SMALL FARM STRATEGIES TO REDUCE WATER QUALITY DEGRADATION

Implementation of efficient use of compost/farm manure and cost-effective irrigation methods as tools to reduce the degradation of water quality in Indian River, St. Lucie, and Broward counties in Florida.

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PROJECT SUMMARY

In 2016, the North South Institute, Inc., in collaboration with small farm stakeholders received a USDA-Natural Resource Conservation Service – Conservation Innovation Grant (USDA-NRCS/CIG - 69-3A75-17-47) to examine what changes could be effected to enhance sustainable small farming practices, minimizing the impact on water quality. Participating producers completed a baseline survey along with soil and irrigation water testing at farm sites within the selected Florida counties. This was followed by a series of training courses provided with technical assistance and outreach from the Institute.

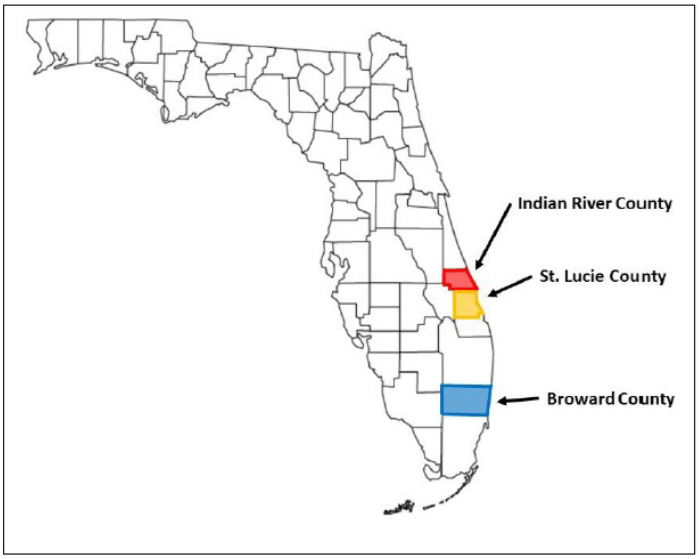
The project serves Historically Underserved Producers, Veteran Farmers and Ranchers by investigating least cost and innovative methods to reduce run-offs and conserve on-farm energy, so that the target groups can minimize farmland degradation, reduce contamination of associated aquifers, and increase on-farm productivity and profitability. These were addressed by exposing farmers and ranchers to (1) the introduction of innovative technologies to reduce nitrate and phosphate run-offs from farms and mitigate poorly timed application of pesticides, and implement cost effective irrigation/smart water applications, resulting in the aquifers and surrounding water-sheds becoming less polluted; (2) efficient use of compost and farm manure; and (3) explore the adoption of solar powered systems for crop irrigation and livestock water.

The project coverage area, considered the zone of influence, is shown below where the producers operate.

Figure 1 Zone of Influence (3 County Clusters) – Broward (Davie), St. Lucie (Ft. Pierce), and Indian River (Fellsmere)

The Zone of Influence included three clusters of producers covering three counties in Treasure Coast and South Florida (Broward, St. Lucie, and Indian River). These producers were exposed to training, technical assistance and outreach.

In addition, mix-method baseline survey and impact evaluation were implemented using small sample frameworks of farms and farmers from three locations. Soil and irrigation water samples from each site were collected and tested in two periods during this project.



Source: North-South Institute, Inc., USDA-NRCS/CIG (2019)

PROJECT IMPLEMENTED IN THREE PHASES

Phase I

Planning, Survey and Data Analysis

- Survey and Data Analysis completed before and after implementation

Phase II

Training, Outreach, and Technology Transfer

- On-farm demonstrations, workshop sessions, and dissemination of technical information incorporated into NRCS & private sector tools and materials

Phase III

Explore, Design and Demonstrate

- How to develop Basic Conservation Plans
- How to Treat Compost/Farm Manure and Pollutants for Run-Off Mitigation
- Introduction of Integrated Renewable Energy/Photovoltaics/ Solar Power Sources for Water Harvest from Wells and Open Ditches and Lay Out of low run-off Irrigation Systems (Drip and Micro)

Water and soil conditions were evaluated using two samples over two periods. Two awareness and practice surveys were conducted at the start and end of this project. Training and outreach conducted in basic farming conservation techniques.

PROJECT PARTNERSHIP

North-South Institute, Inc.

The North-South Institute for International Business, Trade and Sustainable Systems (NSI) is a 501(c) 3 multidisciplinary group whose objective is to promote sustainable development systems and foster eco-economic development within an international business and trade framework. These activities target the developing sectors of the southern United States and emerging markets of selected countries in Latin America, the Caribbean, Africa, and Asia. The implementation strategy involves the empowerment and enhancement of the capabilities of individuals, organizations, and industry through education, training, consultancy, research and policy analysis, and asset acquisition towards the development sustainable livelihoods and improved quality of life.

USDA/NRCS – Conservation Innovation Grant (CIG)

This project was funded through USDA Natural Resource Conservation Service – Conservation Innovation Grant (NRCS/CIG). The project model demonstrates a conservation strategy achieved through implementation of efficient use of compost/farm manure and cost-effective irrigation methods as tools

United States Department of Agriculture
Natural Resource Conservation Services

to reduce the degradation of water quality through run-offs from small-scale farms. The technologies adopted support on-farm sustainability of small farms and ranches through conservation targeting improvement in water quality, especially as these farms are close to bodies of water that drains into the everglades water systems.

PROJECT ACTIVITIES

The activities for this project include (i) Training, Outreach, and Technology Transfer through on-farm demonstrations, workshop sessions, and dissemination of technical information incorporating into NRCS & private sector tools and information; (ii) Implement the Baseline and Impact Surveys – focusing on awareness and practices; and (iii) Completed the retesting of the soil and irrigation water samples from two sites and advised producers in Broward and St. Lucie on soil treatment, fertilizer regime and pesticide usages for various crops.

During September 2017, all sites were affected by hurricane Irma which dumped up to 12 inches of water and caused significant wind damage to the planted crops. To recover hurricane related expenses incurred for farm redevelopment and conservation practices, we have been assisting farmers since February 2018 to complete the application process for FSA's Emergency Conservation Program (ECP). These application activities are still ongoing, as producers wait to receive their approved funds.

In addition to outreach activities, participants completed Baseline and Impact Surveys to identify changes in agricultural practices in line with NRCS/CIG program initiatives. The scope of the Baseline and Impact Surveys were to assess the current level of knowledge/awareness and measure impact of training, technical assistance, and outreach provided regarding (1) proper usages of compost/farm manure, (2) implementation of cost effective of small-scale irrigation systems, and (3) the effects of farm run-offs on water quality. Results were used to identify critical conservation training areas and improve overall training methods to produce effective and consistent outcomes.

Irrigation Pump Evaluation

Major Challenge: Hurricane Irma September 2017

During Hurricane Irma the St. Lucie site was flooded severely, which increased the run-off level of surface water. It was observed in the re-testing of the soil, that all the major levels of tested parameters increased for example hardness increased 10 times, calcium increased 10 times, and sodium increased 10 times. Farmers were advised to use fertilizers which would adjust for these changes.

Over this project period, the Institute conducted:

- 70 Grower One-On-One meetings
- 30 Field Visits for Group meetings
- 49 Technical Assistance and Follow-up Events
- 55 Producer Consultations (in-office and by phone)
- 2 Regional Symposiums
- 4 Field and Workshop Demonstration
- Prepared and Distributed Technical Handbooks on Climate Smart Technology on Soil, Water Management and Micro Irrigation

Conducted solar power consultations to include:

- 4 major group consultations with producers
- Vendor Field Day to evaluate solar system specification requirements for the demonstration sites.
- Field demonstration with groups of farmers
- Regional Symposium and Workshop Demonstrations

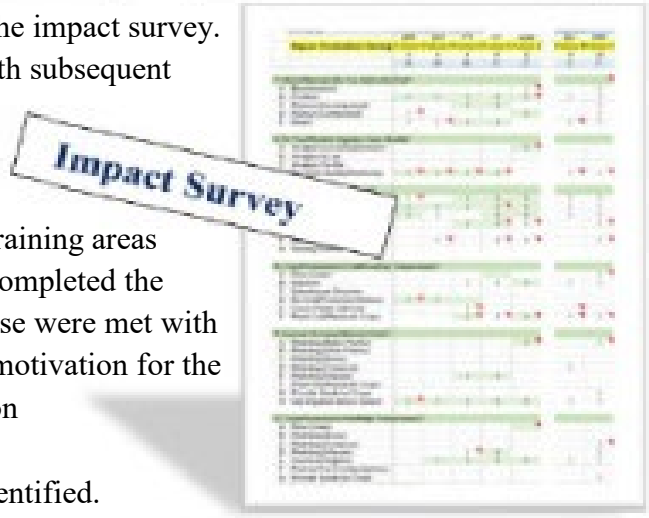
THE PROCESS

Producers from the three selected counties completed the baseline survey with questions covering:

- Production Experience
- Irrigation Systems and Water Quality
- Soil pH and Soil Improvements
- Cover Crops & Weed Control Methods
- Effects of Excess Moisture
- Effects of Extreme Temperatures & Weather Patterns

Training and Technical Assistance Provided

Participating producers from the original group completed the impact survey. Any changes indicated in the original response were met with subsequent survey questions to drill down on the reason(s)/motivation for the change. The Full Technical Evaluation Report available upon request. Training, Technical Assistance, and Outreach were provided covering the critical conservation training areas identified. Participating producers from the original group completed the impact survey. Any changes indicated in the original response were met with subsequent survey questions to drill down on the reason(s)/motivation for the change. The Full Technical Evaluation Report available upon request. Training, Technical Assistance, and Outreach were provided covering the critical conservation training areas identified.




White Plastic Wrapped Beds


Open Source Irrigation System


Farmer Harvesting Crop

MAJOR FINDINGS AND RECOMMENDATIONS – IMPACTS AND OUTCOMES

The high-level project impacts and outcomes can be seen in the following areas:

- 47 Farmers have upgraded their Water Harvest System for irrigation over all sites
- 65 Farmers have improved Lay Out of low run-off Irrigation Systems using traditional 5hp gasoline pumps as the cost associated with similar 5hp solar driven system was prohibitive
- 7 Farmers have improved farm conservation systems using plastic mulch and a combination of micro sprinklers and drip irrigation instead of manure and micro sprinkler irrigation and flood irrigation
- 65 Farmers have improved farm conservation systems using a combination of micro sprinklers and drip irrigation instead of manure and micro sprinkler irrigation and flood irrigation. They received technical material complied in the Technical Handbook.

Survey Comparison

The results and analysis regarding the practices of the producers are presented comparing two periods, baseline and impact surveys. The results show the differences as well as the impact of the technical assistance and training provided to the producers during this project. The following results were seen as a result of the training and technical assistance provided through the project period.

Irrigation Systems &Water Quality

A significant shift towards the practice of using a schedule to determine when to irrigate crops. An improvement in the number of producers who would use irrigation and plant cold-resistant crops to reduce the risks posed by cold and freezing temperatures.

Soil pH and Soil Improvements

Regarding amendments added to the soil, producers indicated an increase in the use of composted manure, mulch, and biostimulants since the baseline survey. Fertilizer, however, continues to be the most used amendment to improve nutrient availability. There was a drastic increase in the producers' awareness of why soil pH is important, however, they could not confidently identify the proper soil pH range recommended for their crops.

Cover Crops & Weed Control Methods

Most of the producers participating in both surveys operate 1-5 acre farms. When it came to controlling weeds, 100% of these producers consistently indicated 'hand pulling' as one of their methods. There was a dramatic shift to incorporate the use of mowers and/or weed trimmers to control weeds, along with slight increases in the use of mulching, hoeing, and herbicides.

These producers use the method of intercropping, growing two or more crops in close proximity to produce a greater yield on a given piece of land, and as a result have not actively used cover crops on their farms. This was clearly evident in the baseline survey, where most of the producers stated that they 'Do not Know' how cover crops benefit the soil. There was a moderate increase in the awareness of how cover crops benefit the soil seen in the impact survey, however more than half were still not able to identify cover crop benefits.

Intercropping Cabbage and Kale

Effects of Excess Moisture

From the baseline survey, with the options given as per the effect of excessive moisture (rainfall), less producers identified flooding and runoff with majority identified root rot and slower growth. In general, while this indicates that although producers having good levels of awareness, they do not have a strong understanding of the comprehensive effects. A more detailed reviewed of each producer's baseline and impact results shows that 20% demonstrated a decrease in subject awareness, while 80% either maintained or increased their awareness of this subject. This is an area that requires extensive training and technical assistance as well as monitoring of the sites.

Effects of Extreme Temperatures & Weather Patterns

There were no significant changes with how these producers protected their crops during hot and high temperatures, with a consistent 80% using overhead irrigation as their main heat protection method. Considering the frequency that irrigation water is used to protect crops from Florida's heat, it is important for producers to be aware of the signs seen when over watering or irrigating crops at a rate faster than the soil can absorb the water. The composition of the soil has an effect on this as well, hence the need to promote more consistent soil and water testing.

Hurricane Irma Wind Damaged Trees

Installing Irrigation System

Beds wrapped in White Plastic

BROWARD COUNTY SITE

The following tables show the 2017 and 2018 water and soil test results for the Broward County site.

Water Test Results

Parameter	Measured Value	
	2017	2018
pH	7.40	8.10
Hardness, mg/kg	379.71	1762.87
Electrical conductivity, dS/m	1.00	0.64
Suspended solids	2.00	3.00
Total carbonates, meq/liter	6.05	3.49
Calcium, (Ca) mg/kg	135.13	528.48
Magnesium (Mg), mg/kg	10.22	107.73
Iron (Fe), mg/kg	Not detected	Not detected
Manganese (Mn), mg/kg	Not detected	Not detected
Sodium (Na), mg/kg	40.28	297.64
Chloride (Cl), mg/kg	82.50	61.74

Soil Test Results

Parameter	Measured Value	
	2017	2018
Soil pH	7.4	7.7
Soil phosphorus (P), mg/kg	32	33
Soil potassium (K), mg/kg	>393	32
Soil magnesium (Mg), mg/kg	54	52
Soil calcium, (Ca) mg/kg	445	497
Organic Matter	5.31%	15.41%

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Source: UF/IFAS Analytical Services Laboratories, Extension Soil Testing Laboratory (2017 & 2018), Test Results

Soil Testing

For the Broward Site: Soil pH on 2018 test reported at 7.7, becoming slightly more alkaline than the 7.4 pH reading from the 2017 test results, which was considered higher than the high end of the recommended range for planting of specialty crops. The levels reported for phosphorus (33 mg/kg) were considered high, while levels for magnesium and calcium were considered adequate. The analytical laboratory did not recommend supplemental application of these nutrients. Moderate levels of supplemental potassium and nitrogen were recommended. The results and recommendations of the baseline soil and water tests were provided to the producers, however, when asked during the impact survey, the producers were not able to confirm that they followed the recommendations provided when adding amendments to their soil. The amounts and frequency added was dependent on the producer's opinion, with producers indicating that they added fertilizer, mulch, lime, and other materials to the soil at different intervals.

Irrigation Water Testing

For the Broward Site: Water pH was reported at 8.1, indicating an increase in alkalinity from the baseline water test, which was already higher than optimum. Electrical conductivity was reported at 0.64 dS/m, and the reduced electrical conductivity from the baseline test of 1.00 dS/m now puts this water in the "good" range for irrigation water. Moreover, the concentrations of sodium and chloride were reported at 297.64 and 61.74 mg/kg, indicating that sodium contributed substantially to the estimate of the total dissolved salts, as indicated by the electrical conductivity test.

ST. LUCIE COUNTY SITE

The following tables show the 2017 and 2018 water and soil test results for the St. Lucie County site.

Water Test Results

Parameter	Measured Value	
	2017	2018
pH	7.80	7.40
Hardness, mg/kg	487.72	4622.84
Electrical conductivity, dS/m	2.43	2.41
Suspended solids	6.00	10.00
Total carbonates, meq/liter	3.02	3.90
Calcium, (Ca) mg/kg	85.12	837.07
Magnesium (Mg), mg/kg	67.06	617.11
Iron (Fe), mg/kg	Not detected	Not detected
Manganese (Mn), mg/kg	Not detected	Not detected
Sodium (Na), mg/kg	329.96	3161.7
Chloride (Cl), mg/kg	685.55	542.90

Soil Test Results

Parameter	Measured Value	
	2017	2018
Soil pH	6.5	6.1
Soil phosphorus (P), mg/kg	18	100
Soil potassium (K), mg/kg	11	71
Soil magnesium (Mg), mg/kg	140	120
Soil calcium, (Ca) mg/kg	1477	1372
Organic Matter	1.95%	1.44%

See the effects of the canal that flooded the site when the Water Management District left it open during Hurricane Irma (Sept. 2017).

NORTH SOUTH INSTITUTE

Source: UF/IFAS Analytical Services Laboratories, Extension Soil Testing Laboratory (2017 & 2018), Test Results

Soil Testing

For the St. Lucie Site: Soil pH, reported at 6.1, was slightly below what would be considered the optimum range for specialty crop production. Levels of calcium (1372 mg/kg), magnesium (120 mg/kg), potassium (71 mg/kg), and phosphorus (100 mg/kg) were considered high, with no supplemental levels of these nutrients recommended. Moderate levels of supplemental lime (665 lbs. per acre) and nitrogen were recommended.

Irrigation Water Testing

For the St. Lucie Site: Water pH was reported at 7.4, slightly higher than optimum, but still less alkaline than this location's baseline water pH of 7.8. Electrical conductivity was reported at 2.41 dS/m, slightly higher than the high end of the range for irrigation of most non-salt sensitive crop species. Moreover, the concentrations of sodium and chloride were reported at 3161.7 and 542.90 mg/L, indicate that nearly 50% of the reported results for electrical conductivity, an indication of total dissolved salts, was due to these two (2) ions.

The water test results for this site show that the values for sodium, calcium, and hardness have each increased nearly 10 times since the baseline water test at this site. This increase was the direct result of the damages caused by Hurricane Irma, where the fields on this site suffered severe flooding from nearby saltwater sources. This flooding lasted several days and has affected the soil and irrigation water as seen in the 2018 test results. Crops irrigated by this water source may have to work harder to extract the nutrients dissolved in the water as a result of these two (2) ions.

It should be noted that comparison of the third site was not available as the farm site used in the baseline was sold by the producers before samples could be collected during the impact phase.

NEXT STEPS

In conclusion, small farmers must become more convinced that frequent soil and water testing are important, especially in growing specialty crops, which are new to the Florida agricultural landscape. In addition, structured field experimentation is required to facilitate testing of run offs, as a result the following are the next steps that will be conducted with is group.

- Conduct annual Conservation Planning with Small Farmers using the NRCS Template.
- While micro irrigation systems power by 5hp gasoline pumps are cheaper per acre, work with private sector to secure cheaper solar powered systems linked to drip irrigation.
- Train farmers in upgrading in-house capabilities in solar power installation.
- Conduct variety and yield trials on farm using properly degraded Compost and Manure to mitigate the excessive use of uncomposed manure, especially at the Broward Site
- Assist Farmers to becoming more aware of improved conservation practices to include:
    - Improved Irrigation Scheduling
    - Increased use of planting Cole Crops
    - Improved use of Soil Amendments – application of lime to impact soil pH
    - Improvement in Weed Management and Control
    - Improvement in the use of Cover Crops, for example the use of perennial peanuts and pasture hemp.

SUMMARY OF OUTPUTS WITH LINKS

Please visit www.nsied.org/training--outreach.html to view the full summary of outputs with associated links below.

USDA NRCS CIG Video
CIG Reporting Pictures Oct 2016-Sept 2017
CIG Reporting Pictures Oct. 2017-Sept 2018
CIG Reporting Pictures Oct 2018-Sept 2019
Conservation Plan Template
Growing Specialty Crops
Micro Irrigation
Mobile Irrigation Lab
Renewable Energy Power System
Rural Energy for America Program
Soil and Water Management
Water and Soil Comparison

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