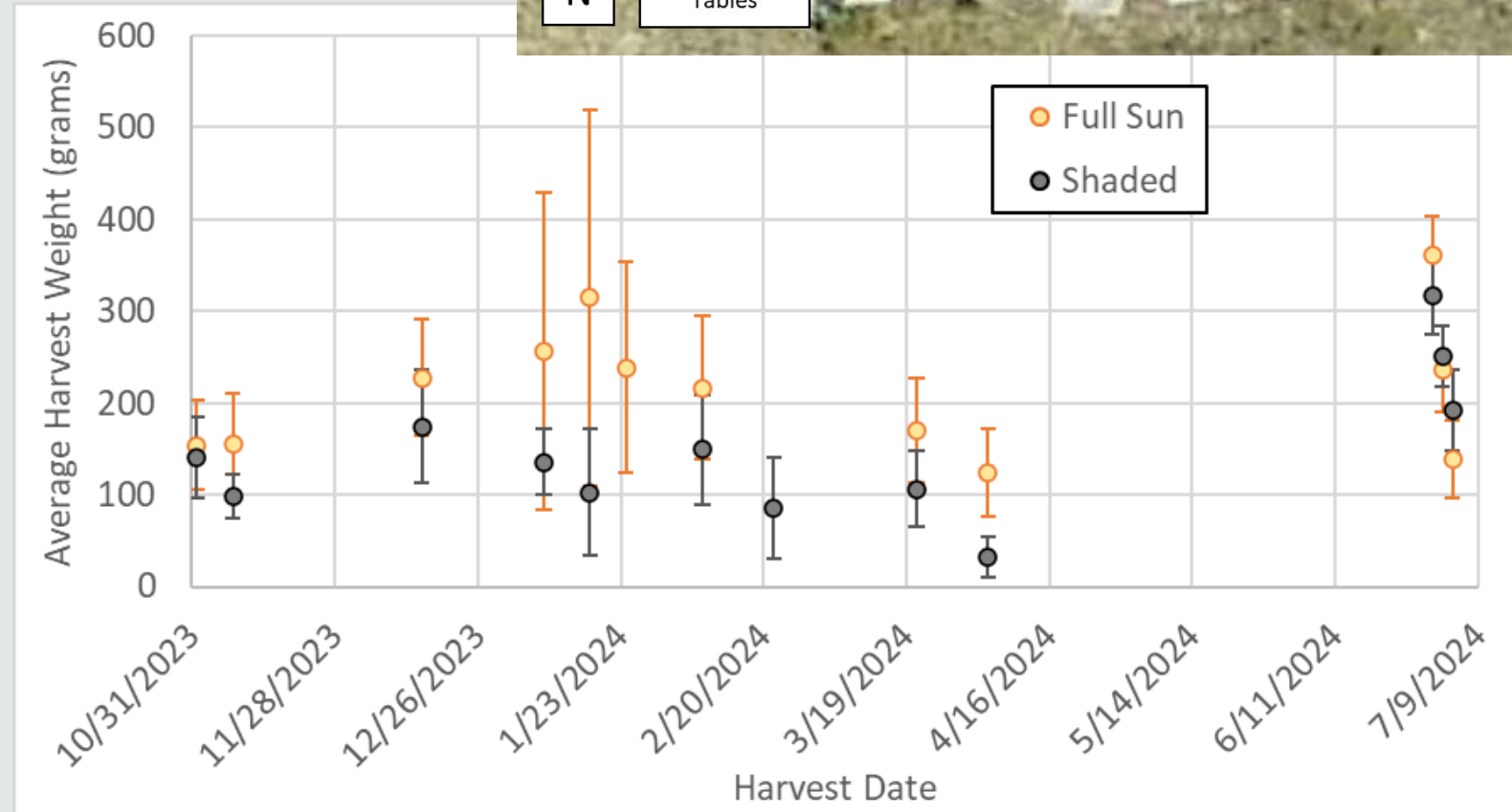


Crop Production:

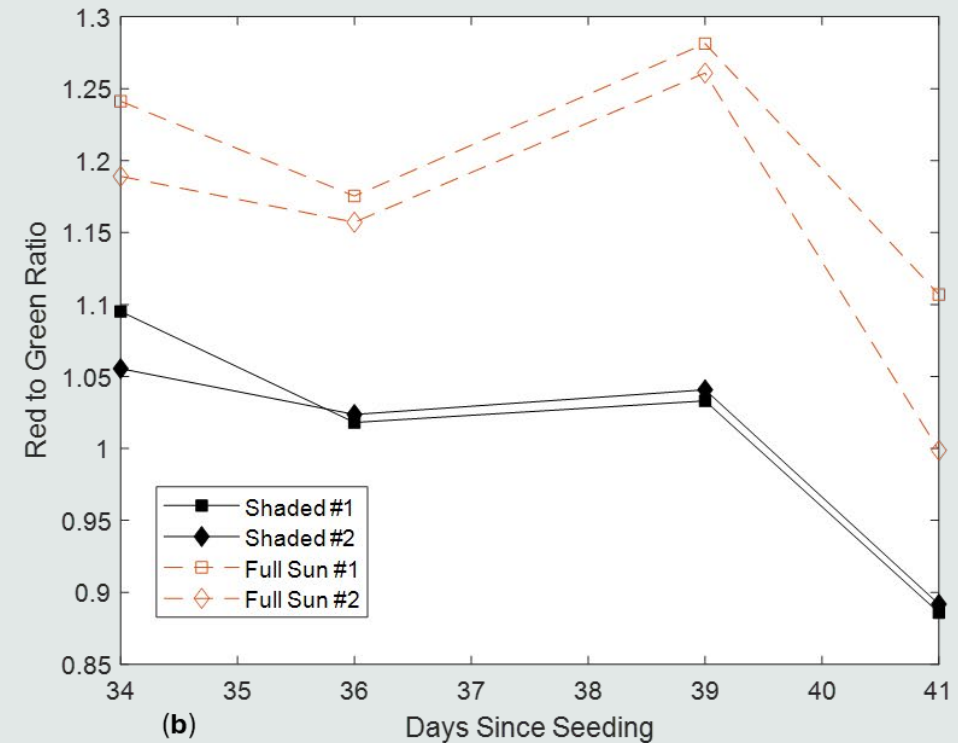
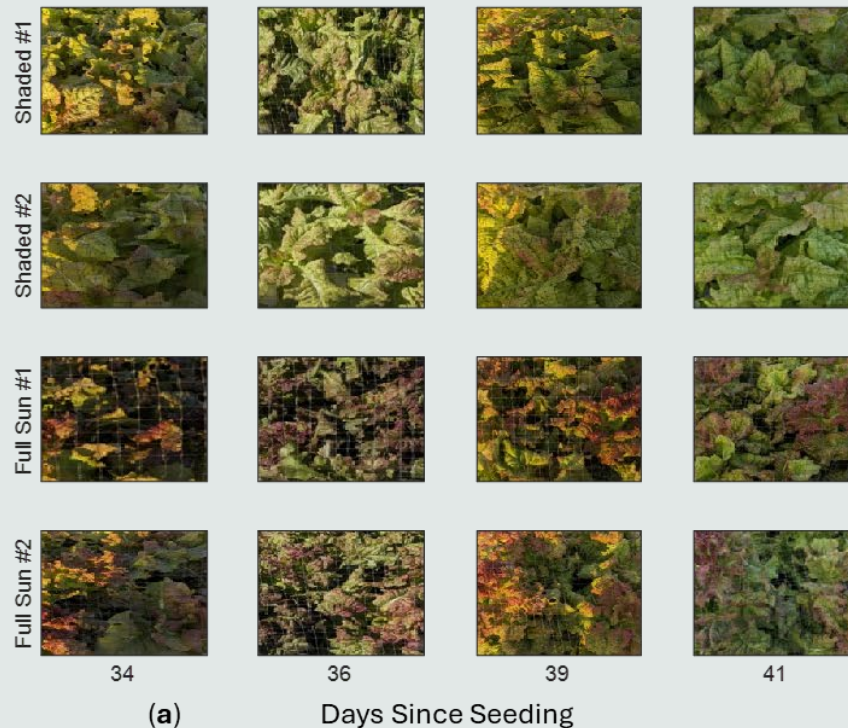
Over the study period the average yield per head of lettuce was:

- 202grams for the Full Sun, and
- 129grams for the Shaded condition

Reduction in yield due to shading, but this reduction is seasonal, and most significant in the winter.



Crop Image Analysis



We've used image analysis to analyze crop growth and quality. Here we see a significant difference in the coloration of the full sun and shaded crops (with the full sun crop being more red and less green)

Systems Require Monitoring / Benefits from Heavy Automation

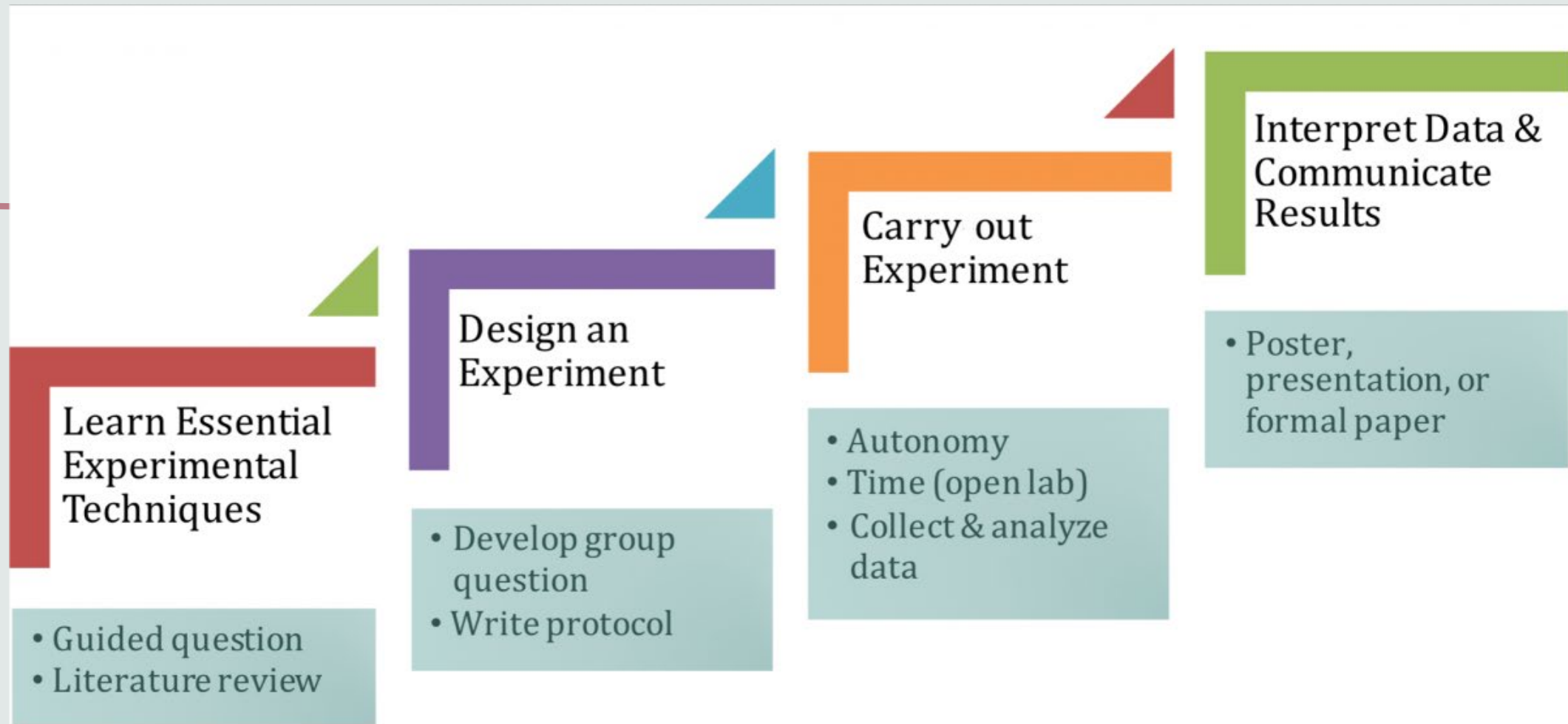
- Closely coupled systems means that failure (or decreased performance) in one area will have a significant negative impact on other areas.
- Resilience of the system, and of individual components must be considered.
- What happens if?

Future Work

- We continue to operate the system to collect data on nutrient solutions and bio-digester effluent as a means of fertigation.
- Adding additional sensor and automation systems.
- Exploring additional funding opportunities to expand system/science.

Part 4 – The Importance of Undergraduate Research

Why Undergraduate Research—Student

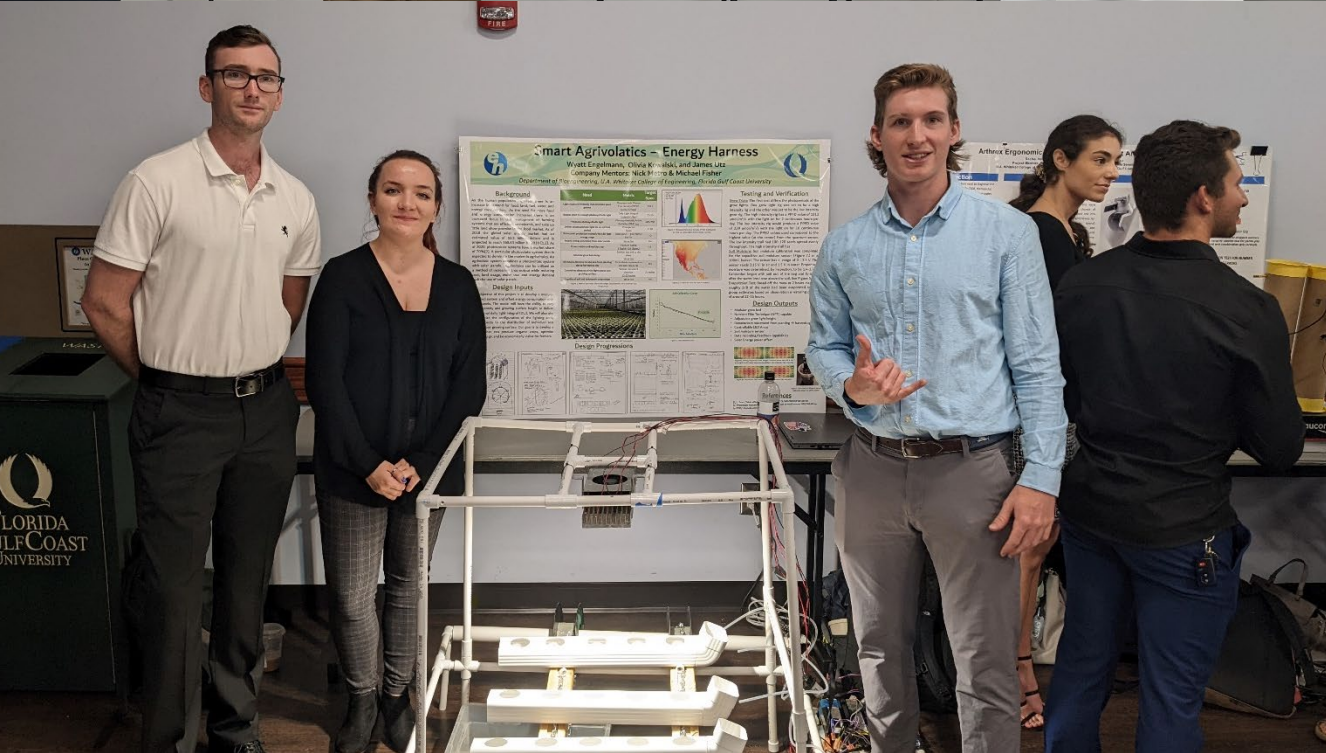
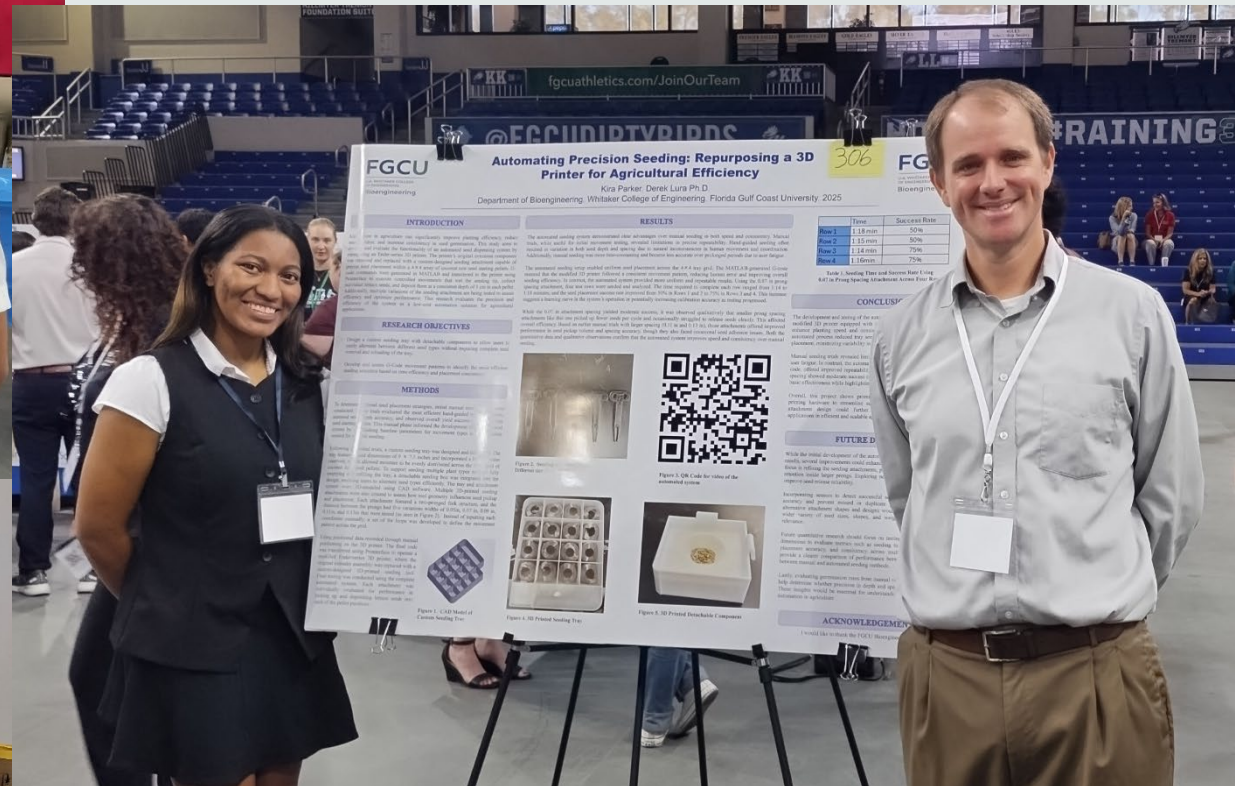
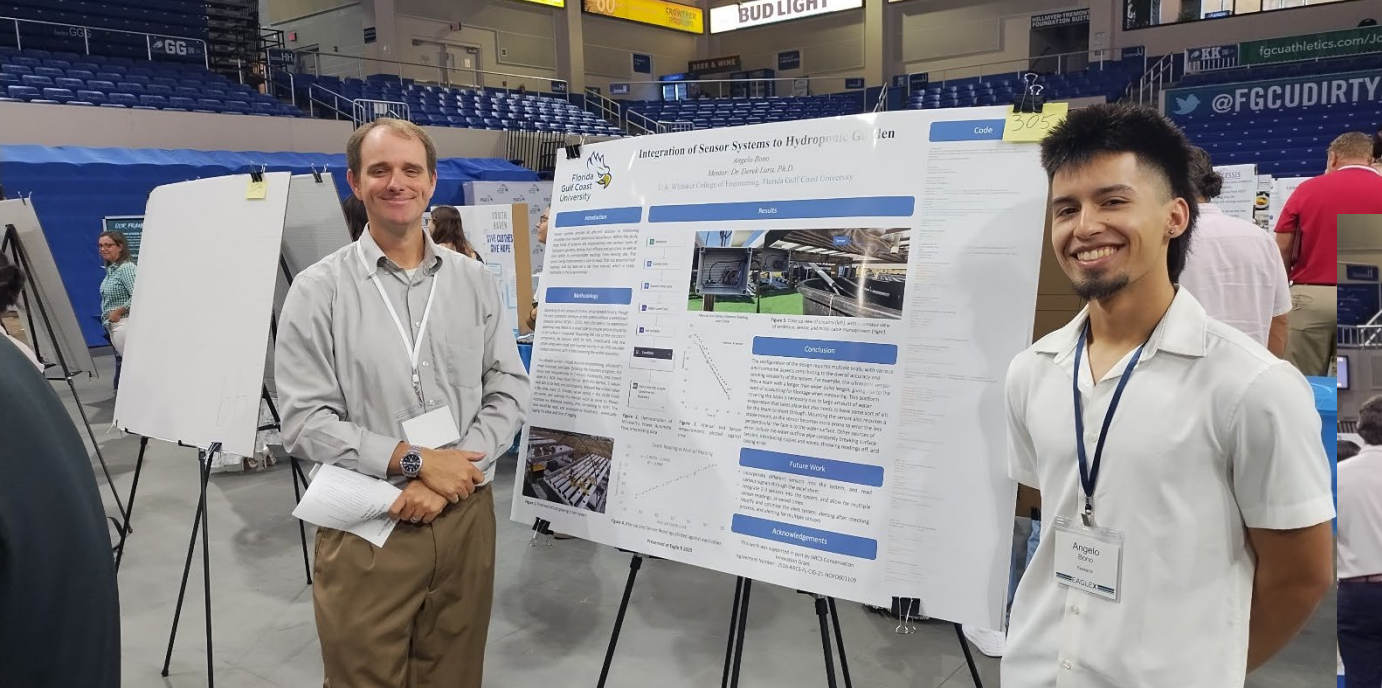


Academic achievement, career goals, grad school, transferable skills, teamwork, community/network, confidence.

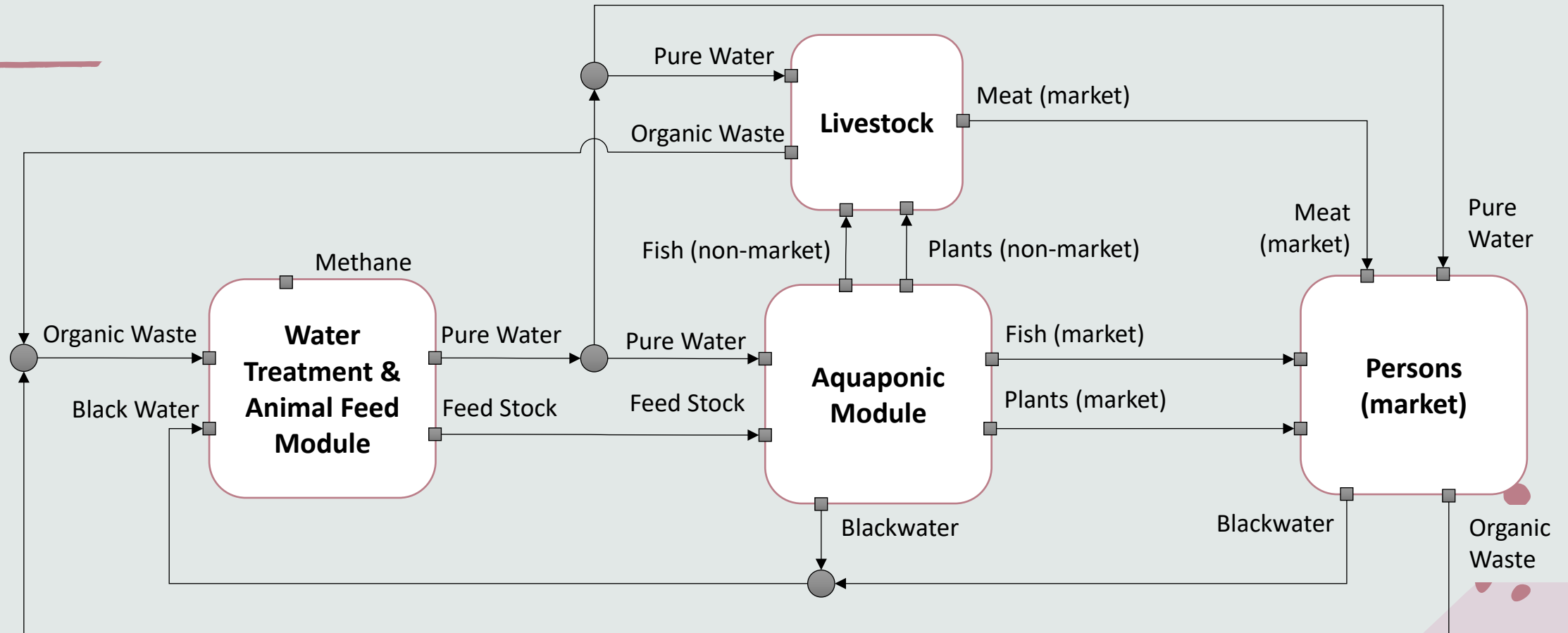
More Than 15 Students Engaged in WEF Research

Some of the Factors Critical to Succeed in Undergraduate Research

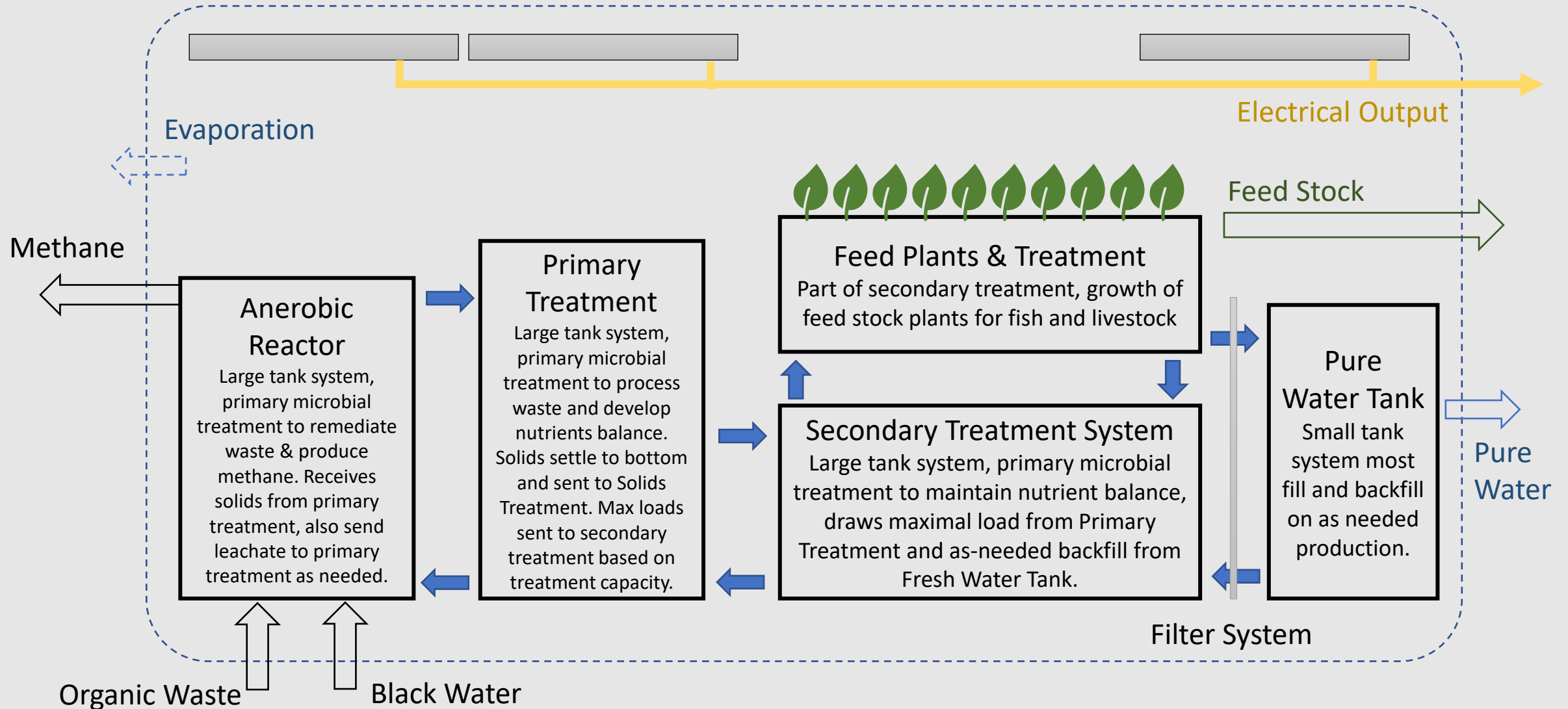
- Students' **motivation, enthusiasm, and hard work**
- Students' **self-esteem and value**
- Students' **time commitment and patience** to research
- Mentorship **relationship between faculty**
- Faculty **establishes clear expectations**
- Open **communication** within the research team
- Availability of **resources and institutional support**
- **knowledge at the time of starting** the research (coursework)
- Clearly defined **hierarchy of students** in the research team and collaborative team



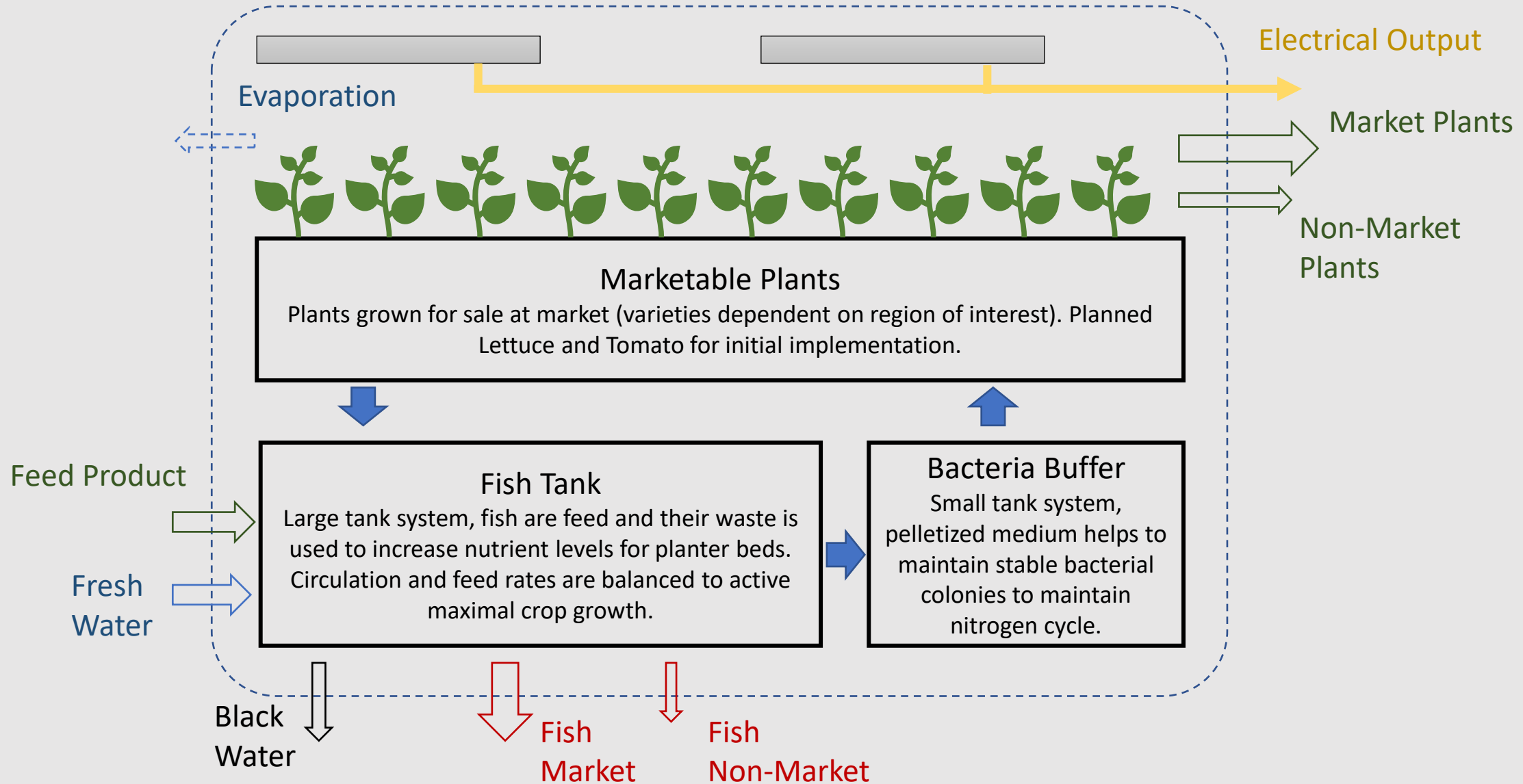
Entirely closed-loop systems



Water Treatment & Animal Feed Module



Aquaponic Module



Evaluation of High Tunnel Systems on Dragon Fruit Production in South Florida



Maruthi Sridhar B. Bhaskar, Priyanka Belbase,
Krish Jayachandran, Mahadev Bhat
Department of Earth and Environment
Florida International University (FIU), Miami, FL





Overview

- Introduction
- Cultivation Challenges
- Objectives
- Experimental Design
- Results: Crop metrics
- Plant and Soil nutrient dynamics
- Conclusion
- Acknowledgement

Introduction: Dragon Fruit

Cultivation Overview

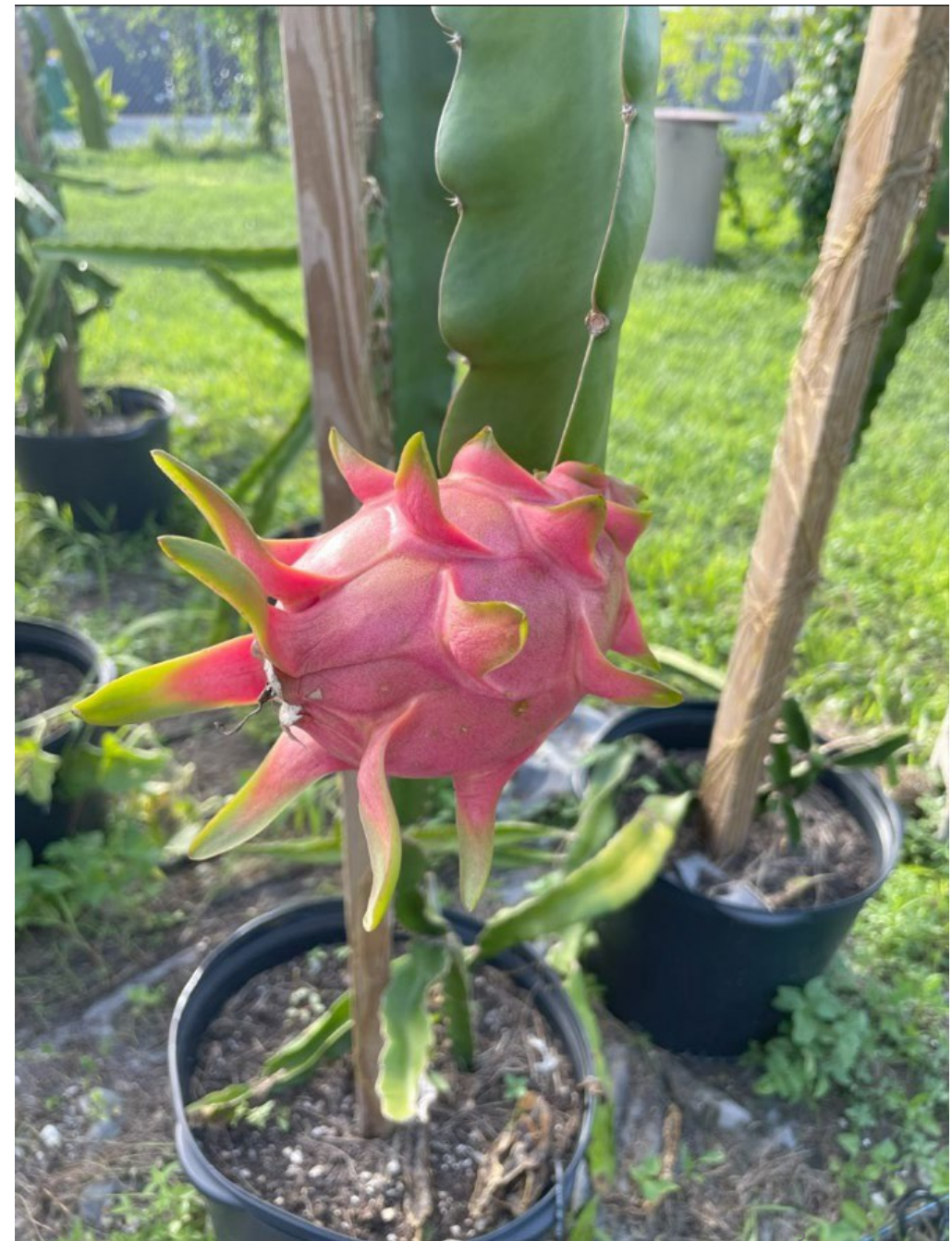
Dragon fruit (*Hylocereus spp.*) is a climbing tropical cactus with high market demand.

Gaining popularity for its rich nutritional profile and health benefits.

Drought-tolerant and adaptable to marginal soils with minimal inputs.

Increasingly cultivated in high tunnels to improve yield and protect quality.

A promising crop for sustainable and climate-resilient agriculture.



Dragon fruit Cultivation Challenges



- Challenges in South Florida: pests, diseases, unpredictable weather
- High tunnels: a possible climate-smart solution



Why High Tunnel Cultivation?

- **High tunnels** are plastic-covered structures for growing crops in a protected environment.
- **Extend growing seasons** and allow earlier/later harvests.
- Reduce exposure to **pests, diseases, and harsh weather**.
- Maintain a **controlled microclimate** for better plant growth.
- Improve **nutrient retention and water-use efficiency**.



Objectives

- To determine the effect of high tunnel facilities on pitaya production and health
- To examine the impact of high tunnel on soil and plant macro and micronutrient concentrations



Experimental Setup – Methods

Dragon Fruit Varieties



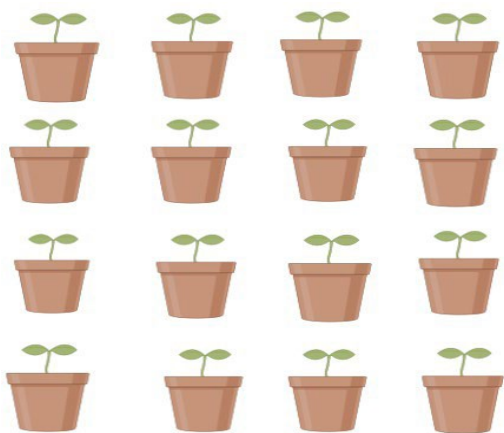
Hylocereus costaricensis
(Red)



Hylocereus megalanthus
(Yellow)

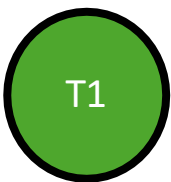


Hylocereus undatus
(White)



Randomized Complete Block
Design (RCBD)

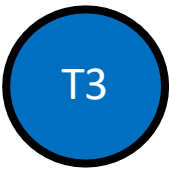
Vermicompost



Control



5t/acre-
0.397kg



10t/acre-
0.79kg



20t/acre-
1.59kg

FIU Organic Garden



Open Environment



Hoop house Environment

Methodology

- A total of 36 plants with four treatments and 3 replicates per plant species were established in the high tunnel and the same experimental setup with another 36 plants were established as control, outside the high tunnel.
- The soil and plant samples were analyzed for N, P, K, Ca, Mg, Zn, Na, and C using standard agricultural soil and plant testing procedures.
- The spectral reflectance of the plant treatments were collected in the spectral range of 350-2500 nm using the handheld spectroradiometer.

FIU Organic Garden

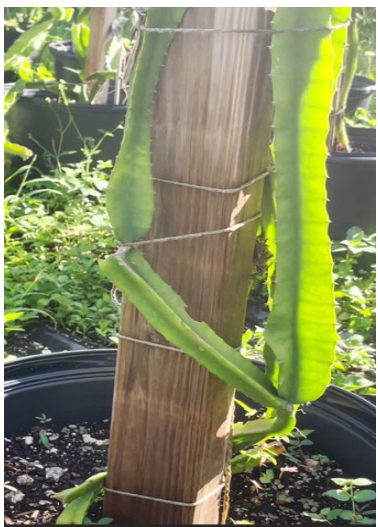
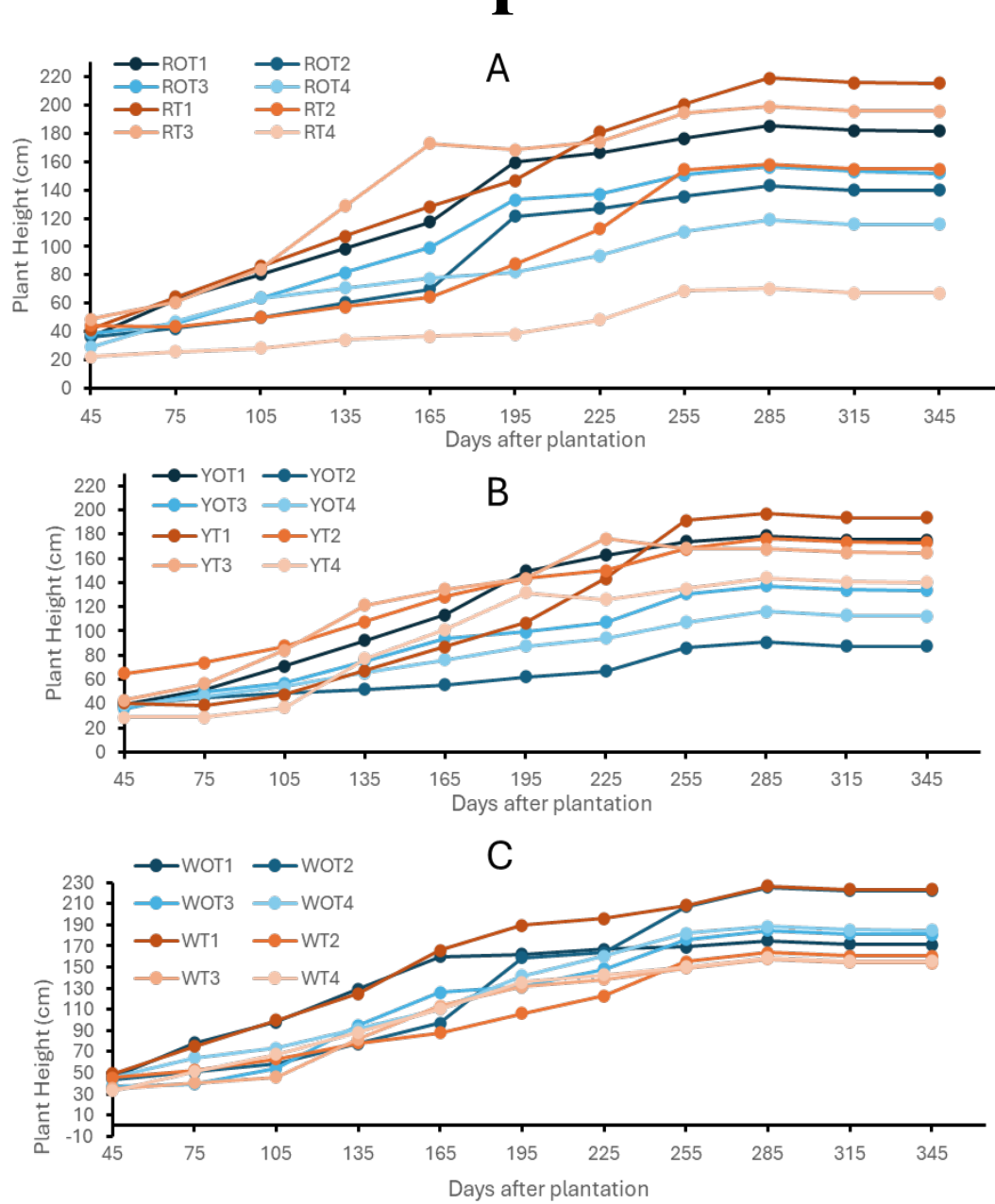


Open Environment



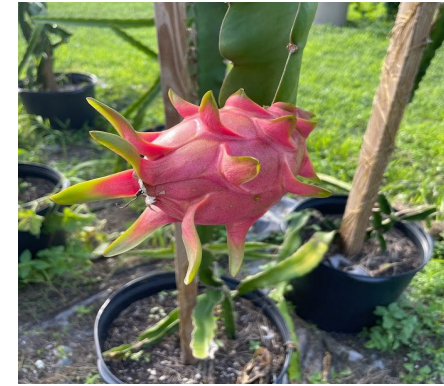
Hoop house Environment

Results: Crop Performance Metrics

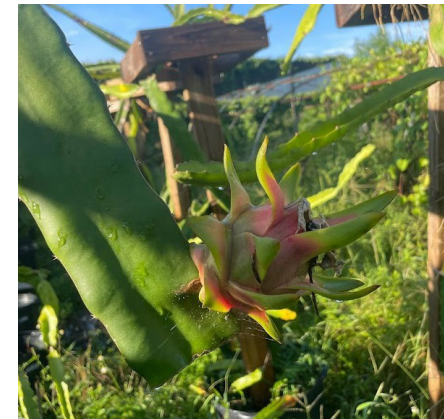


Red Pitaya, Yellow Pitaya, and White Pitaya plants grown in the open environment and high tunnel facility.

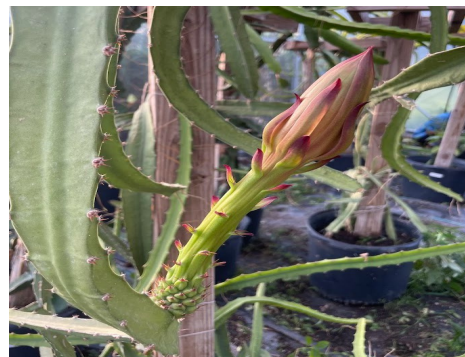
Results: Fruit Flowering and Quality



WP



RP



YP

Results: Soil chemical analysis

Treatment	N (%)	P	K	Ca	Mg	Zn	Na	C (%)	OM	CEC
ROT1	0.9	709 a	153 c	2402 b	952	33	43	15	27	20 a
ROT2	0.8	475 a	178 c	2395 b	918	18	53	15	27	20 a
ROT3	0.8	600 a	264 c	1904 d	1055	19	50	15	26	19 a
ROT4	0.8	512 a	207 c	1967 d	659	16	51	15	27	16 b
RT1	0.7	464 a	517 b	2870 a	810	27	70	12	22	22 a
RT2	0.8	303 b	287 c	2562 b	505	12	77	14	25	18 a
RT3	0.8	347 b	777 a	2459 b	691	12	224 a	14	25	20 a
RT4	0.9	334 b	1004 a	2346 c	692	11	258 a	15	27	20 a

Table 1. Nutrient and metal concentrations in the soil samples collected from the different plant treatments (ppm). Given are mean values (n = 3) of three replicates. † Means followed by a different letter are significantly different at the 0.05 probability level, grouped into classes a, b, and c.

Results: Soil chemical analysis

Treatment	N (%)	P	K	Ca	Mg	Zn	Na	C (%)	OM	CEC
WOT1	0.8	550 b	97 c	2494 b	511	37	45 c	14	24	17 b
WOT2	0.7	294 b	107 c	2528 b	502	13	43 c	13	23	17 b
WOT3	0.8	560 b	225 c	2500 b	822	19	55 c	15	26	20 a
WOT4	0.8	442 b	151 c	2145 b	635	13	39 d	14	25	16 c
WT1	0.8	707 a	413 b	3461 a	795	64	58 c	13	24	25 a
WT2	0.8	345 b	404 b	2695 b	669	15	90 b	14	25	20 a
WT3	0.8	373 b	668 a	2712 b	781	14	183 a	15	27	22 a
WT4	0.9	440 b	622 a	2458 b	704	14	160 b	16	28	20a

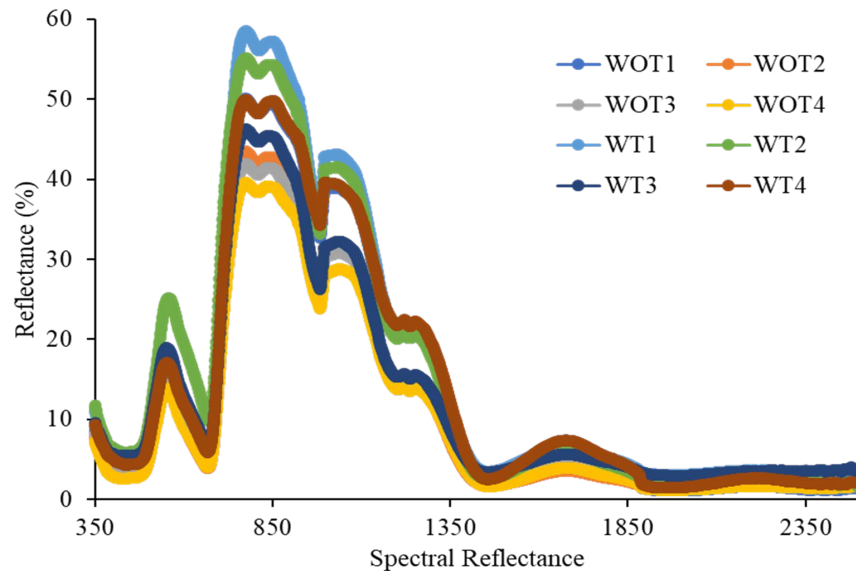
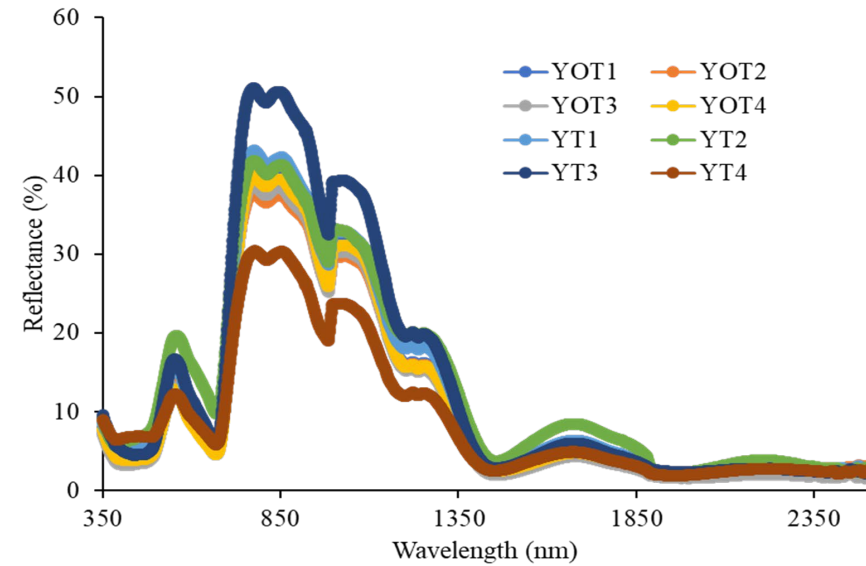
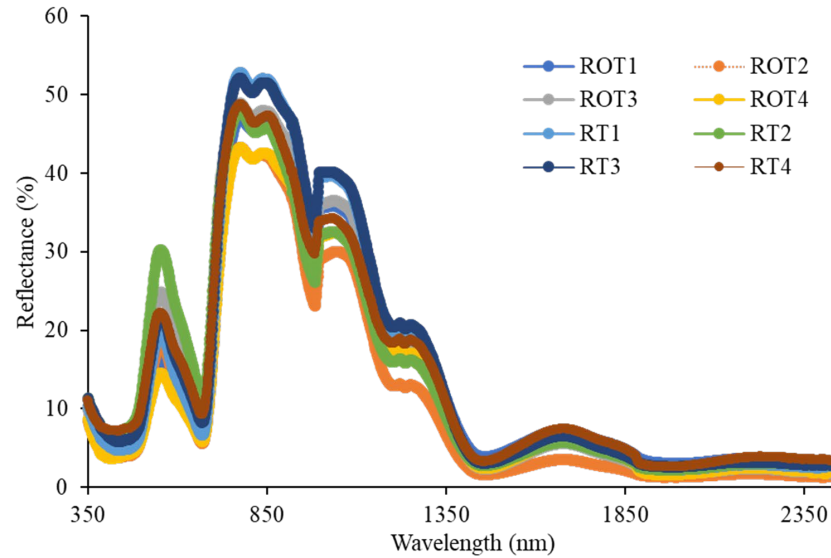
Table 2. Nutrient and metal concentrations in the soil samples collected from the different plant treatments (ppm). Given are mean values (n = 3) of three replicates. † Means followed by a different letter are significantly different at the 0.05 probability level, grouped into classes a, b, and c.

Results: Soil chemical analysis

Treatment	N (%)	P	K	Ca	Mg	Zn	Na	C (%)	OM	CEC
YOT1	0.7	331 b	95 c	2126 d	517	28	35 d	13	22	15 c
YOT2	0.8	277 b	88 c	2106 d	415	13	40 d	15	26	14 c
YOT3	0.7	327 b	103 c	2216 c	422	13	37 d	13	23	15 c
YOT4	0.6	362 b	153 c	1981 e	531	13	39 d	12	21	15 c
YT1	0.7	499 a	323 c	3074 a	674	28	48 c	12	22	22 b
YT2	0.8	297 b	433 b	2564 b	592	12	94 b	14	25	19 b
YT3	0.8	361 b	631 b	2753 b	754	14	183 a	15	27	22 b
YT4	0.8	429 a	1400 a	2578 b	1012	15	360 a	15	26	25 a

Table 3. Nutrient and metal concentrations in the soil samples collected from the different plant treatments (ppm). Given are mean values (n = 3) of three replicates. † Means followed by a different letter are significantly different at the 0.05 probability level, grouped into classes a, b, and c.

Plant Spectral Reflectance

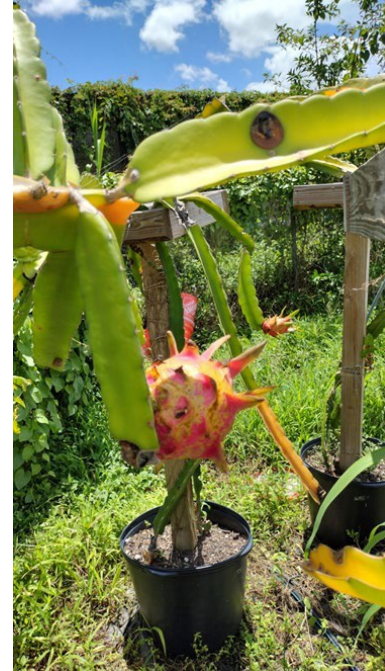


Pitaya plants had higher chlorophyll peak and Near Infrared (NIR) reflectance, indicating more chlorophyll, better biomass and canopy cover under high tunnels.

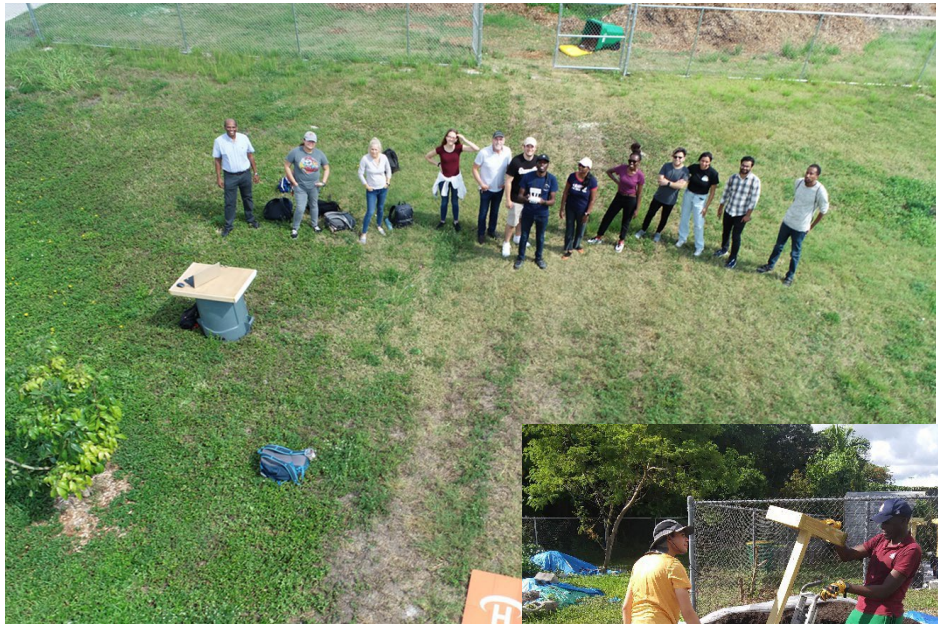
Conclusions

- High tunnels improved **nutrient retention** and **soil health** compared to open fields.
- Dragon fruit showed **higher growth rate** under high tunnel conditions.
- Controlled environment enhanced **water-use efficiency** and **nutrient uptake**.
- High tunnels boosted growth in Pitaya plants after **120** days, especially for Yellow Pitaya.
- **Red and white pitaya** had higher Near Infrared (NIR) reflectance, indicating better biomass and canopy cover.
- Plants in high tunnels **showed fewer diseases**.





Acknowledgements



This research is primarily supported by the USDA-NRCS grant under the award number NR224209XXXXG001.



A close-up photograph of a white lotus flower in full bloom, with its yellow stamens and central seed pod visible. The flower is set against a blurred background of green leaves and blue sky.

General Discussion



Thank you!

- If you have any questions, comments, suggestions for future topics, please fill out our survey!

[Survey](#)

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