XX Semana de la Facultad de Arquitectura e Ingeniería | 10 AÑOS

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Thematic and Methodological:
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Members

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Laura Gaviria Dávila

Stabilization of the effluent from the multi-stage anaerobic treatment system of the Organic Fraction of Municipal Solid Waste (FORSU) for agricultural application

Figura 1. Fuente Propia

INTRODUCTION

The increase in the generation of solid waste and waste products, which by 2019 reached approximately 26.46 million tons worldwide (Caicedo, 2022) and its improper management is one of the main environmental problems caused by humanity and brings with it a great impact of pollution on natural resources, ecosystems, health and environmental quality, which has been caused by population growth, consumerism, ignorance and poor environmental education.

Under this scenario, it is essential to find alternatives to chemical fertilization, such as biofertilizers, which are more environmentally viable and also fulfill the function of providing nutrients to the plants and crops in which they are to be applied.

The utilization of the organic fraction of solid waste through anaerobic digestion is a strategy that has been explored and implemented for food waste treatment and conventional energy generation (Chatterjee and Mazumder, 2015). The anaerobic digestion process generates an effluent or Biol on which interest has increased given its potential as an organic fertilizer, which, although it has many nutrients that can be used by plants, requires an additional stabilization process using coagulants based on Nopal cactus for the reduction of organic load, pathogens, to prevent soil problems and public health affectations and to evaluate its fertilizer potential in the germination of radish seeds (Beggio et al., 2021).Translated with www.DeepL.com/Translator (free version)

Imagen 1. Tomada de dreamstime

Imagen 2. Tomada de Kasalab

OBJECTIVES

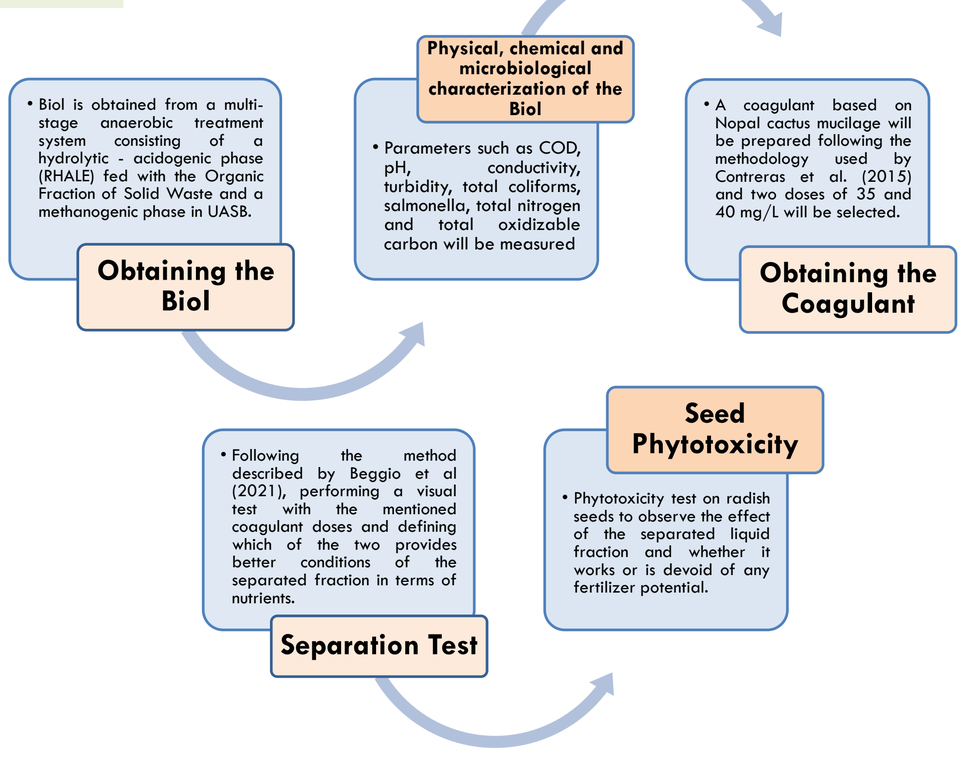
General:

To evaluate the stabilization of the Biol from the multi-stage anaerobic treatment system of the Organic Fraction of Municipal Solid Waste (FORSU) for agricultural use.

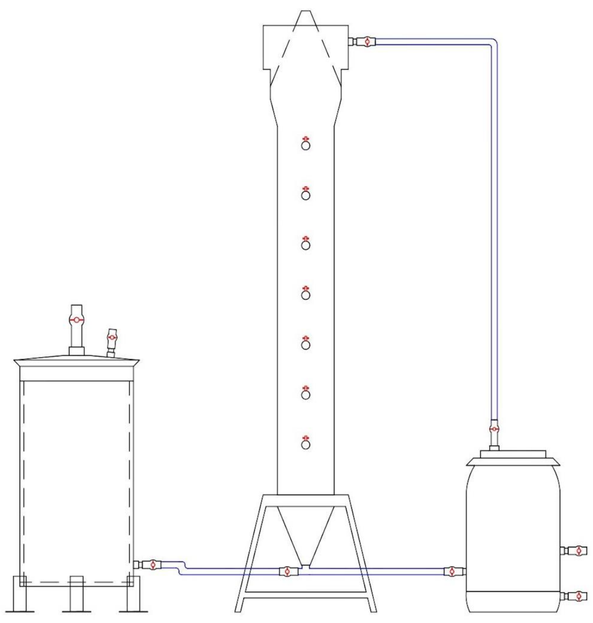
Specific

- To identify the operational parameters of the UASB reactor for the production of the Biol
- To evaluate the effect of Nopal cactus mucilage as a coagulant of Biol
- To evaluate the phytotoxic effect of Biol on seed germination.
- To characterize the Biol physicochemically and microbiologically

METHODOLOGY



ANALYSIS AND RESULTS



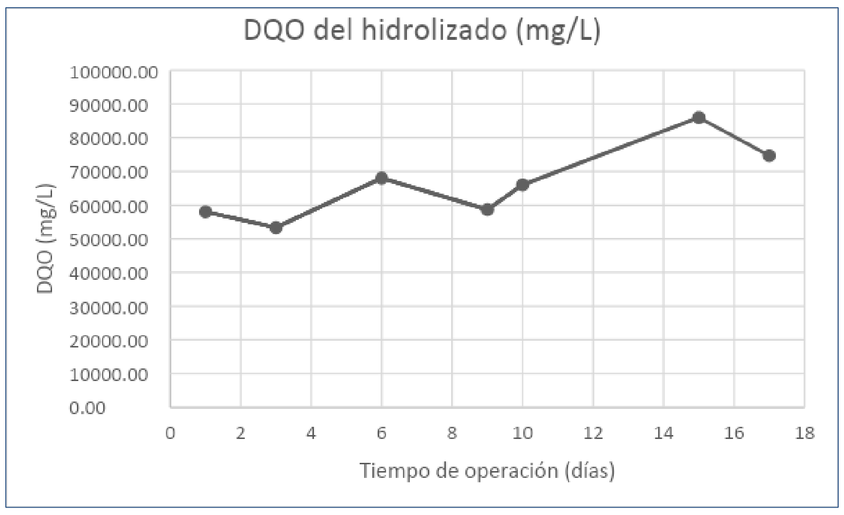


Figure 2. Hydrolyzed COD Graph

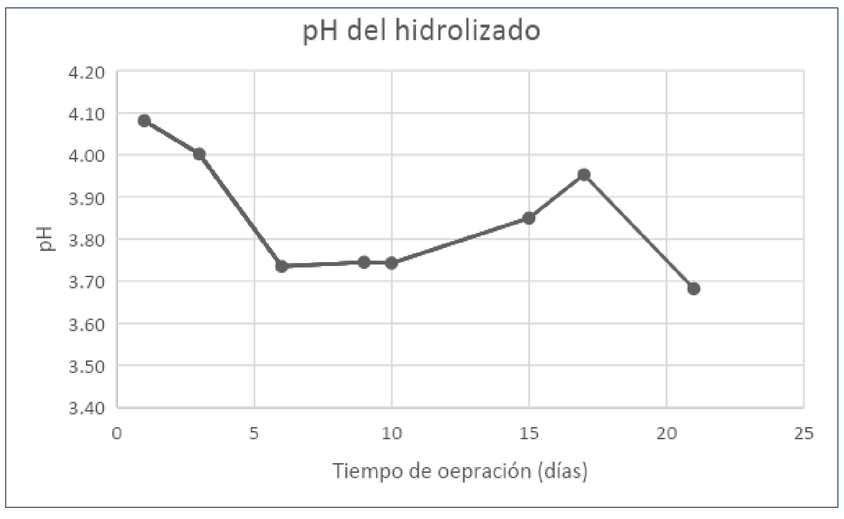


Figure 3. Hydrolyzed pH Graph

Note. pH variation of the hydrolysate, resulting from the degradation of FORSU in the hydrolysis reactor during the 30 days of operation. (Own source).

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IMPLEMENTATION OF A COMPOSTING SYSTEM FOR THE USE OF ORGANIC WASTE IN THE ENTRERRÍOS EDUCATIONAL INSTITUTION.

OBJECTIVE

Implement a composting system in the Entrerríos Educational Institution; in order to increase the use of organic solid waste generated within it.

MEMBERS

Emanuel Vanegas Uribe, Daniela Zapata Bustamante, María Alejandra Marín Otálvaro, Valeria Cardona Correa

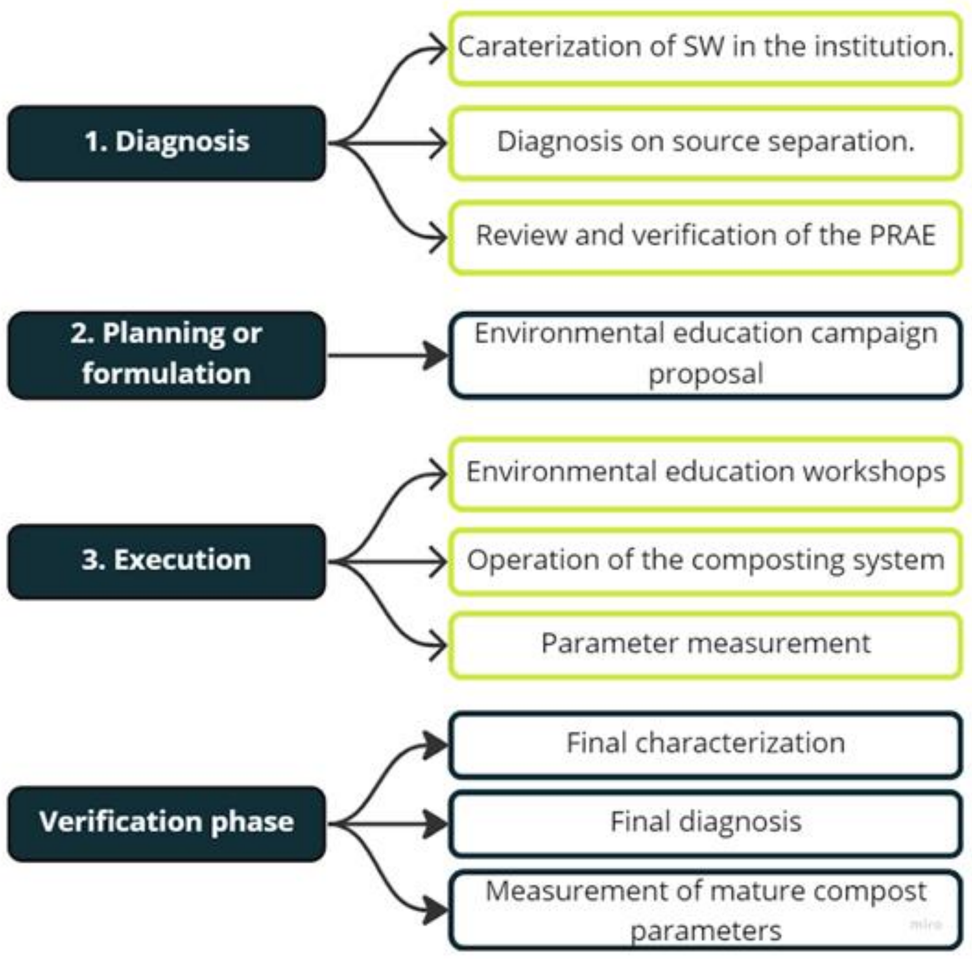
Thematic Advisor: Stephania Lopera

Methodological advisor: Andrea Tamayo Londoño

INTRODUCTION

The global problem due to inadequate SW management is reflected at the local level, An example is the municipality of Entrerríos (Antioquia), which does not have information on the generation or activities for the use of organic SW, even though it is known that this represents ≈35.76% of the 1,172.82 Tons/year generated. That is why it is proposed to implement a composting system in the IEE, to provide an alternative disposal of organic SW generated there, accompanied by environmental education strategies that generate responsible behaviors in students, raise awareness and teach about the benefits that the process brings for the improvement of environmental quality.

METHODOLOGY



PARTIAL RESULTS

1 Initial characterization

43.76 kg/day ≈ 7,8 Tons/year

2 Initial diagnosis

(Faculty and other administrative, general services and food service personnel)

17 people surveyed

ADVANTAGE	DISADVANTAGES
Basic knowledge	
-Environmental awareness. -Positive influence on students. -Participate in previous training on SW.	-Low participation in composting processes. -Little knowledge of the PRAE.

3 PRAE

Preserving a project for the improvement and conservation of gardens in the Institution

The PRAE is in a process of modification and adaptation to these needs

- Promotional campaigns on waste management in households.
- SW management within the institution.
- Composting.

4 Environmental education campaign

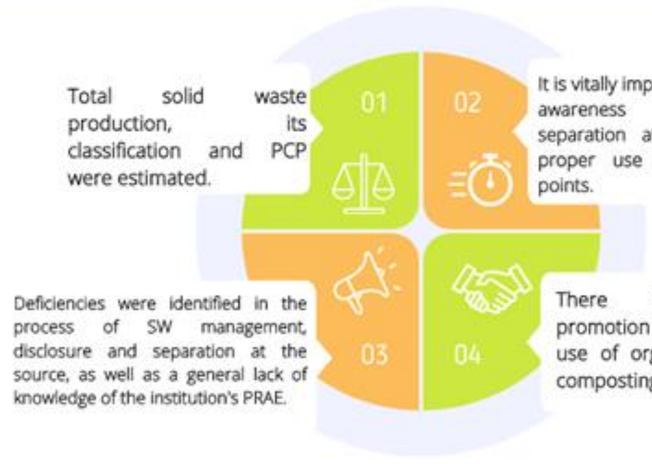
Institutional community formation

- 357 students
- 2 coordinators, 15 teachers
- 3 people in charge of food
- 1 person in charge of general cleaning

Objective

To provide knowledge about the correct disposal of SW and to reinforce the information previously given to students by teachers and encourage students to take positive actions regarding waste management that help protect the environment.

PARTIAL CONCLUSIONS



Bibliographic references

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Degradation of metformin hydrochloride in water applying heterogeneous photocatalysis with TiO_2

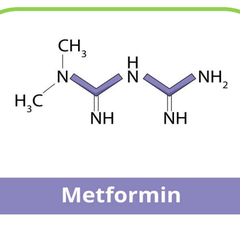
Authors: Stefania Nieto Mora, Jefferson Graciano Restrepo, Santiago Martínez, Emilly Alexandra Ruda Franco.

Adviser: Carlos Fidel Granda Ramírez.

Abstract: Metformin hydrochloride is a very common contaminant of emerging concern in wastewater, which is not degraded by conventional methods used in wastewater treatment plants (WWTP); Due to this, it can occur in the environment at certain concentrations and cause damage to ecosystems and human health. Therefore, the present investigation will seek to evaluate the degradation of this drug by applying heterogeneous photocatalysis with TiO_2 as catalyst.

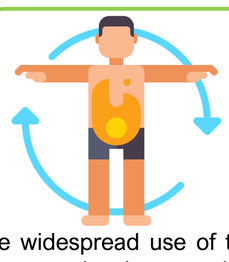
Problem statement:

More than 300,000 chemicals are currently used in industry and at home, of which 4,000 are pharmaceutical products, most of which are over-the-counter.



Metformin

Metformin hydrochloride is believed to be one more drug deposited en masse in the aquatic environment globally



The widespread use of this is concerning because it is administered orally and is probably not metabolized in humans, with about 70% unchanged in the urine.

Methods have not yet been integrated into WWTP that degrade this type of compound, which is why this medicine can be deposited in the environment in concentrations that can be harmful to ecosystems.

Figure 1. Problem statement. Own elaboration

Objectives

To evaluate the efficiency of metformin hydrochloride degradation in synthetic waters by means of heterogeneous photocatalysis with TiO_2.

- To quantify the degradation percentage of a fixed concentration of metformin hydrochloride in water by varying the amount of TiO_2 catalyst.
- Measure the mineralization of metformin hydrochloride at different variations of the TiO_2 catalyst.
- Evaluate the effect of the presence of hydrogen peroxide on the photocatalytic degradation of metformin hydrochloride with TiO_2.

Figure 2. Objectives. Own elaboration

Theoretical Frame

The emerging denomination is understood as contaminants not recognized as such, whose presence in the environment is not necessarily new, but the concern about the possible consequences of these is also due to the fact that no regulations have yet been established that regulate. These compounds are bioaccumulative toxins of natural origin and have a complex chemical composition.

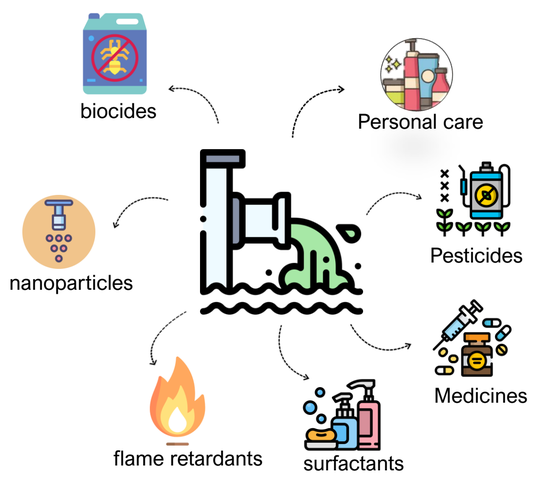


Figure 3. pollutants of emerging concern. Own elaboration

Methodology

Exp	TiO_2(g/L)	H_2O_2 (mM)	Rad (254 nm)
1	0.1	1	YES
2	0.3	1	YES
3	0.5	1	YES
4	1	1	YES
5	0.1	0	YES
6	0.3	0	YES
7	0.5	0	YES
8	1	0	YES
C1	0.5	0	NO
C2	0	0	YES
C3	0	1	NO
C4	0	1	YES

Table 1. experimental design

References

FLOWCODE PRIVACY.FLOWCODE.COM

METHODS

GENERAL OBJETIVE.

- TiO_2 was set at 10 mgL^{-1}.
- The reactions were performed in a photoreaction system that is illuminated with 5 lamps of 254 nm and 15 watts each.
- It was worked with 100 ml of TiO_2 sln at 10 mgL-1 in deionised water that will be subjected to a multiple stirring plate with vel. of 600 rpm.
- The prepared solutions shall be arranged in 250 ml beakers within the photoreaction system, to which TiO_2 and H_2O_2 concentrations shall be added in accordance with the experimental design.

OBJ 1.

- The samples were analyzed using HPLC to determine degradation at the concentration of the contaminant and a total organic carbon quantifier (TOC) equipment to determine the mineralization of the treated solutions.
- The results were taken to graphs.

OBJ 2.

- °Titanium concentrations were varied with values of 0.1 mg L-1, 0.3 mg L-1, 0.5 mg L-1 and 1.0 mg L-1.
- The photoreaction system,
- Data reading using HPLC .
- Data analysis.

OBJ 3.

- The effect of the presence of H_2O_2 was determined, which shall be used at a concentration of 1,0 mMol L^{-1}.
- The results shall be analysed to identify the difference with and without the presence of H_2O_2 by means of graphs.

Figure 4. Methodology. Own elaboration

Partial results

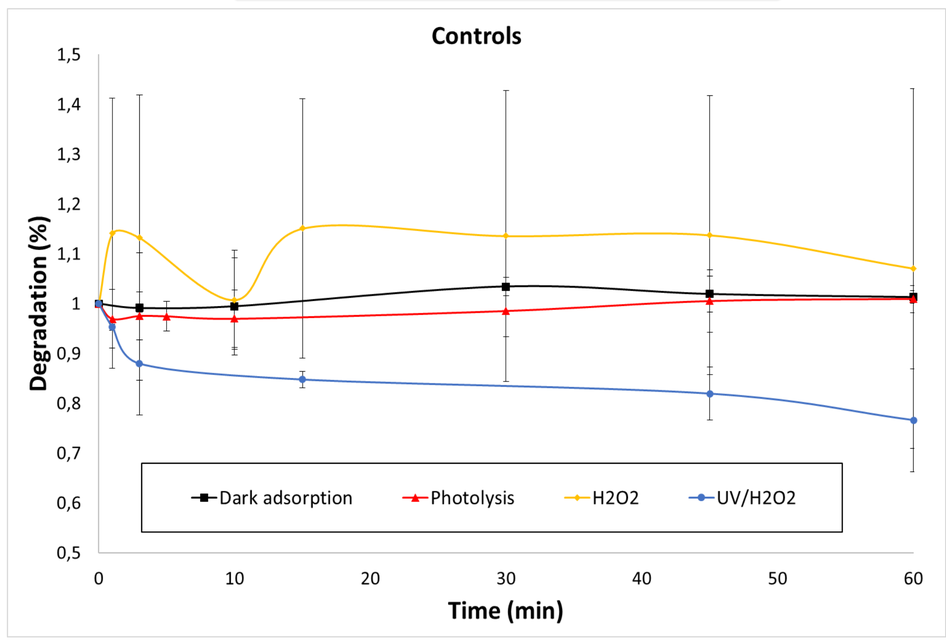


Figure 5. Results

Dark adsorption: an interaction between the contaminant and TiO_2 was not evidenced since no degradation of metformin was observed.

Photolysis: In the photolysis process, no relationship was found between UV radiation of 254 nm and the decrease in the concentration of the contaminant.

Hydrogen peroxide: There is no interaction between hydrogen peroxide and the contaminant, no reduction in metformin concentration was evidenced, however, there could be interference in the data since the deviations are significantly high.

UV/H_2O_2: In this control, a degradation of 24.4% is observed, showing that the combination of hydrogen peroxide with radiation has an impact on the decrease in the concentration of the contaminant.

Partial conclusions

According to the results of the first three controls, it was observed that the contaminant did not present reduction in the dark, in the same way, no interaction was evidenced only with the UV radiation of 254 nm used, so the degradation was not significant. In the case of control 4, which combined UV/H_2O_2, a decrease in metformin of close to 24% was observed, which suggests that H_2O_2 may have a direct impact on the reaction.

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Physicochemical stabilization of biosolids from a wastewater treatment plant using lime to reduce H_2S and CH_4 emissions.

Authors: Ana Belén González Lozano, Daniela Cuartas Piedrahíta y Lizza Fernanda Brid González.
Thematic advisors: Environmental Engineer. PhD. - Julián E. López Correa
Chemical Technologist - Diego Alejandro Vargas Montoya
Chemical Engineer - Ignacio Orozco Restrepo
Methodological advisor: Carlos Fidel Granda Ramírez- PhD.

Introduction

Aims

General

Evaluate a treatment using lime to reduce the emission of compounds (H_2S and CH_4) associated with nuisance odours from biosolids from a WWTP (wastewater treatment plant).

Specific

- To determine some physicochemical characteristics of the biosolids generated in a WWTP.
- To evaluate the effect of application of lime at different doses on the physicochemical characteristics and the emission of compounds (H_2S and CH_4) from the biosolids.
- To determine the presence of potentially toxic elements in untreated and treated biosolids by TCLP test (Toxicity Characteristic Leaching Procedure).

Methodology

Evaluate temperature, pH, EC, humidity, redox potential, H_2S and CH_4 of a biosolid sample.

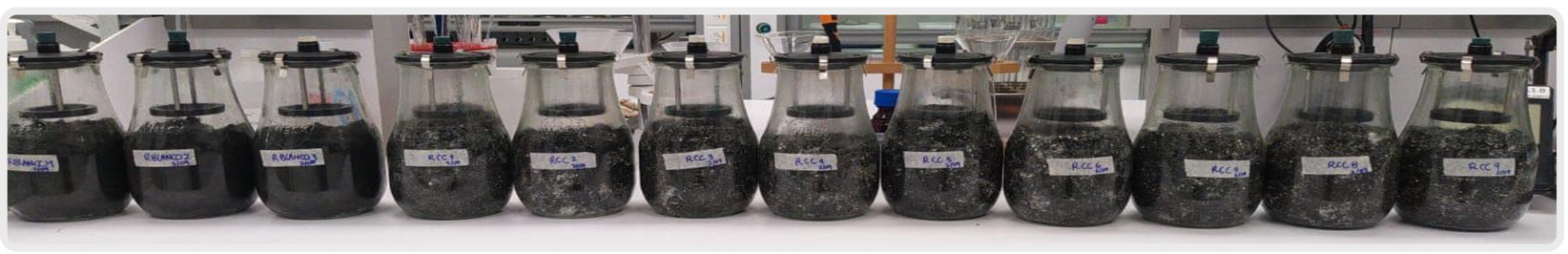
Distribute 12 airtight vials as follows: 3 replicates of blanks, 3 replicates with 5% lime (CaO), 3 replicates with 6% lime (CaO) and 3 replicates with 7% lime (CaO).

From assembly read parameters at 7, 14, 21, 28 days.

Prepare leach solutions for TCLP testing of crude biosolid

Mix raw biosolid samples with leach solutions and shake for 48 hours

Read metal results and compare to allowable limits



The sampling is carried out in a sampling window in storage silos, 1,800 grams of biosolid, stored at room temperature, were used. For the measurements of physicochemical parameters, 1:4 dilution was prepared. The gas measurement was read by Optima 7 Biogas gas measuring equipment.

Preliminary results

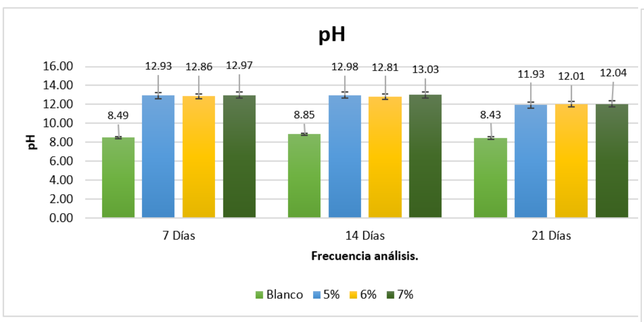


Figure 1. pH

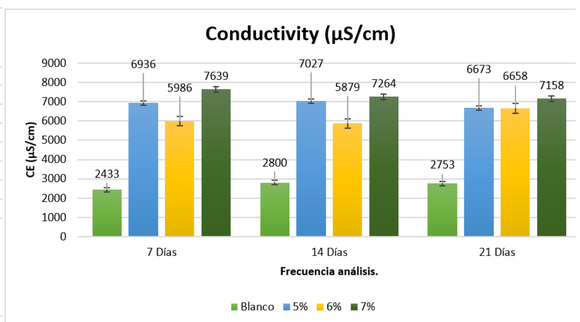


Figure 2. Conductivity

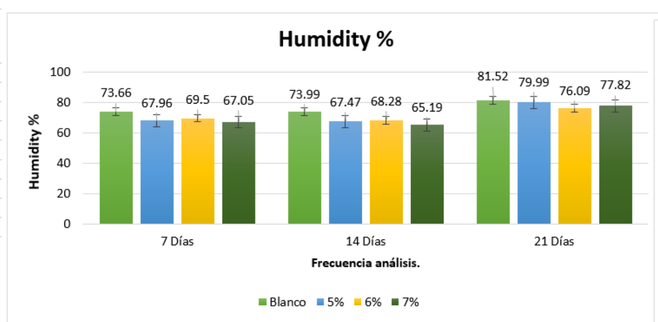


Figure 3. Humidity

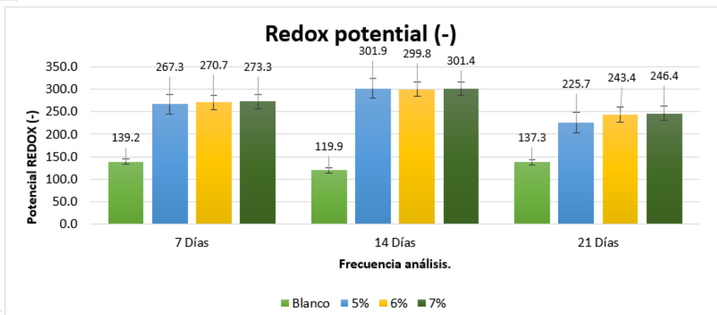


Figure 4. Redox potencial

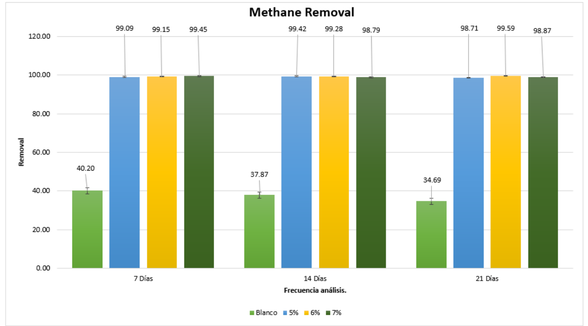


Figure 5. Methane removal

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + calor$$

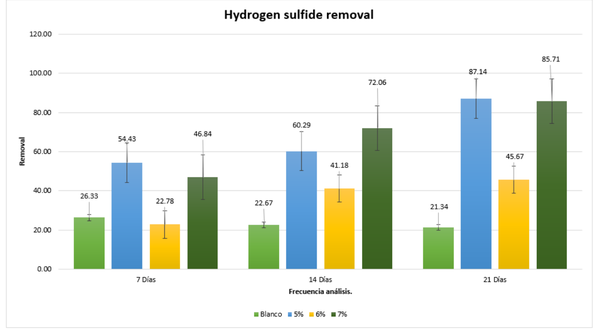


Figure 6. Hydrogen sulfide removal

$$CaO + H_2S \rightarrow CaS + H_2O.$$

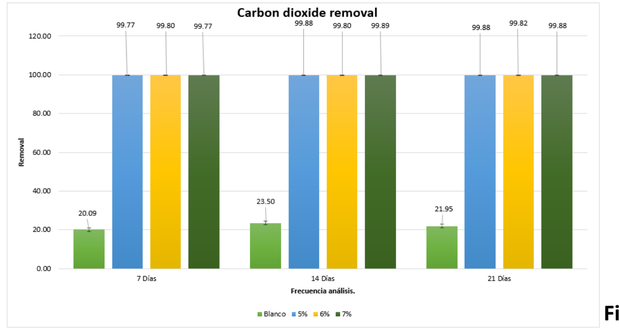


Figure 7. Carbon dioxide removal

$$H_2 + CaO + CO_2 \rightarrow H_2O + O_2$$

Figure 8. calcium oxide spores

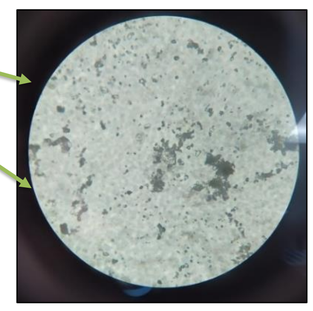


Figure 9. View microscope crystals

Partial conclusions

- ✓ It is observed that the pH always tends to increase, this is due to the fact that lime is highly alkaline.
- ✓ Lime being a natural mineral, when added to the biosolid, significantly increases the conductivity due to the additional amount of minerals it adds to the biosolid.
- ✓ The reactions that are triggered release oxygen causing conditions to become much wetter over the days at rest, hence less dry.
- ✓ Lime clusters are analysed under a microscope and a view of crystals is obtained; this is generated by the reaction between H_2S+CaO which creates CaS calcium sulphide.
- ✓ The reaction of CaO and CO_2 generates humidity and therefore oxygen; this oxygen helps the CH_4 to be consumed, generating CO_2 and water or humidity again, thus passing through the cycle until the test is dismantled.

References

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Evaluation of climate change signals in Northeastern Antioquia based on historical hydroclimatic records.

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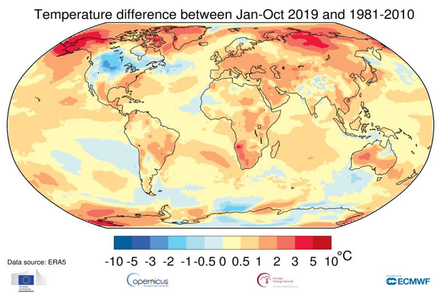
Hernán Darío Salas Parra
Luis Alejandro Builes Jaramillo
Carlos Arturo Hoyos Restrepo
METHODOLOGICAL ADVISOR:
Carlos Fidel Granda

Abstract

The Northeast Antioquia subregion corresponds to 13.6% of the total area of the Antioquia territory, made up of ten municipalities, being gold exploration and exploitation its main economic activity, in the same way it is known for the production of panela, the planting of coffee and for its streams, waterfalls and ecological trails Therefore, this research aims to examine evidence of climate change in the subregion of Northeast Antioquia from measurements hydroclimatic of the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM), and for which it includes the quantification of trends of the time series of hydroclimatic variables (precipitation, flow and temperatures) of the region, for a reference period of 1984-2020, the analysis of significance of these trends and the analysis of geospatial patterns of the same as indicators of climate change.

Statement of the problem

Human influence on global climate change has occurred at an unprecedented rate, and the last 200 years have seen the greatest changes in relation to simulations and historical records. Thus, it became evident that "the average global surface temperature was 1.09°C higher in the period 2011-2020 than in the period 1850-1900, with a greater increase over the land surface of 1.59°C than over the ocean of 0.88°C [1]. This generates great concern since a changing climate causes alterations in the frequency, intensity, spatial extent and duration of extreme weather and climate events [2].



Theoretical Frame

General Objective

To examine evidence of climate change in the northeastern Antioquia subregion based on hydroclimatic measurements from the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM).

Specific Objective

- Quantify trends in the time series of hydroclimatic variables of the Northeastern Antioquia region.
- Identify areas of significant trends through hydroclimatic variables of the Northeastern Antioquia region.
- Analyze geospatial patterns of climate change indicators in the study region.

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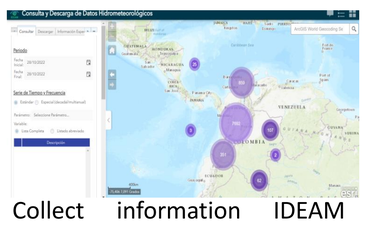
PRODUCCIONES ACADÉMICAS E INVESTIGATIVAS
DE LOS PROGRAMAS DE PREGRADO Y POSGRADO

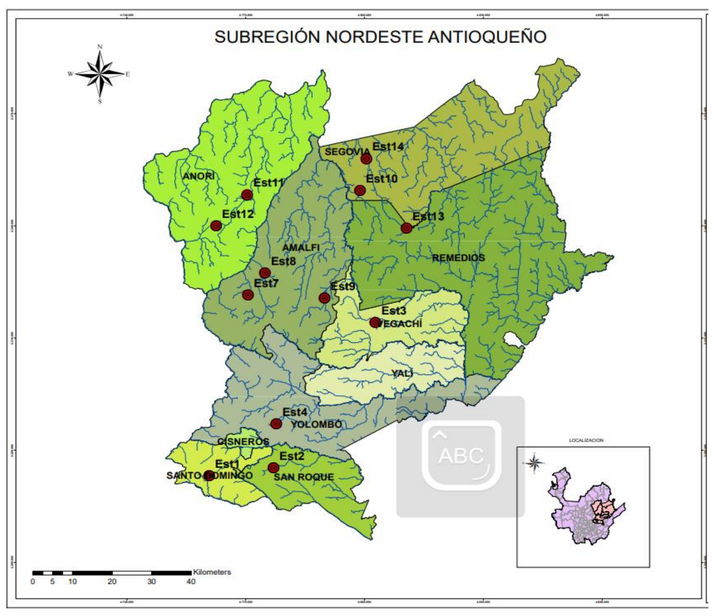
Methodology



Collect information IDEAM Geoportal

Digital cartography information in vector format

Information processing



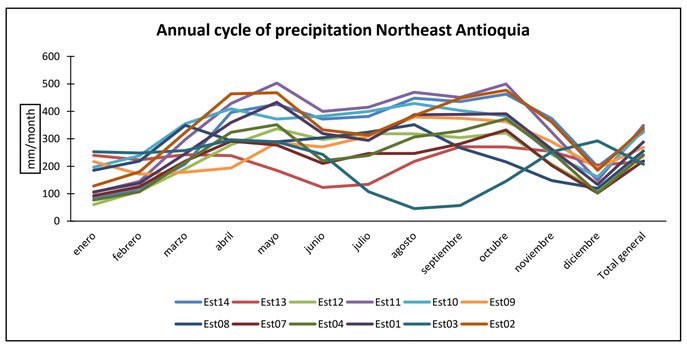
Precipitation, Flow rate, Maximum temperature, climate change, digital mapping in vector format

IDEAM

ArcGIS

python

Partial Results



The monthly rainfall series for the reference period from 1987 to 2020 (34 years) are presented. In general, for the study region, a bimodal annual cycle is found, with seasons of higher rainfall between the months of April-May and October-November. Also, the graphs show two low rainfall seasons during December-January-February and June-July-August.

Partial conclusions

- For the study area there is availability of hydrological series with registration periods greater than 30 years. In addition, for the twelve series of precipitation used in the region, it was possible to guarantee an amount of missing data of less than 10%, data that were filled in using the multiannual daily average.
- The analysis of the annual cycle of precipitation in the rainfall stations of the region shows that the region exhibits a bimodal annual cycle with two high rainfall stations (MAM and SON) and two low rainfall stations (DEF and JJA).
- Trend analysis using the Mann-Kendall test suggests that of the stations analyzed, 80% have statistically significant trends, of which 30% show decreasing trends of up to 20 mm per decade and 70% increasing trends of up to 40 mm per decade.

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Identification of flood risk in Barrio San Fernando de Apartadó, due to the San José de Apartadó river.

What is the high-risk area caused by cyclical flooding of the San José River in the San Fernando neighborhood of Apartadó?

Figure 1- taken from El Colombiano newspaper

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Members:
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- Laura Camila Moreno Rivera
- Erica Y. Vargas Montoya

INTRODUCTION

For this study we will focus on floods that are a natural phenomenon caused by the persistence of rainfall in a given region, and which may also be caused by situations of artificial origin such as difficulty in channelling by natural or artificial blocking [8]. The risk of flooding on the banks of rivers is increased by poor management and pollution, taking into account that the areas of river withdrawals, Ravines, reservoirs, basins and train rails normally serve as shelters and subsequent homes for people who are victims of armed displacement and who present high levels of vulnerability due to the lack of living space [6]. On the other hand, these inadequate settlements of people living in poverty or socially and economically vulnerable prevent the POTS of municipalities from functioning properly and increase environmental risks in ecosystems.

Taking into account all the gaps between Land Use Plans and Risk Management, during this project it is intended to give some contributions to both government entities and the community that lives informally on the banks of the river San José de Apartadó, the situation of vulnerability in which the population is located, some causes related to the growing river, the social and economic situations that lead people to be located in these places contemplated in the POT of the municipality in effect 2011 as "flood risk" and the impacts of these floods on the community, the municipality and the department.

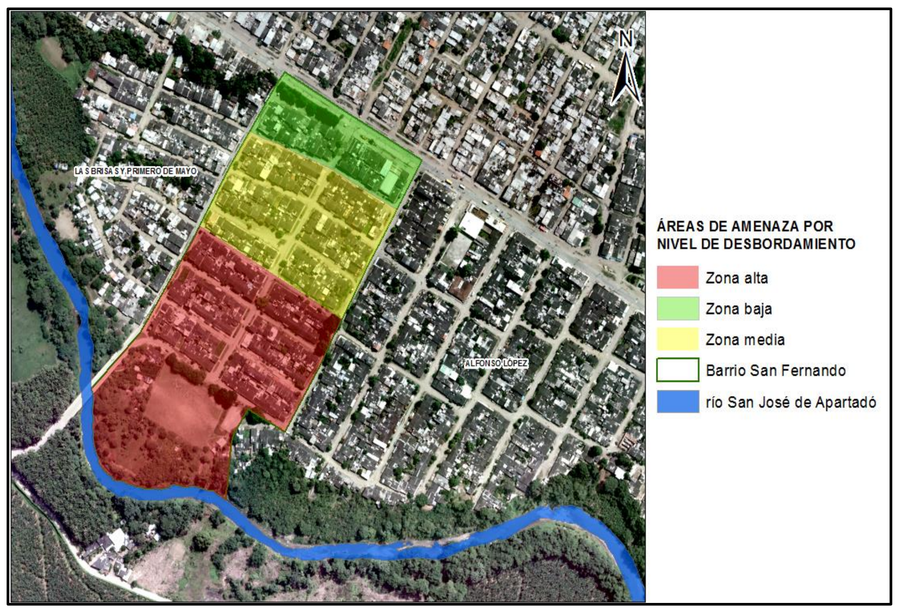

Figure 2- Barrio San Fernando- Apartadó, with threatened areas by overflow level of the San José de Apartadó river. Taken from Geoportal Management of Cadastre Antioquia.

OBJECTIVES

GENERAL:

Identify areas at high risk of flooding by the San José River in the community of the San Fernando neighbourhood of the municipality of Apartadó

SPECIFICS:

- Contextualize the risk situation in the San Fernando neighbourhood along the San José de Apartadó River.
- Characterize the environmental impacts in the San Fernando neighborhood of Apartadó generated by cyclical flooding of the San José River in the delimited area.
- Provide input from environmental engineering in land management and risk management for the exposed vulnerable area.

Figure 3- Floods year 2019- Taken from web pages LA FM y NOTICIAS 1

OVERVIEW

The department of Antioquia is located in the northwest of the Colombian territory; the municipality of Apartadó is located in the northwest area of the department of Antioquia, Urabá subregion, the extension in the urban area is 7.62 Km2 and the extension in the rural area is 592.35 Km2. (Medellín) and has more than 180,000 inhabitants.

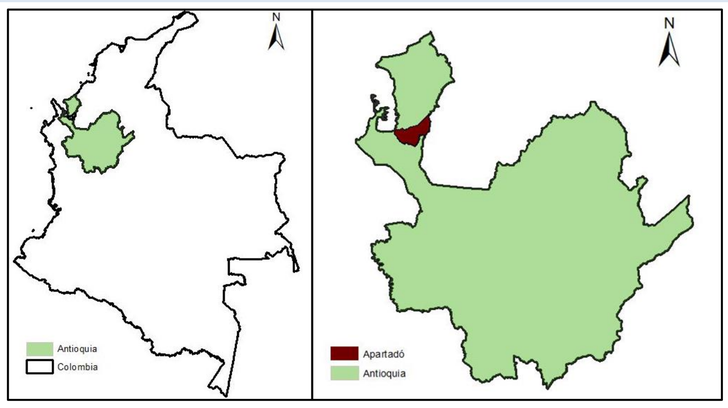

Figure 4- Department of Antioquia in Colombia (left); municipality of Apartadó in Department of Antioquia (right). Taken from Geoportal IGAC (Instituto Geográfico Agustín Codazzi).

METHODOLOGY

To find information in local and departmental newspapers about flooding in the San Fernando neighbourhood of Apartadó

→ Polls to the mayor's office of Apartadó, Corpouraba, and the inhabitants of the San Fernando neighborhood.

→ Interviews will be conducted a the community leaders in the San Fernando neighborhood of Apartadó

→ Environmental impacts will be characterized and risk factors identified in the San Fernando neighborhood of Apartadó

↓

Timeline of floods in the San Fernando neighborhood in the last 15 years

← The information contained in the POT and the Environmental Management Plan will be verified in order to make a map with the threat zones

← Brochure with the results obtained

RESULTS

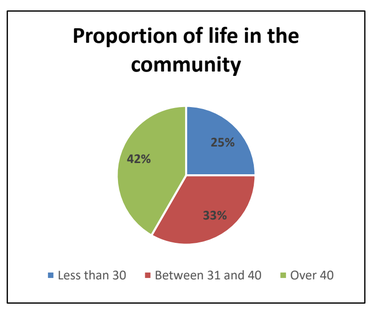

Figure 5- : Life in the San Fernando neighborhood

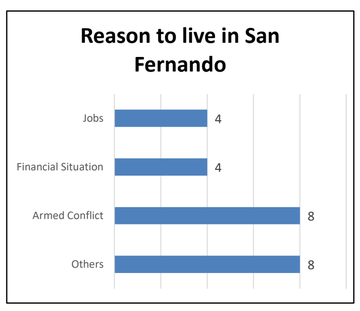

Figure 6- : Life time in the San Fernando neighborhood

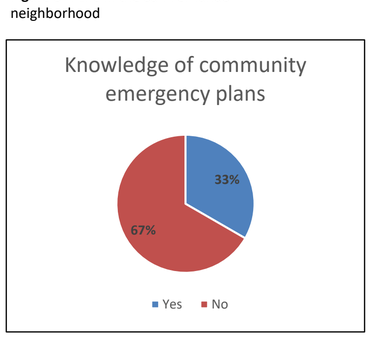

Figure 7- : Knowledge of the risk management programme

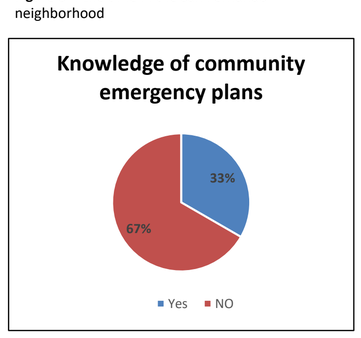

Figure 8: Knowledge of the municipal administration emergency programme

ANALYSIS

- Figure 1: 42% of those surveyed have lived in the San Fernando neighborhood for more than 40 years, and for more than 20 years they have been suffering from the floods suffered by the San José de Apartadó river
- Figure 2: The bar chart shows the reason that led respondents to settle in the San Fernando neighborhood of Apartadó; of which 8 people settled mainly by displacement, the possible reasons can be for the violence suffered in the municipality in the years 80' and 90'
- Figure 3: Of the 24 people surveyed, 20 do not know the flood risk management programme and only 4 know the risk management programme, which shows that the municipal administration has not made campaigns to publicize the risk management program in neighborhoods suffering from flooding caused by the San José de Apartadó river
- Figure 4: 67% of respondents are unaware of the strategies that the municipal administration has to reduce the risk of flooding in El Barrio, showing the lack of disclosure of this plan to the inhabitants of the banks of the San José de Apartadó river

CONCLUSIONS

- According to the information collected in the surveys, most of the inhabitants of the San Fernando neighborhood of Apartadó have not taken any action to protect their homes, In addition, they do not know the plans or programs for situations of risk due to overflow that are in the municipal government and that should be easily accessible by the CAR CORPOURABÁ.
- The public order situation in the 90s in the rural area of the municipality of Apartadó may have been one of the causes of displacement to the urban area, taking into account that according to the municipality's statistics made by DANE 2021, 109514 inhabitants are in the urban area and 20237 in the rural sector.

References

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Effect on the resistance and capillarity of a Drywall sheet composed with guadua and banana stem, as a sustainable construction alternative.

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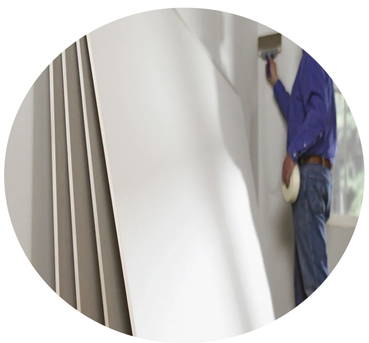
Thematic advisor: Adolfo Andrés Franco Sariego

Methodological advisor: Andrea Tamayo Londoño

Introduction:

The weather change, have been intensified as outcome of some facts such as rising temperature and greenhouse gas emissions. The construction sector is one of the most contributing in it[17]. Because most of the waste is not usable, therefore, this project pretend develop Drywall sheets composed of guagua fibers and banana stem, wich will have applicability in the construction field[12].



Drywall: Posibility of repair, replacement and savings, etc[17].

Guadua: Resistance, low cost, flexibility and elasticity[6].

Banana stem: Ductility, tenacity and resistance[20].

Fiber: Resistance, low density and biocompatibility[13].

General objetive: Develop drywall sheets composed of guadua and banana stem, applicable in the construction field, according to current regulations (NTC).		
Especific objective 1 Prototype drywall sheet's with different doses of guadua and banana stem.	**Especific objective 2** Determine the drywall sheet's resistance manufactured with different doses of guadua fiber and banana stem.	**Especific objective 3** Determine the drywall sheet's capillarity manufactured with different doses of guadua fiber and banana stem.

Methodology:

Partial results:

To carry out the construction of the sheets, a mold was used, which is disassemblable for greater convenience when disassembling the sheets and its material is composed of copper.

When the first Drywall plates were made with guadua fibers and banana stems, some changes in the weights were evidenced, which may be due to the density of each fiber used for the project.

Guadua weight: 127,78 g
Banana stem weight: 118.38 g

Partial conclusions:

With the differences in weights we can choose the material that benefits us the most, depending on the purpose of the construction, whether it is needed with more weight and lighter.

Future:

To be able to demonstrate that natural fibers are environmentally friendly and give properties similar to those of traditional drywall, allowing to replace this in a sustainable way.

Reference:

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Behavioral analysis of substance trends associated with conductivity in surface water bodies using a real-time conductivity sensor

Authors: Diego Steven Arias Arias - Juan Esteban Gonzalez Guerra **Advisors:** Juan David Correa - Fidel Granda

INTRODUCTION

The loss of water masses with optimal quality, the increase in emerging contaminants and the spread of invasive species are clear examples of the problem that decreases in water quality entail. For this reason, it is extremely important to know what conditions the water is in before giving it any use, since it provides fundamental information to identify what conditions it is in and likewise establish adequate strategies that allow good management of the resource.

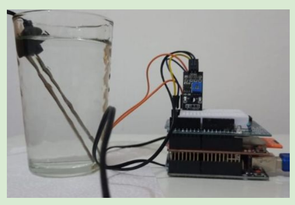
STATEMENT OF THE PROBLEM

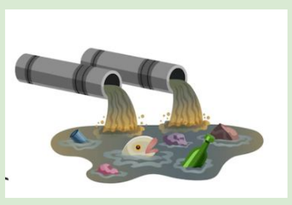
In America, water quality is a limiting factor in access to a safely managed service. The water quality monitoring systems still do not record, as they should, the indicator associated with water quality free of chemical contaminants.

JUSTIFICATION

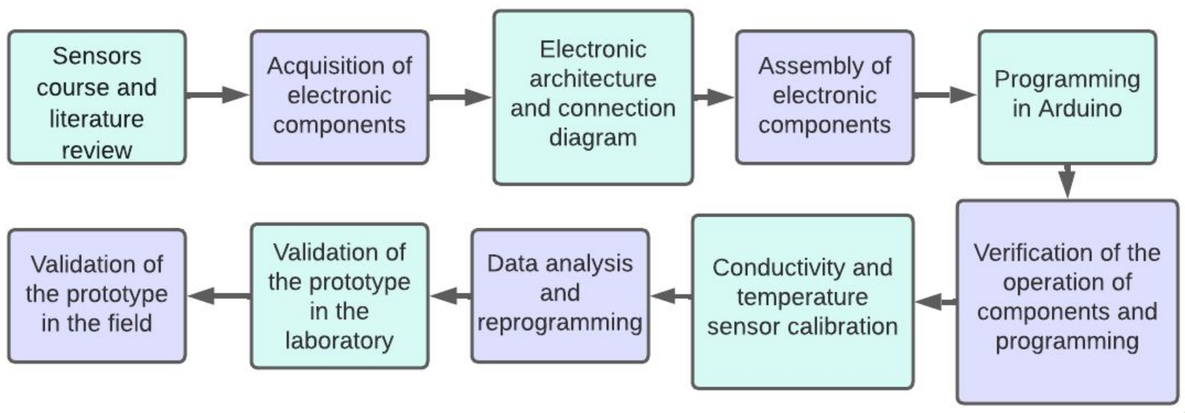
Constant monitoring is very important to obtain information on the physical and chemical properties of water sources that can often be affected by discharges.

The optimization and efficiency of processes is currently being improved by means of intelligent sensors, which take data and allow greater functionality, from self-control and self-configuration to carrying out complex processes.





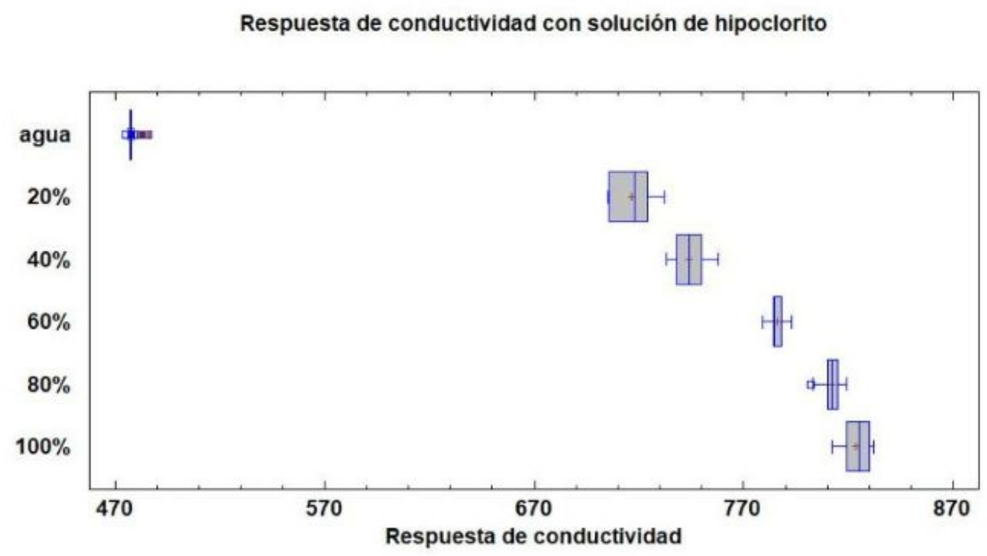
METHODOLOGY

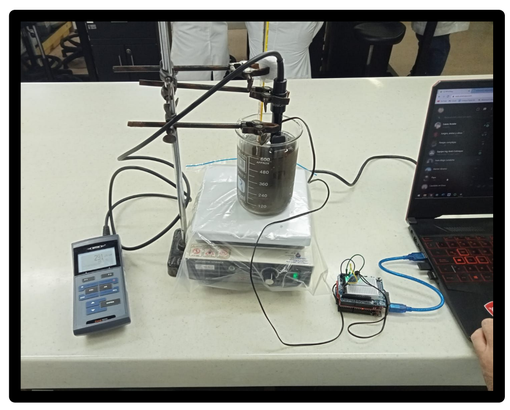


OBJECTIVES

Analyze behavioral trends in the conductivity of water sources due to discharges for decision-making in water resource management through low-cost sensors.

- Prototyping of a sensor for the measurement of conductivity trends and continuous data acquisition over time.
- Check the sensitivity of the sensors and perform the calibration.
- Validate the functional prototype in a surface water source





Resumen Estadístico

	Recuento	*Promedio*	*Desviación Estándar*	*Coeficiente de Variación*	*Mínimo*	*Máximo*	*Rango*
agua	262	477,901	1,99561	0,417578%	475,0	486,0	11,0
20%	262	716,435	8,59216	1,19929%	705,0	732,0	27,0
40%	262	743,855	6,74962	0,907384%	733,0	758,0	25,0
60%	262	785,874	2,96651	0,377479%	779,0	793,0	14,0
80%	262	812,141	3,8316	0,471789%	802,0	819,0	17,0
100%	262	823,679	6,38817	0,775565%	812,0	832,0	20,0
Total	1572	726,648	117,436	16,1613%	475,0	832,0	357,0

References

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Design and implementation of a low-cost modular system for drinking water treatment in some rural areas of Antioquia.

Authors: Juan Pablo Pino Arango – Alejandra Marín Orozco **Advisors:** Carlos Fidel Granda Ramírez – Adolfo Andrés Franco Sariego

INTRODUCTION

In Colombia, one third of the territory does not have access to drinking water and basic sanitation services, and the people with the greatest scarcity of resources are the most affected, as is the case in rural areas of Antioquia. These communities are the most vulnerable to gastrointestinal diseases and the shortage of water resources for the production of basic foodstuffs. Due to this, it is necessary to address and provide solutions to meet the needs of the inhabitants and improve their quality of life, ensuring the coverage and quality of water in the territory.

PROBLEM DEFINITION

Access to safe water, good hygiene and sanitation is one of the many deprivations experienced by some of the world's poorest groups.

In Colombia, of the 17,549 deaths that occur each year, 71.6% are due to Acute Diarrheal Disease (ADD) due to the state of water quality.

In the department of Antioquia 1.9% of urban dwellings do not have access to potable water, and 72.3% (398,081 rural dwellings) do not have access to potable water.

JUSTIFICATION

Water is the focal point of sustainable development and is fundamental for socioeconomic development, energy production, food production, ecosystems and for human survival.

Safe and easily accessible water is of vital importance because of the uses and purposes to which it is put in everyday life, whether it is used for drinking, domestic use, or recreational purposes .

GENERAL OBJECTIVE

Implement a low-cost modular system for drinking water treatment that can be extrapolated from the redesign and according to the physicochemical characteristics of the water to be treated in rural areas.

SPECIFIC OBJECTIVES

- Analyze the physicochemical and microbiological conditions of water used for human consumption.
- Design the drinking water treatment system according to the required processes.
- Construct the modular drinking water treatment system according to previous designs.
- Determine the potabilization efficiency of the modular system built.
- Develop a manual describing the construction, installation and monitoring of the system.

RESULTS

Water characterization phase

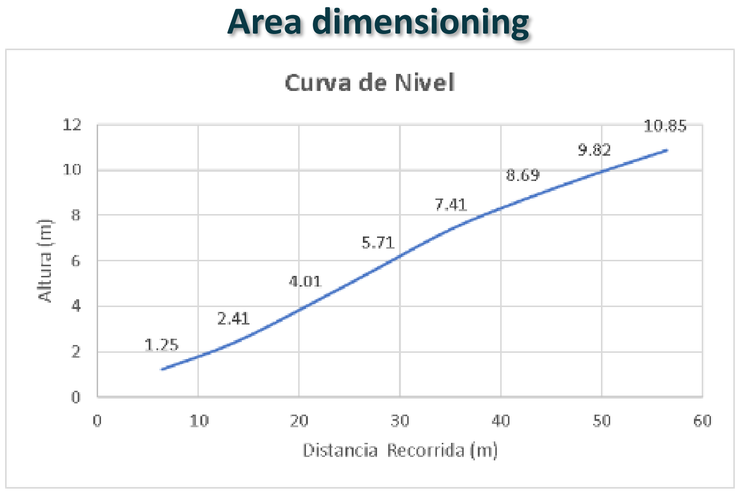
Table 1. Results of physicochemical parameters

Parámetro	Método	Equipo	Valor
pH	Potenciométrico	pHmetro OHAUS Starter 3100	6.86 ± 0.03
Turbiedad (NTU)	Nefelométrico	Scientific Inc. Micro Pi	1.81± 0.26
Conductividad (mS/cm)	Potenciométrico	WTW Cond 3310	14.07± 0.12
Color aparente (PCU)	Fotométrico	HANNA instruments HI 97727	25.67± 4.04
Alcalinidad (mg CaCO3/L)	Potenciometría	pHmetro WTW pH 3110	25
COT (mg/L)	EPA 9060, EPA 4151	SHIMADZU, ASI-L AUTO SAMPLER	0.255 ± 0.12
Dureza (mg CaCO3/L)	Volumetría		10.01

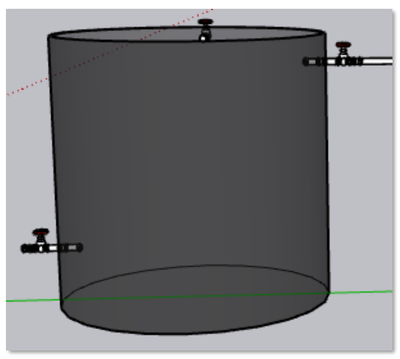
Table 2. Results of microbiological parameters

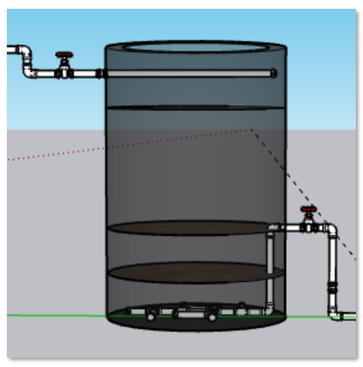
Parámetro	Técnica	Valor
Coliformes totales (UFC/100mL)	Filtración por membrana	109 ± 23.33
Coliformes fecales (UFC/100mL)	Filtración por membrana	23.5 ± 2.12
Mesófilos (UFC/100mL)	Filtración por membrana	200
Pseudomonas aeruginosa (UFC/100 mL)	Filtración por membrana	1

Area dimensioning



Modular system design





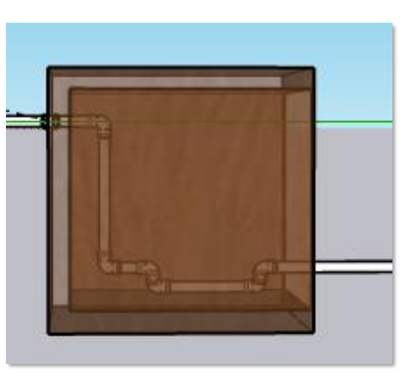


Table 3. System cost

Costo del sistema	
Desarenador	$ 90,000.00
Filtración lenta de arena	$ 220,000.00
Filtro de carbón activado	$ 130,000.00
Lámpara UV	$ 240,000.00
Tanque de almacenamiento	$ 90,000.00
Total	$ 770,000.00

PARTIAL CONCLUSIONS

With the results obtained from the water characterization, the treatment stages of the system (sand trap, sand filter, activated carbon filter and UV lamp) were determined.

The level curve of the land indicates that the height between the first tank of the system and the farm is 10.85 meters, which is sufficient pressure for the water to reach the faucet.

According to the characteristics of the water to be treated, the conditions of the farm and its location, the design of each of the mentioned components is made, with their respective costs and materials for its construction

BIBLIOGRAPHY