Nutrient Management

Conservation Practice Code 590, Practice Specifications

SCOPE

This specification serves as a guide for planning the Conservation Practice Nutrient Management (Code 590). The objective of this practice is to provide the essential nutrients for optimum plant/agricultural production while minimizing risk to water, air, or soil quality. This document will be used by agricultural producers who apply for NRCS financial and technical assistance for Nutrient Management and conservation planners.

DEFINITION

Manage rate, source, placement, and timing of plant nutrients and soil amendments while reducing environmental impacts.

NRCS Caribbean Area soil sampling for Nutrient Management. (Credit: USDA-NRCS Caribbean Area)

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve plant health and productivity.
- Reduce excess nutrients in surface and ground water.
- Reduce emissions of objectionable odors.
- Reduce emissions of particulate matter (PM) and PM precursors.
- Reduce emissions of greenhouse gases (GHG).

- Reduce emissions of ozone precursors.
- Reduce the risk of potential pathogens from manure, biosolids, or compost application from reaching surface and ground water.
- Improve or maintain soil organic matter.

CONDITIONS WHERE PRACTICE APPLIES

All fields where plant nutrients and soil amendments are applied. Does not apply to one-time nutrient applications for establishment of permanent vegetation.

GENERAL

A nutrient budget shall be developed for each crop in the crop rotation based on realistic yield goals that consider all potential sources of nutrients including, but not limited to, animal manure and organic by-products, wastewater, commercial fertilizer, crop residues, legume credits, nitrogen fixation, and irrigation water.

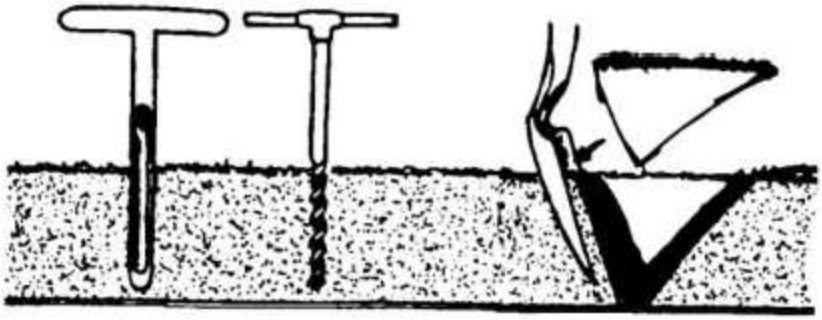
Realistic yield goals shall be based on historic yield data provided by the farmer or established by the Land Grant University and local fertilizer research findings.

Plans for nutrient management shall specify the source, amount, timing, and method of application of nutrients on each field to achieve realistic production goals, while minimizing movement of nutrients and other potential contaminants to surface and/or ground waters.

Soil, water, tissue, and manure tests shall be used following the recommendations of the Land Grant University or provided by a certified crop professional, such as licensed agronomist in Puerto Rico. Soil phosphorus (P) and potassium (K) levels will be evaluated at least once every 2 years or as recommended by a specialist. Soil, water, manure, and tissue test analyses shall be performed by laboratories that have United States Department of Agriculture Animal and Plant Health Inspection Service (APHIS) soil permits to receive and process soils from Puerto Rico and the United States Virgin Islands (USVI).

HOW TO TAKE A SOIL SAMPLE

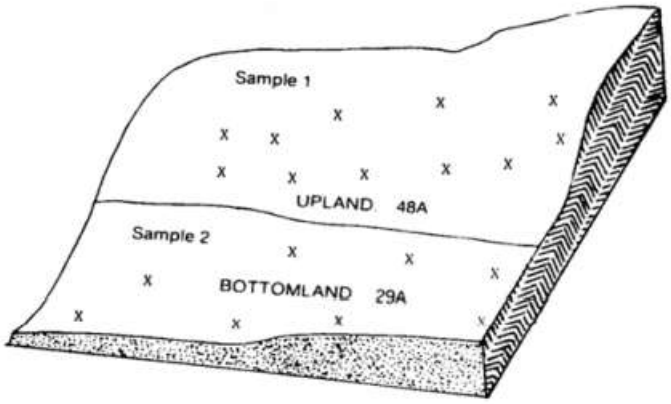
To determine the level of nutrient in the soil, one practice is to obtain a soil nutrient analysis. The soil sample can be taken using a shovel, auger or soil probe.



Sample can be taken with a soil probe, auger, or a shovel. (Credit: Waypoint Analytical Laboratories)

Soil Sampling demonstration with a shovel or a soil probe. (Credit: USDA-NRCS Caribbean Area)

Do a field assessment to determine the quantity of soil samples that should be necessary taking into consideration the soil series, slope, history of agricultural management, proximity to a water body, rock formations or any other consideration that can have a direct effect on soil nutrient availability.



Field with marked soil slope difference should be considered separately for nutrient management. (Credit, Waypoint Analytical Laboratories)

A representative soil sample is comprised of a mix of subsamples taken from an area of interest combined to make a composite sample. The soil samples should be taken from a depth of 0-8 inches, varying according to crop special needs and root growing characteristics. Most plants have the highest concentration of nutrient absorbing roots in the first 8 inches and is in this area were can be altered by the application of fertilizer and other soil amendments.

All subsamples comprising a composite sample should be taken at the same depth. Take between 10-20 subsamples per field using a random pattern to limit sampling bias and ensure a representative sample of the soil of the field. Uniformly mix subsamples in a clean bucket to generate a uniform soil mix. Take out any debris, rock, animal, or plant material from the composite soil sample.

Bucket with soil subsamples mix and soil packed in a plastic bag identified with the Field name or number. (USDA-NRCS Caribbean Area)

Soil sample prepared for shipping with required documentation and permits. (Credit USDA-NRCS Caribbean Area)

The soil sample should be prepared and shipped with the required documentation and permits. A soil sample submission information sheet should be requested by the sampler to the selected laboratory and completed with the required information. If the soil sample will be shipped to a laboratory outside of Puerto Rico or USVI, the APHIS permit to receive foreign soil must be provided by the laboratory.

The soil sample should be sealed within two plastic bags. Label the sample bag with the appropriate field number or name. Place the sample in the shipping box with the laboratory soil lab analysis request form. For shipping soil to the Continental US, attach to the outside of the shipping container the address shipping label, and an envelope with a copy of the lab's APHIS permit to receive foreign soils. Follow any additional label instructions provided in the permit conditions.

Nutrient loss risk assessments

Use current NRCS-approved nitrogen (N), P, and soil erosion risk assessment tools to assess the site-specific risk of nutrient and soil loss.

Complete an NRCS-approved nutrient risk assessment for N on all fields where nutrient management is planned unless the State NRCS, in cooperation with State water quality control authorities, has determined specific conditions where N leaching is not a risk to water quality, including drinking water.

Complete an NRCS-approved nutrient risk assessment for P when any of the following conditions are met—

- P application rate exceeds Land Grant University fertility rate guidelines for the planned crop(s).

Table 8. Application rate according to P Index rating

P Index rating	NMP/P application rate
Low	Nitrogen Based
Medium	Nitrogen Based
High	Phosphorus Based (based on crop uptake)
Very High	Do Not Apply N or P

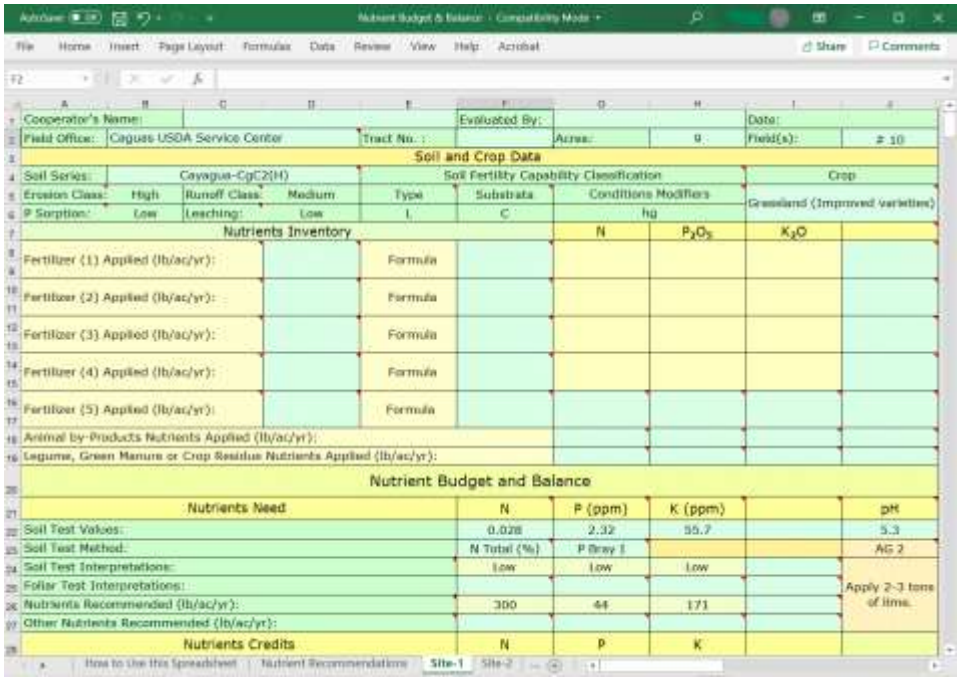
- The planned area is within a P-impaired watershed.
- The site-specific conditions equating to low risk of P loss have not been determined by the NRCS in cooperation with the State water quality control authority.

Any fields excluded from a P risk assessment must have a documented agronomic need for P, based on soil test P and Land Grant University nutrient recommendations.

Nutrient Management Plan

After receiving the soil analysis, use the Nutrient Budget and Balance tool to determine the amount of nutrients to be placed in accordance with the Nutrient Management (590) conservation practice standard. Follow the provided instructions to select the required crop. Enter the corresponding analysis results into the tool and determine the required amount of N, P and K.

For assessing nutrient needs by crop use the Nutrient Budget and Balance tool that is available in the FOTG on Section 2. This tool will provide nutrient recommendations based on expected yield according to land grant research and documentation.



Cooperator's Name:				Evaluated By:			Date:	
Field Office:	Caguas USDA Service Center		Tract No. :		Acres:	9	Field(s):	# 10
Soil and Crop Data								
Soil Series:	Cayagua-CgC2(H)			Soil Fertility Capability Classification			Crop	
Erosion Class:	High	Runoff Class:	Medium	Type	Substrata	Conditions Modifiers	Grassland (Improved varieties)	
P Sorption:	Low	Leaching:	Low	L	C	hg		
Nutrients Inventory						N	P_2O_5	K_2O
Fertilizer (1) Applied (lb/ac/yr):			Formula					
Fertilizer (2) Applied (lb/ac/yr):			Formula					
Fertilizer (3) Applied (lb/ac/yr):			Formula					
Fertilizer (4) Applied (lb/ac/yr):			Formula					
Fertilizer (5) Applied (lb/ac/yr):			Formula					
Animal by-Products Nutrients Applied (lb/ac/yr):								
Legume, Green Manure or Crop Residue Nutrients Applied (lb/ac/yr):								
Nutrient Budget and Balance								
Nutrients Need				N	P (ppm)	K (ppm)		pH
Soil Test Values:				0.028	2.32	55.7		5.3
Soil Test Method:				N Total (%)	P Bray 1			AG 2
Soil Test Interpretations:				Low	Low	Low		
Foliar Test Interpretations:								Apply 2-3 tons of lime.
Nutrients Recommended (lb/ac/yr):				300	44	171		
Other Nutrients Recommended (lb/ac/yr):								
Nutrients Credits				N	P	K		

For N balance, follow Nitrogen Credit Assessment. This tool evaluates the field history of nitrogen application, including the use of cover crops, compost and manure to the field. If a value of 4 or more is obtained, Soil N supply is high, apply 60-80% of LGU recommended rate. If the obtained value is 2-3 or less, soil N supply is Medium apply 80-90% of LGU the recommended rate. If the obtained value is 0-1, Soil N supply is Low, apply maximum recommended nitrogen rate.

Soil N Supply Assessment Tool (Credit Dr. David Sotomayor, 2022)

		Binary system	
Indicator	Description	1	0
Antecedent cover crop	Previous crop residue > 4,000 kg DM/ha and less than six months of termination		
Manure application	Manure application within the past 24 months providing total N at least of 40 kg N/ha		
Fertilizer N rate	Antecedent N rate > estimated whole-crop N removal		

Soil organic matter (SOM)	SOM > threshold >4% for soils with >35% clay; > 2.5% for all others		
Soil profile dissolved inorganic N (DIN) [1]	DIN > 25 mg NO3-N/kg soil		

Total Score
0 to 1 = Soil N supply is Low, apply maximum recommended N rate
2 to 3 – Soil N supply is Medium, apply 80 to 90% of maximum recommended N rate
4 to 5 = Soil N supply is High, apply 60 to 80% of maximum recommended N rate

Operation and Maintenance Plan

The developed nutrient management plan should remain in effect for at least three consecutive years as required by Planning Policy.

Review or revise plans periodically to determine if adjustments or modifications are needed. At a minimum, review and revise plans as needed with each soil test cycle, changes in fertilizer and/or manure management, according to volume or manure analysis, plants and crops, or plant and crop management.

Monitor fields receiving animal manures and biosolids for the accumulation of heavy metals and P in accordance with LGU guidance and State law.

For animal feeding operations, significant changes in animal numbers, management, and feed management will need additional manure analyses to establish a revised average nutrient content.

Calibrate application equipment to ensure accurate distribution of material at planned rates. Follow LGU or equipment manufacturer guidance on proper equipment design, plumbing, and maintenance.

Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation to explain the difference.

Protect workers from and avoid unnecessary contact with nutrient sources. Take extra caution when handling anhydrous ammonia or when managing organic wastes stored in unventilated tanks, impoundments, or other enclosures.

Use/dispose of material generated from cleaning nutrient application equipment in an environmentally safe manner.

Collect, store, or field apply excess material in an appropriate manner.

Recycle or dispose of nutrient containers in compliance with state and local guidelines or regulations.

Maintain records for at least 5 years to document plan implementation and maintenance. Records must include—

[1] Preferably 1M KCl extraction, with a 0 to 60 cm soil sample.

- All test results (soil, water, compost, manure, organic by-product, and plant tissue sample analyses) upon which the nutrient management plan is based.
- Listing and quantification of all nutrient sources (including all enhanced efficiency fertilizer products) that are planned for use and documentation of all nutrient imports, exports and onsite transfers.
- Date(s), method(s), and location(s) of all nutrient applications.
- Weather conditions and if the soil is to wet at the time of application, elapsed time from manure application to rainfall or irrigation event(s).
- Plants and crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and plant or crop residues removed.
- Dates of plan review, name of reviewer, and recommended adjustments resulting from the review.

For variable rate nutrient management plans, also include—

- Maps identifying the variable application location, source, timing, amount, and placement of all plant and crop nutrients applied.
- GPS-based yield maps for crops where yields can be digitally collected.

Specific Site Requirements

The 4Rs of nutrient stewardship

Manage nutrients based on the 4Rs of nutrient stewardship—apply the right nutrient source at the right rate at the right time in the right place—to improve nutrient use efficiency by the crop and to reduce nutrient losses to surface and groundwater and to the atmosphere.

Nutrient source

Choose nutrient sources compatible with application timing, tillage and planting system, soil properties, crop, crop rotation, soil organic content, and local climate to minimize risk to the environment.

Determine nutrient values of all nutrient sources (e.g. commercial fertilizers, manure, organic by-products, biosolids) prior to land application.

Determine nutrient contribution of cover crops, previous crop residues, and soil organic matter.

For operations following USDA's National Organic Program, apply and manage nutrient sources according to program regulations.

In areas where salinity is a concern, select nutrient sources that limit the buildup of soil salts. When manures are applied, and soil salinity is a concern, monitor salt concentrations to prevent potential plant or crop damage and reduced soil quality.

Apply manure or organic by-products on legumes at rates no greater than the LGU estimated N removal rates in harvested plant biomass, not to exceed P risk assessment limitations.

For any single liquid application of nutrients (e.g., liquid manure, fertigation, etc.) —

• Do not exceed the soil's infiltration rate or water holding capacity.

• Apply so that nutrients move no deeper than the current crop rooting depth.

• Avoid runoff or loss to subsurface tile drains.

Nutrient rate

Plan nutrient application rates for N, P, and K using LGU recommendations or industry practices when recognized by the LGU. Lower-than-recommended nutrient application rates are permissible if the client's objectives are met.

At a minimum, determine the rate based on crop/cropping sequence, current soil test results, and NRCS approved nutrient risk assessments. Where applicable, use realistic yield goals.

For new crops or varieties where LGU guidance is unavailable, industry-demonstrated yield and nutrient uptake information may be used.

Estimate realistic yield potentials or realistic yield goals using LGU procedures or based on historical yield or growth data, soil productivity information, climatic conditions, nutrient test results, level of management, and/or local research results considering comparable management and production conditions.

Nutrient application timing and placement

Consider the nutrient source, management and production system limitations, soil properties, weather conditions, drainage system, soil biology, and nutrient risk assessment to develop optimal timing of nutrients. For N, time the application as closely as practical with plant and crop uptake. For P, time planned surface application when runoff potential is low. Time the application of all nutrients to minimize potential for soil compaction.

For crop rotations or multiple crops grown in one year, do not apply additional P if it was already added in an amount sufficient to supply all crop nutrient needs.

To avoid salt damage, follow LGU recommendations for the timing, placement, and rate of applied N and K in starter fertilizer or follow industry practice recognized by the LGU.

Do not surface apply nutrients when there is a risk of runoff, including when—

• Excessive soil moisture

• Soils are water-covered.

• The top 2 inches of soil are saturated.

Exceptions for the above criteria related to surface-applied nutrients when there is a risk of runoff can be made when specified conditions are met and adequate conservation measures are installed to prevent the offsite delivery of nutrients. NRCS, in cooperation with the State water quality control authority, will define adequate treatment levels and specified conditions for applications of manure if soils are wet or covered by water or the top 2 inches of soil are

saturated, referred to EQB (Regulation for the Control of Animal Waste in Livestock Operation, 2008) At a minimum, the following site and management factors must be considered:

- Climate (long-term)
- Weather (short-term)
- Soil characteristics
- Slope
- Areas of concentrated flow
- Organic residue and living covers
- Amount and source of nutrients to be applied
- Setback distances to protect local water quality

Follow all applicable State requirements and regulations when applying nutrients near areas prone to contamination, such as designated water quality sensitive areas, (e.g., lakes, ponds, rivers and streams, sinkholes, wellheads, classic gullies, ditches, or surface inlets) that run unmitigated to surface or groundwater.

If you have any questions regarding conservation practice Nutrient Management 590, contact the State Agronomist.

REFERENCES

Sotomayor, D., Martinez, G. (2019) Fertilizer Recommendations Guide for Some of the Most Common Crops in the Caribbean,
Final Project Report under Cooperative Agreement no. 68-F352-16-501 between USDA-NRCS and Univ. of Puerto Rico Mayagüez. 1 April 2019.

USDA (2022) Nutrient Management Conservation Practice Standard, USDA-NRCS

USDA-NRCS (2021) Nutrient Budget Version 3