Revista
Torreón Universitario
ISSN 2410-5708 / e-ISSN 2313-7215
Year 13 | No. 38 | October 2024- January 2025

Economic and environmental valuation of the contribution of organic matter to the soil, through the calculation of available nitrogen, on the Santa Elisa farm, municipality of Jinotepe, with projection in the Golden Triangle of the department of Carazo

Mario José Gaitán
National Autonomous University of Nicaragua, UNAN-Managua, Regional University Center of Carazo, CUR-Carazo.
https://orcid.org/0009-0007-4732–6197
mario.gaitan@unan.edu.ni

Cesar Augusto Arévalo Cuadra
National Autonomous University of Nicaragua, UNAN-Managua, Regional University Center of Carazo, CUR-Carazo.
https://orcid.org/0000-0001-8954-3586
carevalo@unan.edu.ni

Ariel Arístides Sánchez González
Universidad Nacional Autónoma de Nicaragua, UNAN-Managua, Centro Universitario Regional de Carazo, CUR-Carazo.
https://orcid.org/0009-0009-8146-5822
ariel.sanchez@unan.edu.ni

Submitted on July 10th, 2024 / Accepted on October 10th, 2024
https://doi.org/ 10.5377/rtu.v13i38.19317

Keywords: Organic matter, nitrogen, environmental valuation, economic valuation.

Agriculture
SCIENTIFIC ARTICLES

ABSTRACT

This article presents the economic and environmental valuation of the contribution of available or usable nitrogen from the Organic Matter (OM) of the soil, in Santa Elisa farm, municipality of Jinotepe, with valuation projection in the Golden Triangle, department of Carazo. The research was developed to promote the viability and sustainability of agriculture; which requires adequate management of natural resources (soil, forest, water), which allows the economic growth of the rural sector (FAO:2015). The methods of valuation of environmental goods and services of the soil encompass a variety of approaches that seek to quantify the economic value of the services that soils provide to society; in this research, they are related to: - Cost-Benefit Evaluation, - Cost-Effectiveness Evaluation, - Integrated Ecosystem Valuation and - Multicriteria Approaches. The assessment is based on the results of the soil analysis carried out on the Santa Elisa farm, an agricultural production unit, where the percentage of organic matter present in the soil at 12.98% (Soil Analysis UNA – LABSA, 2022), was calculated using the amount of nitrogen available, usable in the production system, which represents the producer saving costs for nitrogen fertilization of C$ 19, 350.00/hectare, resulting from 311.52 kg of nitrogen available in the soil, equivalent to 14.89qq/ha of commercial urea estimated at market price of C$ 1,300.00/qq; totaling an economic benefit of organic matter of C$ 135,450.00, in 7 ha, and the gold triangle C$ 37,732,500.00 in an area of 1,950 ha.

1. INTRODUCTION

This research was carried out on the Santa Elisa farm (Lat11°52´2438 N, Long 86°11 ´50.10 W) located in the community of Las Breñas in the municipality of Jinotepe, department of Carazo, in the so-called golden triangle; which aimed to determine the amount of organic matter present in the soil and by means of technical formulas of international application, to know the availability of Nitrogen and quantify its economic value.

The study in turn projects the quantification of the economic contribution of nitrogen, in a homogeneous ecosystem, surrounding the productive unit studied; the Golden Triangle with an area of 1,950 hectares, projecting an area in the same conditions, which allows quantifying the environmental subsidy that the region represents for producers. This is not without first clarifying that the historical evidence reflects that this area of the department of Carazo has been under the coffee production system for more than 150 years; the same that characterized the study unit.

The state of the art in the use of methods of valuation of environmental goods and services of soil encompasses a variety of approaches, which seek to quantify the economic value of the services that soil provides to society. Among the most prominent methods are:

Contingent Valuation, Travel Cost Valuation, Declared Preferences, Cost-Benefit Evaluation, Cost-Effectiveness Evaluation, Integrated Ecosystem Valuation, Simulation and Remote Sensing Models, Multi-Criteria Approaches, Environmental Impact Assessment, Land Use Systems Assessment.

From the detailed analysis of the main valuation methods, this research is mainly related to 4:

- **Cost-Benefit Evaluation:** Allows comparing the monetary costs and benefits of a project or policy that affects the soil. By attributing monetary values to land-related benefits and costs, it can be determined whether a project is socially beneficial.
- **Cost-Effectiveness Evaluation:** Measures the relationship between costs and the effectiveness of achieving a specific goal, such as restoring a ground service.
- **Integrated Ecosystem Valuation:** Seeks to value soil services as part of broader ecosystem systems. It considers the interactions between different components of the ecosystem and how they affect the services provided by the soil.
- **Multi-criteria approaches:** They consider multiple criteria, not only economic, when evaluating land services. They incorporate social, environmental, and cultural values into decision-making.

The use of methods for valuing environmental goods and services of soil focuses on increasingly sophisticated and multidisciplinary approaches, which allow the economic value of land services to be quantified more accurately and comprehensively. These methods are essential for informing policies, management and conservation decisions, and the promotion of sustainable practices (Ripka de Almeida, A, da Silva, C, and Hernández, A; 2018).

The methodological application of economic and environmental analysis of soil organic matter, through the calculation of available nitrogen provided by it, is carried out with the percentage of organic matter present in the soil of 12.98%, according to soil analysis UNA – LABSA, 2022. An economic valuation of the nutritional contribution of organic matter was carried out through an economic valuation of the commercial Urea market, an assessment of the contribution of organic nitrogen available in the soil.

This research aims to infer soil management in the region of the Golden Triangle located between the municipalities of San Marcos, Diriamba, Dolores, and Jinotepe. To make a soil management plan that allows conserving the levels of organic matter, to achieve better yields, because this region has the same soil, climatic, forest, temperature, and rainfall conditions, which is of utmost importance for agriculture in this region and to guarantee the sustainability of production systems.

1.1. Contextualization

At the international level, the United Nations Environment Programme (UNEP) is the main global voice on the environment, linked to the SDGs. In the national context, reference is made to the National Plan to Combat Poverty and for Human Development. At the institutional level, the UNAN-Managua Research Lines are considered. The integration of the study with these three dimensions of research is described below.

- Sustainable Development Goals. ODS

Goal 15: Sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss. 15.3 Linked to desertification, rehabilitate degraded lands and soils, including lands affected by desertification.

Goal 2: End hunger. Food safety. 2.4. Sustainability of food production systems and applying resilient agricultural practices that increase productivity and production, maintenance of ecosystems, and progressively improve soil and land quality.

Goal 12: Ensure sustainable consumption and production patterns. 12. Assist developing countries in strengthening their scientific and technological capacities to move towards more sustainable consumption and production patterns. (UN:2016)

- National Plan to Combat Poverty and for Human Development (PNLCP – DH)

More and Better Production in the Countryside, Developing Agribusiness and Healthy Consumption. The Government will continue to promote its Food and Nutrition Security and Sovereignty Policy; promoting national production and market stability.

Ensure the Production of Sufficient Food for Food Security and Improved Nutrition for All. Continue to promote and develop the rural and urban family economy, through socio-productive plans, programs, and strategies.

Strengthen Productive Programs with Orientation to the Areas of Socioeconomic Dynamization, Items with Potential and Emerging Production. Agricultural Strategies of the National System of Consumption and Commerce (SNPCC), to identify and prioritize the items with the greatest socio-productive impacts, to improve the direction of financial resources and human talents. Among the items to be strengthened are cocoa, Fruits, Rice, and Vegetables.

Measures to Address the Impacts of Climate Variability and Climate Change, Considers: Climate Change, sustainable management, degradation, conservation and sustainable use of biodiversity, design, and implementation of environmental policies, programs and projects and protection of natural resources, prevention and control of environmental pollution for the

conservation of ecosystems and avoid irreversible damage to our mother earth (PNCLP – DH. 2021)

- UNAN – Managua Research Lines (2021)

Economics.

CEC-1 Line: Socio-Productive Development, Entrepreneurship and Welfare. Socio-productive development and the strengthening of primary economic areas, at the local, territorial, country, and regional levels, from economic, social, environmental, and political approaches. Sub Line CEC-1.1: Behavior of Economic Units. Socio-productive development of agricultural exploitation (EA).

Agricultural Sciences

CAG-1 Line: Agricultural Production System. Agroecological production, with environmental sustainability, contributes to food security and sovereignty. CAG- Sub Line

2. MATERIAL AND METHOD

The economic valuation of the contribution of nitrogen available in the soil is methodologically part of the soil sampling; This is made at a depth of 20 cm from the ground. Several samples were taken, which were mixed to have a single representative sample of the land and taken to the soil laboratory for their respective analysis. The laboratory that presents the results of the chemical analysis of the soil is from the UNA – LABSA, (May 2022). Those that allow quantifying the levels of Nitrogen in the soil, which can technically be valued economically at the level of productive units, through methods of valuation of environmental goods and services of soil.

2.1. Type of Study

Sampieri (2018) states: "Descriptive research is used to detail and characterize a phenomenon, allowing a deeper understanding of its properties and relationships."

Due to its scope, this research is quantitative, and descriptive; It tries to quantify the amount of nitrogen available that provides the Organic Matter (OM) of soil on the Santa Elisa farm, from its respective chemical analysis of soil. It is descriptive because a historical analysis of the farm is carried out to understand its agronomic management, to understand the reason for the organic matter content found in the productive unit.

A study of the economic and environmental valuation of the soil based on the percentage of soil organic matter, which yields the result of the chemical analysis of the soil. From which the total nitrogen and the available nitrogen are calculated.

Regarding the Positivist paradigm developed in this article, Comte (1853), states: Positivism is defined as "the system of thought that considers that the only authentic knowledge is that which is obtained through experience and observation"

2.2. Methods

The method to calculate the amount of available nitrogen provided by soil organic matter is by calculating the weight or mass of a hectare (ha) of soil. Using the results of the soil analysis regarding the content of organic matter found in the soil.

The conclusions found by Stevenson are taken. 1982. Humic acids, organic N, amino acids, microbial inoculant, tissue culture ... well as by NH2, CH_2, and other groups. and mentioned, Perdomo, C. and M. Barbazán. 2001. Nitrogen. Chair of fertility. Soil and water area. Where the following two conditions are concluded:

a. For every 100 kg of OM, there is 5 kg of Total Nitrogen

a. Of the 100% of total nitrogen found in the soil, only 2% is available to the plant, from there it is calculated:

Methodology for calculating the amount of available nitrogen provided by soil organic matter

- **Calculation of the weight of a hectare of soil**

V= area x depth

Bulk density: 1.2 tn/m3

D = M/V

M =D x V

- **Calculation of the amount of nitrogen according to the percentage of organic matter reflected in soil analysis of the analyzed farm**
- **Calculation of Total Nitrogen**
- **Available Nitrogen Calculation**

To determine the nitrogen contribution of soil organic matter in the unit and research area. In the equivalent of Nitrogen to commercial Urea, according to market price.

2.3. Data analysis and processing

Data processing is carried out based on the results of the chemical analysis of soil (Illustration. Results of chemical analyses in soils; soil and water laboratory). To calculate the total nitrogen and nitrogen available to the crop. From these results, they are converted to

46% urea kgs, which can be provided by soil organic matter, based on the amount of available nitrogen found.

Once the number of kgs of urea at 46% provided by the organic matter has been found, an economic valuation is made of how much the organic matter of the soil contributes monetarily to the production system, multiplying the market value, which translates into cost savings for the producer, due to the purchase of nitrogen fertilizers.

An analysis complemented by a historical timeline of agronomic management of the production system substantiates the amount of organic matter found.

3. RESULTS

Agricultural Production System. It integrates work from soil preparation and agroecological systems.

3.1. Contribution of organic matter to the soil, by calculating available nitrogen

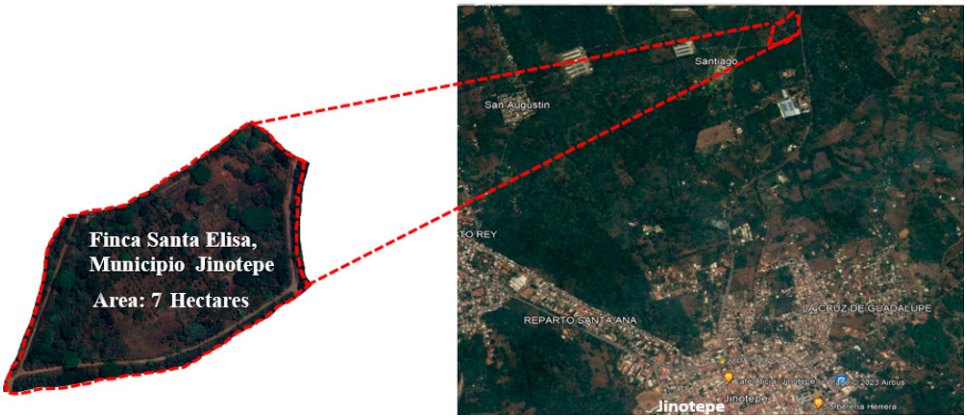
The economic and environmental valuation of the contribution of organic matter to the soil, through the calculation of available nitrogen, on the Santa Elisa farm, municipality of Jinotepe, with projection in the triangle of the department of Carazo, is described below.

The main reserve of nitrogen in the soil is organic matter, since, of the total nitrogen in the soil, approximately 98% is in the form of organic compounds and the remaining 2% in inorganic form. However, N in organic form is also not available as such to the plant but must be converted into inorganic forms (nitrate (NO3 -), ammonium (NH4 +), and nitrite (NO2 -). Even so, organic forms of nitrogen serve as a reserve of this nutrient for subsequent production cycles. (Stevenson. 1982) mentioned by (Perdomo and Barbazán. 2001).

Finca Santa Elisa, Jinotepe Municipality, Carazo Department

Image 1

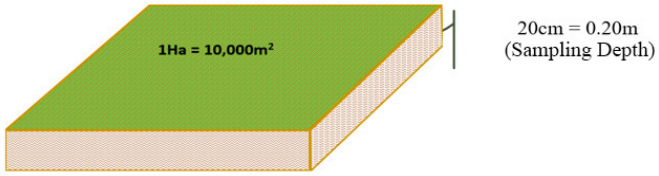
Finca Santa Elisa, Jinotepe Municipality, Carazo Department



Note: google earth Pro. 2023

The study yields very significant results, calculations of the amount of total nitrogen and nitrogen available; The valuation is based on the 12.98% OM presented by the soil study.

Calculation of the weight of one ha of soil



V= area x depth

V= 10,000 m^2 x 0.2 m

V= 2000 m^3

Bulk density: 1.2 tn/m^3

D = M/V

M =D x V

M = 1.2 tn/m^3 x 2000/m^3.

M = 2,400 tn (if one tn = 1000 Kg)

M = 2,400,000 Kg

Calculation of the amount of nitrogen according to the percentage of organic matter reflected in soil analysis of the Santa Elisa farm 12. 98%.

100 kg of soil ---------- 12.98 kg of OM

2,400,000 Kg of soil --------- X

X = 311,520 kg WM

Calculation of Total Nitrogen

For every 100 kg of OM, there is 5 kg of Total Nitrogen

311,520 Kg MO ---------- 100 %

X ---------- 5%

X = 15,576 Kg of Total Nitrogen

Available Nitrogen Calculation

Of the amount of total nitrogen found, only 2% of nitrogen is available to the plant.

15,520 kg NT ---------- 100%

X ---------- 2%

X = 311. 52 kg of Available Nitrogen

This means that the organic matter of the soil of the Santa Elisa farm provides an amount of 685,344 pounds of nitrogen.

The commercial nitrogen on the market is 46% UREA

1 QQ UREA---------- 46 lb N

X ---------- 685.344 lb de N

X = 14. 89 qq of commercial urea is what soil organic matter provides

3.2. Economic Nitrogen Quantification and Benefit Extrapolation

In monetary value, this means 14.89 qq x C$ 1,300.00 = C$ 19, 350.00, a savings of the producer in the purchase of nitrogen fertilization.

The area surrounding Finca Santa Elisa, the so-called golden triangle, has an approximate area of 1,950 hectares; with similar production conditions in the last 150 years.

Image 2

Golden Triangle, Carazo Department

Note: Google Earth Pro. 2023

Based on the economic valuation of the soil provided by organic matter with 12.98% in the Santa Elisa farm; It is estimated:

Economic Valuation Golden Triangle = Area x Profit per ha

Economic Valuation Golden Triangle = 1950ha x C$ 19,350.00

Economic Valuation Golden Triangle = C$ 37,732,500.00

4. CONCLUSIONS

The organic matter available in the soil at Finca Santa Elisa provides a total of 311. 52 kg of Available Nitrogen, which is equivalent to 14. 89 kgs of urea per ha, which allows us to infer the following assessment:

The commercial value of 46% urea is C$ 1,300.00 in the national market, which would mean that the producer saves C$ 19,350.00 for the purchase of nitrogen fertilization.

The economic value of the soil provided by organic matter with 12.98% in Santa Elisa farm in 7 hectares of avocado is C$ 135,450.00

No nitrogen applications are required for the avocado crop. In general, the avocado crop extracts 64 kg of nitrogen from the soil after each harvest. Therefore, it has sufficient reserves of nitrogen fertilizers.

The soil has a high Cation Exchange Capacity (CEC) due to its high organic matter content. High CIC gives them a greater capacity to retain nutrients, which normally makes them more fertile.

This work can infer the agronomic management of soils, in the micro-region called the golden triangle that joins the municipalities of San Marcos, Diriamba, and Dolores-Jinotepe because they have the same climatic and soil conditions. With the characteristic that they were coffee-growing areas.

Laboratorio de suelos y agua de la UNA
UNA-LABSA
Formato del sistema de gestión

Informe de resultados de análisis químicos en suelos

LABSA-FG-7.8-01 Versión 01 Revisión 0

Fecha de recepión de muestra: 6/5/2022
Fecha de Muestreo: 6/5/2022
Entidad: NA
Contácto: Hassell Cristina Mercado Mercado
Descripción de la muestra : Quinto de Agronomía
Código/LABSA: S-2022-0148

Fecha emisión/Informe: 19/5/2022
Fecha/análisis: 19/05/2022
Finca: Santa Elisa
Municipio: Jinotepe
Departamento: Carazo
Informe No. 204

		Parámetro	Resultados	Unidades	Método
RUTINA		pH (H_2O)	6,16	-	GLOSOLAN-SOP-06
		Materia Orgánica	12,98	%	GLOSOLAN-SOP-02
		Nitrógeno	N/A	%	GLOSOLAN-SOP-14
		Carbono Orgánico	N/A	g/kg	GLOSOLAN-SOP-02
		Fósforo disponible	ND	ppm	GLOSOLAN-SOP-10
		Conductividad Eléctrica	57,27	µS/cm	GLOSOLAN-SOP-07
		Aluminio	N/A	mEq/100 g suelo	NOM-021-RECNAT-2000/AS-33
BASES DEL SUELO	DISPONIBLE	K	0,99	mEq/100 g suelo	KSSL-4Bta1b (MODIFICADO)
		Ca	9,39	mEq/100 g suelo	KSSL-4Bta1b (MODIFICADO)
		Mg	3,16	mEq/100 g suelo	KSSL-4Bta1b (MODIFICADO)
	INTERCAMBIABLE	K	1,18	mEq/100 g suelo	KSSL-4Bta1b
		Ca	13,28	mEq/100 g suelo	KSSL-4Bta1b
		Mg	4,28	mEq/100 g suelo	KSSL-4Bta1b
		Na	0,04	mEq/100 g suelo	KSSL-4Bta1b
		CIC	25,92	mEq/100 g suelo	KSSL-4Bta
MICRO ELEMENTOS		Fe	2,40	mg/kg	MELICH I
		Cu	3,10	mg/kg	MELICH I
		Mn	15,30	mg/kg	MELICH I
		Zn	9,70	mg/kg	MELICH I
ANALISIS ESPECIALES		Carbonatos	N/A	mg/kg	NOM-021-RECNAT-2000/AS-20
		B	N/A	mg/kg	AZOMETINA-H
		SO_4^{2-}	N/A	mg/kg	TURBIDIMÉTRICO
		NO_3^-	N/A	mg/kg	ESPECTROFOTOMÉTRICO UV-VIS
		NH_4^+	N/A	mg/kg	ESPECTROFOTOMÉTRICO UV-VIS
		Acidez intercambiable	N/A	mEq/100 g suelo	NOM-021-RECNAT-2000/AS-33
		Hidrógeno intercambiable	N/A	mEq/100 g suelo	Calculado
		pH (KCl)	N/A	-	GLOSOLAN-SOP-06

Se da fe únicamente de la muestra analizada
Las opiniones e interpretaciones no se encuentran dentro del alcance de acreditación y son emitidos bajo la responsabilidad del Laboratorio. El laboratorio tiene disponible la información completa relativa a los ensayos.
Se indica con asterisco los parámetros dentro del alcance de Acreditación

Leyenda:
N/D: No detectado
N/A: No analizado

Ing. MSc. Leonardo García Centeno
Director de LABSA
NO VÁLIDO SIN FIRMA NI SELLO

FIN DE ESTE INFORME

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