
XXIV SEMANA DE LA FACULTAD
ARQUITECTURA E INGENIERÍA
VIGILADA por el Ministerio de Educación Nacional
INSTITUCIÓN UNIVERSITARIA COLEGIO MAYOR DE ANTIOQUIA®
Acreditados en ALTA CALIDAD
Alcaldía de Medellín
Distrito de
Ciencia, Tecnología e Innovación

Analysis of the Current Situation of Domestic Water Security in the Brisas del Picacho Community.

MEMBERS:

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Environmental Engineering Program

2024-2

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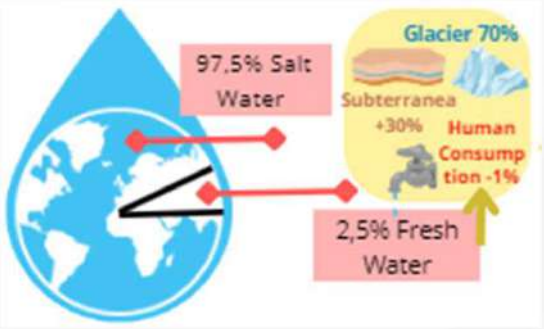
PROBLEM

In Colombia, one third of its urban population is still affected by water stress. An example of this is the **Brisas del Picacho** sector located in Commune 6



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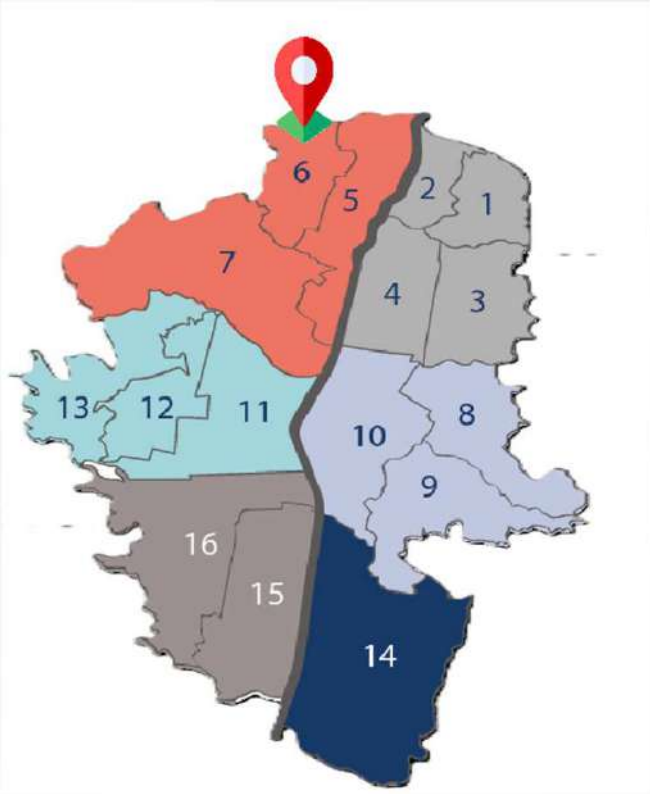
Map of Medellin by Communes



https://www.medellincomovamos.org/medellin

THEORETICAL FRAMEWORK

https://commons.wikimedia.org/wiki/File:Sustainable_Development_Goal_6.png

https://washresources.cawst.org/es/resources/c067c465/disinfect-your-water-sodis

d/https://aguaymedioambienteconciencia.com/seguridad-hidrica-mas-que-un-ods-6-una-necesidad/

METHODOLOGY

For the assessment of domestic water security risk in the Brisas de Picacho community, information was collected regarding the quality and quantity of water, which are indicators of threat in the area (sectors with drinking water, sectors with raw water, and sectors with a mix of water).

Fuente propia

$$\text{WQRI (\%)} = \frac{\sum \textit{Risk score assigned to unacceptable characteristics.}}{\sum \textit{Risk score assigned to the analyzed characteristics.}} * 100$$

METHODOLOGY

Experiment	Type of surface	Hub Type	irradiation
1	Curve	Black	Yes
2	Curve	Aluminum	Yes
3	Flat	Black	Yes
4	Flat	Aluminum	Yes
C1	Flat	N/A	Yes
C2	N/A	N/A	No

Fuente propia

A symmetric factorial experimental design was used for the implementation of the

de experimentos= Exp= n^k

Número de niveles= n =2

Número de factores = k =2

Controles = C =2

Replicas = R =3

Ensayos = (Exp+C)xR

Ensayos = (n^k + C) xR

Ensayos = (2^2+2)x3 =18

To gather information, surveys were conducted with a specific number of people, and this number was determined using the finite population equation.

$$n = \frac{N * Z^2 * p * q}{d^2 * (N-1) + Z^2 * p * q}$$

Where:

n= Representative sample of the population

N= Total number of dwellings

Z= 1,645

P= Expected proportion

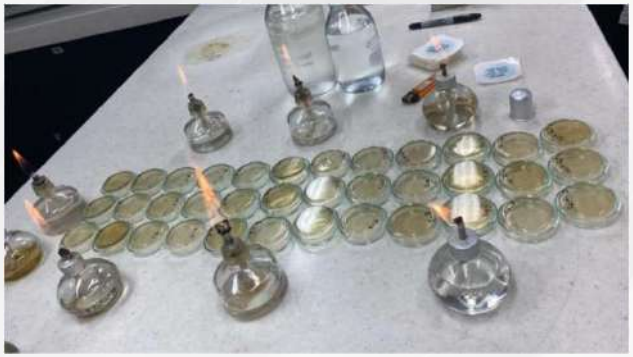
q= 1 – p

d= precision

RESULTS OF THE CHARACTERIZATION.

Characterization of raw water in the Brisas del Picacho sector.		
Characteristics	**Res. 2115 de 2007**	**Sample 1**
***Escherichia Coli* (CFU)**	0	90
Total Coliforms (CFU)	0	3150
Free Residual Chlorine (mg/L)	0,3-2,0	0
Turbidity (NTU)	2	0.7
Apparent Color (UPC)	15	0
pH	6,5-9.0	8,617
Alkalinity (mg/L)	200	49,67
Conductivity (µS/cm)	1000	214

Characterization date: February 2024



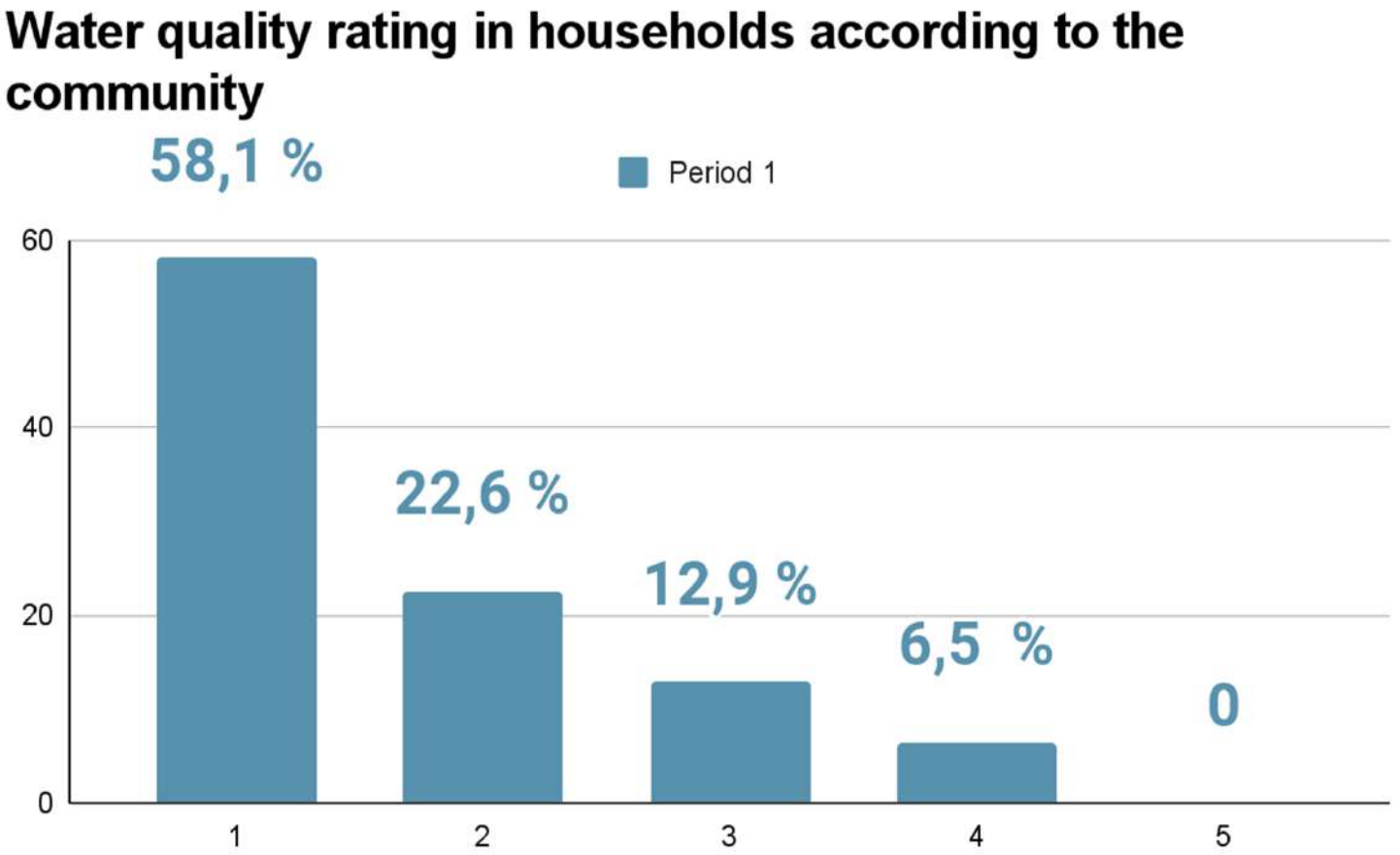
Fuente propia

RESULTS DETERMINATION OF CAPTURED FLOW.

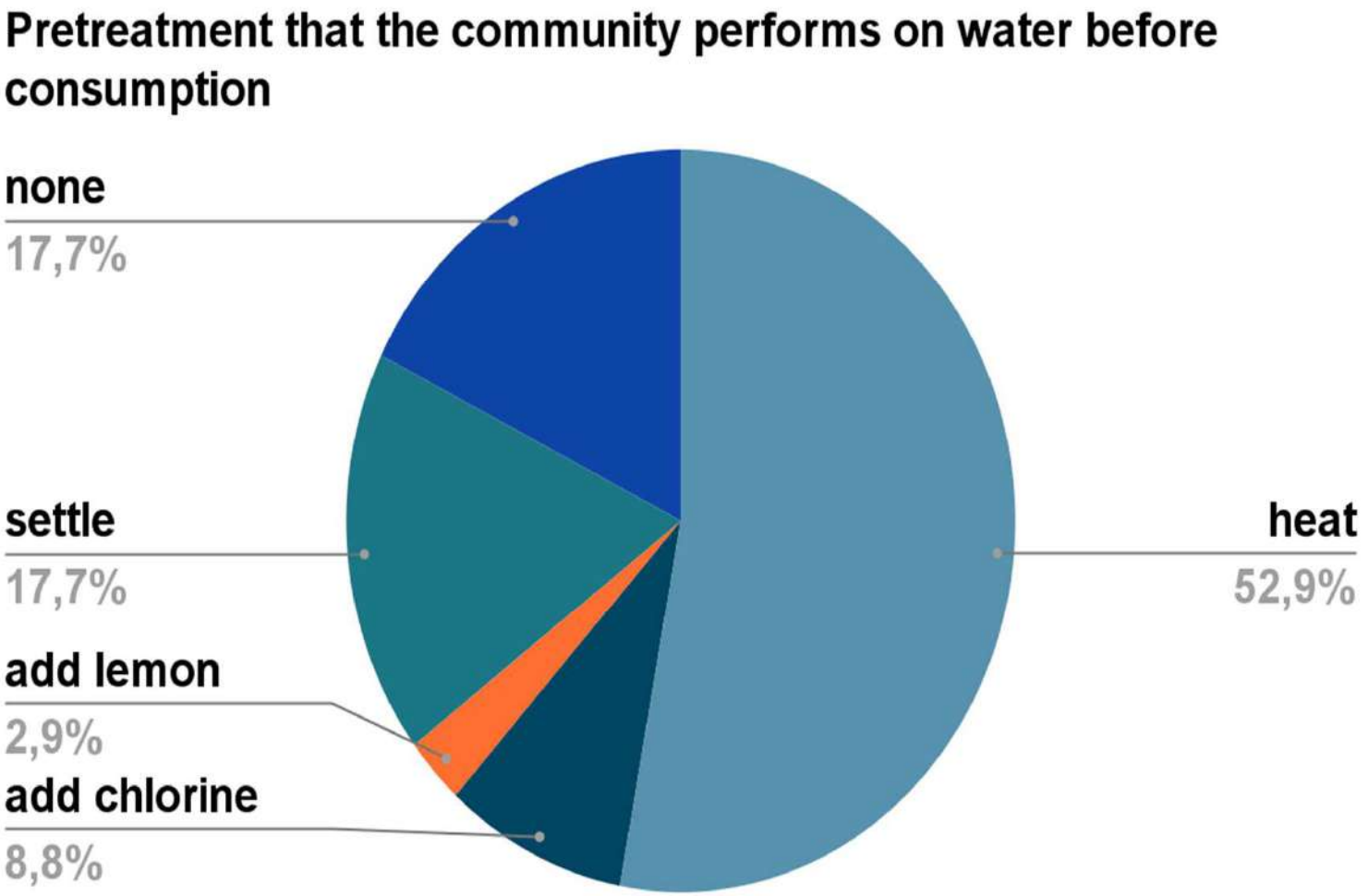
Flow study.		
Flow of the Brisas del Picacho sector (Raw Water)	Flow of the Brisas del Picacho sector (EPM Water)	Basic consumption flow (Res. CRA 750/2016)
$777{,}2\ \frac{L}{Day*Home}$	$620{,}5\ \frac{L}{Day*Home}$	$433{,}3\ \frac{L}{Day*Home}$

The results of data collection were presented through surveys in a representative sample of the population, which was determined using the finite population equation and yielded a total of 44 people.

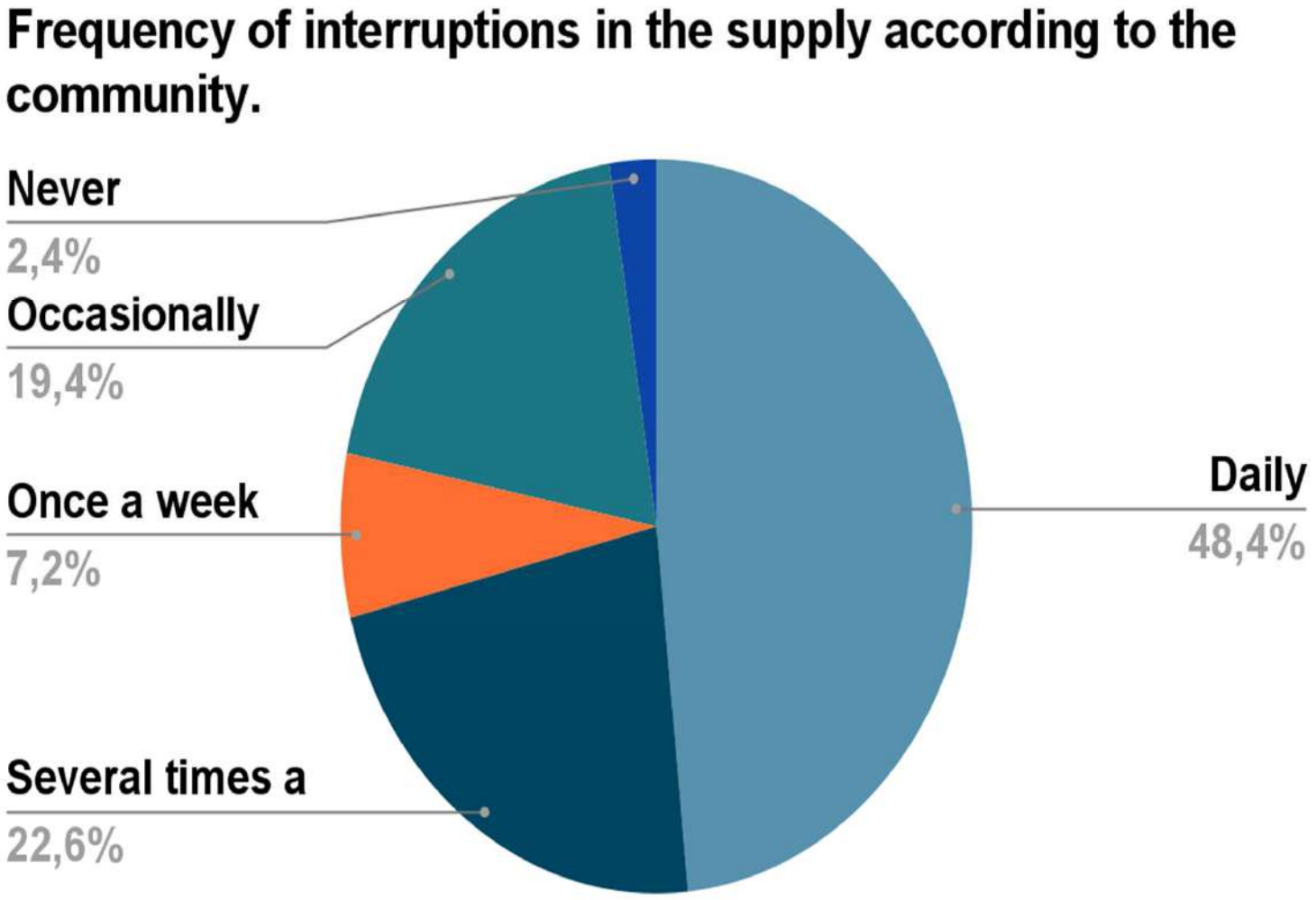
RESULTS SURVEY ANALYSIS.



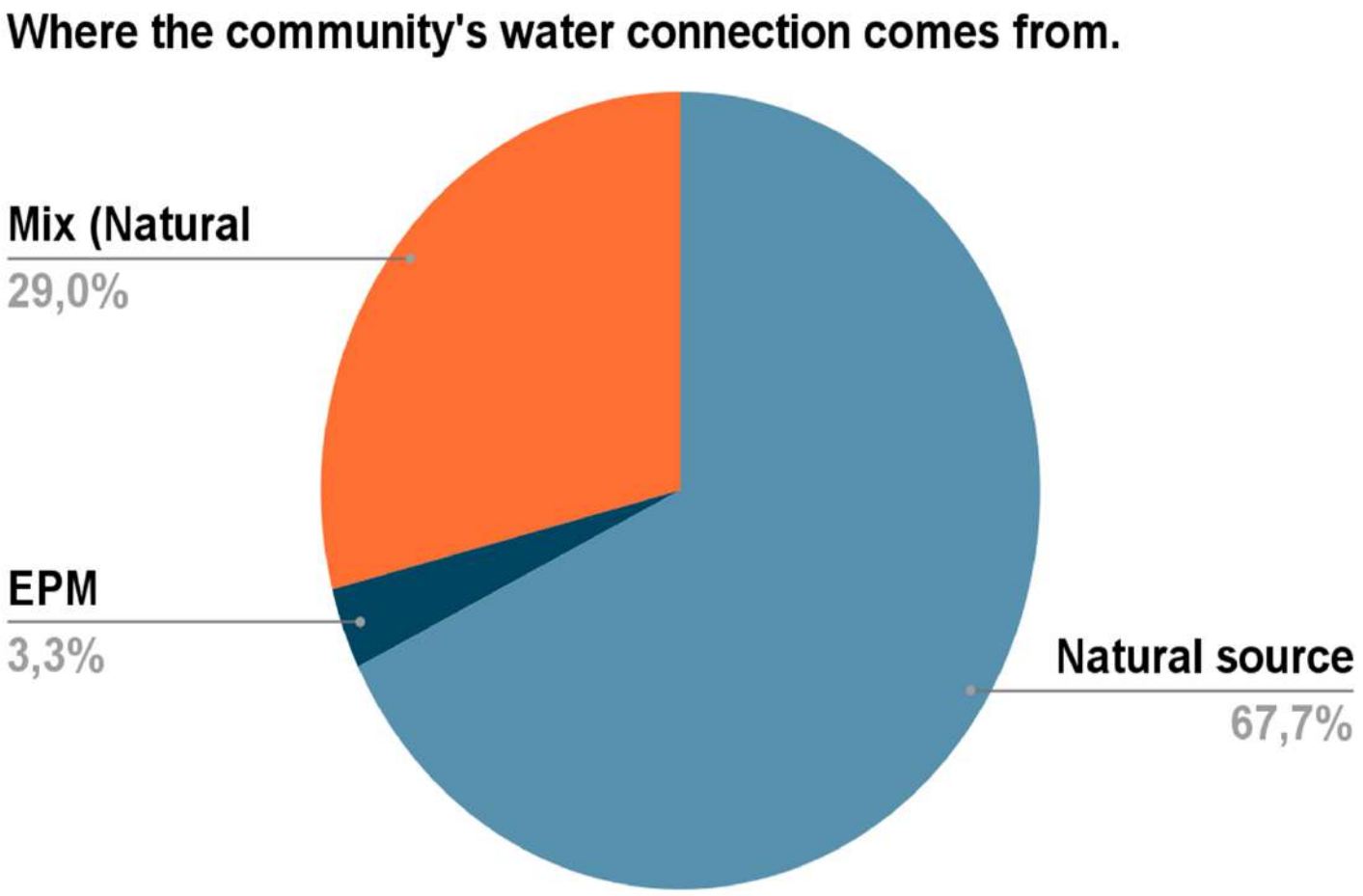
RESULTS SURVEY ANALYSIS.



RESULTS SURVEY ANALYSIS.



RESULTS SURVEY ANALYSIS.

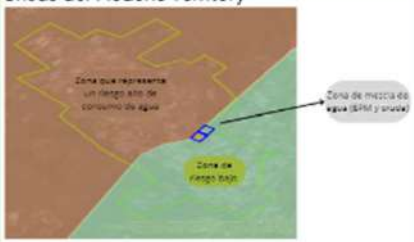


RESULTS SOCIALIZATION

Leaflet 1.

RISK MAP FOR HYDROLOGICAL HAZARDS IN THE BRISAS DEL PICACHO NEIGHBORHOOD

Brisas del Picacho Territory



Risk Identification

Based on the analysis of the risk map, developed from the Water Quality Risk Index (IRCA) score, the community's level of exposure to hydrological risk has been determined. In this map, the Brisas del Picacho sector is outlined with a green line and divided into three zones:

- **Red:** Corresponds to the area where the water supply is raw water, which, with a 70% share, represents a high health risk.
- **Green:** Indicates the area where the water supply comes from EPM, with a 1.5% share that does not pose a health risk.
- **Blue:** Corresponds to the zone that has access to both raw water supply and EPM supply, affected by the characteristics of the red and green zones, depending on the supply used.

HEALTH RISKS

Individuals exposed to or consuming poor-quality water face the possibility of contracting infectious gastrointestinal diseases. Some of the most common symptoms include:

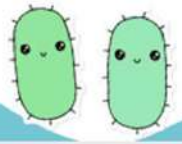
Nausea, Vomiting, Diarrhea, Fever.

MICROORGANISMS IN CONTAMINATED WATER

The microorganisms that cause these diseases are Escherichia coli (E. coli) and Total Coliforms.

What are E. coli and coliforms?

They are bacteria found in contaminated water and can cause diseases if consumed, so their presence indicates that the water is not safe to drink.



! PROTECT YOUR FAMILY !

The community of the Brisas del Picacho neighborhood must take immediate action to prevent water contamination and reduce the spread of diseases. Implement the recommended processes such as:

- SODIS (Solar Water Disinfection)
- Chlorination
- Boiling water

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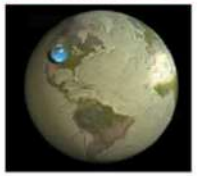
RESULTS SOCIALIZATION

Leaflet 2. Side A

DOMESTIC WATER SECURITY IN THE BRISAS DEL PICACHO SECTOR

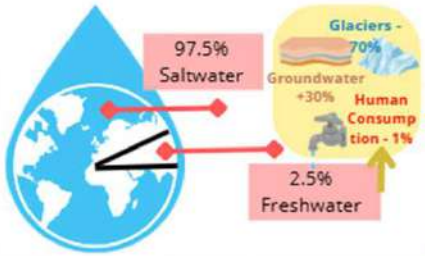


"The Importance of Properly Treated Water: Key to Health and Well-being."

Water treatment is increasingly necessary due to scarcity and the growing demand for it. Accessible, affordable, and sustainable drinking water supply for all households around the world can reduce cases of gastrointestinal diseases, along with good hygiene.

DID YOU KNOW...

Despite the fact that planet Earth is mostly composed of water, the reality is that only a small portion is suitable for human consumption.



ECONOMIC PROCESSES OF TREATMENT

SODIS

(Solar Water Disinfection) Consists of purifying water using sunlight. It is a low-cost technique that can help reduce waterborne diseases in communities with limited access to safe drinking water.

Procedure

Use clear plastic bottles, preferably PET (Wash the bottle thoroughly before using it for the first time).

Fill the bottles with the water that needs to be disinfected.

Place the bottles in a location where they receive direct sunlight, such as on a roof, on a metal sheet, or on a black surface.

Leave the bottles exposed to the sun for at least 6 hours on sunny days. On cloudy days, leave them for a complete 1 to 2 days.

ECONOMIC TREATMENT PROCESSES

Chlorination

It involves disinfecting water using chlorine, especially with bleach, to ensure safer consumption for humans.

Procedure

- Take 1 liter of water and let it sit (15 minutes if it is turbid).

- Add one drop of 5% bleach for each liter of water.

- Mix the water to ensure the distribution of the bleach.

- Let it sit for 30 minutes to allow for proper disinfection.

RESULTS SOCIALIZATION

Leaflet 2. Side B

ECONOMIC TREATMENT PROCESSES

Heating Water

It involves heating the water to a sufficiently high temperature to eliminate the microorganisms present in the water.

Place the amount of water you wish to disinfect in a pot.

Turn on the stove and let the water boil for a specified time depending on the quantity.

After the water has boiled, let it rest in a jug.

ADVANTAGES

1. One of the advantages of SODIS is that it does not require energy sources.
2. The chlorination procedure is easy, economical, and effective.
3. Heating water is a widely recognized method. It eliminates bacteria, viruses, and parasites that can cause diseases.

DISADVANTAGES

1. Disinfection using the SODIS method depends on the climate.
2. Excess chlorine can cause irritation and gastrointestinal problems.
3. The method of heating water requires a constant heat source, which can be impractical.

CONCLUSION

When choosing a water disinfection method, it is essential to select the one you consider most efficient and accessible according to your needs. Methods such as SODIS, boiling water, or chlorination are effective options that can be adapted to different situations and available resources. The most important thing is to ensure the safety of the water to protect everyone's health. Choose wisely and ensure clean water for your well-being!

AUTHORS

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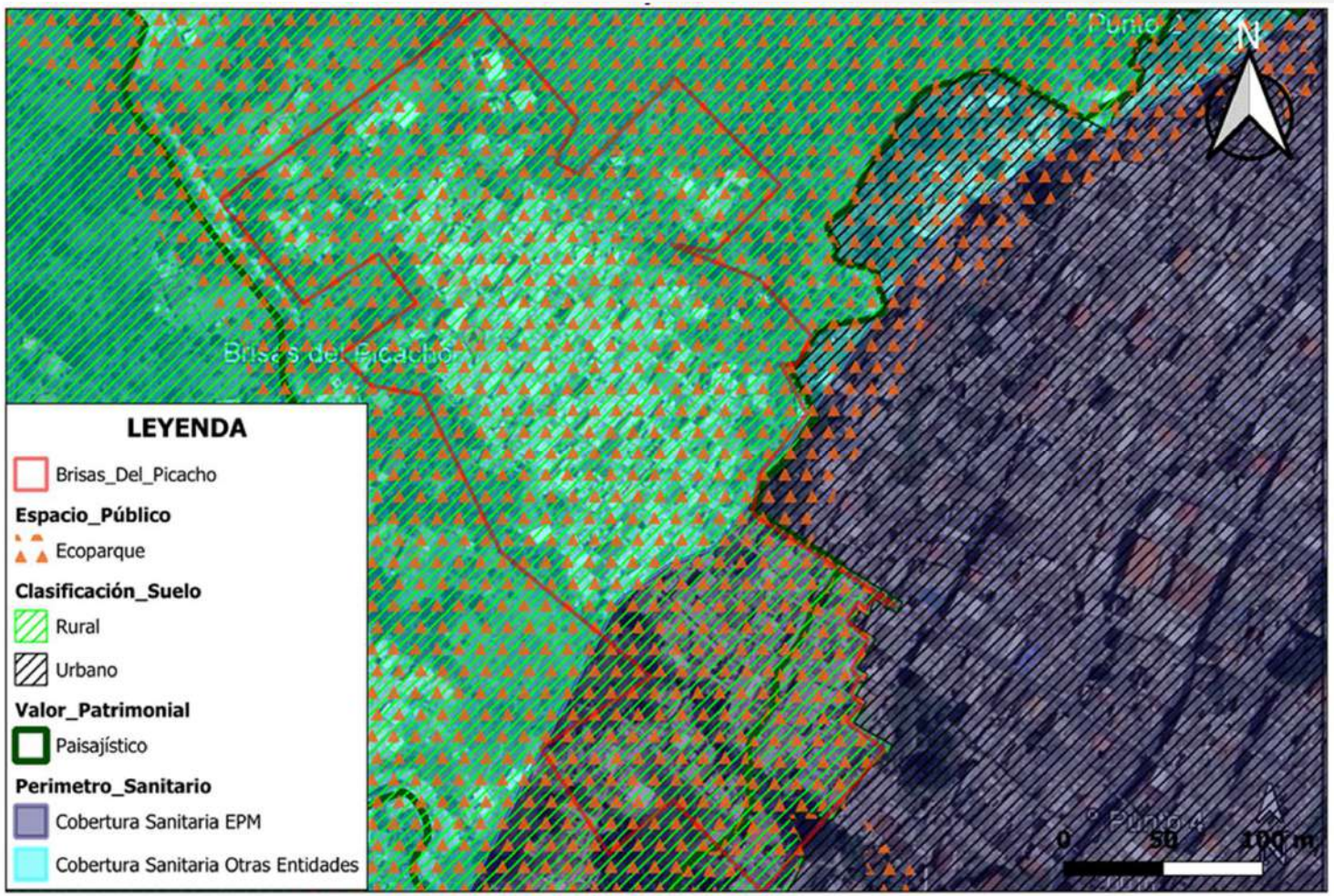
RESULTS CARTOGRAPHIC ANALYSIS.

Territorial planning map of the Brisas del Picacho sector.



RESULTS DETERMINATION OF THE WATER QUALITY RISK INDEX (IRCA)

IRCA of raw water in the Brisas del Picacho sector.

Characteristics	Sample 1	Score
***Escherichia Coli* (CFU)**	90	25
Total Coliforms (CFU)	3150	15
Free Residual Chlorine (mg/L)	0	15
Turbidity (NTU)	0,7	15
Apparent Color (UPC)	0	6
pH	8,617	1,5
Alkalinity (mg/L)	46,67	1

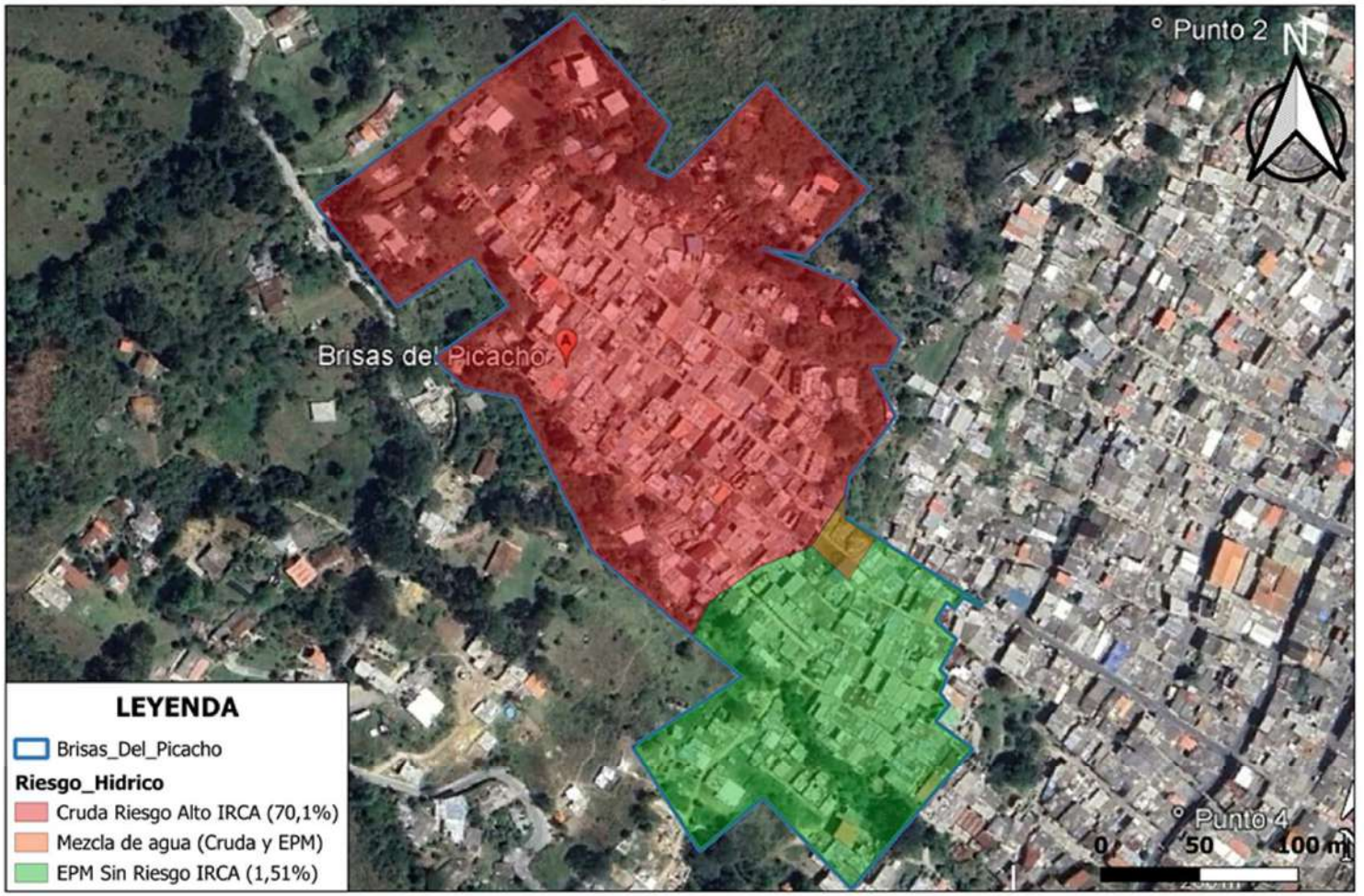
Risk level according to IRCA.

Clasificación IRCA (%)	Nivel de Riesgo	IRCA por Muestra
80,1 – 100	INVIABLE	Agua NO apta para consumo humano
35,1 – 80	ALTO	Agua NO apta para consumo humano
14,1 – 35	MEDIO	Agua NO apta para consumo humano
5,1 - 14	BAJO	Agua NO apta para consumo humano
0 - 5	SIN RIESGO	Agua apta para consumo humano

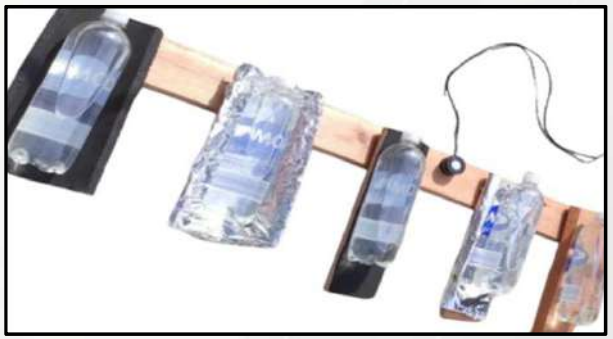
$$\text{WQRI (\%)} = \frac{25 + 15 + 15}{25 + 15 + 15 + 15 + 6 + 1{,}5 + 1} * 100 = 70{,}1\%$$

RESULTS CARTOGRAPHIC ANALYSIS.

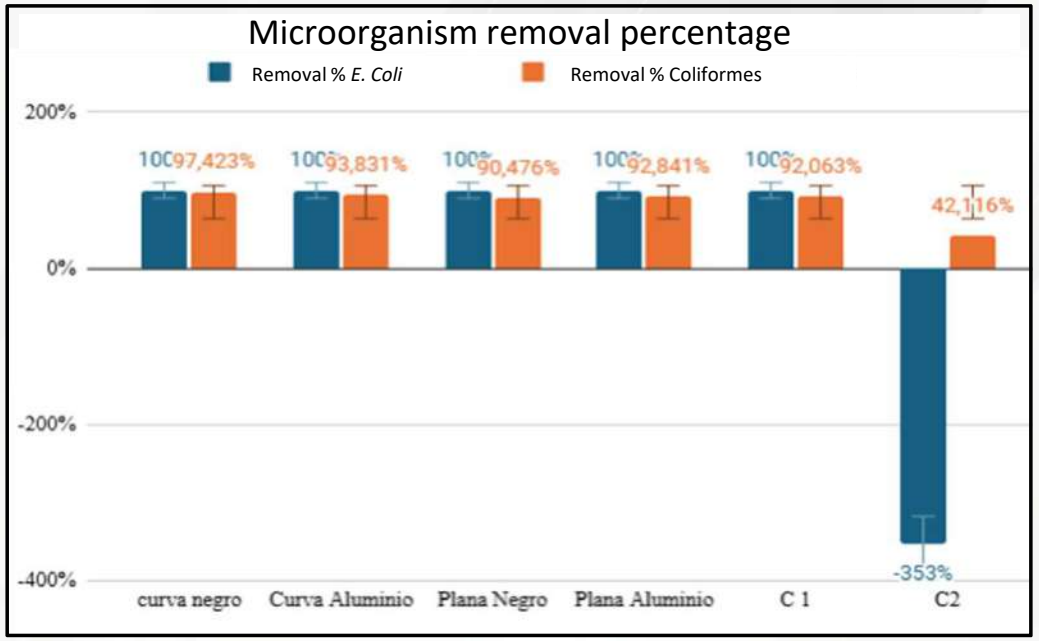
Water risk map of the Brisas del Picacho sector.



RESULTS APPLICATION OF THE SODIS PROCESS.



SODIS Results		
Surface Type	**Microorganism**	**% Removal**
Black Curve	*E. Coli*	100%
	Total Coliforms	97.423%
Aluminum Curve	*E. Coli*	100%
	Total Coliforms	93.831%
Black Flat	*E. Coli*	100%
	Total Coliforms	90.476%
Aluminum Flat	*E. Coli*	100%
	Total Coliforms	92.063%
C1	*E. Coli*	100%
	Total Coliforms	92.063%
C2	*E. Coli*	-352.778%
	Total Coliforms	42.116%



CONCLUSION

- In conclusion, the Brisas del Picacho community was open and collaborative during the interview and sampling process, providing key information and demonstrating awareness of the impact of lack of access to drinking water. This support facilitated the identification of threat factors related to both the quality and quantity of available water.
- Through the assessment of the Water Quality Risk Index (IRCA) and the measurement of flow rate, it was possible to identify quality levels in different sectors and evaluate the availability of the resource. These indicators are essential for understanding water risks and defining effective strategies for the management and improvement of water access in the community.

GRACIAS

Effect of arbuscular mycorrhizal fungi on cadmium uptake and translocation in seedlings of *Coffea arabica L*

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2024

COFFEE IN COLOMBIA

- Third largest producer in the world.
- Exports: 10,579,302 bags in 2023.

FNC (2023)

CHALLENGES

- Contamination by heavy metals (cadmium)
- Plant diseases.

Vallejos-Torres et al. (2022)

Research problem

CADMIUM IMPACT

- Toxicity and accumulation in soils and plants.
- Risks to public health.
- Negative effects on crop quality.

Llatance et al. (2018)

Theoretical framework

Cd problem in coffee

Coffee cultivation in Colombia faces the challenge of contamination by Cd, a toxic heavy metal. This accumulates in the plants and can affect the quality of the coffee we consume.

Role of AMF

Arbuscular mycorrhizal fungi (AMF) are a promising biotechnological solution as they can reduce the amount of Cd transferred from the soil to the plant.

Previous investigations

Previous research showed that AMFs immobilize cd in roots, reducing its passage to the edible parts of the plant. Perez-Moncada (2019) y Abdelhameed & Metwally (2019).

Objectives

General

Evaluate the effect of arbuscular mycorrhizal fungi on cadmium uptake and translocation in Coffea arabica L. seedlings.

Specifics

Analyze the physicochemical characterization of the soil.

Evaluate the effect of inoculation with arbuscular mycorrhizal fungi on the development of coffee seedlings in soils with different cadmium concentrations.

Determine the translocation of Cd absorbed by coffee seedlings with mycorrhizal amendment in contaminated soils.

Methodology

SOIL → **PLANTS** → **CADMIUM** → **MYCORRHIZA** → **PLANTING**

Andisol
A horizon

Chapolas Var.
Castillo

25 y 50 mg/Kg

300 spores/g

3 months

Experimental design:
(E+C)*R=(3+3)*3=18 seedlings

Variables

- Biometric (cm, g)
- Mycorrhizal colonization (%)
- Cadmium concentration (mg/Kg)

The statistical analysis was performed using Statgraphics to conduct an analysis of variance (ANOVA) and a means difference test using Tukey with a significance level of P: 0.05.

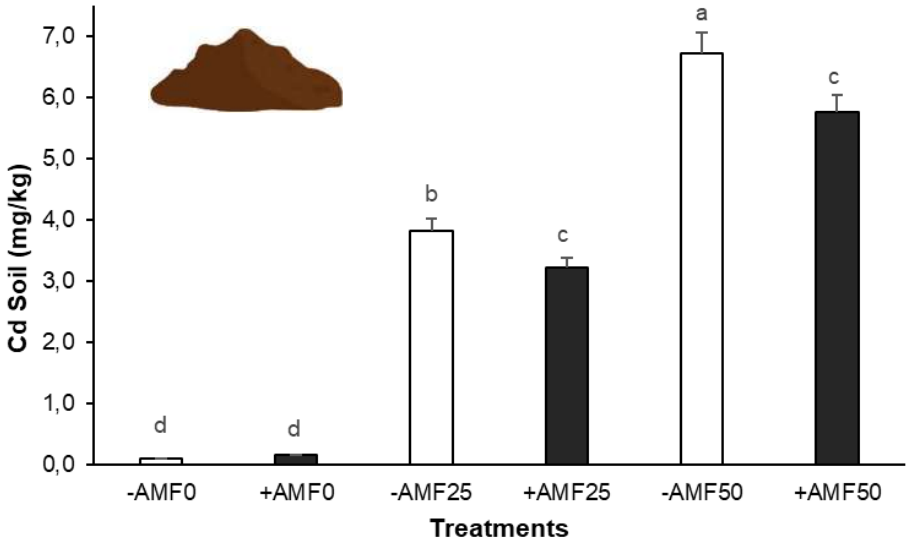
Results

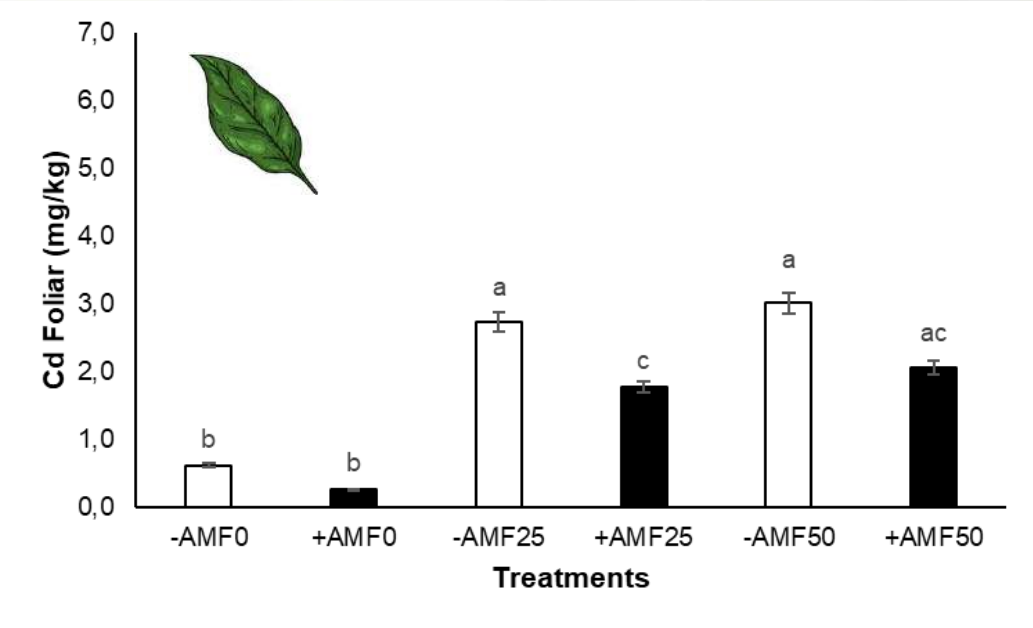
Figure 1. Effect of arbuscular mycorrhizal fungi on cadmium uptake in soil.

Results and analysis

Inoculated with AMF

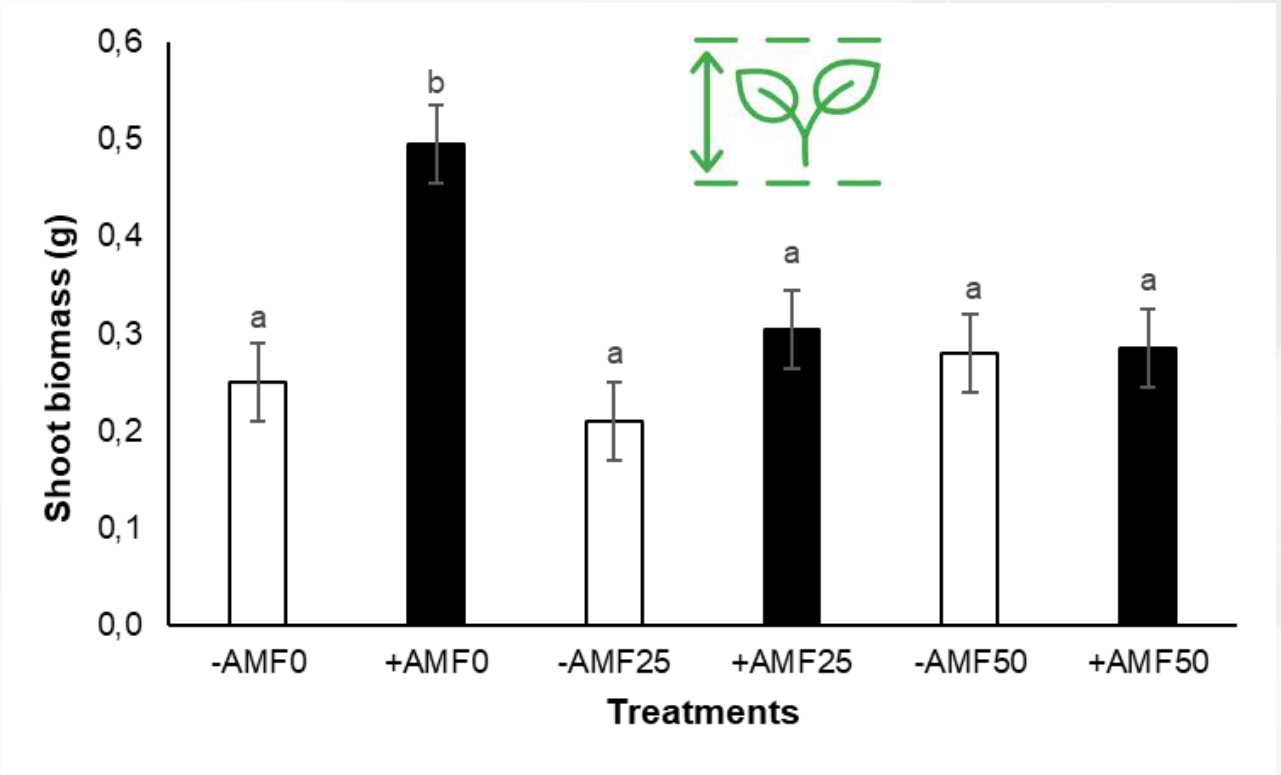
Not inoculated with AMF





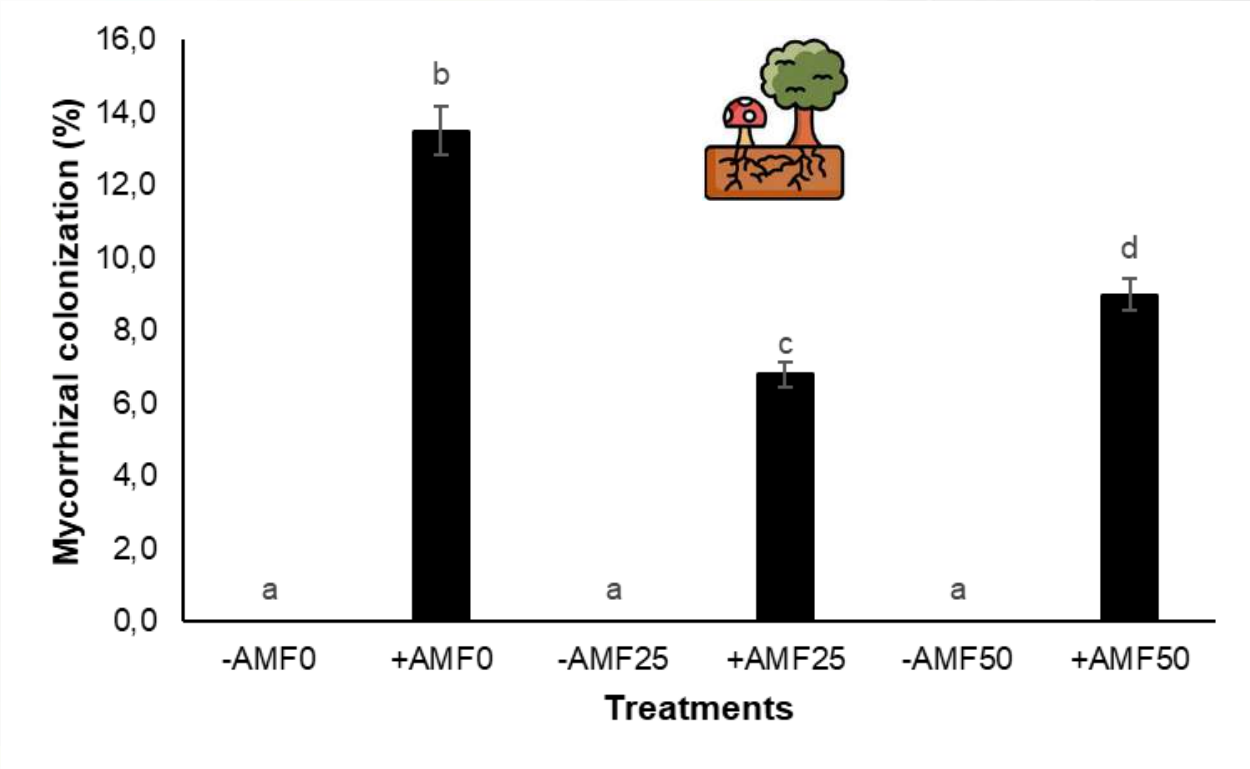
Inoculated with AMF

Not inoculated with AMF



Inoculated with AMF

Not inoculated with AMF



Conclusions

Plants inoculated with arbuscular mycorrhizal fungi (AMF) exhibited better growth and lower cadmium accumulation in leaf tissues, even in soils with elevated concentrations of this metal, demonstrating the ability of AMF to mitigate cadmium stress and improve nutrient availability.

AMF present themselves as an effective strategy for the bioremediation of contaminated soils by reducing cadmium translocation to the edible parts of the plant and contributing to agricultural sustainability, allowing coffee plantations to be safer and more productive in areas affected by heavy metals.

The use of AMF not only improves coffee quality by reducing cadmium content in the edible parts, but also strengthens food security and promotes more sustainable agricultural practices, minimizing the need for chemical interventions.

SEMANA DE LA FACULTAD DE ARQUITECTURA E INGENIERÍA

Events

Scientific Research, Technological Development, and Innovation Project Bank - 2024

- **Regional**
- **National**

XXI CONGRESO COLOMBIANO DE LA CIENCIA DEL SUELO

"LA SALUD DEL SUELO COMO BASE PARA EL DESARROLLO SOSTENIBLE"

DEL 28 DE OCTUBRE AL 1 DE NOVIEMBRE

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Effect of Construction and Demolition Waste (CDW) as amendments in soil enriched with microorganisms, *Penicillium janthinellum* and *Bacillus megaterium*

Research Project
Elián Andrés Chancí López
Brian Alexis Rojas Guisao

Thematic Advisor - Laura Osorno Bedoya
Methodological Advisor - Alejadro Builes Jaramillo

RESEARCH PROBLEM

Excavation, demolition, repair, civil works and construction improvements (Santos,2021).

CDW accounts for 50% of the total annual solid waste generated worldwide (Santos,2021).

CDW is classified as follows: susceptible to use and not susceptible to use (Santos,2021).

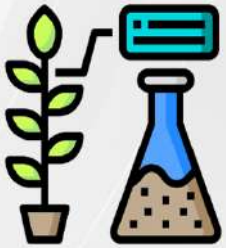
In Colombia, they represent 40% of total solid waste: 22 million Tons (Palacio, 2023).

Between 60-90% of CDW is deposited in authorized sites, only 20% is recycled (Palacio, 2023).

THEORETICAL FRAMEWORK

Circular economy: Innovative approach to resource and waste management (Tserng, 2021).

The reuse of CDW in crops could be an alternative for its reduction (Rodríguez - Suárez, 2020).



Bio - solubilization (Schueler, 2021).

The nutritional status of plants depends on the macro and micronutrients in the soil (Vatansever, 2017).

Penicillium janthinellum (Chona, 2013) and *Bacillus megaterium* (Zhao,2021).

Liming effect (Rodríguez - Suárez, 2020).

GENERAL OBJETIVE

Evaluate the effect of construction and demolition waste (CDW) as amendments enriched with soil microorganisms *Penicillium janthinellum* and *Bacillus megaterium*.

SPECIFIC OBJECTIVES

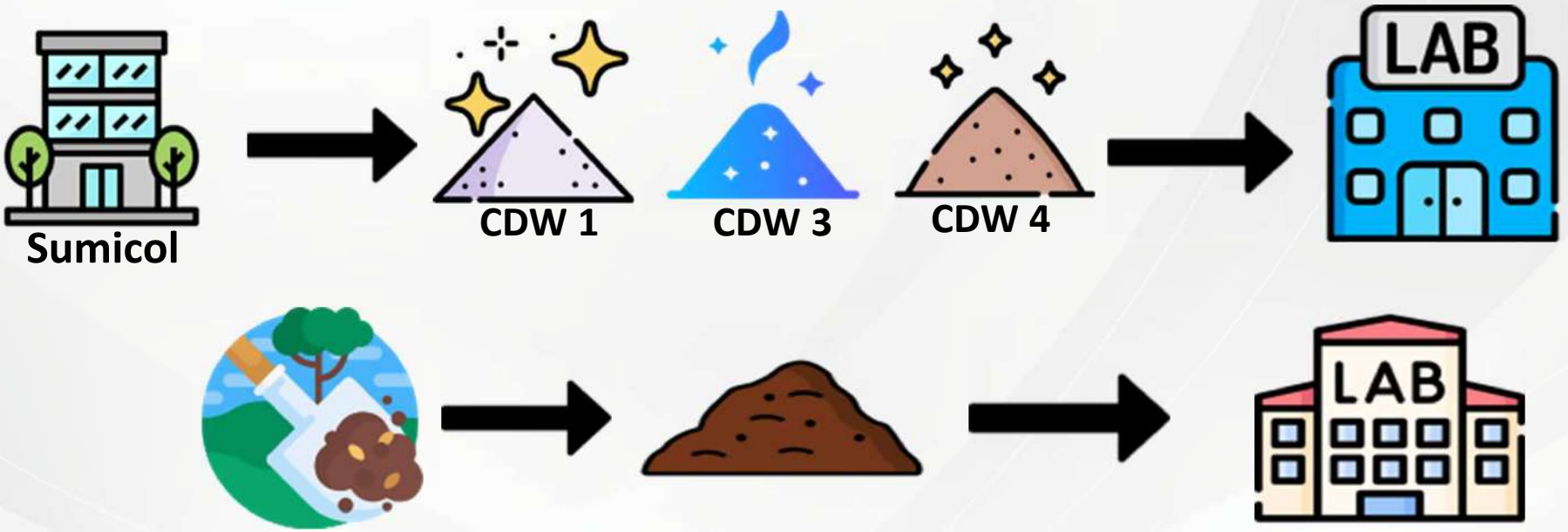
1. Characterization physico-chemical of soil and CDW.

2. Evaluate the biosolubilization of CDW under *in vitro* conditions with *Penicillium janthinellum* and *Bacillus megaterium*.

3. Determine the liming and nutritional effect of CDW in soils.

METHODOLOGY

1. Characterization physico-chemical of soil and CDW.

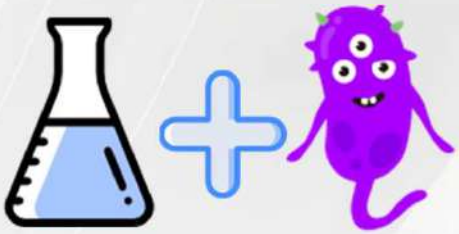


METHODOLOGY

2. *In vitro* biosolubilization.

uninoculated

P. Janthinellum



B. megaterium

CDW 1

CDW 3

CDW 4

METHODOLOGY

3. CDW Liming effect

20 g of soil

2- 32 g of CDW /kg of soil

20 days

RESULTS

1. Characterization physico-chemical of soil and CDW

Table 1. Characterization physico-chemical of soil.

PARAMETER	Result	Range	Analysis
Mg (cmol (+)/kg)	0,7	(1,5 - 2,5)	B
S (mg/kg)	18	(12 - 15)	A
pH	5,7	(6,0 - 6,5)	B
Ca (cmol (+)/kg)	1,1	(3 - 6)	B
Si (mg/kg)	6,9	(20 - 30)	B
CICE (cmol (+)/kg)	3,31	(5 - 10)	B

Table 2. Characterization chemical of CDW (X-ray fluorescence).

PARAMETER	CDW 1	CDW 3	CDW 4
CaO (%)	0,262	0,259	0,300
MgO (%)	0,080	0,000	0,000
S (%)	0,660	0,080	0,082
SiO2 (%)	0,179	0,423	0,423

Table 3. Initial pH of CDW

PARAMETER	CDW 1	CDW 3	CDW 4
pH	10.780	11.770	11.583

RESULTS

2. *In vitro* biosolubilization.

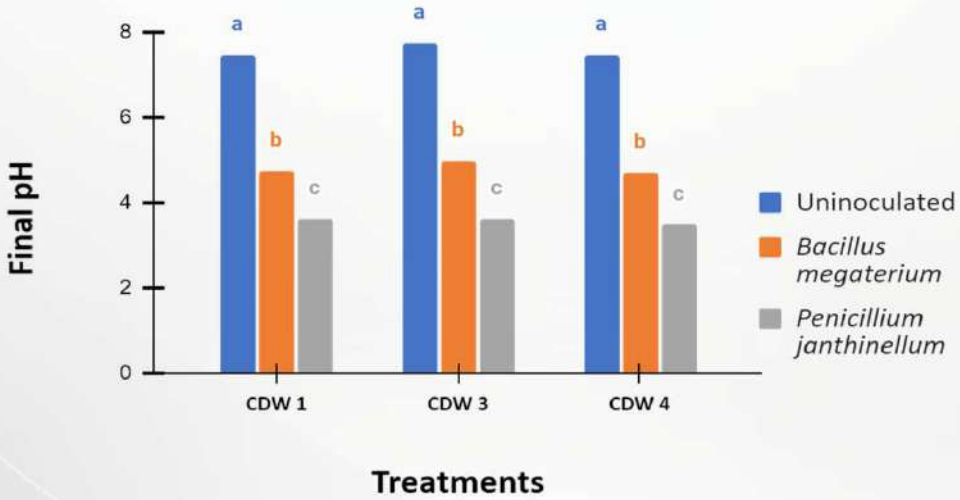


Figure 1. pH as an indicator of biosolubilization of CDW 1, 3, and 4 after biosolubilization for 7 days.

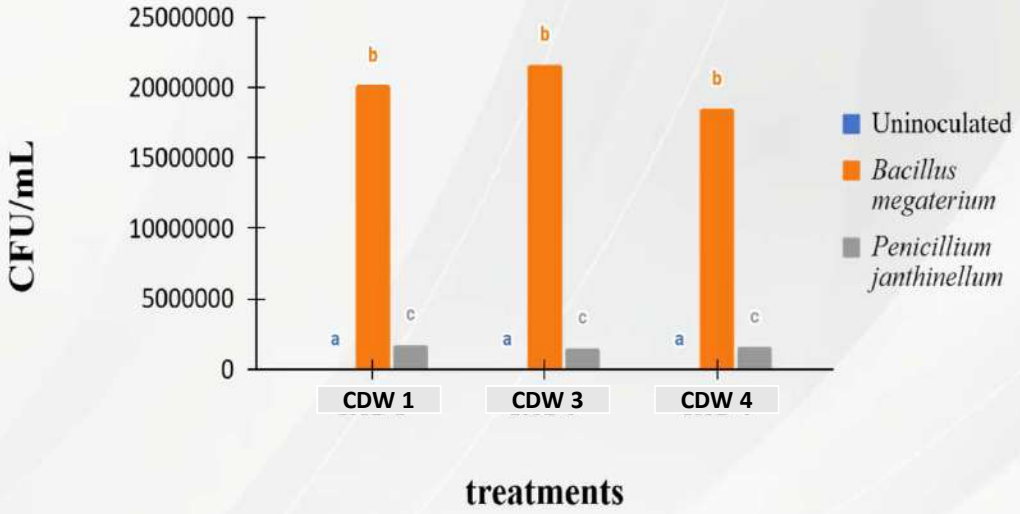


Figure 2. Microorganism count (CFU/mL) of CDW 1, 3, and 4 after biosolubilization for 7 days.

RESULTS

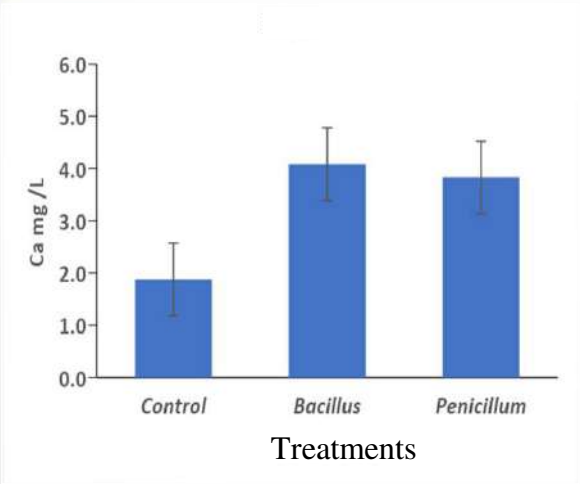


Figure 3. Available calcium (mg/L) from CDW 1 after biosolubilization for 7 days.

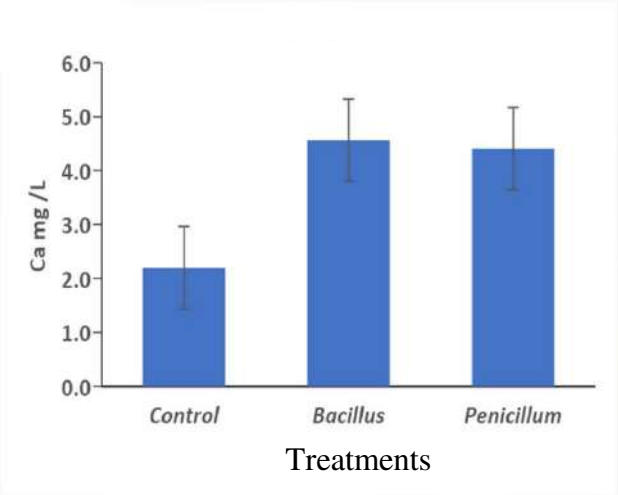


Figure 4. Available calcium (mg/L) from CDW 3 after biosolubilization for 7 days.

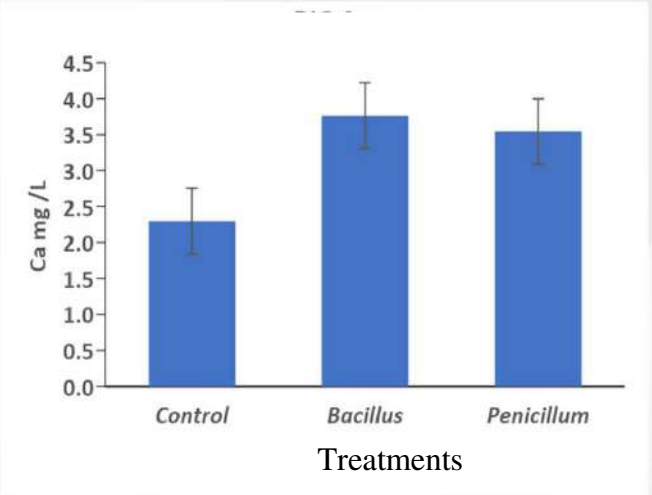


Figure 5. Available calcium (mg/L) from CDW 4 after biosolubilization for 7 days.

RESULTS

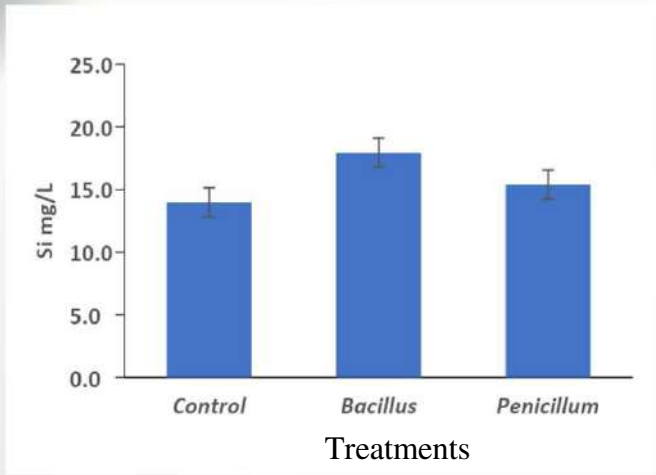


Figure 6. Available silicon (mg/L) from CDW 1 after biosolubilization for 7 days.

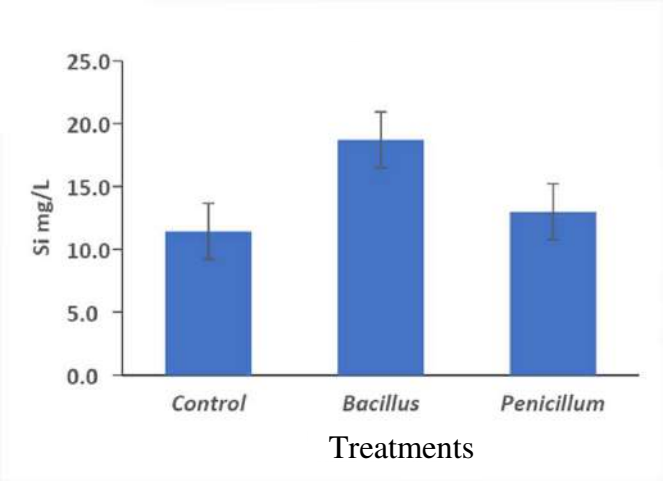


Figure 7. Available silicon (mg/L) from CDW 3 after biosolubilization for 7 days.

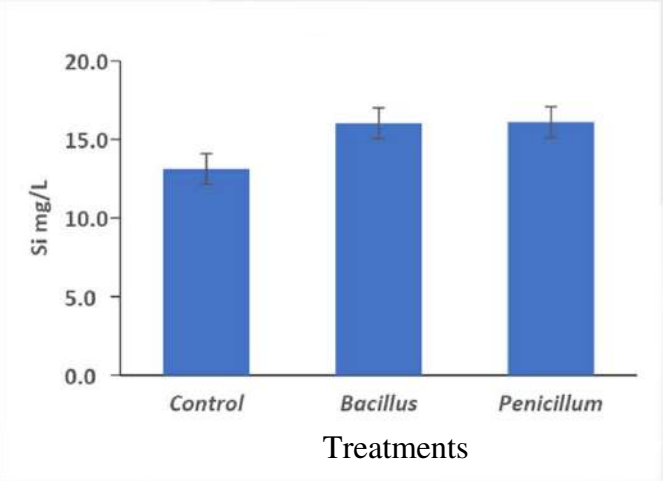


Figure 8. Available calcium (mg/L) from CDW 4 after biosolubilization for 7 days.

RESULTS

3. CDW Liming effect.

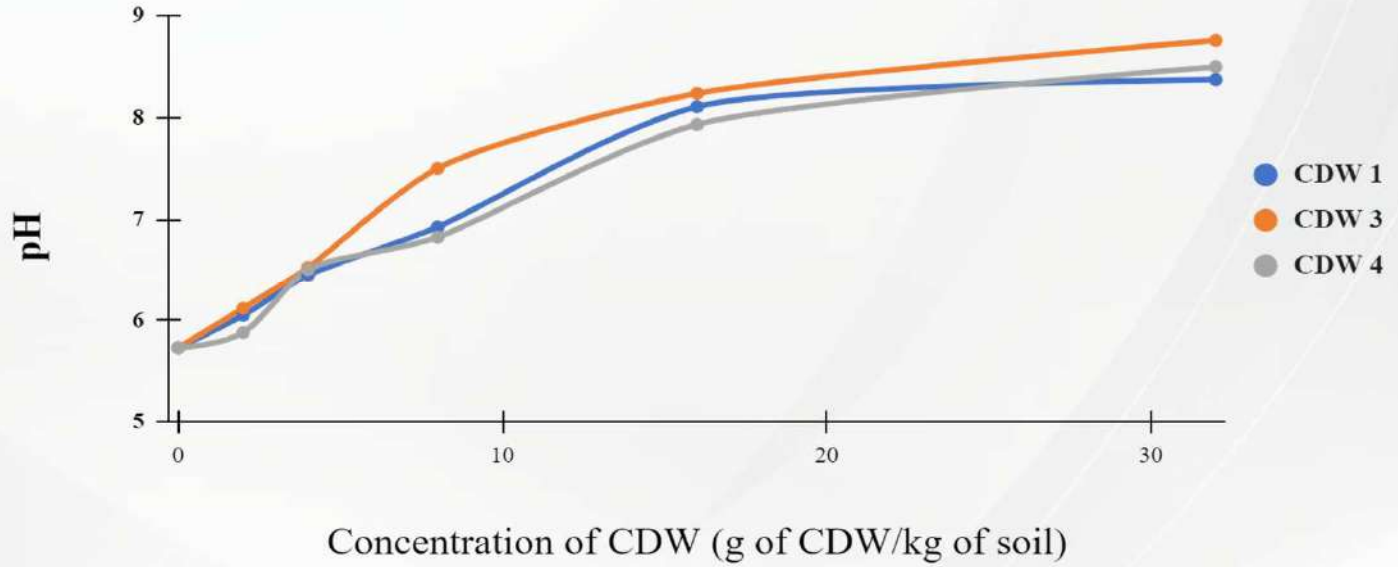


Figure 9. Variation of pH vs. Concentration of CDW (g of CDW/kg of soil) after the incubation test with lime for 20 days.

RESULTS

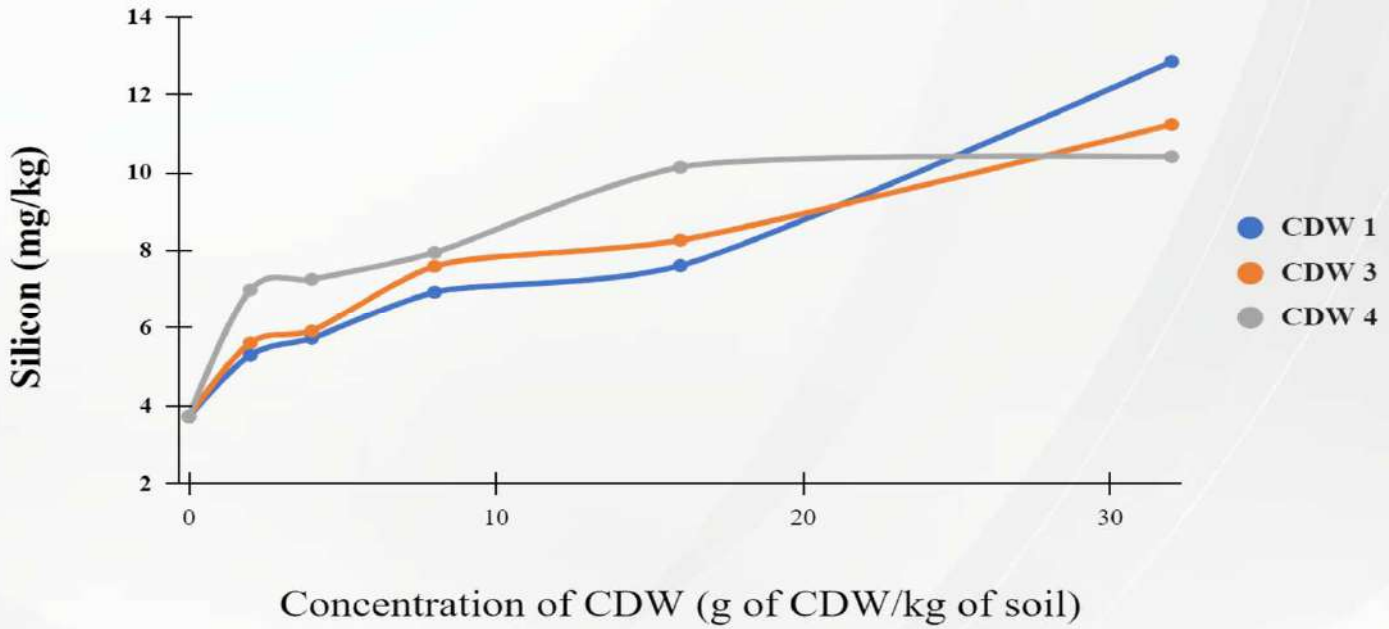


Figure 10. Variation of silicon vs. Concentration of CDW (g of CDW/kg of soil) after the incubation test with lime for 20 days.

RESULTS

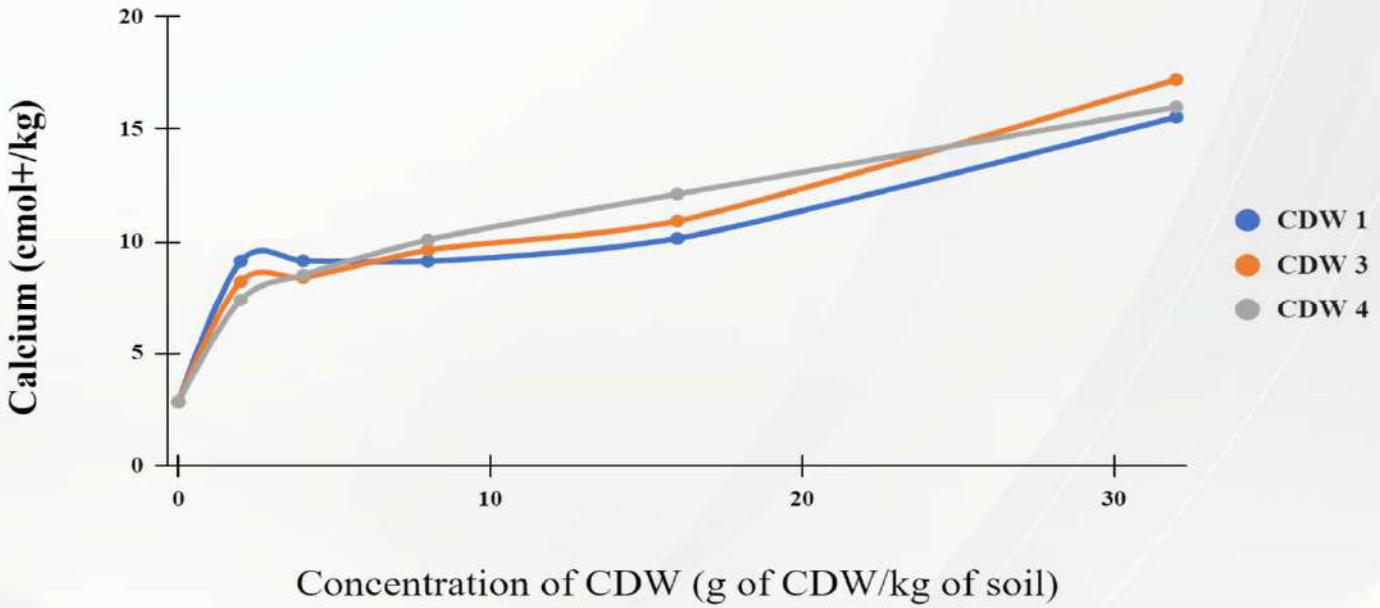


Figure 11. Variation of calcium vs. Concentration of CDW (g of CDW/kg of soil) after the incubation test with lime for 20 days.

CONCLUSIONS

- The physicochemical characterization of the soil and the chemical characterization of the CDW were successfully carried out. This process allowed for the identification of their properties, thus verifying that they are suitable specimens for the development of the project.
- The CDW shows differences in color, composition, and pH. Among its composition, the concentrations of Ca, Mg, S, and Si are considered nutrients for plants. Its high pH values allow it to be used as liming materials.
- The biosolubilization of CDW was achieved under in vitro conditions using *Penicillium janthinellum* and *Bacillus megaterium.*
- It is confirmed that the CDW used has a liming and nutritional effect on the soil.

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Perception and estimation of noise emission at the IU Colegio Mayor de Antioquia according to Resolution 627 of 2006.

Ana María Tamayo Betancur – Isis Angélica Ríos Ochoa

Julián Esteban López Correa

Proyecto de investigación

IU Colegio Mayor de Antioquia.

2024-2

RESEARCH PROBLEM

¿How does the community perceive noise and how does it relate to the measured levels?

Fig1. Top view of IU Colmayor

THEORETICAL FRAMEWORK

Brazil: 89.65% of university areas exceed noise limits, affecting concentration (Zannin et al., 2013).

Mexico: Noise levels above the recommended level affect student welfare (Montaño et al., 2012).

Thailand: Discrepancy between measured levels and noise perception (Onchang and Hawker, 2018).

Regulations in Colombia: Resolution 627 of 2006 establishes limits of 65 dB for academic areas and 55 dB for libraries.

OBJECTIVES

Evaluate the perception of the university community on sound pressure levels and based on these perceptions, to carry out noise measurements and their compliance with Resolution 627 of 2006.

Evaluate the perception of noise in the university community, using a standardized Likert scale questionnaire.

Developing a monitoring plan for sound pressure measurements based on noise perception for environmental monitoring, which includes the areas identified as critical.

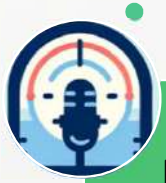
Comparing the results obtained with the limits allowed in Resolution 627 of 2006, in order to evaluate the degree of compliance with current regulations.

Developing a graphical representation using isolines that integrates sound pressure measurements to identify critical areas.

METHODOLOGY

Graphical representation (Isolines) QGIS with IDW Interpolation

Data relation Perception VS Decibels levels



Noise Measurement Resolution 627

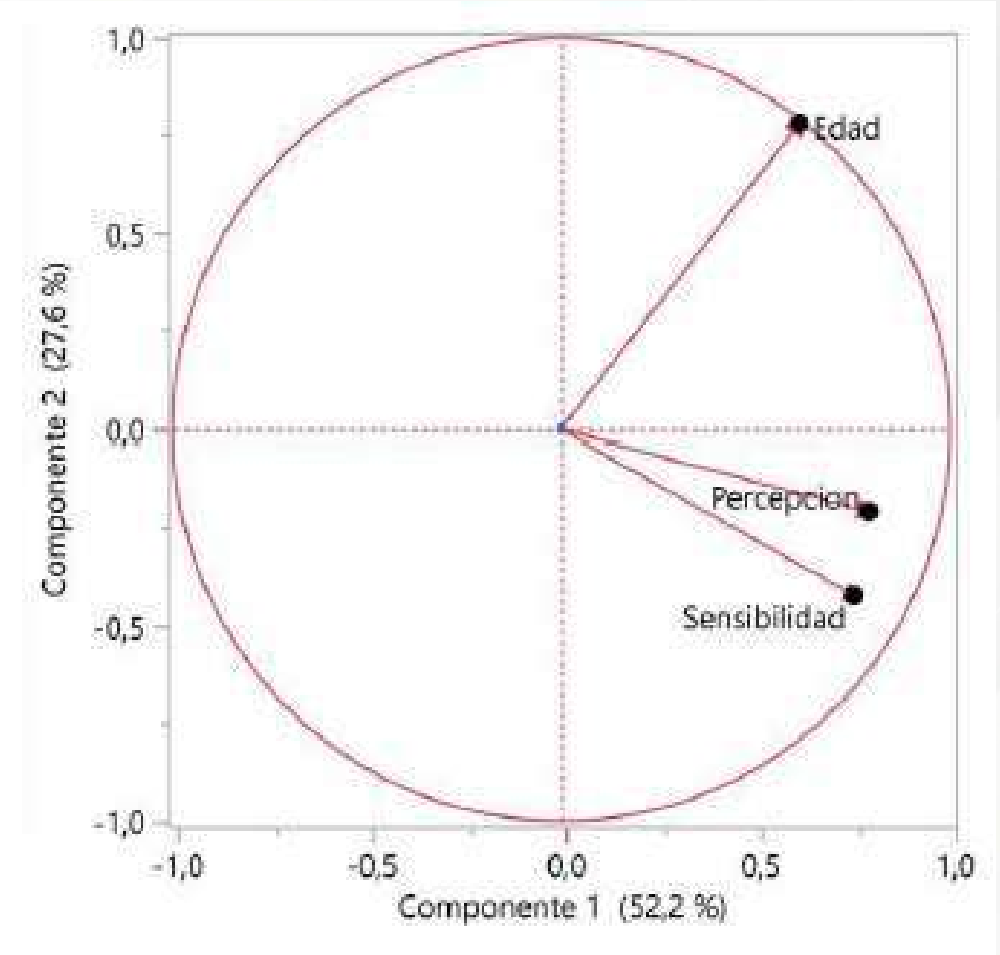
Data Analysis JMP Pro Software and Google Forms Compilation

Survey Design NTC 6012 and Delphi Method

Sampling Identification University Information

ANALYSIS AND RESULTS

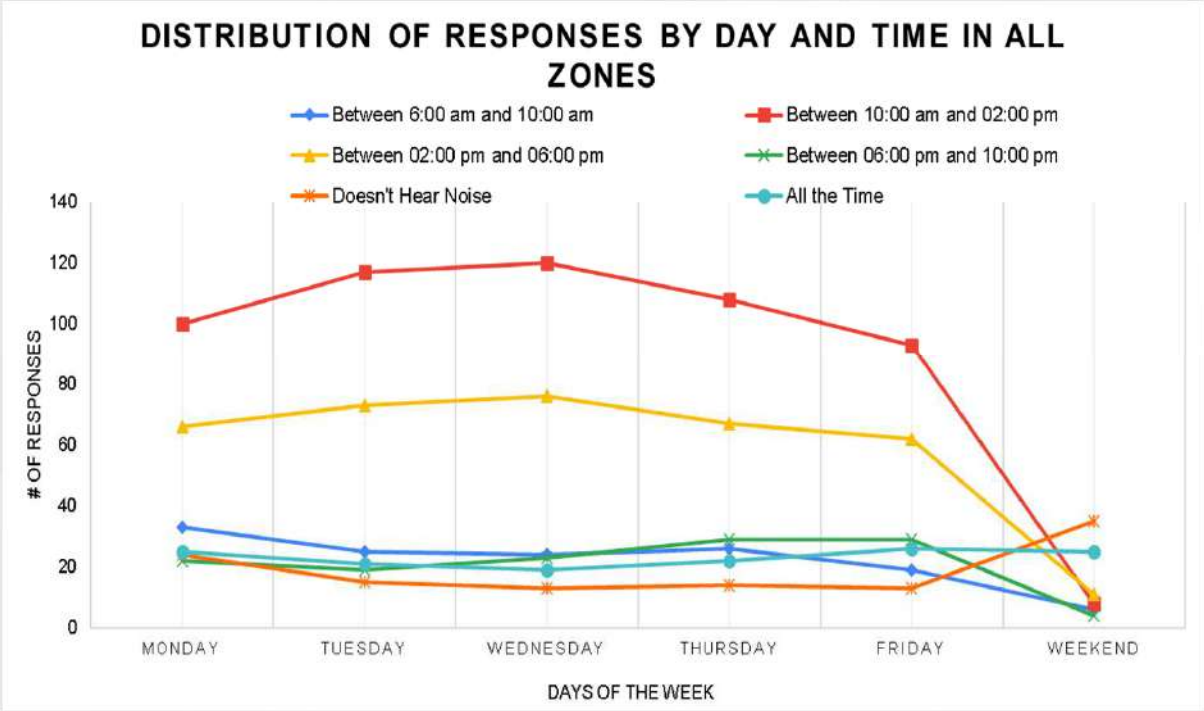
The sample size was from 359 surveys, distributed equally between five zones (Library, Academic Block, Cafeteria, Sports Zone and Block A).



ANALYSIS AND RESULTS

The measurements were made on Tuesdays, Wednesdays and Thursdays, between 10 am and 2 pm, this being the most critical time in areas such as Block A, the Cafeteria, the Library and the Academic Block. In the Sports Zone, the measurements were made between 3 pm and 6 pm

Fig2. measurement points.



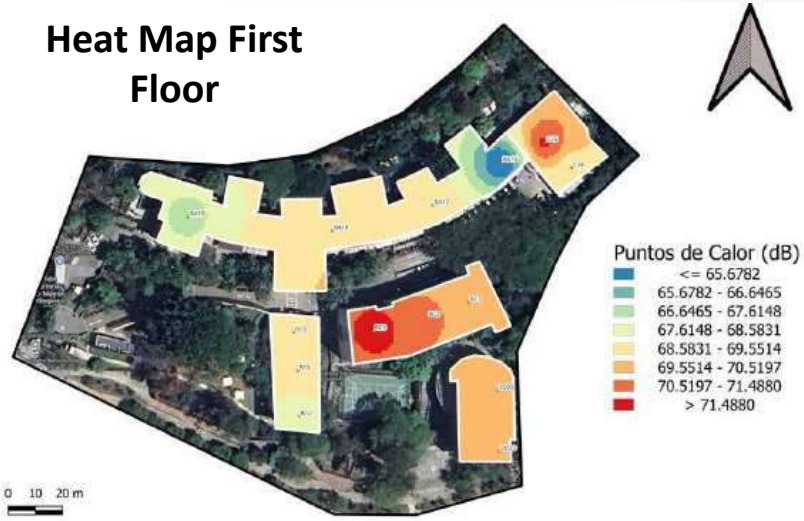
ANALYSIS AND RESULTS

Relationship between perception and measurements

Compliance with regulations

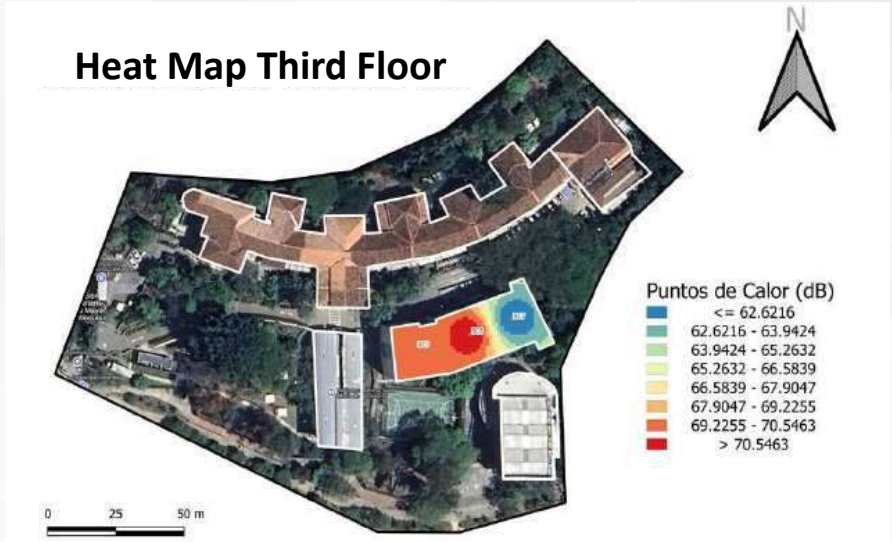
University Zone	Total arithmetic average for each Zone (dB)	Median of Perception	Range of the dB Scale for Perception	Perception/measurement Relationship	Standard Resolution (dB)	Measurement/Standard Relationship.
Library (B)	65,67	4	60 - 80 dB	Coincides	55 dB	No coincides
Block A (BA)	67,87	4	60 - 80 dB	Coincides	65 dB	No coincides
Cafeteria (C)	70,39	4	60 - 80 dB	Coincides	70 dB	No coincides
Sports Zone (ZD)	68,47	3	40 - 60 dB	No coincides	70 dB	No coincides
Block C (BC)	69,42	4	60 - 80 dB	Coincides	65 dB	No coincides

Heat Map First Floor

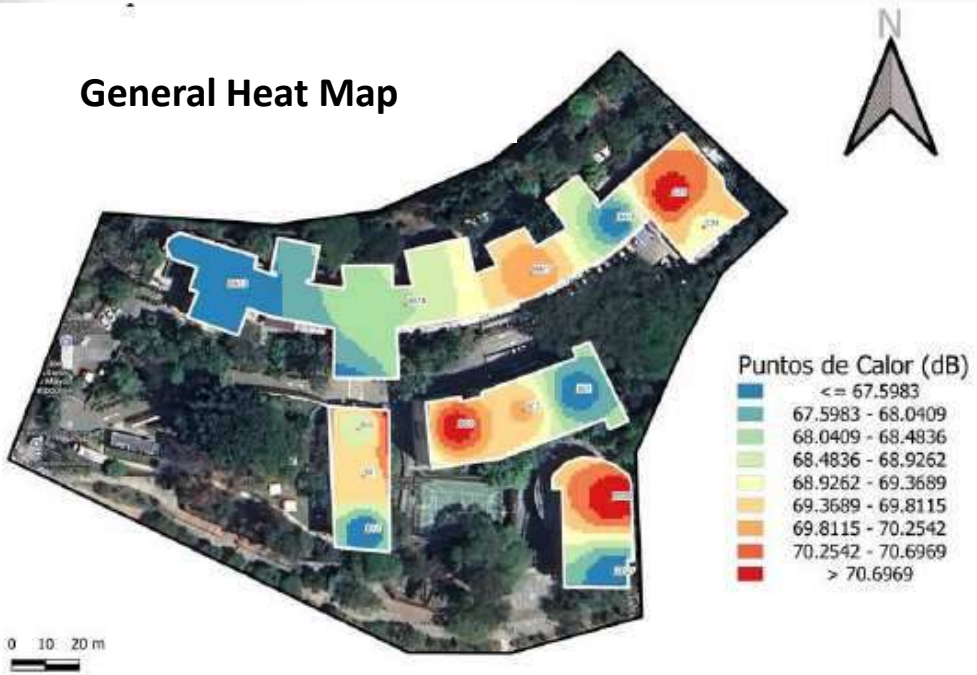


Heat Map Second Floor

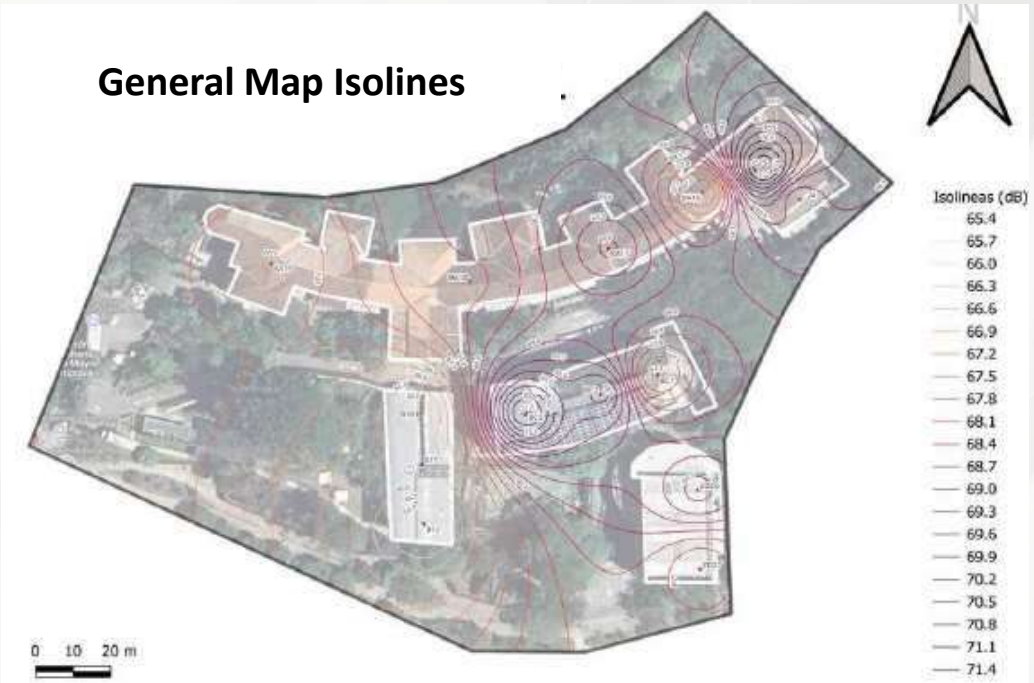
Heat Map Third Floor



General Heat Map



General Map Isolines



Conclusions

Critical noise levels: The time zone of greatest noise exposition is from 10:00 am to 2:00 pm, affecting all areas evaluated..

Areas that do not comply with the standard: Measurements indicate that the Library, Blocks A and C, Sports Zone, and Cafeteria exceed the limits established by Resolution 627 of 2006.

Perception vs. Reality: The perception of noise is consistent with measurements in most areas. However, in the Sports Zone, the actual noise levels are higher than which the community perceives.

RECOMMENDATIONS

Future research should thoroughly evaluate how noise affects academic performance and the welfare of the university community and establish appropriate interventions.

References

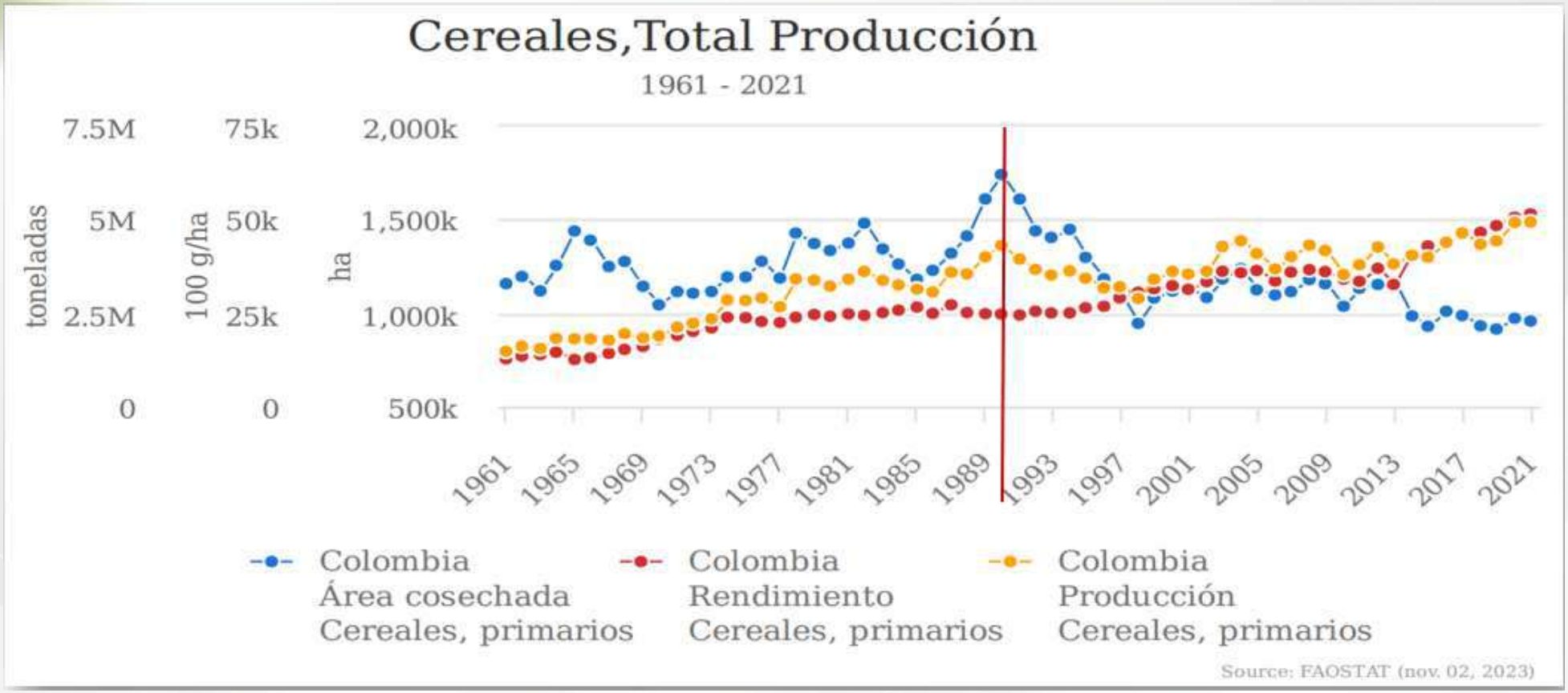
Thank you

Effect of biofertilization with digestates enriched with *Azospirillum brasilense* on the development of Zea mays seedlings

Verónica Jaramillo Saldarriaga
Ana Judith Zapata Manco

Thematic Advisor: PhD Laura Osorno Bedoya
Methodological Advisor: Gina Hincapié Mejía
2024-2

RESEARCH PROBLEM



THEORETICAL FRAMEWORK

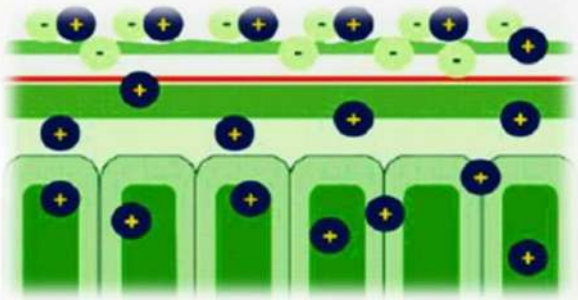
DIGESTATE

https://es.pngtree.com/freepng/canister-of-plant-fertilizers-vector-icon-liquid-organic-chemical-vector_12569656.html

APPLICATION TECHNIQUES

FOLIAR

https://www.portalfruticola.com/noticias/2017/10/16/fisiologia-de-la-fertilizacion-foliar-en-las-plantas-principios-y-aplicaciones/



CEC: Cation Exchange Capacity

EDAPHIC

https://humusnatural.com/rizobacterias-promotoras-del-crecimiento-vegetal/

Azospirillum brasilense

OBJECTIVES

Evaluate the effect of biofertilization with digestates enriched with *Azospirillum brasilense* on the development of maize seedlings.

SPECIFIC

01

Stabilize a digestate derived from an anaerobic fermentation reactor of organic waste for agricultural use.

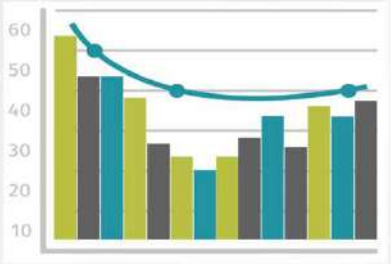
02

Characterize the physicochemical properties of the soil to understand the initial conditions.

03

Evaluate the effect of the application of biol enriched with *Azospirillum brasilense* on plant growth.

METHODOLOGY PRELIMINARY STAGE

Physicochemical characterization of the soil	Zea mays seedlings	Digestate	*Azospirillum brasilense*	Biometric Data
				
SOIL Physicochemical characterization of the initial soil**.**	**EXPERIMENTAL UNIT** 36 seedlings 12 pots Watering 3 times/week with H_2O Watering treatment 1 time/week	**LIQUID ORGANIC FERTILIZER** Origin: Animal organic wasteBiodigester: Hydrolysis reactor and a UASB reactor	**DIMAZOS** From the Biocultivos laboratory, it is found at concentrations of $1x10^8$ CFU/ml.	**BIOMETRIC DATA** Analysis of weekly and final biometric data

TREATMENTS

[T_A] *Azospirillum brasilense*		5 ml/plant Once at seedling planting.
[T_B] Digestate		50 ml/plant Once a week
[T_AB] *Azospirillum* + Digestate		5 ml *Azospirillum*/plant Once at seedling planting 50 ml/plant of Biol once a week
[T_C] Control		100 ml H_2O/plant

RESULTS AND ANALYSIS

Results of the physicochemical characterization of the biol and the soil used for the project in the experimentation stage.

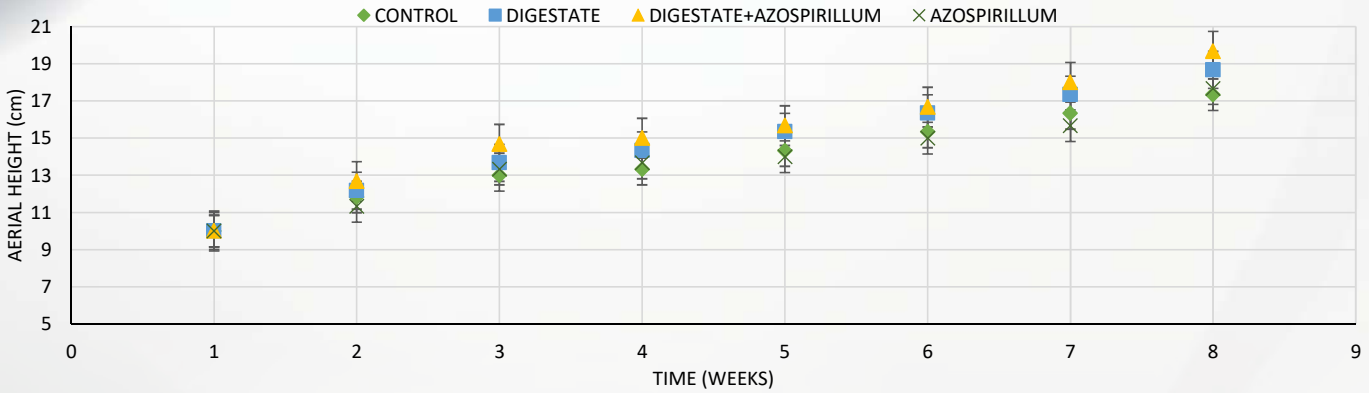
PHYSICOCHEMICAL ANALYSIS OF THE BIOL					
Parameter	Units	Technique	Rule	Result	NTC 5167/2022
CO	g/l	Titrimetric		0.99	>20
pH (straight)	U pH	Standard method	NTC 5167	7.08	2.5--8.5
C.E. (1/100)	dS/m			0.043	-
N-Org. Total	g/l	Titulométrica	NTC 370	0.594	>15
C/N	-	Mathematical calculation		1.66	-
Total solids	g/l	Standard method	NTC 5167	10.6	<40
Fixed solids	mg/l		NTC 897	4272	-
Volatile solids	mg/l	Mathematical calculation		6328	-
DQO total	mgO2/l	Standard method	SM 5220-D	5450	-

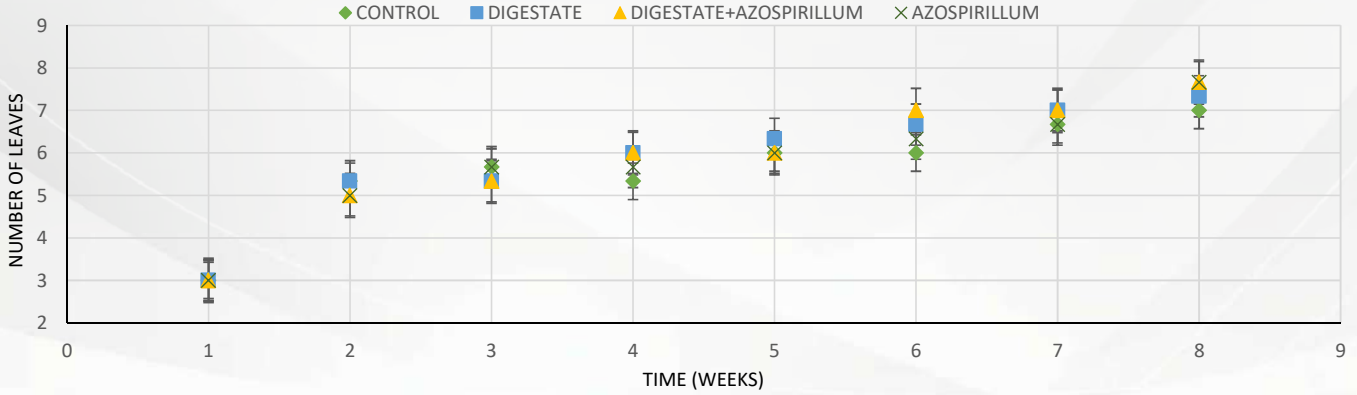
PHYSICOCHEMICAL ANALYSIS OF THE SOIL			
Parameter	**Result**	**Units**	**Range**
Sand	50	%	20--70
Silt	20	%	30--50
Clay	30	%	10--25
Class	Sandy clay loam	-	Frank
pH	5.5		5.5--6.0
CE	0.15	Ds/M	1--2
MO	5.6	%	5--10
P3-	5	mg/kg	15--30
S^{2-}	47	mg/kg	6--12
Al^{3+}	0	Cmol (+)/kg	<1
Ca^{2+}	7.2	cmol (+)/kg	3--6
Mg^{2+}	2.2	Cmol (+)/kg	1.5—2.5
K^{+}	0.33	Cmol (+)/kg	0.15--0.30
CEC ef	9.76	Cmol (+)/kg	5--10
Fe^{2+}	53.3	mg/kg	25--50
Mn^{2+}	7.8	mg/kg	5--10
Cu	3.7	mg/kg	3--5
Zn	2.4	mg/kg	3--5
B	0.2	mg/kg	0.5--1.0

The soil is clayey loam with a slightly acidic pH of 5.5

RESULTS AND ANALYSIS

Aerial height and number of leaves of Zea mays plants in the exploratory stage, with respect to the time from week 1 to week 8, each being the average of 3 data points according to the treatments: TA: *Azospirillum brasilense* Treatment, TD: Digestate Treatment, TBA: Digestate + *Azospirillum brasilense* Treatment, and C: Control.





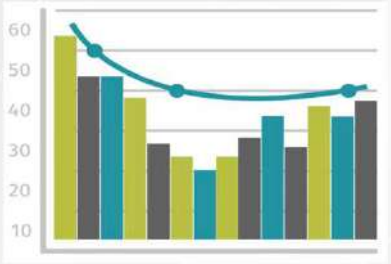
CONCLUSIONS OF THE PRELIMINARY STAGE

In the characterization of the biol, it is evident that it is low in organic nitrogen, making it suitable for the experiment, as combining it with *Azospirillum* will promote the transformation of N_2 to NH^+_4 and NO^-_3 that are assimilable by the plant

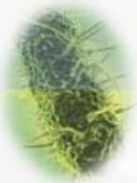
According to the soil analysis, it was determined that it is a clayey loam with a slightly acidic pH characteristic of Colombian soils. However, the limited availability of substrate area generated a nutritional deficit in the plants, affecting the nutrient adsorption rate, which in turn hinders the growth of the leaf area, causing an impact on nutrient translocation.

During the course of weeks 8 to 9, the plants exhibited a decrease in growth, chlorosis, wilting, weak stems that were brown in color, and flaccid leaves, many of which had already fallen off the stems—characteristics of death across the different treatments. The mortality can be attributed to various initial factors at the time of planting, such as the substrate used or the seedlings themselves. The death is not attributed to the digestate, as it was only present in two treatments.

METHODOLOGY – ADJUSTMENT STAGE

Physicochemical characterization of the soil	Zea mays seedlings	Digestate	*Azospirillum brasilense*	Biometric Data
				
SOIL Physicochemical characterization of the initial soil**.**	**EXPERIMENTAL UNIT** 40 seedlings 4 germination beds Watering 3 times/week with H_2O Treatment watering every 15 days	**LIQUID ORGANIC FERTILIZER** Origin: Plant organic waste.From the company Terrazonet.	**DIMAZOS** From the Biocultivos laboratory, it is found at concentrations of $1x10^8$ CFU/ml.	**BIOMETRIC DATA** Analysis of weekly and final biometric data

TREATMENTS

[T_A] *Azospirillum brasilense*	 	5 ml Azospirillum/plant Once at seedling planting
[T_B] Digestate	 	50 ml/plant of Digestate diluted in 100 ml of H_2O, every 15 days.
[T_AB] *Azospirillum* + Digestate	  	5 ml *Azospirillum*/plant Once at seedling planting 50 ml/plant of Digestate diluted in 100 ml of H2O, every 15 days.
[T_C] Control	 	100 ml H_2O/plant

RESULTS AND ANALYSIS

Results of the physicochemical characterization of the TERRAZONET digestate showed a pH of 7.15, ideal for the presence of macronutrients and micronutrients that are essential for plant growth and development.

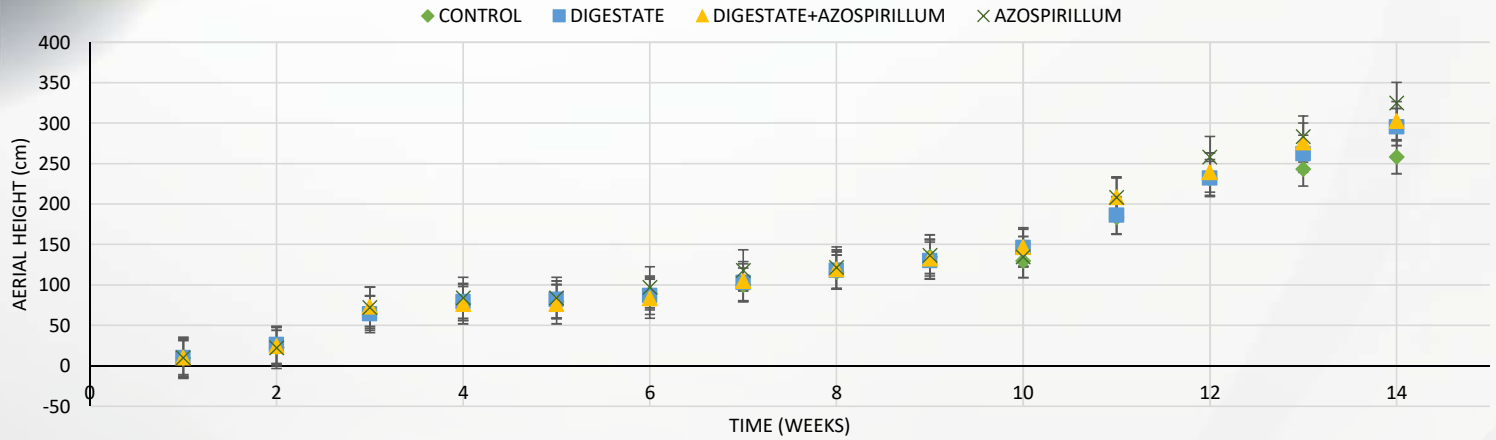
PHYSICAL CHEMICAL ANALYSIS OF THE BIOL TERRAZONET					
Parameter	**Technique**	**Norma**	**Resultado**	**d.e**	**Unid.**
Total calcium	E.C	No aplica	0.48	0.01	g/L
Total magnesium	E.C	No aplica	0.0871	0.0001	g/L
Total Nickel	A.A	SM3111B	1.12	0.03	ppm
Total Potassium	E.C	No aplica	0.83	0.01	g/L
Total sodium	E.C	No aplica	0.317	0.001	g/L
Total Zinc	E.C	No aplica	0.00398	0.00005	g/L
Oxidizable organic carbon	Titulométrica	NTC 5167	1.59	-	%
Electrical conductivity (1/200)	Potenciometría	NTC 5167	0.95	-	dS/m
Density (20 °C)	Gravimetría	NTC 5167	1	-	g/cm3
Total phosphorus	Espectrofotometría	NTC 234	0.45	-	%
Total suspended solids	Gravimetría	SM 2540D	673	-	mg/L
Total organic nitrogen	kjeidehl	NTC 370	1.13	-	%
pH (10%)	Potenciometría	NTC 5167	7.15	-	-
C/N Ratio	No aplica	No aplica	1.4	-	-

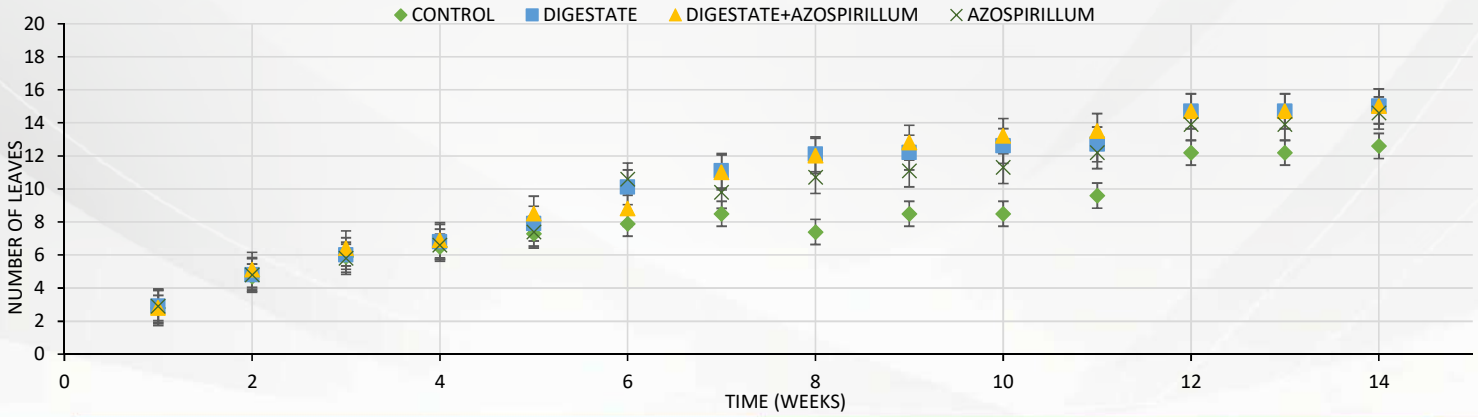
Results of the microbiological analyses, recognizing the importance of identifying their presence, as this can directly influence the effectiveness of the fertilizer and the health of the soil and plants.

MICROBIOLOGICAL ANALYSIS						
Mesophil esu.f.c./g	**Thermophiles u.f.c./g**	**Mold u.f.c./g**	**yeast u.f.c./ g**	**Nematode y/o Protozoa**	**Whole bacteria u.f.c./g**	**Salmonella / 25g**
3,3 E+05	8,0E+02	2,4E+02	8,70E+02	Missing	5,00E+01	Negative

RESULTS AND ANALYSIS

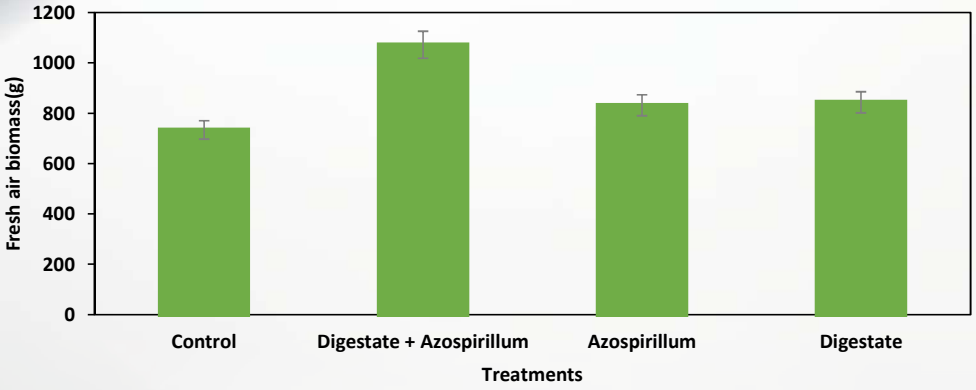
Aerial height and number of leaves of Zea mays plants in the adjustment stage, with respect to the time from week 1 to week 14, each being the average of 10 data points according to the treatments: TA: *Azospirillum brasilense* Treatment, TD: Digestate Treatment, TDA: Digestate + *Azospirillum brasilense* Treatment, and C: Control.

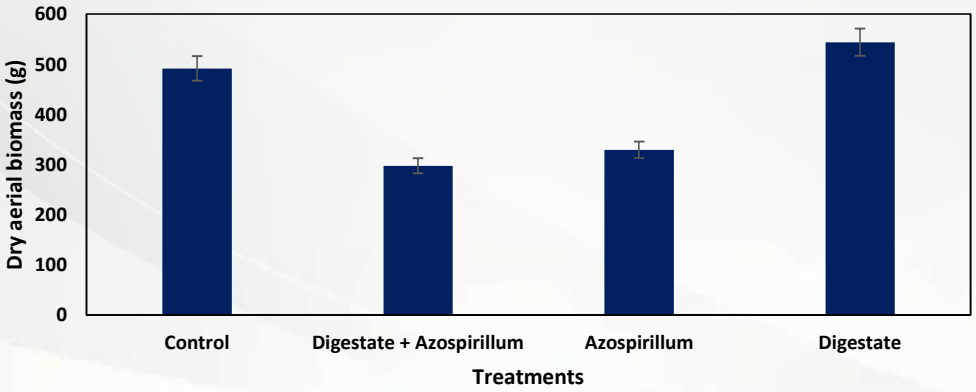




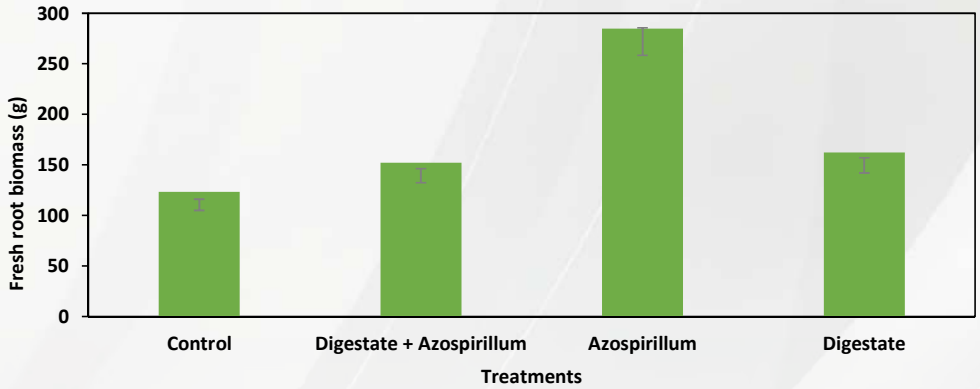
RESULTS AND ANALYSIS

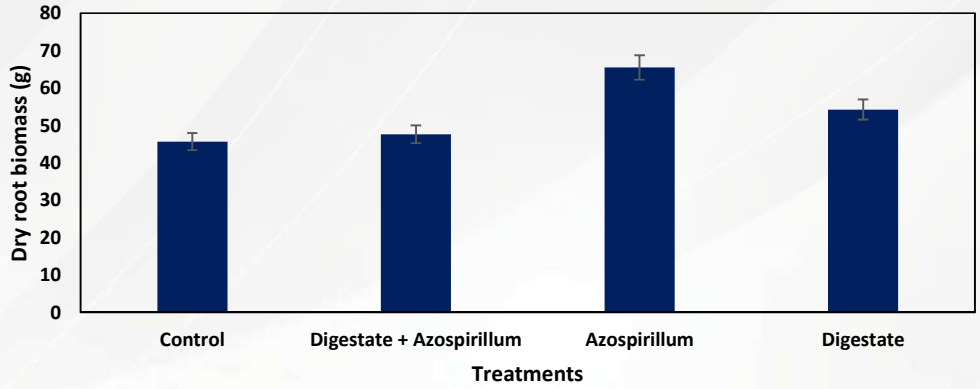
Fresh and dry aerial biomass of Zea mays plants in the adjustment phase over 14 weeks, with each column representing the average of 10 data points according to the treatments.





Fresh and dry root biomass of Zea mays plants in the adjustment phase over 14 weeks, with each column representing the average of 10 data points according to the treatments.





CONCLUSIONS OF THE ADJUSTMENT STAGE

The difference between the two digestates used influenced the final results of each stage. In the adjustment stage, the digestate used was of plant origin, which contained phytohormones whose properties enhanced rooting and the formation of new leaves. This was evidenced by the biometric data of the plants with TD and TDA.

In the case of the Digestate treatment, the data showed a potential yield of the plant in terms of dry aerial biomass, as greater dry aerial biomass correlates with higher grain production. It fulfilled its function of stimulating flowering and fruiting, increasing foliage, and accelerating shoot growth.

The digestate enriched with *Azospirillum brasilense* increased the root growth of the plants, allowing them to absorb all the macro and micronutrients provided by the digestate through their roots. The combination of the digestate with *Azospirillum* fulfilled the roles of foliar stimulant and fertilizer, activating the microbial processes in the soil and strengthening plant growth.

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THANK YOU!

Analysis of Environmental and Social Indicators in Colombian University Sustainability Reports (2022-2023) according to GRI and SDGs

Author: Yurley Cano
Thematic advisor: Julián Esteban López Correa
Methodological advisor: Gina Hincapié
Institución Universitaria Colegio Mayor de Antioquia
October of 2024

Research Problem

Question: how do Colombian universities disclose their environmental and social sustainability performance?

Context: increasing demand for sustainability reporting in the education sector.

Significance: transparency and commitment to sustainability in higher education.

Theoretical Framework

GRI Empowering Sustainable Decisions

- **Global Reporting Initiative (GRI):** The main standard for sustainability reporting.
- **Sustainable Development Goals (SDGs):** The UN's 2030 agenda of 17 goals for sustainable development. **Relevance:** Key tools for assessing sustainability in universities.

Objectives

Main Objective: To examine the disclosure of environmental and social information in sustainability reports.

Sub-objectives

Identify universities in the MERCO ranking that publish sustainability reports.

To analyse the environmental and social indicators reported in sustainability reports based on GRI standards and the SDGs for the period 2022 - 2023 in the education sector - universities.

Determine the most common environmental and social indicators in the sustainability reports of the education sector - universities, and their alignment with the SDGs.

Methodology

Identification of the universities reported in the MERCO ranking for the period 2022-2023 in Colombia that report under the GRI standard and the sustainable development objectives (SDGs)

Compilation of sustainability reports for the period 2022 – 2023 of the education-university sector

Inspection of content and identification of recurrence in indicators

. Analysis of the information obtained in the sustainability reports of the education-university sector

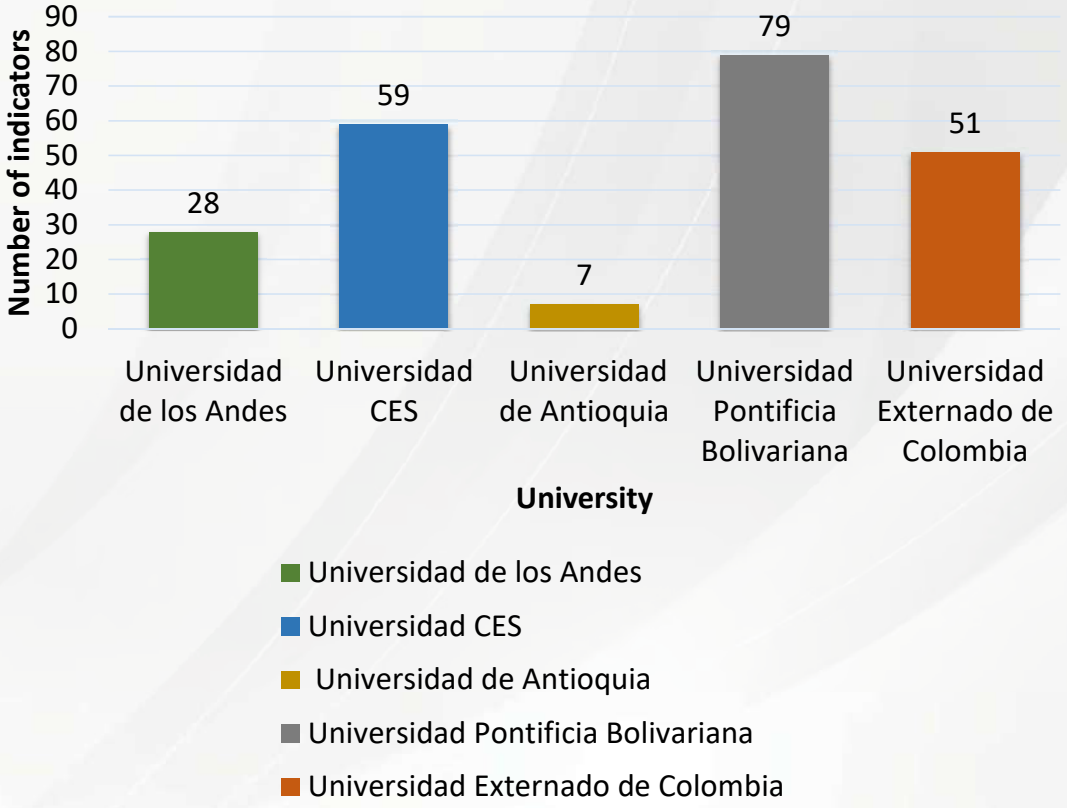
Universities Belonging to Ranking MERCO 2022-2023

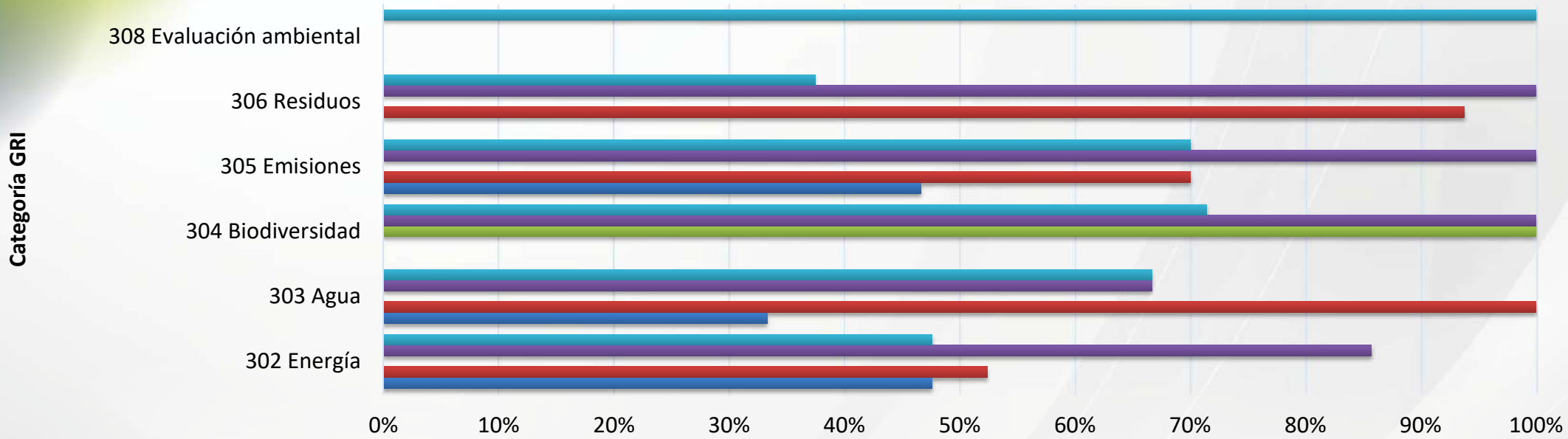
Position	Company
1	Pontificia Universidad Javeriana
2	Universidad Nacional de Colombia
3	Universidad Del Rosario
4	Universidad Eafit
5	Universidad de los Andes
6	Universidad de la Sabana
7	Universidad Ces
8	Universidad Ean
9	Universidad del Norte
10	Universidad de Antioquia
11	Universidad Pontificia Bolivariana (UPB)
12	Universidad Externado de Colombia
13	Universidad Autónoma de Occidente

Results – Environmental Indicators

- Institutions highlighted **Pontifical Bolivarian University:** 79 indicators.
- **CES University:** 59 indicators.
- **University of Antioquia:** 7 indicators.

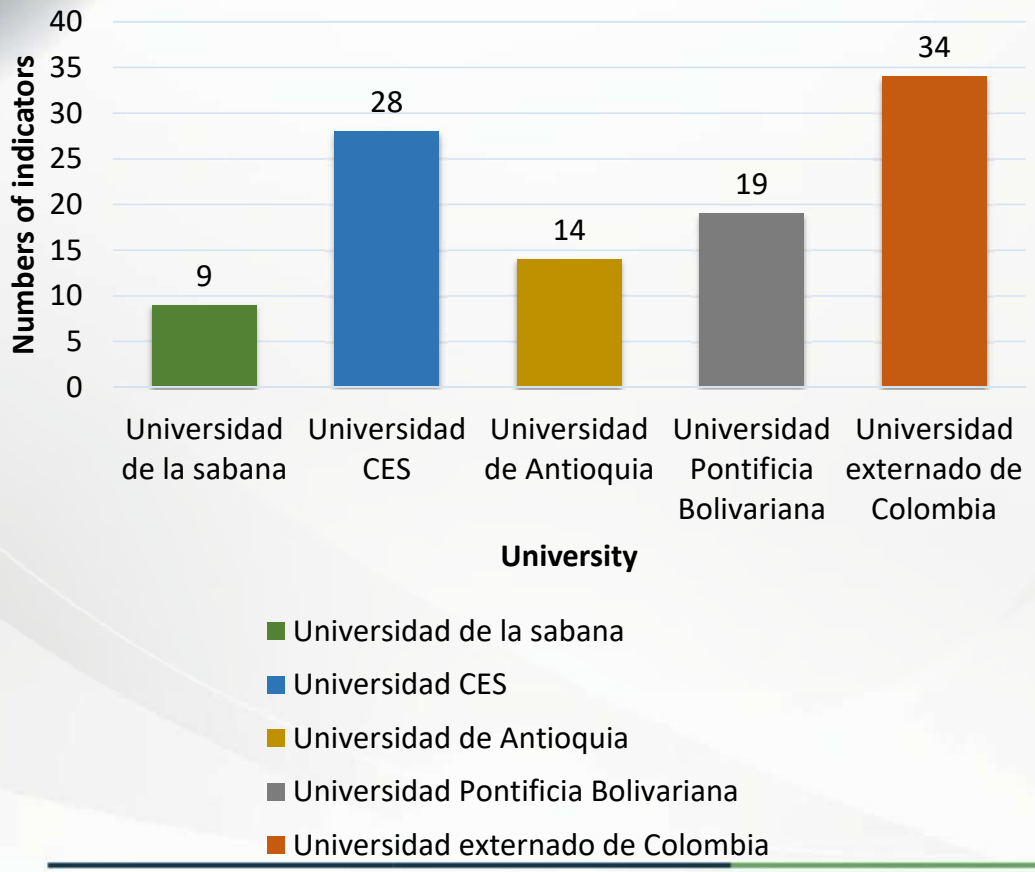
Main Environmental Indicators: Energy, water, biodiversity, emissions, and waste.





	302 Energía	303 Agua	304 Biodiversidad	305 Emisiones	306 Residuos	308 Evaluación ambiental
Universidad Externado de Colombia	48%	67%	71%	70%	38%	100%
Universidad Pontificia Bolivariana	86%	67%	100%	100%	100%	0%
Universidad de Antioquia	0%	0%	100%	0%	0%	0%
Universidad CES	52%	100%	0%	70%	94%	0%
Universidad de los Andes	48%	33%	0%	47%	0%	0%

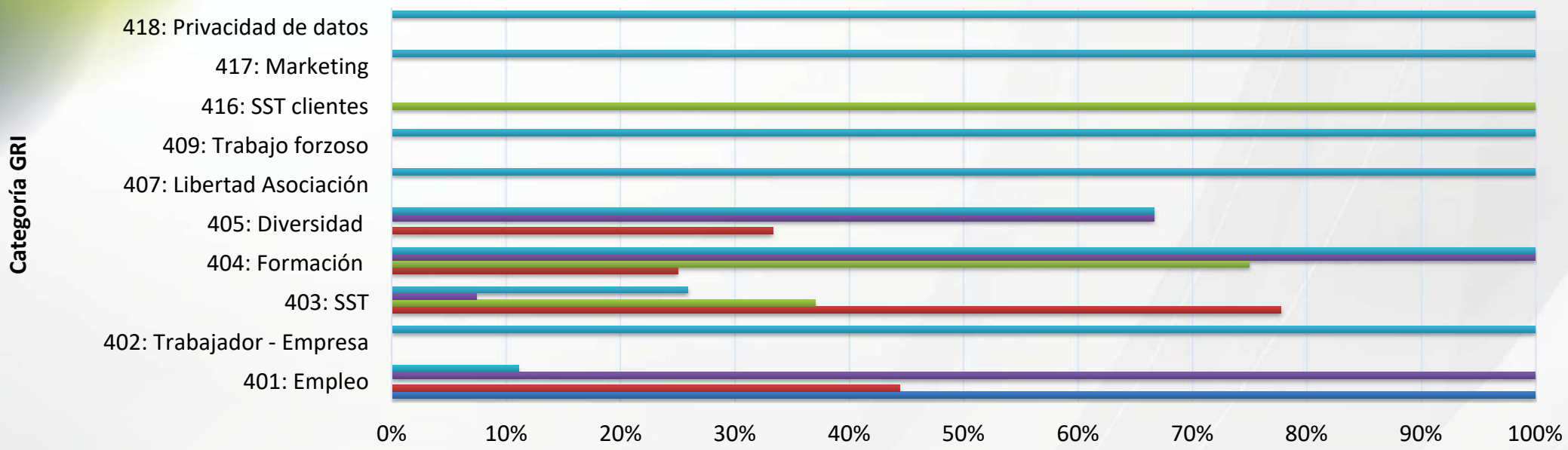
Results – Social Indicators



Leading Universities:

- **Externado University:** 34 indicators.
- **CES University:** 28 indicators.
- University of La Sabana: 9 indicators.

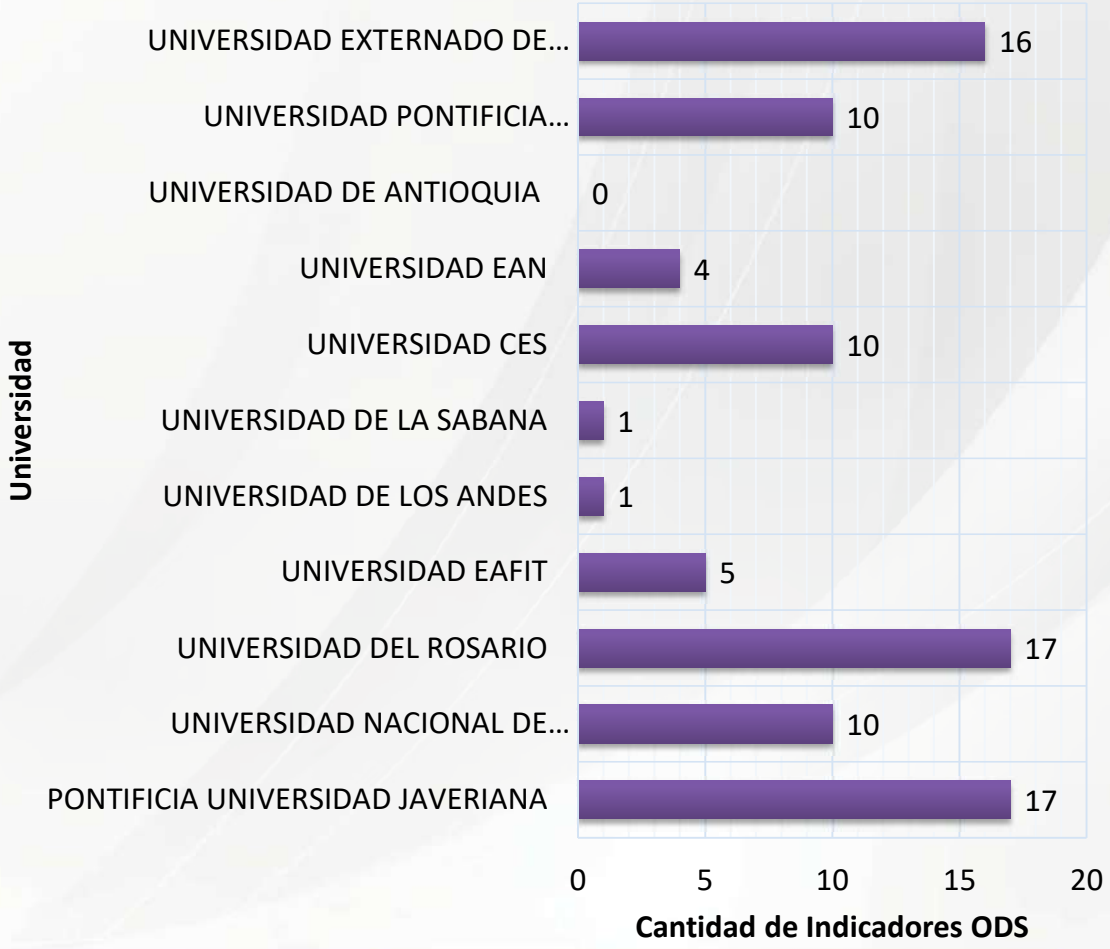
Main Categories: Employment, Diversity, occupational health and safety.



	401: Empleo	402: Trabajador - Empresa	403: SST	404: Formación	405: Diversidad	407: Libertad Asociación	409: Trabajo forzoso	416: SST clientes	417: Marketing	418: Privacidad de datos
Universidad Externado de Colombia	11%	100%	26%	100%	67%	100%	100%	0%	100%	100%
Universidad Pontificia Bolivariana	100%	0%	7%	100%	67%	0%	0%	0%	0%	0%
Universidad de Antioquia	0%	0%	37%	75%	0%	0%	0%	100%	0%	0%
Universidad CES	44%	0%	78%	25%	33%	0%	0%	0%	0%	0%
Universidad de la Sabana	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Results – SDGs.

- Highlighted ODS:
- **Pontifical Javeriana University and University of Rosario:** 17 indicators.
- **Externado University:** 16 indicators.
- **Main SDGs:** Affordable energy (SDGs 7), Responsible Production (SDGs 12), Partnerships (SDGs 17).



Conclusions

- **Unequal commitment:** Varying levels of transparency and sustainability.
- **Areas for Improvement:** Greater alignment with SDGs and GRI standards.
- **Importance of disclosure:** Strengthens reputation and social engagement

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Combining anaerobic digestion slurry and different biochars to develop a biochar-based slow-release NPK fertilizer

David Esteban Villada Puerta, Manuela Velásquez Sánchez, Ana María Gómez Perea.
Students
Ph.D Julián Esteban López Correa - Msc. Andrea Tamayo Londoño, **Thematic advisors**
Ph.D Gina Hincapié Mejía, **Methodological advisor**

Research project

2024 - 2

Content

1. Research problem
2. Theoretical framework
3. Objectives
4. Methodology
5. Results
6. Analysis of results
7. Conclusions
8. Bibliographic References

Research problem

1. • Use of organic waste

2. • Nutrient recovery

3. • Circular economy

Theoretical framework

DIGESTATE

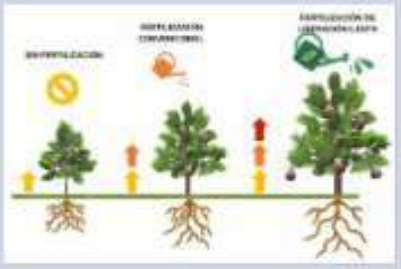
- Biological Transformation - Anaerobic Digestion.
- **Literature review:** Kebede et al., (2023).

BIOCHAR

- Thermochemical transformation.
- **Literature review:** Ndoung et al., (2021); Rombel et al., (2022).

SLOW RELEASE FERTILIZER

- Increasing the bioavailability of nutrients.
- **Literature review:** Wang et al., (2022); Duan et al., (2023).

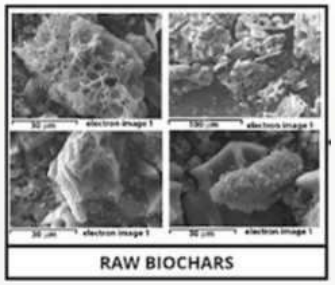


Objetive

- Formulate biochar-based fertilizers using digestate from anaerobic treatment of municipal waste and biochar from agricultural waste.

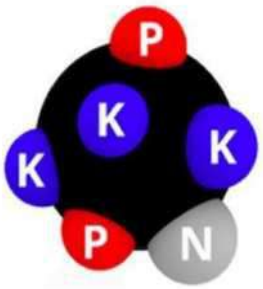
METHODOLOGY

BIOGAS SLURRY STORAGE



RAW BIOCHARS

IMPREGNATION PROCESS



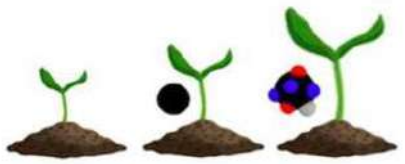
BIOCHAR-BASED SLOW-RELEASE NPK FERTILIZER

SELECTION CRITERIA

- N, P AND K CONTENT
- SLOW RELEASE PERFORMANCE

- O/C
- H/C
- BASE CATIONS CONCENTRATION
- CEC

NUTRIENTS (NPK) UPTAKE BY CUCUMBER PLANTS



CONTROL | RAW BIOCHARS | BIOCHAR-BASED SLOW-RELEASE NPK FERTILIZERS

Results and analysis

Physicochemical characterization of materials.

Table 1. Characteristics of raw materials

Characteristics of raw materials					
Characteristics	CS	RS	QS	SCB	DIGESTATE
pH	10,31	10,44	9,67	10,36	8,25
CE (µS cm^{-1})	519	565	554	431	1575
N (%)	2,2	1,3	1,8	1,6	
P (PO_4^{3-}) (g kg^{-1})	0,7	0,2	0,9	0,3	
K (g kg^{-1})	1,9	0,6	1,2	0,8	
NTK (mg l^{-1})	-	-	-	-	23000
P (mg l^{-1})	-	-	-	-	15000
K (mg l^{-1})	-	-	-	-	18000

Table 2. Characteristics of biochar-based fertilizers

Characteristics of biochar-based fertilizers				
Characteristics	CS-BF	RS-BF	QS-BF	SCB-BF
pH	8,87	8,98	8,88	8,78
CE (µS cm^{-1})	1752	1711	1750	1694
NTK (g kg^{-1})	54	33	63	41
P (PO_4^{3-}) (g kg^{-1})	194	1,7	60	2,8
K (g kg^{-1})	35,1	2,9	17,7	5.2

Results and analysis

SEM - EDS

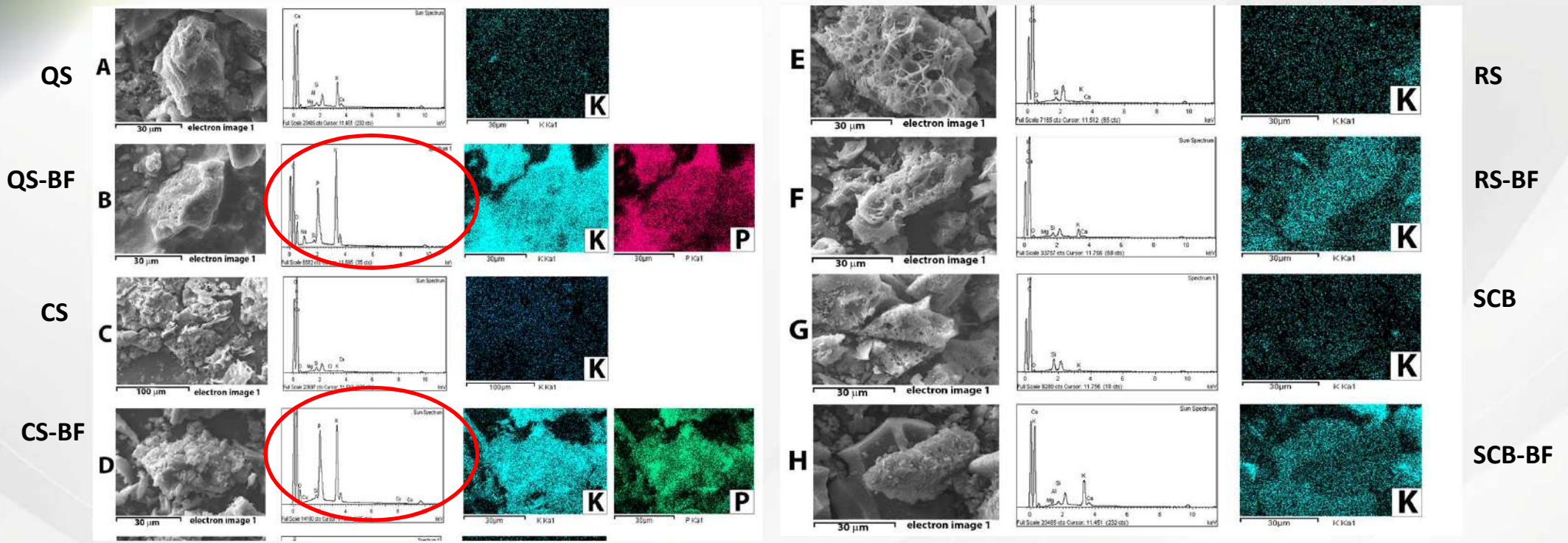


Fig 1. SEM images, EDS spectrum, and SEM-EDS maps. The following information is displayed for each material from left to right: SEM image, EDS spectrum, and SEM-EDS map.

Results and analysis

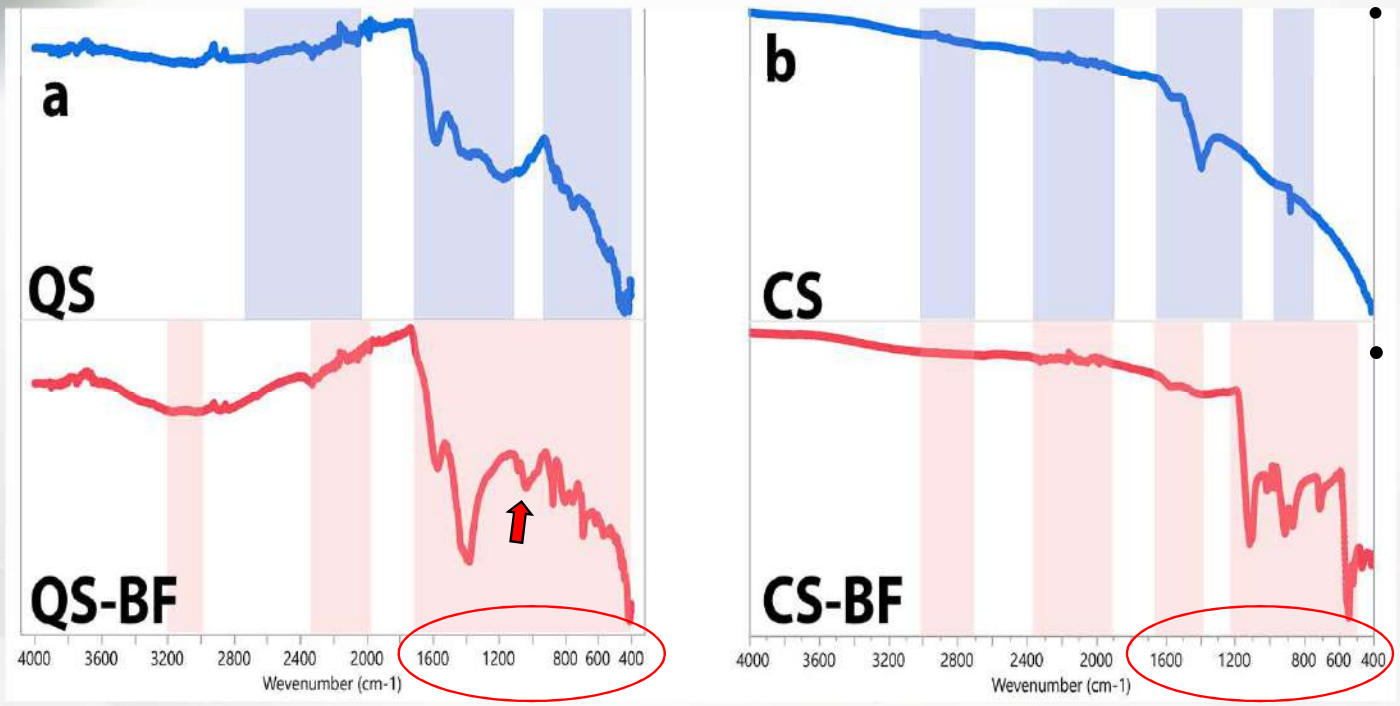


Fig 2. FTIR spectra of the raw biochar and the biochar-based fertilizers. The shaded areas indicate the regions where the characteristic functional groups are present in each material. (a) QS and QS-BF. (b) CS and CS-BF.

FTIR

- Bands at 1350-1260, 1100-1050, 1420-1300 and 720-590 cm- 1 present in QS and the CS can be attributed to oxygen-containing functional groups (O-H and C-O).
- Additionally, bands observed at 540, **1000–1100**, 1050–990, and 1350–1250 cm− 1 , may be associated with the adsorption of P on the biochars.

Results and analysis

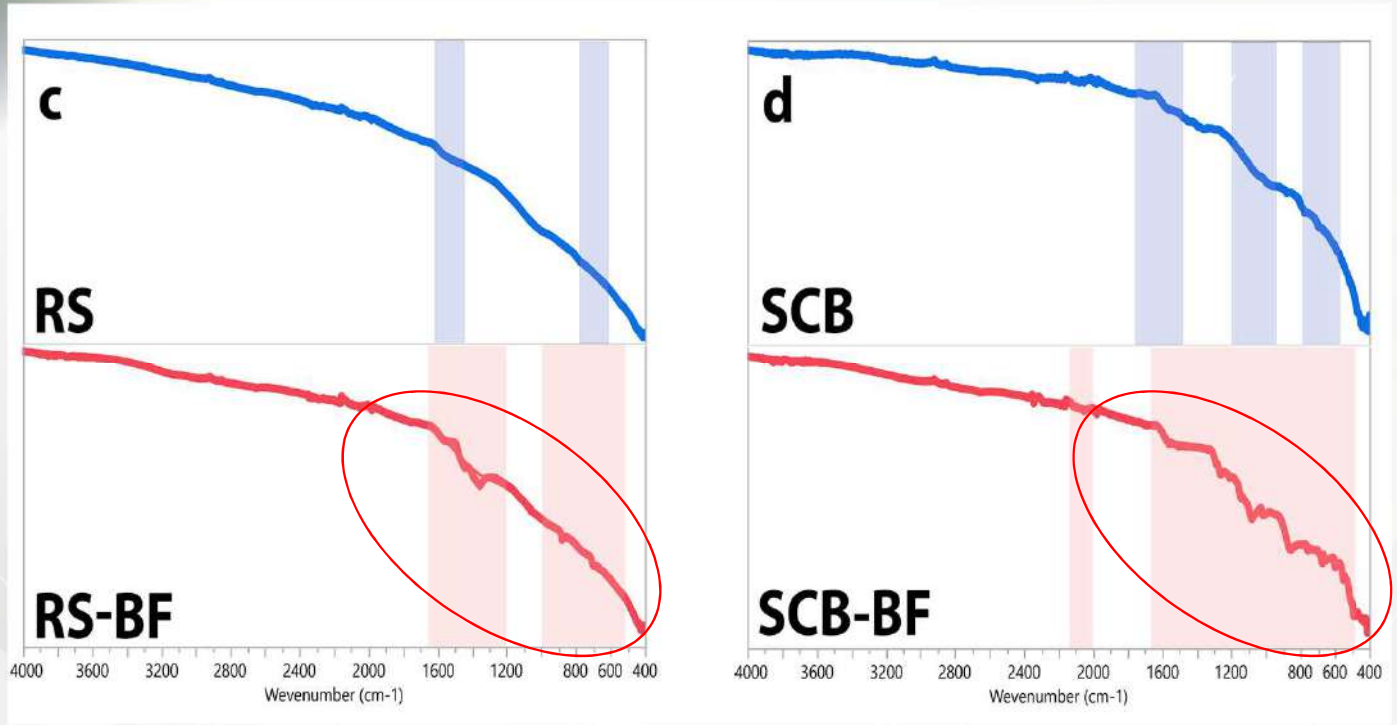


Fig 3. FTIR spectra of the raw biochar and the biochar-based fertilizers. The shaded areas indicate the regions where the characteristic functional groups are present in each material. (c) RS and RS-BF. (d) SBC and SBC-BF.

FTIR

- Overall, it was observed that the QS and CS exhibited a higher variability of functional groups compared to the RS and SBC.

Results and analysis

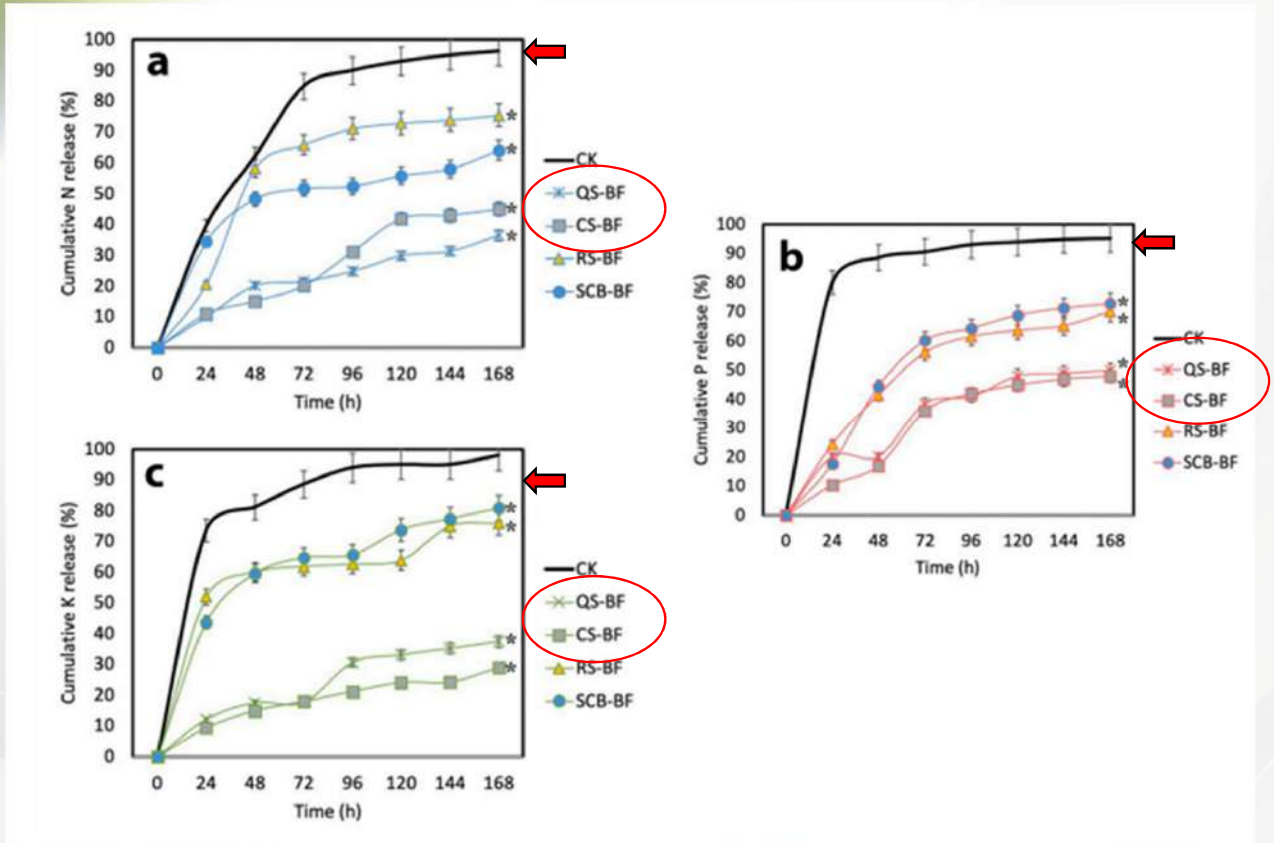


Fig. 4. (a, b, and c) Comparison of N, P, and K release behavior from biochar-based fertilizers and commercial mineral NPK 15–15-15 fertilizer (CK).

SLOW RELEASE

- The QS-BF fertilizer released 37%, 57% and 38% NPK, respectively, after 168 hours. CS-BF fertilizer released 47%, 53% and 29% NPK in the same period.

- Nutrient release in the control occurs in an accelerated and not very gradual way at the end of 168 hours, compared to the formulated biofertilizers.

Results and analysis

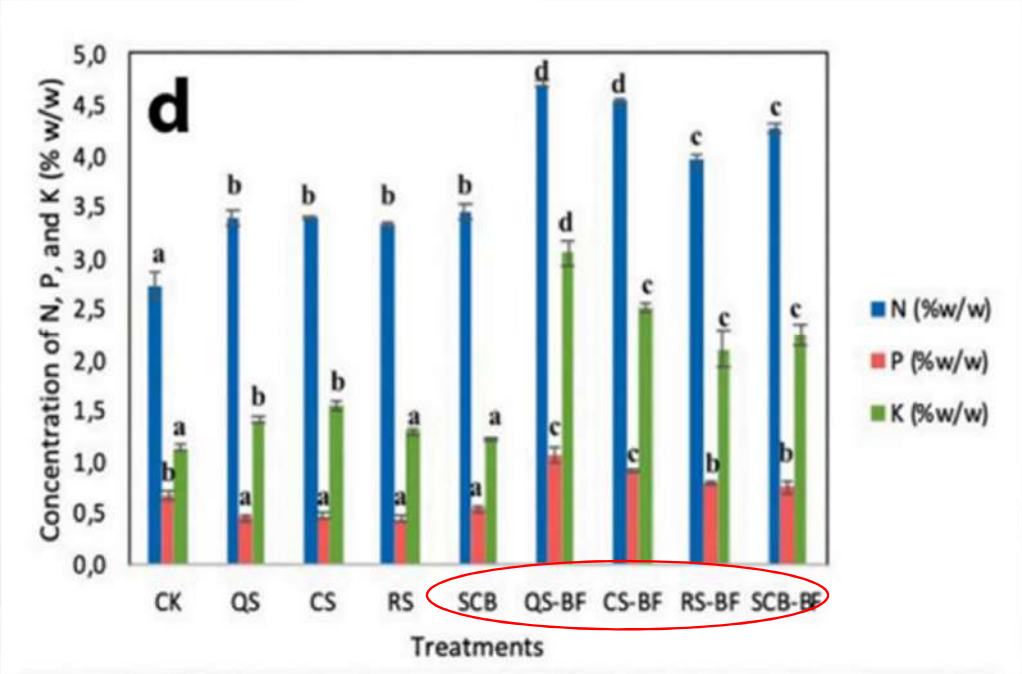


Fig 5. (d) Concentration of N, P and K in cucumber shoots after 30 days.

BIOASSAY

- Incorporation of biochar-based fertilizers into the soil had positive effects, leading to an average increase in N, P and K concentration of ~61, ~32 and ~19 %, respectively.

Conclusions

- According to our results, biochar derived from quinoa and corn residues were the best performing raw materials for the production of biochar-based NPK fertilizers.

- Higher O/C and H/C ratios, together with higher ash content, surface area and cation exchange capacity, are favorable characteristics when choosing biochar for the manufacture of biochar-based fertilizers.

- The slow release test showed that N, P and K were released in a controlled manner in solution and the bioassay results showed that the application of biochar-based fertilizer increased N, P and K concentrations in cucumber seedlings.

Publication

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Science of The Total Environment

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Combining anaerobic digestion slurry and different biochars to develop a biochar-based slow-release NPK fertilizer

Esteban Villada [a 1], Manuela Velasquez [a 1], Ana M. Gómez [a 1], Juan D. Correa [a], Juan F. Saldarriaga [b], Julián E. López [a], Andrea Tamayo [a]

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Analysis of the urban heat island effect from Landsat satellite images and ArcGIS software in the municipality of Medellín.

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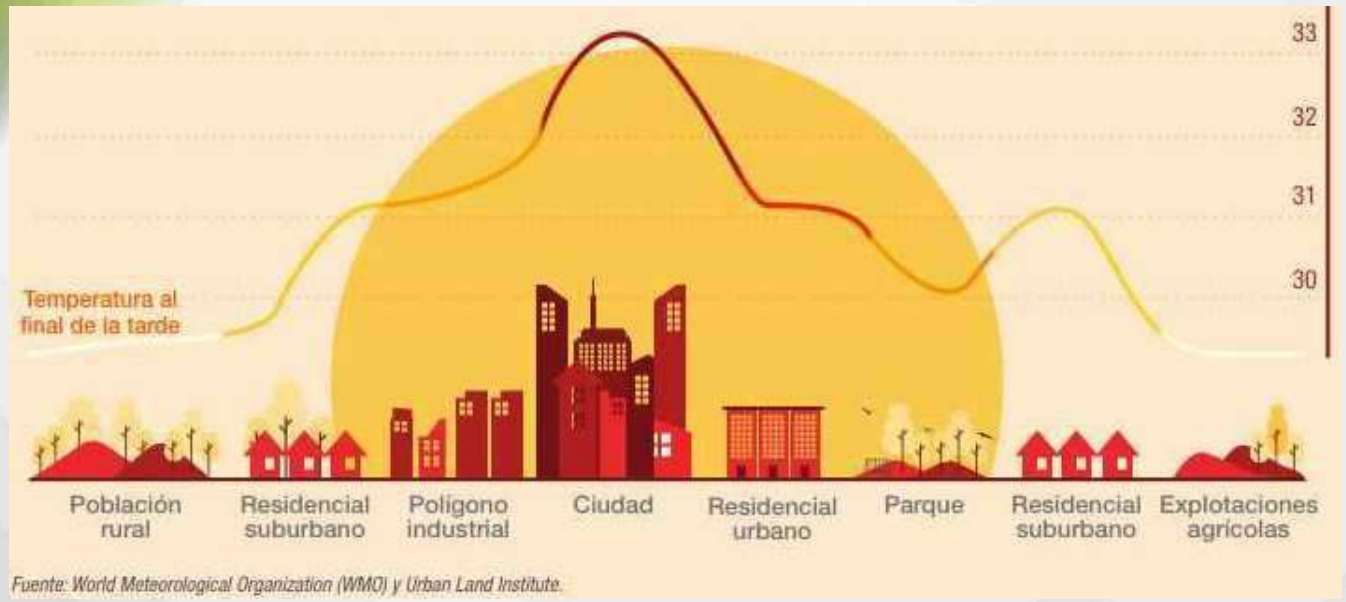
INTRODUCTION.



Fuente: World Meteorological Organization (WMO) y Urban Land Institute.

General Objective.

To analyze the urban heat island effect from Landsat satellite images and ArcGIS software in the municipality of Medellín.

Specific.

First Objective.

- To determine the existence of vegetation cover in Medellín using the most up-to-date shapesfile with respect to the POT and Geo Medellín.

Second Objective.

- To determine the increase in surface temperature of the city of Medellín with Landsat images processed in ArcGIS software.

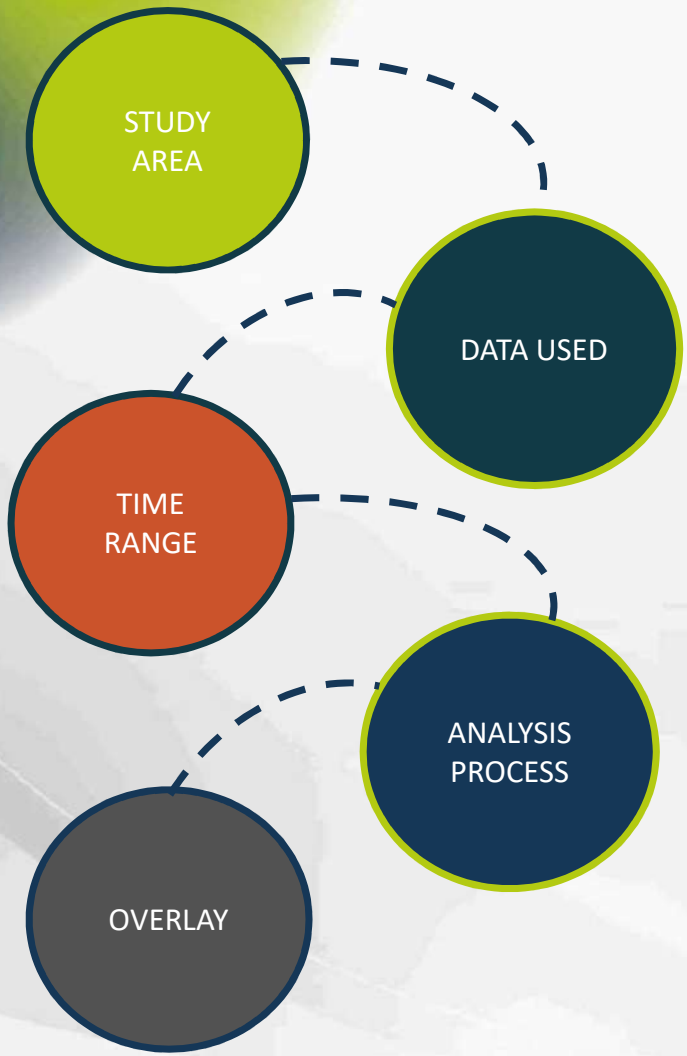
Third Objective.

- To analyze the temperature record of the urban heat island of the city of Medellín with the existing vegetation cover.

Fourth Objective.

- To propose possible solutions to mitigate the increase in the urban heat island phenomenon with respect to the variation in surface temperature and existing vegetation cover.

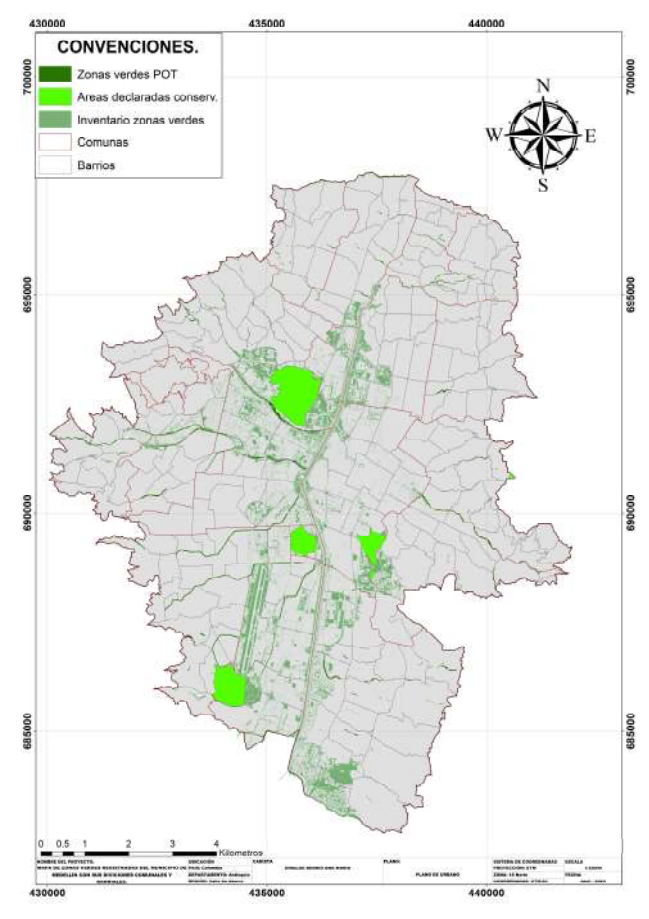
Methodology.

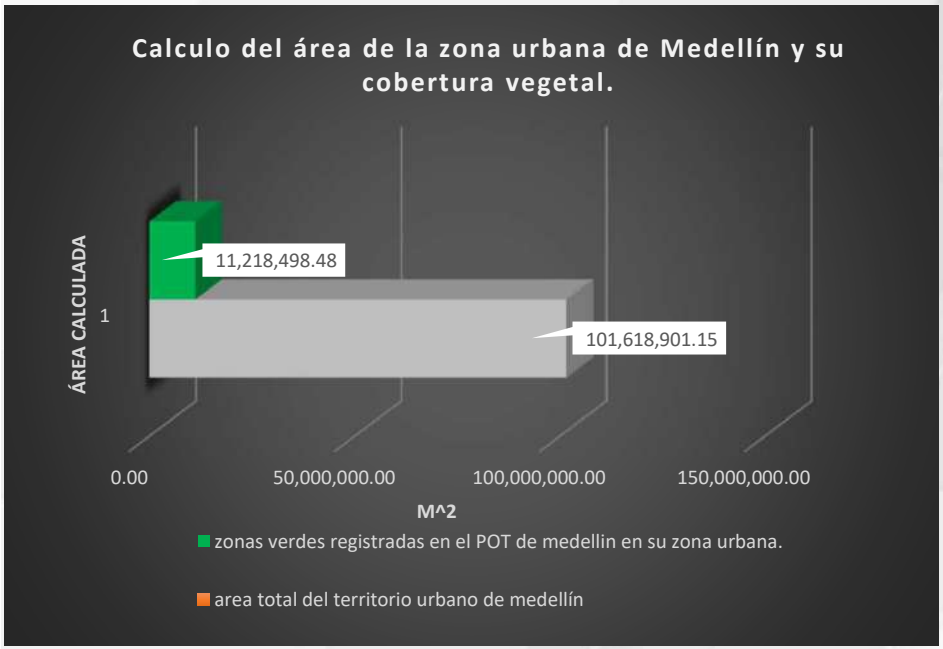


- Medellín, located in the Aburrá Valley of the department of Antioquia.
- Landsat satellite images and shapefiles from Geo Medellín.
- The study covers three three-year periods: 2014-2017, 2017-2020 and 2020-2023.
- ArcGIS tools were used to calculate LST and NDVI, allowing for the evaluation of variations in temperature and vegetation cover.
- Vegetation cover layers were overlaid on the UHI maps to identify their relationship.

RESULTS AND ANALYSIS.

GREEN AREAS REGISTERED IN MEDELLÍN.

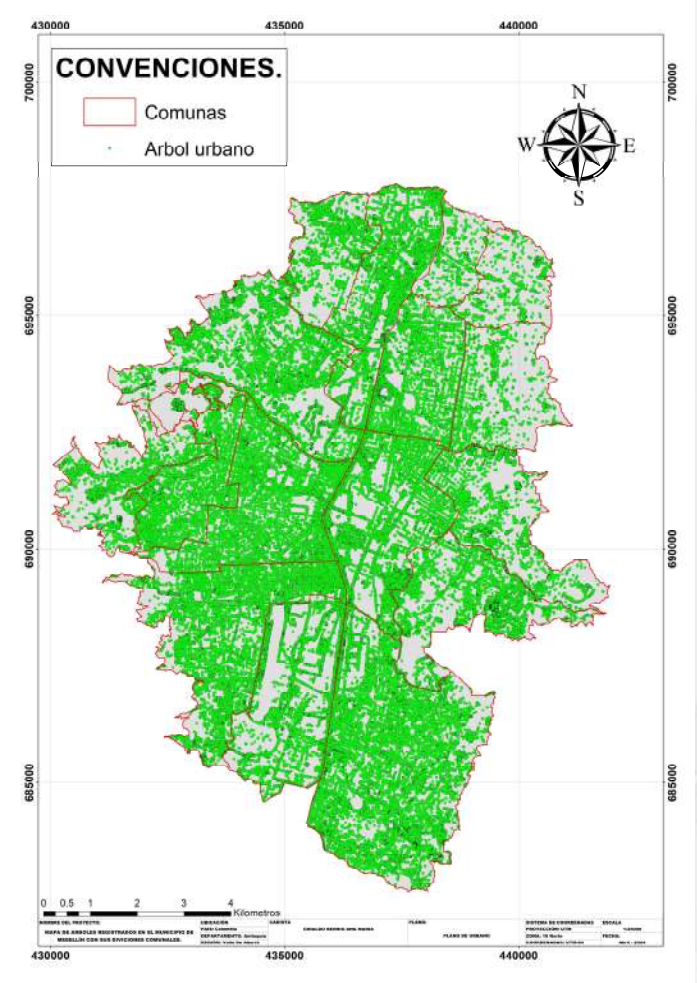




Of a total urban area of 101,618,901.15 m2, only 11,218,498.48 m2 are registered vegetation cover.

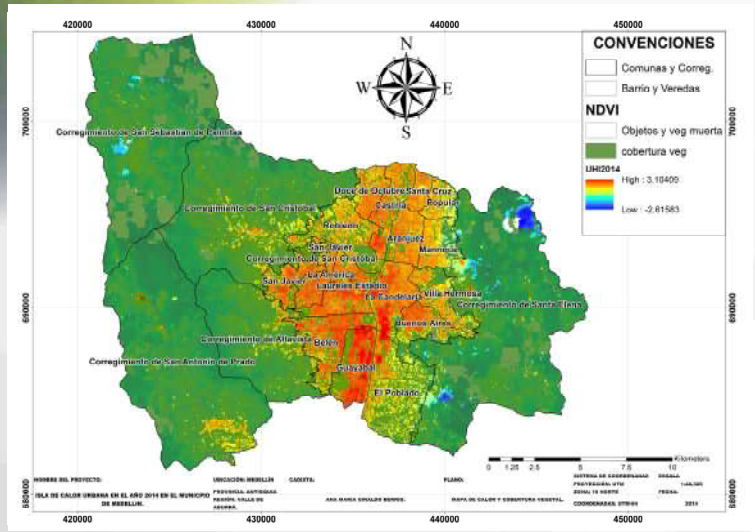
Which is equivalent to only 11.04% of the urban territory of Medellín with vegetation cover.

INVENTORY OF URBAN TREES.



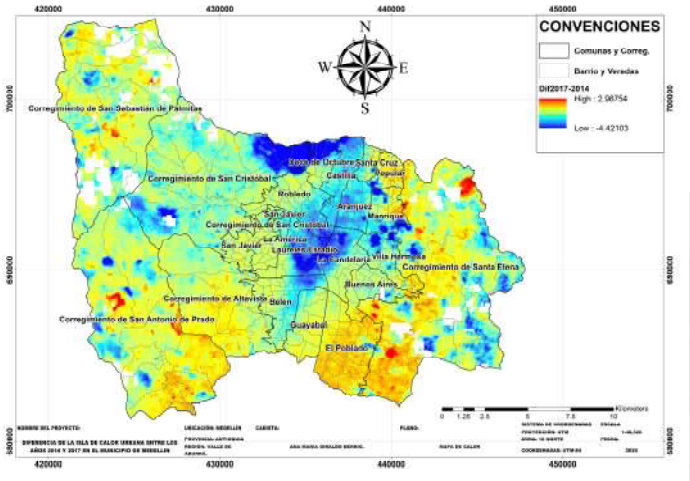
Areas with more trees have lower temperatures; areas without sufficient vegetation show increases in surface temperature.

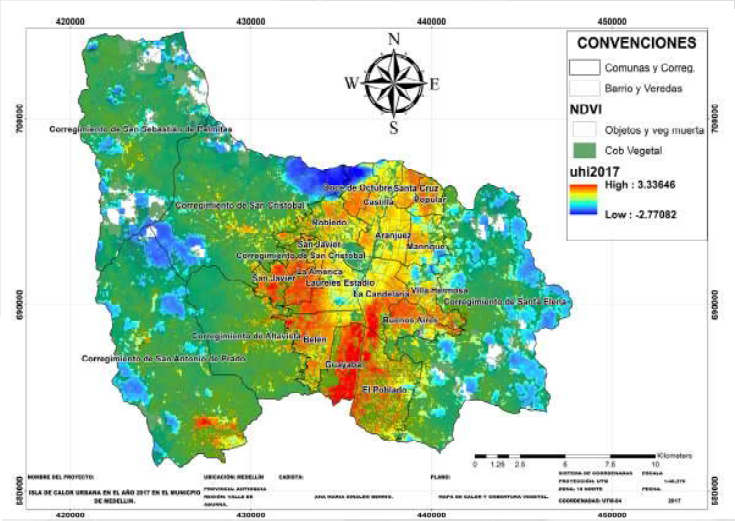
Laureles and Guayabal have more trees, while Doce de Octubre and Santa Cruz have less trees.



2014

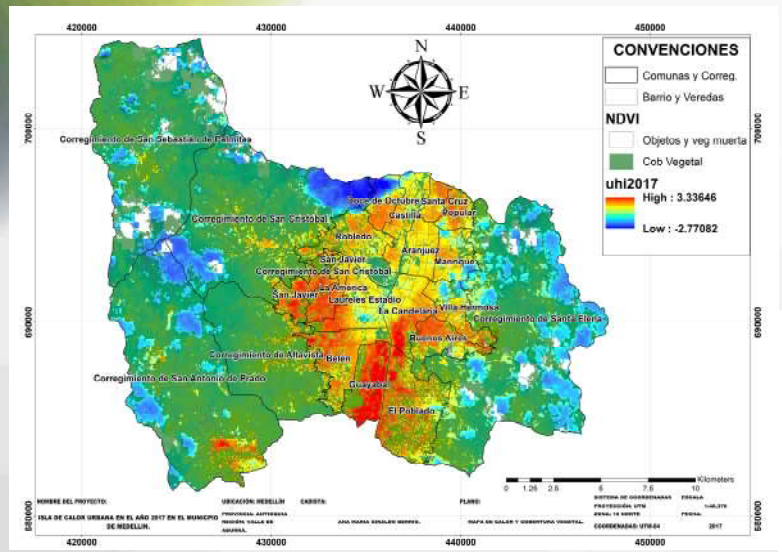
2014-2017





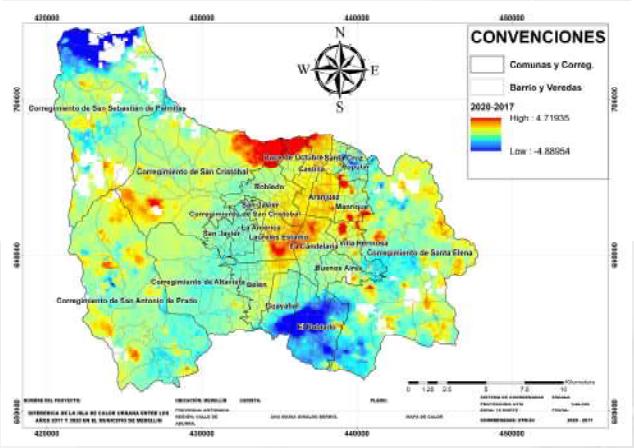
2017

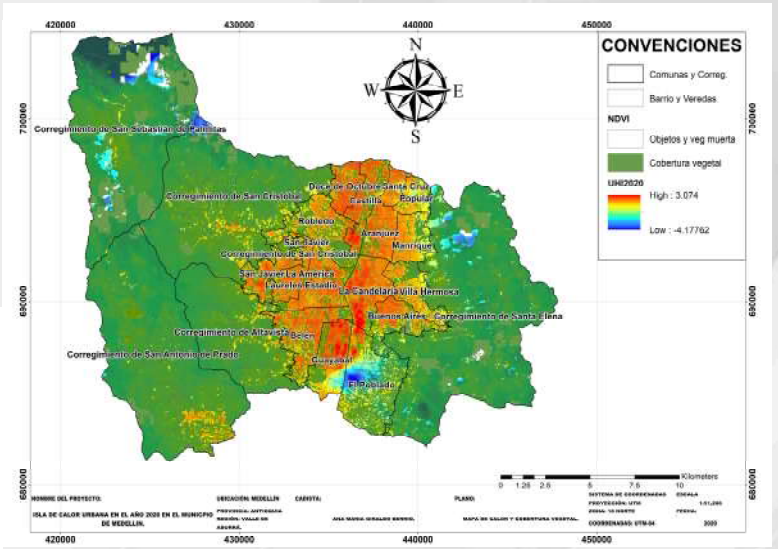
TEMPERATURE VARIATIONS AND OVERLAPPING LAYERS.



2017

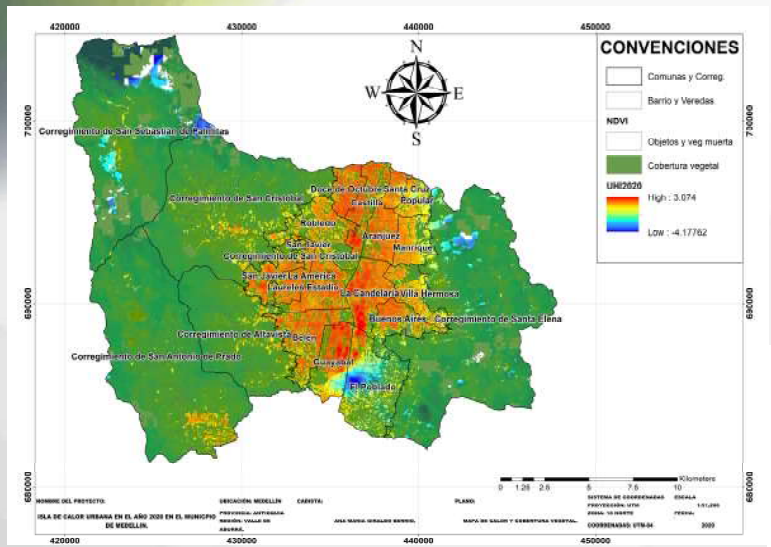
2017-2020





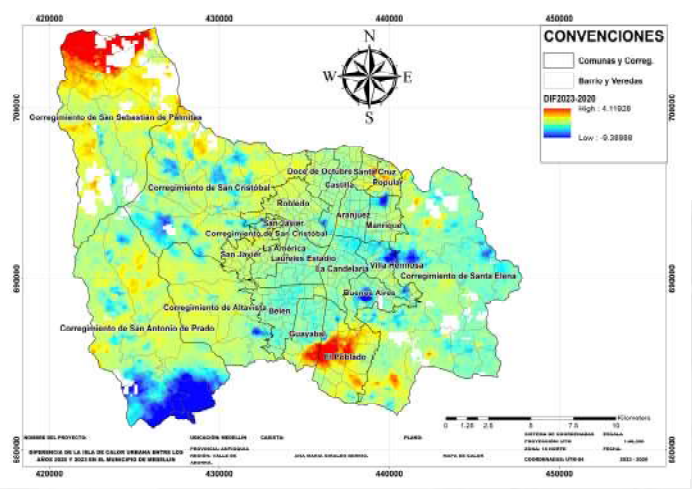
2020

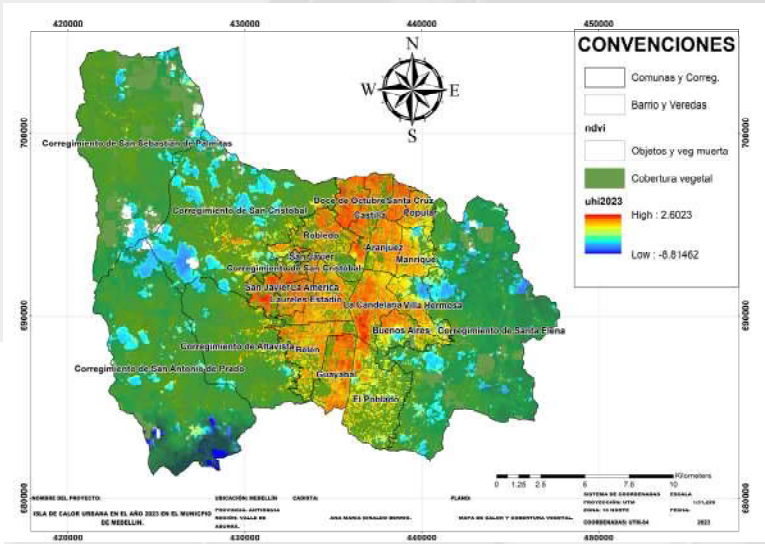
TEMPERATURE VARIATIONS AND OVERLAPPING LAYERS.



2020

2020-2023

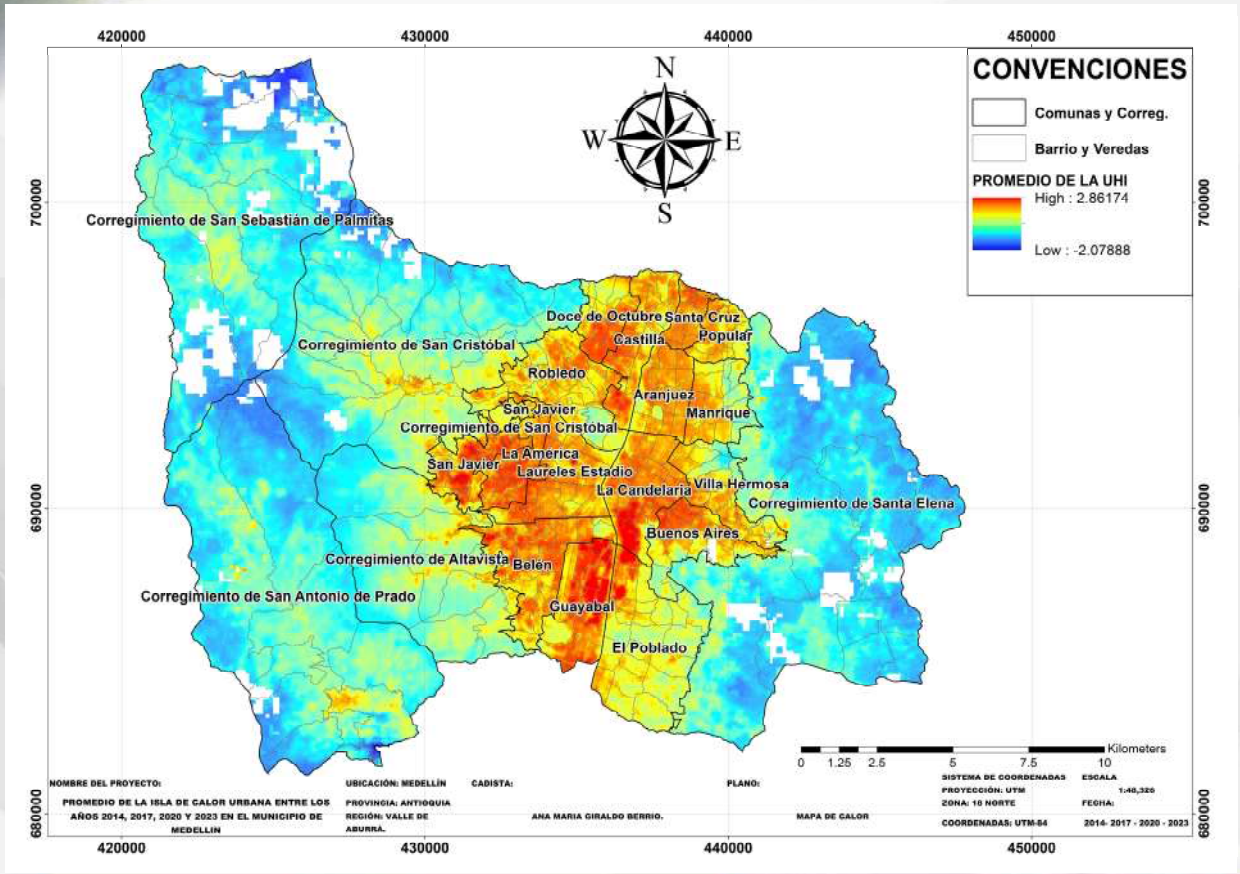


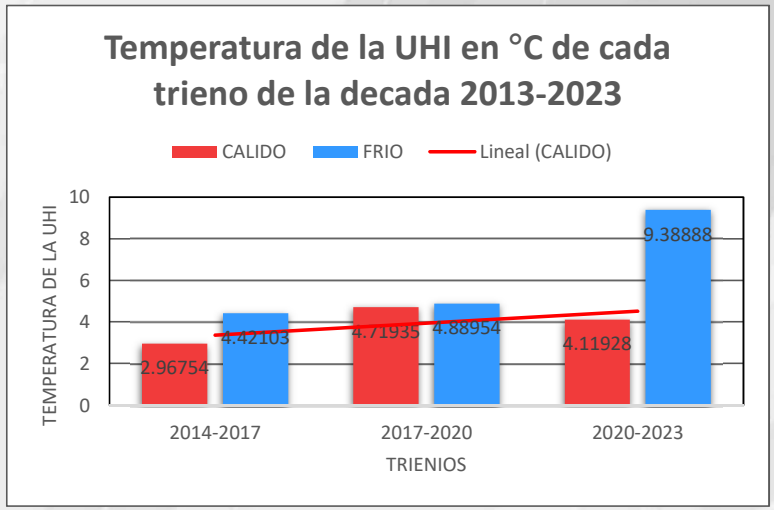


2023

TEMPERATURE VARIATIONS AND OVERLAPPING LAYERS.

AVERAGE OF THE VARIATIONS OF UHI.





RECOMMENDATIONS FOR MITIGATION AND REDUCTION OF UHI.











DEL 28 DE OCTUBRE AL 1 DE NOVIEMBRE

CONCLUSIONS.

Sustainable strategies

Temporary climate factors, such as La Niña, briefly moderated temperatures (2020-2023), but do not replace the urgency of sustainable strategies to mitigate the UHI.

Remote sensing and GIS technologies identified critical areas, providing essential information for public policies focused on the expansion of green areas and sustainable urban planning.

Implementing green infrastructure and tree planting programs contributes to effective thermal regulation and urban comfort, promoting a city resilient to climate change.

Vegetation cover.

Vegetation cover occupies only 11.04% of the urban area of Medellín.

Areas with limited vegetation, such as Doce de Octubre and Santa Cruz, registered temperature increases.

Better-forested areas such as Laureles Estadio and Guayabal experienced temperature reductions.

Global comparisons reinforce that a 1% increase in vegetation could decrease surface temperature by 0.102°C

THANK YOU SO MUCH!

References

The following bibliographical references are some that are part of the development of the project.

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