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EDITOR'S LETTER

Dear readers, university community, and authors:

It is a pleasure to present the most recent issue of the *Espacio I+D Innovación más Desarrollo* Journal, with which we close this volume and celebrate our 12th anniversary of continuous publication. Undoubtedly, this month of October has a special meaning as it coincides with the 50th anniversary of the highest school in Chiapas, the Universidad Autónoma de Chiapas, our publishing house.

During this half-century, the university has established itself as a quality educational option, responding with commitment to the complex needs of Chiapas' context. On this occasion, in this publication we join the celebration with a significant achievement: obtaining the Indexing certificate that officially incorporates us into the AmeliCA Open Science index (UNESCO, CLACSO, and Redalyc-AmeliCA), thus recognizing the quality of our editorial management and contents of this journal, which is part of the Editorial Directorate of the Secretariat of Identity and University Social Responsibility of the UNACH. This distinction allows us to join the search catalog of this non-profit organization based in Mexico, which mainly groups publications from Latin America, Asia, and Africa, to strengthen and advance the development of different branches of open science from academic and scientific institutions.

In this issue, you will find articles from various disciplines and approaches from different institutions, such as: Thermal Properties of Conventional and Non-Conventional Materials in the Construction of Rural Housing; Initial Renovation of Traditional Cocoa Plantation through Decoupling Pruning; Inclusion and Schooling Process for Haitian Migrant Children in Tapachula, Chiapas; Current Potential Distribution of el Dorado (*Coryphaena hippurus*) in the Pelagic Ecosystem of the Southeast Coast of the Mexican Pacific Ocean; Water Management and Governance in Yashanal and Tzajalchen, Tenejapa, Chiapas (2015-2020); and Econometric Determination of Factors Affecting the Performance of Dissemination Activities. The Case of the JC/CUC DAIA Science Club. Likewise, we invite

you to read the academic document entitled: Challenges of Female Scientists at the Universidad Central "Marta Abreu" Las Villas.

We hope that the materials presented will interest you and that you will continue to accompany us in the next volume, to continue strengthening the production and dissemination of knowledge, which has already been consolidated in the academic community, both inside and outside our institution.

For the Awareness of the Need to Serve

The editorial team,
Espacio I+D, Innovación más Desarrollo journal.

"*Por la conciencia de la necesidad de servir*"
Universidad Autonoma de Chiapas

ARTICLES

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Thermal Properties of Conventional and Non-Conventional Materials in the Construction of Rural Housing

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— Abstract—

The determination of the thermal conductivity of four materials used in rural housing construction is presented, pine wood board, reinforced concrete slab, concrete block, and a non-conventional proposal of a sawdust panel, in addition to calculating the thermal resistance of systems using the values obtained. The thermal conductivity was obtained according to the ASTM C177-91 (2019) standard, by the steady-state test method using a guarded hot plate equipment (EPCG). The thermal conductivity data were used to compare the differences in thermal resistance and their compliance with the Mexican standard NMX-C-460-ONNCCE-2009 (2009), a standard that indicates the method of calculating thermal insulation through thermal resistance called value "R" (Thermal resistance). The results indicate that the use of the conventional slab and the zinc sheet is very far from compliance with the minimum "R" of the standard, while options such as thermal insulators with local materials such as wood and sawdust panels allow us to get closer. to compliance with the standard. This has an impact on the thermal conditions inside that will contribute to improving the thermal comfort conditions of people, benefiting their health and minimizing the cold conditions that the inhabitants of the rural community of Monte Sinaí II usually perceive in a temperate climate. Fénix, in the municipality of Cintalapa, in the state of Chiapas.

In these temperate climate conditions, focusing on the rural community Monte Sinaí II el Fénix, in the municipality of Cintalapa, in the state of Chiapas. Another factor considered relevant is the cultural factor that people seek to transition from local materials to industrialized materials, an aspect that can be observed in the community, which is why this work seeks to disseminate the virtues and opportunities from the thermal factor presented by using the materials premises of a community.

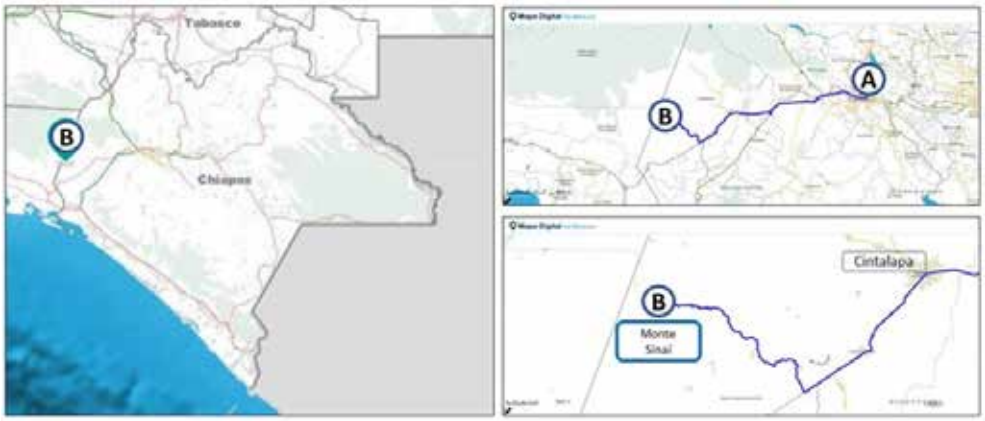
Keywords:

Thermal conductivity, thermal resistance, pine wood and sawdust panel.

In Mexico there are non-mandatory standards that allow evaluating compliance with thermal insulation of materials for construction, such as the official Mexican standard NOM-020-ENER-2011 (2011) and the Mexican standard NMX-C-460-ONNCCE-2009 (2009), although they have focused on evaluating and reducing the use of equipment to cool the space, such as air conditioning, commonly used to decrease air temperatures inside homes, thermal insulation can also be analyzed to reduce heat losses from an interior space.

In the case of homes, one of the components that has the greatest thermal loss or gain, which could contribute to thermal discomfort due to cold or heat, is the roof, since in a warm climate it receives direct and indirect solar radiation during sunny hours, while in a temperate climate, heat is lost during the nights. In this sense, it is considered an important factor to give technical values to the thermal virtues that the use of local materials can present, and in this case, the community has the sustainable forest management of pine wood, so it was chosen to determine the thermal properties of a sample of pine wood board and a panel of sawdust was prepared, a product of the sawmill managed by the Monte Sinai community.

Monte Sinai II (El Fénix) is an indigenous rural community located in the municipality of Cintalapa, located east of the state in the mother mountain range of Chiapas, bordering the state of Oaxaca, with geographical coordinates of 16.67 degrees North latitude and 94.01 degrees West longitude, with an altitude of 1300 m.a.s.l. El Fénix stands out because Chiapas is one of the states in the country where deforestation is growing and illegal logging predominates. This community transitioned 15 years ago to sustainable forest use and has approximately half a thousand inhabitants and 56 ejidatarios that share 1080 hectares. Today they have a certified community forestry company, granted by the Forest Stewardship Council (Guzmán & Díaz, 2019).



Note. Source: Ruiz et al, 2022.

Figure 1. Monte Sinai Location (A: Tuxtla Gutierrez; B: Monte Sinai II El Fénix)

MATERIALS AND METHODS

For the measurement of thermal conductivity, a Guarded Hot Plate Equipment (GHP) was used. This team is in the Faculty of Architecture developed within the framework of the National Laboratory of Housing and Sustainable Communities of UNACH. The equipment consists of a hot plate connected to a variable voltage transformer and a cold plate connected to a recirculating thermostatic bath. The flatness of the sample was verified, its thickness was measured at three points per side, and it was placed between the cold plate and the hot plate. A transfer of thermal energy (heat) is generated in the hot plate towards the cold plate through the sample. The thermal conductivity at the time of achieving the steady state in the system is calculated by ASTM C177-91 (2019). The temperatures of the plates were measured with "t" type thermocouples, collecting the data with an acquirer connected to the measurement interface programmed in LabView, the records are programmed every 10 seconds to determine when the stable state of the system is achieved. The thermocouples were calibrated using a thermostatic bath by ASTM E 220-07A. The thickness of the samples was carried out with a vernier calibrator, the measurement area with a flexometer, and the power supplied with digital multimeters.

The apparent thermal conductivity of the material was determined from the steady state equation for the hot plate equipment:

$$\lambda = \frac{q\,L}{\Delta T\,A}$$

Note. Source: Lira Cortés, 2010.

Figure 2. Equation 1. Equation to calculate the thermal conductivity of the material

Where:

- q is the heat flow through the sample in W.
- λ is the apparent thermal conductivity of the sample in W/m K.
- ΔT is the temperature difference applied to the sample in °C or K.
- L is the thickness of the sample in m.
- A is the effective cross-sectional area in m^2.

When a material sample is a laminar composite and contains porosities, empty cells, or mixtures of materials, heat can be transferred by convection and radiation. In addition to conduction, in these cases, the parameter λ, of the previous equation is called effective or apparent thermal conductivity.

Thermal resistance is defined as the inverse of the thermal conductivity multiplied by the thickness of the sample.

$$R=\frac{L}{\lambda}$$

Note. Source: NMX-C-460-ONNCCE-2009 (2009).

Figure 3. Equation 2. The equation for calculating thermal resistance

The measurement area of the system is 0.199 m x 0.197 m being an area of 0.128 m2. The guard area comprises 0.10 m on each side, for this reason, samples with a minimum dimension of 0.20 m x 0.20 m are requested.

For thermal resistance, we followed the standard NMX-C-460 ONNCCE-2009 (2009). The total thermal resistance of an element of the envelope; the "R" value is the sum of the surface resistances, internal and external, and the thermal resistances of the various layers of the various materials that make up the element of the envelope, this sum is also known as "R" value. The equation for the calculation "R" is as follows:

Equation 1: Simplified calculation of the thermal resistance of a homogeneous material.

$$K=\frac{1}{R_T}=\frac{1}{\frac{1}{hi}+\frac{1}{he}+\frac{L_1}{\lambda_1}+\frac{L_2}{\lambda_2}+\frac{L_3}{\lambda_3}+\frac{L_n}{\lambda_n}}$$

Note. Source: NMX-C-460-ONNCCE-2009 (2009).

Figure 4. Equation 3. Simplified calculation of the thermal resistance of a homogeneous material

The following values make up the said equation:

- K is the coefficient of thermal transmission, in W/m² K.
- L is the layer thickness of the material in the component, in m.
- λ is the thermal conductivity of the material obtained from tabulated values, manufacturer's reports, or laboratory tests, in W/(m K).
- *hi* is the interior surface conductance, in W/m²K, its value (of the standard NOM-008-ENER-2001) is 8.1 for vertical surfaces, 9.4 for horizontal surfaces with upward heat flow (from floor to indoor air or from indoor air to ceiling), 6.6 for horizontal surfaces with downward heat flow (from ceiling to indoor air or from indoor air to floor).
- *he* is the external surface conductance, in W/m²K, its value is equal to 13 (of the NOM-008-ENER-2001 standard).
- *N* is the number of layers that make up the portion of the envelope.

- *RT* is the total thermal resistance of a portion of the building envelope, surface to surface, m² K/W.

RESULTS

In the different samples, the surfaces were not treated because they met the characteristics of the contact of the surfaces with the hot plate and cold plate. The results obtained from the determination of thermal conductivity using EPCG are presented below.

Reinforced concrete slab

The sample of reinforced concrete slab evaluated has an average thickness of 0.1018 m. The sample complies with the minimum area for the test, measuring 0.30m x 0.30 m. The measurement period was on October 6, 2022, from 9:00 a.m. to 7:00 p.m.

Figure 5. Reinforced concrete slab sample

Table 1
Reinforced Concrete Slab Test Results

Variable	Average Value
Apparent thermal conductivity (W/m K)	**2.036**
Thermal resistance (m^2 K/W)	0.05
Thickness (m)	0.1018
EPCG Average Working Temperature (°C)	31.05
Temperature on hot plate (°C)	40.35
Temperature on cold plate (°C)	21.54
Plate temperature difference (°C)	18.81
Effective measurement area (m^2)	0.128
Power supplied (W/ m^2)	381.83
Start of test (hr:mm) – end of test (hr:mm)	9:00 h to 19:00 h 10 hours of measurement approx.

Figure 6. LabView Measurement Interface in Reinforced Concrete Slab Test Stabilization

Solid concrete block

The concrete block sample has an average thickness of 0.15096 m. The sample complies with the minimum area for the test, measuring 0.30m x 0.30 m. The measurement period was on November 2, 2022, from 9:00 a.m. to 7:00 p.m.

Figure 7. Concrete Block Sample

Table 2
Concrete Block Test Results

Variable	Average Value
Apparent thermal conductivity (W/m K)	**1.815**
Thermal resistance (m^2 K/W)	0.08318
Thickness (m)	0.15096
EPCG Average Working Temperature (°C)	28.01
Temperature on hot plate (°C)	33.07
Temperature on cold plate (°C)	22.95
Plate temperature difference (°C)	10.12
Effective measurement area (m^2)	0.128
Power supplied (W/ m^2)	121.514
Start of test (hr:mm) – end of test (hr:mm)	9:00 h to 19:00 h 10 hours of measurement approx.

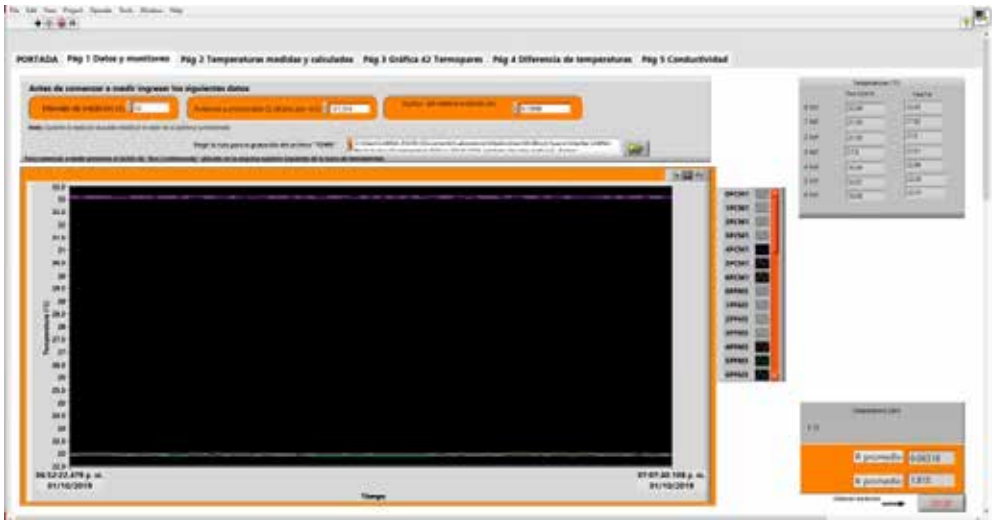


Figure 8. Measurement interface in LabView in concrete block test stabilization

Pinewood

The test of the pinewood board, with an average thickness of 0.0229 m. The samples comply with the minimum requested area of the test, measuring 0.30m x 0.20 m. This board is from the sustainably managed pine wood of Mount Sinai.

Figure 9. Pine Wood Board Test

Figure 10. Enabling Wood Panel on Hot Plate Equipment (EPCG)

Table 3
Pine Wood Board Test Results

Variable	Average Value
Apparent thermal conductivity (W/m K)	**0.1191**
Thermal resistance (m^2 K/W)	0.1923
Thickness (m)	0.0229
EPCG Average Working Temperature (°C)	31.6
Temperature on hot plate (°C)	37.93
Temperature on cold plate (°C)	25.28
Plate temperature difference (°C)	12.64
Effective measurement area (m^2)	0.128
Power supplied (W/ m^2)	69.12
Start of test (hr:mm) – end of test (hr:mm)	11:30 h (28 Jan) - 14:20 h (29 Jan). 14 hours with 50 minutes of measurement approx.

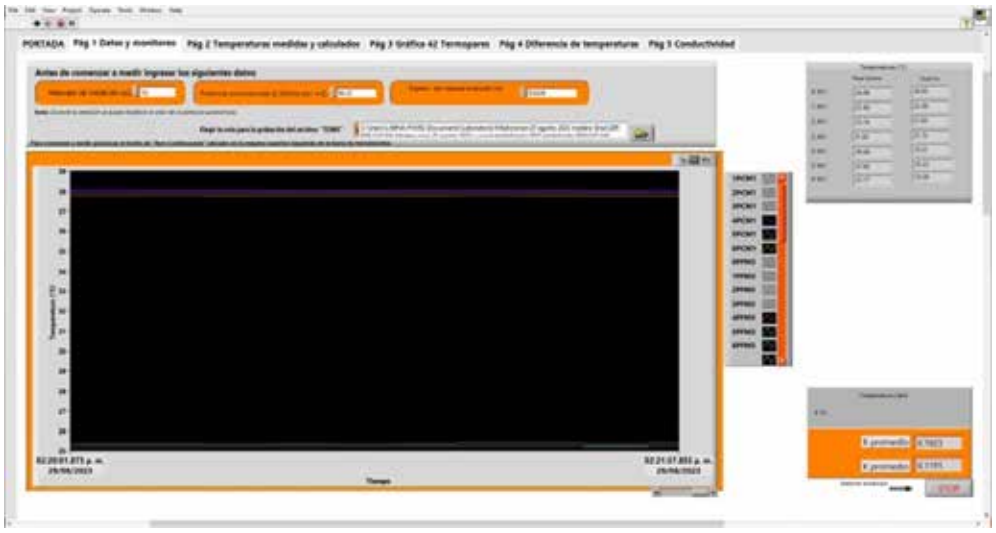


Figure 11. LabView Measurement Interface in Pinewood Board Test Stabilization

Sawdust panel

The sawdust panel sample has an average thickness of 0.1018 m. The sample complies with the minimum area for the test, measuring 0.30m x 0.30 m. This panel was manufactured. The measurement period was from October 27, 2022, at 1:30 pm, to October 28 at 8:37 am.

Figure 12. Sawdust Panel Sample

The sawdust panel was made with easily accessible materials, and it was initially experimented with its elaboration in a wooden mold, compressing it manually, and bonded with a mixture of water and white glue, the ratio used of the mixture was 1:8, a portion of white glue and 8 portions of water. The drying time was about one week. The elaboration can be seen in the following figure, in addition to the fact that students were involved in this activity.

Figure 13. Preparation of sawdust panel, a product of Mount Sinai sawmill

Table 4
Pine Wood Board Test Results

Variable	Average Value
Apparent thermal conductivity (W/m K)	**0.08696**
Thermal resistance (m^2 K/W)	0.2936
Thickness (m)	0.025535
EPCG Average Working Temperature (°C)	34.09
Temperature on hot plate (°C)	43.19
Temperature on cold plate (°C)	24.99
Plate temperature difference (°C)	18.2
Effective measurement area (m^2)	0.128
Power supplied (W/ m^2)	66.75
Start of test (hr:mm) – end of test (hr:mm)	13:30 h to 8:37 h 17 hours with 7 minutes of measurement approx.

Figure 14. Measurement interface in LabView in sawdust panel test stabilization

OBTAINING THE THERMAL RESISTANCE VALUE

In the case of the calculation of thermal resistance, the values obtained from the determination of thermal conductivity were used. Only the case of the sheet was not determined because it is a standardized material and that of the Catalogue of Constructive Elements of the CTE (2010) was used, another reference to compare determined values of thermal conductivity was that presented by Eduardo González (2003). Below are calculations and systems composed of layers according to the calculation of NMX-C-460-ONNCCE-2009. Zinc foil roofing is added as a comparison as it is commonly used in rural communities. For thermal conductivity value of the zinc foil, the CTE (2010) was used.

Table 5
Calculated thermal resistance for a zinc foil

Material (**)	Thickness (m) b	Conductivity thermal (W/mK) h o K (***)	Thermal insulation (m²C/K) Formula [b/(h o k)]
rsi		6.6	0.152
Zinc foil	0.003	110	0.00003
rse		13	0.077
		R (m²°K/W)	0.228

Tabla 6
Calculated thermal resistance of a reinforced concrete slab

Material (**)	Thickness (m) b	Conductivity thermal (W/mK) h o K (***)	Thermal insulation (m²C/K) Formula [b/(h o k)]
rsi		6.6	0.152
Reinforced concrete slab	0.10	2.036	0.04912
rse		13	0.077
		R (m²°K/W)	0.278

Table 7
Calculated thermal resistance of an apparent concrete block wall

Material (**)	Thickness (m) b	Conductivity thermal (W/mK) h o K (***)	Thermal insulation (m²C/K) Formula [b/(h o k)]
rsi		8.1	0.123
Concrete block	0.15	1.815	0.08264
rse		13	0.077
		R (m²°K/W)	0.283

Table 8
Calculated Heat Resistance of Zinc Sheet Roofing with Wood

Material (**)	Thickness (m) b	Conductivity thermal (W/mK) h o K (***)	Thermal insulation (m²C/K) Formula [b/(h o k)]
rsi		6.6	0.152
Pinewood	0.0229	0.1191	0.19228
Zinc foil	0.003	110	0.00003
rse		13	0.077
		R (m²°K/W)	0.421

Table 9
Calculated thermal resistance of zinc sheet roofing with sawdust panel

Material (**)	Thickness (m) b	Conductivity thermal (W/mK) h o K (***)	Thermal insulation (m^2C/K) Formula [b/(h o k)]
rsi		6.6	0.152
Sawdust panel	0.01018	0.08696	0.11707
Zinc foil	0.003	110	0.00003
rse		13	0.077
		R ($m^2°K/W$)	0.346

Table 10
Calculated heat resistance of a wall system with wood and air inside

Material (**)	Thickness (m) b	Conductivity thermal (W/mK) h o K (***)	Thermal insulation (m^2C/K) Formula [b/(h o k)]
rsi		6.6	0.152
Pinewood	0.0229	0.1191	0.19228
Air	0.1	0.026	3.84615
Pinewood	0.0229	0.1191	0.19228
rse		13	0.077
		R ($m^2°K/W$)	4.459

A summary of the calculated thermal resistance values of the different systems is presented below for discussion.

Table 11
The concentration of thermal resistances calculated from the thermal conductivity, obtained in the laboratory

Type of system	Constructive system	Calculated thermal resistance **R** (m^2K/W)	Reference thermal conductivity used
Conventional constructive systems	Zinc sheet roofing	0.0228	CTE (2010)
	Reinforced concrete slab	0.0229	Lab test
	Apparent concrete block wall	0.1	
Non-conventional construction systems using local materials	Zinc sheet roofing with wood	0.421	Lab and CTE test (2020)
	Zinc sheet roofing with sawdust	0.346	
	Wooden wall with internal air space	4.459	Lab test

CONCLUSION

Concerning the concentrate presented in Table 1, the thermal resistances of conventional systems, the highest R-value is 0.1 m^2K/W, being that of the apparent concrete block wall and the lowest value is 0.0228, being that of the zinc roof. Referring to the NMX-C-460-ONNCCE-2009, standard, where the reference to comply with it for roofs is a thermal resistance (R) of 1.4 m^2K/W and for walls a thermal resistance (R) of 1 m^2K/W, it is possible to identify that the value of the zinc foil roof does not approach 2% of the value that must be met for a roof. In the case of the apparent concrete block wall, it is 10% of the minimum value for walls.

For unconventional proposals, using local materials the R-value of the system, using a zinc roof but with a wooden board underneath, an R-value of 0.425 m^2K/W was obtained, representing 30% of the R-compliance value of 1.4 m^2K/W for roofs. For the sheet roof system with the sawdust panel, the R-value was 0.346 m^2K/W, representing 24.7% of the compliance value, and finally, the R-value of the wall system that has a layer of wood, the air inside and a layer of wood outside, obtained an R-value of 4.459 m^2K/W, exceeds compliance with the standard.

Based on comparing the thermal conductivity obtained in the wood fiber panel, the work of Troppová et al. (2015) is appreciated, where a work on the thermal conductivity of boards or panels from wood fiber is reported. The thermal conductivities were obtained with different conditions of working temperature of the system and humidity of the panel, in which a thermal conductivity from 0.048 W/mK to 0.088 W/mK was obtained; when comparing it with the value obtained in this work of the sawdust panel that resulted from 0.08696 W/mK (table 4), we see that the highest conductivity value coincides with conditions. In the work of Božiková et al. (2021), it was found that the thermal conductivity values of a panel made with pine wood residues from 0.08 W/mK to 1.0 W/mK, also results in values similar to that obtained in this work. Finally, in another research by Medved et al. (2021) determined a thermal conductivity of 0.084 W/mK, for a panel made with compressed wood fibers under pressure, carried out with a procedure similar to this work. These previous studies serve as a reference on the thermal conductivity of the wood fiber panel, determined in this work, is practically the same or similar to the values found in similar research. This value and reference are relevant because thermal resistance is calculated as a system and the different proposals are in Table 11. can be seen.

Therefore, it is evident that zinc foil roofing systems have an R-value well below the norm, and this allows us to infer that it is inefficient to resist heat flow, which causes the zinc foil to cool quickly during the night, losing heat to the interior space, so temperatures in a temperate climate could be

cold inside. Otherwise, during the day it gains heat and quickly warms the inside. The option of using pine wood as an insulator would improve the thermal comfort conditions inside, with the virtue of being a local and replaceable material. The possibility of manufacturing panels with sawdust residues is also presented as an alternative use to insulate zinc roofing in this community.

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Initial Renovation of Traditional Cocoa Plantation through Decoupling Pruning

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— Abstract—

The cocoa produced in Mexico has great cultural, environmental, and social relevance, and is cataloged by the IICO as fine-aroma cocoa, which is produced mainly by small producers in agroforestry systems in the states of Tabasco and Chiapas, however it has plantations with trees that are over 20 years old, which is one of the factors that impact the low productivity and profitability of the crop, so the objective was to validate the agronomic and economic feasibility, in the renovation of a traditional and unproductive plantation of cocoa with two forms of execution of pruning, one manual and the other mechanized. The research was carried out in a 45-year-old plantation, located in Comalcalco, Tabasco, it was carried out in two stages, in the first the two forms of execution were tested: traditional pruning with a machete and the use of a chainsaw, each on one hectare, comparing. The efficiency and cost of each one and the best result were evaluated in a second stage on 6 hectares, in the first stage the number of days of labor and the cost of the tools and supplies required were counted, and in the two stages The number of shoots formed at the base and in the upper part of the trunk, the number of bearings in flowering, fruiting and the incidence of fruits diseased by moniliasis were evaluated monthly, for which analysis of variance was performed. The results indicate that pruning with a chainsaw is more efficient and lower cost. In pruned trees, a greater number of shoots, greater flowering, and fruiting are observed; also a considerable reduction in the incidence of moniliasis.

Keywords:

Theobroma cacao L.; rehabilitation of plantations; agronomic practices.

Cocoa is considered one of the main tropical plantation crops in southeastern Mexico. According to the SIAP report (SIAP-SADER, 2020), there is a cultivated area of 59,655 ha; the states with the largest area are Tabasco and Chiapas; and of lesser relevance, Oaxaca and Guerrero. The average national production is 26,076 tons of dry beans, which is insufficient to supply domestic demand, forcing the industry to import cocoa beans from other countries. It is estimated that 70% of the cocoa consumed in Mexico is imported, either as dry beans or in the form of processed products.

In many of the cocoa-producing countries, yield per productive unit is considered low and is declining, among the causes are limited technological management, damage caused by diseases and pests, and the aging of plantations (Quiroz & Amores, 2002; Assiri et al., 2009; Adebiyi & Okunlola, 2013; Taiwo et al., 2015; Assiri et al., 2016; Santos et al., 2016; Niether et al., 2018).

A relevant aspect of the renovation is the size of the farm. In countries where producers have large plantations, the renovation does not present a major problem. However, in many countries in Mexico, producers have small production units with cocoa, since most of them only cultivate 1 to 2 hectares per family. In Mexico, cocoa is traditionally grown in permanent accompaniment of trees in a diverse agroforestry system, so that the population of cocoa trees ranges between 500 and 600 per ha, which are planted at distances of between 4 and 5 m between plants, and tops reach heights that on average range between 6 and 8 meters. 80% of existing cocoa plantations are over 40 years old, so their productive potential is limited, in addition to the losses caused by diseases, especially moniliasis (*Moniliophthora roreri*) and black spot (*Phytophthora spp*.) that cause serious crop losses, and the poor technical management of the plantation. One hectare of cocoa produces between 100 and 300 kg/year of dry cocoa, so to recover the production and profitability of this crop, the renewal of the current plantations is imminent (Ramírez 2008; Avendaño et al., 2011; Díaz-José et al., 2013; Espinosa-García et al., 2015).

In an old cocoa plantation, the renovation implies the elimination or gradual change of the old cocoa trees and their replacement with improved material with greater productive potential, while incorporating practices such as the replanting of cocoa plants, pruning, sanitary management, plant nutrition, and regulating or improving shade (Ramírez et al., 2009).

For the renewal and recovery of the production of decaying or unproductive cocoa plantations, various technological strategies have been developed, among which the pruning of the crown and reduction of height, the total renewal of the crown, the reception of the trunk, the regeneration of the tree using a basal pacifier with or without grafting, practices that must be done partially to preserve the best branches and stimulate basal shoots to be grafted with outstanding materials (Enríquez 1985; Bourgoing et al.,

2009; Ramírez et al., 2009; Arvelo et al., 2017; Govindaraj & Jancirani, 2017; Gutiérrez-Brito, Leiva-Rojas & Ramírez-Pisco, 2019).

A technological alternative for recovering the productive capacity of old and unproductive plantations has been developed by the AUDES CACAO-CHOCOLATE of the Autonomous University of Chiapas (UNACH). The basis of this renewal strategy is the pruning of old trees, which allows them to reduce their height and prepares the plantation for the integration of disease management practices, especially moniliasis, fertilization, shade regulation, replanting, and grafting on basal shoots (Ramírez et al., 2009).

Taking the background described, this research aimed to validate on a commercial scale the agronomic response of a traditional cocoa plantation to the application of tree decoupling pruning as part of the renovation, as well as the estimation of the costs of this intervention.

MATERIALS AND METHODS

Test facility and plant material

In collaboration with the company Cocoa Farms Mexico SAPI de C.V. and a cooperating producer, a research module was established in July 2019 taking a 6.5-hectare traditional plantation, formed by a typical cocoa-shadow agroforestry system, located in the Emiliano Zapata community of Comalcalco, Tabasco. The plantation is 45 years old and receives a little technical traditional management (no pruning, no phytosanitary management, no fertilization). Cocoa trees come from a genetic mixture of the Trinitario type, they are planted in a frame 4x4 m between plants.

In Stage 1, the decoupling pruning was carried out between July and August 2019, the criterion applied was to cut the trunks or canopies at a height of 3 m from the ground, which is equivalent to reducing approximately 70% to 80% of the leaf area. A test was developed in which two forms of execution were compared: a) manual pruning with a machete and manual pruner was carried out on one hectare, and b) pruning with a chainsaw was carried out on an area of one hectare.

From the results obtained in this first stage, Stage 2, was carried out, in which decoupling pruning was applied to the surface with the best form of execution until the 6 ha were completed.

Witness treatment

As a control treatment, an area of 0.5 ha was left; the cocoa trees were not pruned and received the producer's traditional management.

Quantified variables

In the initial test, the number of days of labor and the cost of the tools and supplies required were counted.

To quantify the response of the trees to pruning, monthly, from the pruning carried out, the number of shoots formed at the base and the top of the trunk, the number of bearings in flowering, the fruiting, and the incidence of fruits sickened by moniliasis were recorded, for which a sample of 100 pruned trees and 100 from the control lot was taken. The data generated were processed using the analysis of variance.

Agronomic management of the experimental site

Weed control: weed control was carried out every three months by manual cutting with a machete complemented by the help of a gasoline engine weeder; the first weeding was carried out in July.

Disease management: at the time of pruning, all fruits affected by moniliasis and black spot diseases were manually removed. Subsequent sanitary management consisted of monthly sprays of 10% calcium polysulfide, based on the results reported by Ramírez et al., (2011).

Fertilization: to nourish the cocoa plants, foliar sprays are made monthly of liquid fertilizer in a concentration of 2% V/V, prepared by the technique proposed by López et al., (2015) that contains the elements: nitrogen, phosphorus, potassium, calcium, magnesium, manganese, iron, sodium, boron, zinc, and copper.

Climatic data: during the period from July 2019 to March 2020, which includes the information presented, the monthly records of total precipitation and average, maximum, and minimum temperature, generated at the National Meteorological Service (https://smn.conagua.gob.mx/es/) were taken for the CARTB station located in the municipality of Cárdenas, Tabasco (Longitude -93.41 W; Latitude 17.80 N) which is located approximately 15 km from the experimental lot.

RESULTS AND DISCUSSION

The data on the climatic conditions that were presented during the period from July 2019 to March 2020, such as rainfall and average, maximum, and minimum temperatures, are presented in Table 1, which shows that the driest months were August 2019 and March 2020; those that recorded the highest rainfall were October and September 2019. As for the average temperature, it ranged from 24.2 to 29.9 °C, the minimum from 19.8 to 24.7 °C, and the maximum from 27.8 to 35.7 °C, which are considered suitable for cocoa growth.

Table 1

Monthly precipitation and average, maximum, and minimum temperature during the period from July 2019 to March 2020

Months	Total precipitation (mm)	Average temperature (°C)	Minimum temperature (°C)	Maximum temperature (°C)
July 2019	104.0	29.3	24.4	34.2
August	50.5	29.9	24.7	35.7
September	211.1	27.3	23.9	32.7
October	367.2	27.3	23.4	31.2
November	332.5	25.0	21.2	28.8
December	125	24.0	21.1	27.8
January 2020	92.5	24.2	19.8	28.2
February	134	24.8	20.5	29.1
March	0	27.4	21.4	33.4

Note. Data recorded at the CARTB Station, of the National Meteorological Service, Cárdenas, Tabasco, Mexico. Longitude -93.41 W; Latitude 17.80 N.

The estimated costs for one hectare of the decoupling pruning application are presented in Table 2, considering the two techniques, the traditional execution with a machete and the technified one with a chainsaw. The results obtained show that the execution of this practice in a traditional way is more expensive and requires more time than when it is executed with the help of a chainsaw. The data show that the labor required in the first case was 1.9 times higher than that required when it is done with a chainsaw. The cost of the remaining tools used in both techniques is similar.

The cost of the traditional pruning technique was 6,466.00 MXN, which is higher than the estimated cost with the use of a chainsaw. In addition, the time in which this driving practice is executed is reduced, since the chainsaw allows a more efficient handling of the workforce, thus reducing working hours.

It should be noted that, in technified pruning, even when the cost of fuel and engine additive is added, and an annual depreciation cost of the equipment, the total calculation per hectare results in 4,448.70 MXN, which is 2,017.3 MXN cheaper than that of the traditional technique.

As for the acquisition cost of the chainsaw equipment, this is variable since it depends on the brand and capacity, the producer can access inexpensive price equipment. In the market, there is equipment whose price ranges from 3,000 MXN to 12,000 MXN, depending on the brand and capacity. For the analysis, a chainsaw with an estimated cost of 4,300 MXN and a useful life of 6 years was considered. In this way, an annual amortization cost of 728.9 MXN was estimated.

Table 2

Cost per hectare of applying decoupling pruning in a traditional cocoa plantation

Concept	Traditional pruning		Technified pruning	
	Amount	Cost	Amount	Cost
Labor (wage)	38	5700	20	3000
Machetes	4	280	4	280
High branch pruner	1	390	0	0
Sharpening files	8	96	4	48
Gas (l)	0	0	15	277.5
Engine additive (llitro)	0	0	0.5	45
Annual chainsaw depreciation cost	0	0	1	728.9
Cost (Mexican pesos)		$6,466.00		$ʃ4,448.70

Note. 1 US Dollar = 18.07 Mexican pesos

One of the immediate effects of the application of pruning is that when shading is reduced, there is a greater entry of light and better ventilation of the plantation, whose effects are remarkable since the induction of vegetative buds that give rise to shoots is stimulated, both at the base of the trunk and at the top. The results obtained presented in Table 3 show that the number of induced shoots per plant, both in the aerial part and at the base of the trunks, is higher in the pruned trees compared to the control treatment. The average number of aerial shoots was 7.5 in pruned trees and 5.0 in the control trees. In induced shoots at the base of the trunk, an average of 1.56 was quantified in pruned trees and 0.20 in the control.

Table 3

Average number of induced shoots per plant at the top and base of the trunk

Months	Induced renewals at the base of the trunk				Upper trunk renewals			
	Pruned	Control	F-value	Proba-bility > F	Pruned	Control	F-value	Proba-bility > F
Sep 2019	1.74	0.59	37.88	0	13.8	1.28	170.46	0
Oct	1.99	0.44	43.31	0	13.44	24.75	103.21	0
Nov	2.8	0.41	43.30	0	20.7	9.2	64.98	0
Dic	1.3	0	25.3	0	0	0.01	1	0.310
Jan 2020	1.4	0	1	0.319	0	0	0	0
Feb	0.8	0	0	0	1.9	0.01	38.75	0
Mar	0.91	0	31.50	0	2.4	0	22.41	0
Average	1.56	0.20			7.5	5.0		

Figure 1 shows the reaction of trees to pruning, the induction of shoots, both at the base of the trunk and at the top is widespread in pruned trees.

It should be noted that the shoots quantified in the control plants, from September to November, correspond to climatic effects that cause reactions in the phenology of cocoa, an effect that was also observed in surrounding plantations.

Regarding the effects on flowering, Table 4 shows that in September, October, and November, there is a flowering period that manifests itself both in pruned trees and in those of the control treatment, in which the pruning was applied, an average of 6.4 bearings with flowers and 3.8 in the control was quantified, and an extension of the flowering period until December and January was also observed.

Table 4

Average number of bearings in flowering per pruned and control plant

Months	Pruned	Control	F-value	Probability > F
Sep 2019	15.86	7.6	73.787	0
Oct	10.15	13.62	29.964	0
Nov	15	5.5	119.913	0
Dec	2.9	0	22.779	0
Jan 2020	0.96	0	3.964	0.048
Feb	0.05	0	1	0.319
Mar	0	0	0	0
Average	6.4	3.8		

Due to the structure of the traditional agroforestry system in which cocoa is grown under the permanent shade of trees, often with excessive shade to which is added the self-shading effect generated by cocoa trees, which increases with age and the poor management of the tree crown and height, it is undoubtedly that the system influences the phenological behavior of the crop (Blaser et al., 2018). In these conditions of excessive shade, the emission of leaf shoots and flowering is less intense and less frequent than those observed in plantations with less shade, a criterion that is consistent with the reports of various investigations (Ampofo & Bonaparte, 1981; Enríquez, 1985; Ken-Ichi, da Silva & Alvim, 1997; Bouley, Somarriba & Olivier, 2000; Vanhovea, Vanhoudtb & Van Dammea, 2016) which indicate that in very shaded plantations the leaf regrowth and flowering are of less intensity and frequency than in cocoa trees with less or little shade; if the age of the plantation is added to this effect, the expected yields of cocoa per hectare are not high.

According to Niether et al. (2018), cocoa agroforestry systems, in addition to providing shade, create a suitable microclimate for cocoa

development. According to these authors, it is necessary to consider the time and intensity to balance light and water availability in case of pruning, since this generates seasonal changes in temperature and humidity with effects on cocoa phenology and production.

a) b) c) d)

Figure 1. Induction of vegetative tissue (shoots) as a reaction of cocoa trees to de-copping pruning

Regarding the effect of pruning on fruiting, Tables 5 and 6 show the average number of chilillos per tree, referred to as young fruits less than two months old, and the production of cobs or developed fruits per tree, during the period from September 2019 to March 2020. In general, pruned trees showed higher fruiting compared to the control.

It is important to note that even though decoupling pruning considerably reduces the productive area of the trees, the productive capacity of these trees exceeded the response of the control treatment. In pruned trees, an average of 8.51 chilillos and 2.74 healthy cobs per plant were quantified, while in the control, the values reached were 4.2 chilillos and 0.83 cobs per tree, respectively.

An additional important effect is the reduction in the incidence of diseased fruits due to moniliasis as an effect of pruning. The average number of infected chilillos by moniliasis in pruned trees was 0.32, while in the control, an average of 2.7 infected chilillos was quantified, which is equivalent to a reduction of the disease by 88.14 %. In the case of developed fruit, a similar tendency was observed; in the control, an average of 2.16 diseased fruit per tree was quantified, while in the pruned trees only 0.02 was quantified, equivalent to a 99.02% reduction of the disease. One of the effects of pruning is to favor better aeration and greater air circulation in the plantation, which reduces humidity or prevents its accumulation, thus counteracting the microclimate that favors conditions for M. roreri to grow (Ramirez, 2008, Ochoa-Fonseca, et al., 2017).

Table 5

Mean number of healthy and diseased chilillos (fruit less than 2 months old) per tree in pruned and control treatments

Months	Healthy chilillos				Infected chilillos			
	Pruned	Control	F-value	Probability > F	Pruned	Control	F-value	Probability > F
Sep 2019	1.74	2.79	35.9	0	1.31	3.17	26.9	0
Oct	1.99	7.69	80.5	0	0.3	4.7	191.1	0
Nov	7.90	8.64	0.51	0.474	0.22	8.9	280.4	0
Dec	12.17	4.45	26.7	0	0.19	0.94	4.96	0.027
Jan 2020	18.90	2.94	77.2	0	0.07	0.43	5.24	0.023
Feb	11.30	2.17	60.3	0	0.12	0.34	3.01	0.084
Mar	5.57	0.6	84.9	0	0.02	0.13	3.39	0.067
Average	8.51	4.2			0.32	2.7		

Table 6

Average number of healthy and infected cobs per tree in pruned and control treatments

Months	Healthy cobs				Infected cobs			
	Pruned	Control	F-value	Probability > F	Pruned	Control	F-value	Probability > F
Sep 2019	0.05	0.14	1.966	0.162	0.04	1.04	29.66	0
Oct	0.4	0.6	2.223	0.138	0.06	1.23	26.71	0
Nov	1.35	0.71	4.937	0.027	0	6.09	190.6	0
Dec	1.17	1.38	0.365	0.546	0.07	3.47	56.95	0
Jan 2020	1.81	1.08	3.433	0.065	0	0.61	16.03	0
Feb	7.8	1.3	63.419	0	0	2.01	31.97	0
Mar	6.6	0.61	83.065	0	0	0.67	13.17	0
Average	2.74	0.83			0.02	2.16		

Figure 2 shows the effects of pruning in pruned trees on the induction of flowering and fruiting.

Figure 2. Effects of topping pruning on flowering and fruiting induction in treated trees

Given the importance of cocoa and the value of the cocoa-chocolate chain, the production and profitability of the crop are of great importance, especially for small producers. Previous experiences related to plantation management (Enriquez, 1985; Quiroz & Amores, 2002) indicate that the productive life of a plantation from an economic point of view is between 20 and 25 years. At this stage, the trees are generally very tall, many of them have died or are decayed or infected, and there is excessive shading (Assiri et al., 2009; Niether et al., 2018). In addition, diseases such as black rot (*Phytophthora* spp.) and Moniliasis (*Moniliophthora* roreri) have accumulated their effects as evidenced by the damage in various parts of the tree and the damage caused to crops (Ramirez, 2008). In general, yields are low, so to restore production it is necessary to renew the plantation.

However, in addition to the technical implications, renovation presents economic, social, and cultural repercussions (Bourgoing et al., 2009; Assiri et al., 2009; Assiri et al., 2016; Santos et al., 2016; Ogunlade et al., 2017). There is a general perception of grower opposition to changing traditional management systems and renewing the old plantation. In addition, the financial aspect occupies an important place, since it is common that the producer does not have the resources to finance the costs of plantation renovation. In addition, future income will depend on the size of the farm, the recovery of the plantation and the yields to be achieved after the intervention.

Two strategies can be used to renovate an old cocoa plantation: the first consists of cutting the old trees and planting a new plantation, which makes it possible to change the tree population, the planting design, and the genetics of the cultivated material. Generally, this is observed in countries where cocoa is grown on large extensions; renovation consists of the felling of the old plantation, followed by replanting with improved material.

For producers who have small extensions of crops, as is the case of Mexico and most Latin American producing countries, the strategy is to take advantage of the existing plantation and through management change or rejuvenate the aerial structure of the trees. In this sense, to rejuvenate old trees, pruning becomes a crucial practice through which the aerial structure is changed, the height of the trees is reduced and above all the productive tissue is renewed, which leads the plant to a greater photosynthetic activity and, therefore, a better production (De Almeida & Valle, 2007; DaMatta, 2007). From the social point of view, the technique is adaptable to the conditions of each producer, and a plan can be established to partially renew, for example, a determined number of plant rows, in a staggered manner, according to the producer's available resources.

Pruning as a management practice for adult cocoa trees has effects on plant phenology as well as on some yield components. Previous research has shown that, for optimal production, it is necessary to apply proper tree

management to maintain an appropriate canopy and height (Enriquez, 1985; Quiroz & Amores, 2002; Ramirez et al., 2009; Arvelo, 2017; Govindaraj & Jancirani, 2017; Gutierrez-Brito, Leiva-Rojas & Ramirez-Pisco, 2019).

On the other hand, pruning opens the possibility of incorporating other technological components such as sanitary management and fertilization (Quiroz & Amores, 2002; Ramírez et al., 2011; López et al., 2015). To increase the population of cocoa trees, Enriquez (1985), Adegbola (1988), and Moreira (1994) suggest sowing plants after pruning to increase the density by modifying the planting pattern or arrangement. Also, the shoots or "suckers" that are induced at the base of pruned trunks by pruning can be used to obtain new plants, which may or may not be grafted with improved material (Enriquez, 1985; Napitulu & Pamin, 1994; Moreira, 1995; Ramirez et al., 2009; Quiroz & Amores, 2002; Adebiyi & Okunlola, 2013; Arvelo et al., 2017).

Regardless of the renovation strategy chosen by the producer, pruning old trees will be an essential activity, and its application will depend to a large extent on the size of the farm, the condition of the trees, and the available resources. The results presented show that regardless of the quantity, intensity, and proportion of trees to be pruned, the incorporation of technology such as the use of chainsaws results in more efficient work in time and lower cost.

CONCLUSIONS

The pruning of old cocoa trees with a chainsaw was more efficient in terms of yield, time, and lower cost than traditional pruning using a machete as a cutting tool.

Pruning induces in a short time the formation of vegetative and reproductive tissue in the plants, which is manifested in the emission of new shoots in the upper part and at the base of the trunks, and there is a greater flowering and fruiting per tree. Pruning also induces a considerable reduction in the incidence of moniliasis-infected fruit.

The technique of decoupling pruning by incorporating the use of a chainsaw presents an adaptable alternative for small producers due to the reduction in costs, less labor, and greater time efficiency.

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Inclusion and Schooling Process for Haitian Migrant Children in Tapachula, Chiapas

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— Abstract—

The objective of this article is to describe how the inclusion and schooling process of Haitian migrant children is carried out in primary schools in the city of Tapachula, Chiapas, as part of the agreement established between ACNUR and the state government. Of Chiapas in 2020 "all children to school, for the right to education of refugee children" Through the ethnographic method, the discourse and practice in daily school life are compared so that the research findings and reflections disrupt the structural, cultural, social, and economic barriers that migrant children go through in their school inclusion. Finally, the pedagogical challenges to be assumed to improve social conditions regarding the school inclusion of migrant children are exposed.

Keywords:

Education; migration; childhood; Tapachula.

In recent years, the southern border of Mexico has occupied a central place in the international political agenda due to the "overflow" growth of migrant groups from diverse latitudes: Central Americans, Cubans, Venezuelans, and Haitians, as well as transcontinental (Africans, Indians, Arabs,) settled as refugees since 2016. Several of them remain in this region for months due to migratory procedures, others, in the impossibility of accessing a favorable response, choose to leave the city of Tapachula through the migrant caravans, such as those that occurred on October 22, 2018, and in January 2019, an event that marked a watershed of the migratory exodus, as well as the cultural encounter that came to add more than 5 to 7 thousand people.

With this event, the unusual record of record flow of human mobility was counted by the thousands. This situation generated a series of challenges for local and international institutions of humanitarian assistance to migrants. According to data from the World International Organization (IOM, 2019), of the 300 and 500 migrants who passed through the city of Tapachula in 2019, the migratory flow increased to 1000 people a day, mostly from Honduras, Guatemala, Haiti, and Cuba. Nationalities that made up the third migrant caravan of approximately 13 people.

For 2020 and 2021, the period of greatest spread of COVID-19, the city of Tapachula registered, according to the narrative of the local press, approximately 120 thousand stranded migrants with a greater number of migrant children. Several of them were installed, fortunately, in shelters; others, sleeping outdoors or sheltered in improvised plastic (nylon) or cardboard camps; they settled in public spaces such as parks: Miguel Hidalgo and Bicentenario. The adverse humanitarian crisis complicated not only the migration procedures but also the medical care of international organizations. In this regard, it was possible to see long lines of women, children, entire families, adults, and others in wheelchairs (due to physical wear and tear) to be attended at the Olympic Stadium in Tapachula.

Faced with this harsh context of social upheaval and humanitarian crisis in the "Prison City", as migrants call Tapachula, Chiapas, the cultural encounter in the Soconusco region multiplied in unimaginable numbers, as well as the needs to be met. In 2022, while carrying out fieldwork, the fifth caravan was presented on June 6 of the same year, which was made up of approximately 15 thousand people of which it is estimated "it is made up of children and adolescents with a total of 20%" (*Save the Children*, 2022). While this happens in terms of mobility, those who remain waiting for their safe passage or to organize a new caravan, recreate forms of socialization, habits, and languages that are enriched and diversified in the area. Due to the settlement of migrant groups in outlying districts of the city, cultural encounters become visible in neighborhoods, churches, and schools.

On this last point, in educational matters, the government of the state of Chiapas and the United Nations High Commissioner for Refugees (UNHCR) agreed on January 22, 2020, to improve opportunities for access to education through the "School Access Route for Refugees and Asylum Seekers and the UN Refugee Agency" (UNHCR, 2020). With this agreement, it is expected to improve social conditions in terms of school inclusion of migrant children.

Two years after this proposal and the increase in migrant children in school spaces, the central objective of the research is to learn from school ethnography how the process of inclusion and schooling of Haitian migrant children is carried out. The following specific objectives are pursued: a) Identify through school ethnographic work the process of school inclusion that characterizes the experience of Haitian migrant children in Tapachula, Chiapas; b) Describe the participation of school actors: directors, teachers, children, family, and government organizations, around school inclusion; c) Explain the pedagogical strategies employed by teachers concerning the school inclusion of Haitian migrant children. Finally, the barriers and challenges to assume in the daily work of inclusive education in this border city in southern Mexico are presented as reflections.

The article is divided into four sections. The first presents the theoretical conceptualizations of school inclusion and its adaptation in Mexico. In addition to contextual elements of the arrival of Haitian migration to Mexico in 2018 and 2021. The second part consists of the methodological body. The third section describes the analytical concepts of the research results. Finally, the final reflections.

CONCEPTUALIZATIONS OF INCLUSIVE EDUCATION

The international context of educational policy in the field of inclusive education is located in the agreements of the "International Forum on Inclusion and Equity in Education "All Students Count" (UNESCO, 2019), there the progress and challenges of the "Education for All Project that derived from the World Conference on Special Educational Needs, held in Salamanca (Spain) in 1994", (Ainscow, 2019) were evaluated. As a result of these agreements, in 2016, UNESCO prepared the 2030 agenda action plan, which strengthens inclusive education, equity, and the environment. Highlighting the following:

> It highlights the need to address all forms of exclusion and marginalization, disparities, and inequalities in access, participation, learning processes, and outcomes. It also advocates focusing special attention on those who have been traditionally excluded from educational opportunities, such as students from

> the poorest households, ethnic and linguistic minorities, indigenous populations, and people with disabilities. (p. 11)

The commitment to inclusive education proposes that educational environments rethink their pedagogical practices, taking into account school diversity and the socio-cultural transformation of the context. According to Booth and Ainscow (2015), educational inclusion is linked to the development of "a common school for all" that encompasses the participation of all:

> This is not an aspect of education related to a certain group of students. It has to do with coherence in the improvement or innovation activities that are usually carried out in schools under a variety of initiatives so that they converge in the task of fostering learning and the participation of everyone: students and their families, staff, the management team, and other members of the community. (Booth & Ainscow, 2015, p. 24)

Educational inclusion, according to Ainscow (2019), is a process, and as such, one must learn to live with difference and diversity. The goal is to focus on identifying and removing barriers. The work includes assistance, participation, and moral responsibility of the school community to overcome the dichotomy between integration and inclusion. In this regard, Escribano and Martínez (2013) pointed out that the confrontation between integration and inclusion requires a different way of thinking about educational work, which implies rethinking concepts such as quality, quality of life, participation, equity, tolerance, and diversity, to which are added the elements of inclusion: students, parents, teachers, and school.

On the other hand, as García (2018) pointed out, in Mexico the term educational inclusion arose as a result of changes in international educational policy from 1993 to 1995 when "the National Educational Integration Project (PNIE)" was implemented, which was modified by 2002 when the National Program for Strengthening Special Education and Educational Integration (PNFEEIE) was created. In this process of conceptual redefinitions, Special Educational Needs (SEN) was changed to Barriers to Learning and Participation (BAP).

> In 2013, the SEP ordered the integration of different programs that served a diverse population (Indigenous children, migrants, children with disabilities, and children with outstanding abilities and aptitudes, among others) into a new program, the National Program for Inclusion and Educational Equity (PNIEE), which led to the disappearance of the PNFEEIE. (García, 2018, p. 50)

With these changes in educational policy, the PNIEE began to use the term inclusive education in school contexts, adapting to the needs of each institution. Therefore, the term "educational integration" was no longer used and was replaced by the term "inclusive education". Currently, special education units such as Regular Education Support Service Units (USAER) and special schools such as Multiple Attention Centers (CAM) are the ones that guide teachers in their pedagogical practice.

Although there are many conceptualizations of inclusive education, the challenge lies in practice, in daily school life, and in the way in which the agents of inclusion (teachers) give meaning to this school project. For the Anglo-Saxon world, it is expressed as inclusive education, and for the rest of the Latin American countries as "School for all". Inclusive education, therefore, is not initially about places. "It is, first and foremost, *an attitude* of profound respect for differences and commitment to the task of not making them obstacles but opportunities." (Echeita & Sandoval, 2002, p. 44)

Locally, in the case of Chiapas, the route of School Access for Refugees or Asylum Seekers, proposed by UNHCR and the government of the state of Chiapas, recognized the importance of improving access to education for migrant children. This proposal not only exposed the need to make pedagogical work more flexible but also highlighted the importance of including the participation of migrant children in the school scenario as a contextual need and new pedagogical approaches.

> The Ministry of Public Education of the state of Chiapas identified more than 600 applicants for refugee status in schools in the state. The Ministry admitted that one of the challenges is obtaining accurate data on the entry of the asylum-seeking and refugee population in Chiapas. For this reason, they hope that thanks to the presentation of the school access route, the different SEP agencies will be able to coordinate and obtain more reliable statistics. (Pierre in ACNUR, 2020)

CONTEXT: REACHING MEXICO'S SOUTHERN BORDER!

The municipality of Tapachula Chiapas, on Mexico's southern border, is a strategic internment point for migrants and refugees. Its geographic location makes it a place of origin, transit, destination, or return of migratory flows. Reaching the southern border becomes that sigh, that breath, that the immigration process grants while the process is resolved and they continue to the United States or to some other northern state of the country to find a better job. The momentary truce is just one of the many places to travel along the long route to the north of the country. In this regard, the delicate testimony presented below is the very evidence of multiple stories that accompany the

difficult journey of migrant children: "Finally, I'm not going to walk anymore! -said Shaika, a 12-year-old girl, who narrates her migratory journey:

> I arrived here 9 months ago. I don't remember the exact date, but I know it's been 9 months. I arrived in Peru in 2017 and spent 4 years there. Well, I was going to be 5 and I left in 2021 to come here (Mexico): me, my grandmother, my brother, my aunts, my uncles. There are nine in my family. We left Peru because of political and economic issues, so we came here.
>
> I went through the jungle to come to Mexico. You find all kinds of animals, it's super dangerous! There's no food and the water is super dirty, sometimes the water carries you away, and there are even demons there! There are people injured, dead, and sometimes they even kill them in front of you with a gun, they rape people in front of you, and if people don't bring money or something of value, they rape the daughter, the mother, and if the father tries to interfere they kill him or any family member who gets in the way. Someone tried to rape me [...] (she lowers her head and starts crying).
>
> I walked for two weeks without water and food. You walk whenever you can, but you can't sit for too long because it's dangerous. You have to cross rivers, but not by walking, it is between the rocks, and if you fall, the water takes you. I could no longer breathe from walking, I asked my mom to stay there, I felt like my heart was going to stop from a scare, I could not breathe at all. When I arrived in Costa Rica I was hospitalized because my breathing was very bad and I had a heart problem.
>
> The passage through Central America was on foot and in buses, when we arrived in Guatemala it was nighttime, and some gentlemen checked us, they lifted our clothes to see what we were carrying, and quickly let us walk and hide because the immigration agents and thieves were coming from all sides. Then we took one of those boats from the Guatemalan side [referring to the rafts] and with that we crossed. (Shaika, personal communication, June 16, 2022).

The multiple life narratives expressed by women of all ages, girls, adolescents, and adults, emphasized the vulnerability they experience as they are exposed to assaults, rape, harassment, as well as crime and persecution by police officers. As Shaika said: "-The road has to go on and leave behind what you can; what you can't try to forget along the way". The abundant jungle that extends between the Colombia-Panama border, better known as the Darien Gap, is also an area of increased insecurity for them. At this intersection, three more adolescents claimed to have been raped.

According to Coulange (2018), contextualizing the Haitian migratory exodus responds to a process of structural crisis that is situated in the mid-twentieth century. In this period, the migration of Haitians was specifically to Caribbean countries: the Dominican Republic and Cuba, where the

economic investment by the United States went to the sugar mills that attracted cheap labor. In the case of South America, Montoya and Sandoval (2018), Coulange (2016, 2018), and Vargas (2021) agree that the increase in this migration was due to the 2010 earthquake, as well as the cholera epidemic that broke out in the same year and Hurricane Matthew in 2016. Thus, the combination of natural catastrophes and epidemics further damaged the already crumbling social fabric of the Haitian people. In the face of such a humanitarian crisis "the U.S. government relaxed its immigration policy towards Haitians, granting *Temporary Protected Status*" (Coulange & Castillo, 2020, p. 5) countries like Chile, Brazil, and Mexico did the same.

The 2014 World Cup celebrations and the 2016 Olympics in Brazil increased the labor supply and labor requirements for the construction of stadiums, buildings, factories, and stores. This situation expanded the work opportunities for Haitians. Several of them established since 2010 were able to maintain a stable life for a certain period. However, at the end of the international events, the employment situation changed radically. Unemployment began to fracture tempers, as well as the migrants' economy. In this regard, Coulange (2020) noted:

> Haitians settled in this country found themselves in a socio-labor context marked by the disappearance of thousands of jobs and recurrent socio-political turbulence. Faced with this situation, they began to look for new migratory alternatives in the region - redirecting mainly to Chile - and outside of it. (p. 5)

Regarding the Haitian migratory exodus in the case of Mexico, Vargas (2021) identified 4 processes that make up the flow of this migration, specifically to the border city of Tijuana:

a) The 2016 exodus, mostly Haitians from South American countries
b) That of 2018 and 2019, through the migratory phenomenon "ant group"
c) The worsening of the social situation and the demonstrations and migrant caravans
d) The COVID -19 pandemic. (p. 31)

In this vein, the work of Stephanie Brewer, Lesly Tejada, and Maureen Meyer (2022) for the Washington Office on Latin America WOLA,[1] States:

1 WOLA is a leading research and advocacy organization promoting human rights in the Americas. Our vision is to achieve a continent in which public policies protect human rights and recognize human dignity, and where justice prevails over violence.

> In 2021, Mexico received a record of 130.627 asylum applications, more than 100 times the number received just eight years ago, in 2013. The top three nationalities seeking asylum in Mexico in 2021 were people from Haiti, Honduras, and Cuba. The number of Haitian applicants increased the most from 2020 to 2021, from 5.917 to 51.337. (p. 7)

Perhaps, a curious and interesting fact to add that gives another reading of the "boom" of the Haitian presence in southern Mexico, is the one pointed out by Vargas (2022), who identified that many of the Haitians entering the country through Tapachula, the majority self-assigned as Congolese, suppose that the Haitians proceeded in this way to expedite their passage through Mexico heading north, in such a way that "the increase in Haitians in that border city went from 12 registered in January 2016 to 2,048 in August 2016" (Vargas, 2022, p. 33).

According to the various conversations that took place in the field between Haitian men and women aged 30 and over, they pointed out that the migratory route has two courses: from Haiti to Brazil, then Chile, Venezuela, Colombia, Central America, Mexico (Tapachula southern border and Tijuana northern border), or from Haiti to Chile, then Chile to Peru, Peru-Ecuador-Colombia-Panama-Costa Rica-Nicaragua-Honduras-Guatemala-Mexico, a journey of approximately 10 countries, as can be seen in Figure 1.

Figure 1. Migration path map. Source: Own elaboration

After the assassination of President Jovenel Moïse in Haiti on July 7, 2021, things became even more complicated. This allowed criminal groups to take over the country, leaving out any possibility of remaining and closing for many the option of returning. In this regard, Icenice, a 37year-old Haitian woman, said:

> I left Haiti at the age of 19 before the earthquake. Imagine now, killing our president! Even us. What are we going to do? We have to look for a future. For now, I'm calm here. (Icenice, personal communication, June 18, 2022)

By contextualizing the Haitian migratory exodus, the place of destination becomes relevant. In this logic, Soconusco, specifically the border city of Tapachula, has a historical knowledge of the cultural diversity, past and present, of immigrants from Europe, Asia, and North America, such as Germans, English, French, Italians, Canadians, Americans, Japanese, and Chinese, who entered the country at the end of the 19th century. Some cultural traits remain in force locally, as is the case of the German, Chinese, and Japanese ancestors.

Regarding the Central American migration[2] that defines the cultural mosaic of this region by historical relations before and after the border delimitations (1824), it can be said that its persistent economic and cultural connection represents a scenario of multiple cultural, social, and economic relations. In this encounter of cultural diversity, the 'multinational' identity of Soconusco resignifies itself in the social space and the urban landscape, where recognition and denial of 'some' identities against 'others' by phenotypic, linguistic, cultural, and economic criteria, wrapped in discourses and stereotypes, as happens with Haitians.

METHODOLOGY

From the simultaneous tensions generated by the settlement of new cultures in the city of Tapachula and nearby towns, racist and xenophobic speeches were evidenced in the local press representing the vox populi. Part of this sociocultural impact manifested itself in a short time, especially in primary schools, which saw a strong presence in Haitian childhood. This situation

2 See Manuel Ángel Castillo and Mónica Toussaint (2015), en la frontera sur de México: orígenes y desarrollo de la migración centroamericana.

Martha Luz Rojas – Wiesner (2018), remontar fronteras para trabajar en el sur de México: el caso de adolescentes de Guatemala en Tapachula. Both studies address the processes of change of migration from a long-term socio-historical period and its complexities that are experienced in the daily life of migrant youth.

aroused my interest in approaching, a study of the school ethnography of Mercado (1997), on classroom spaces, and pedagogical contexts.

The methodology of this research is of qualitative approach and interpretative method, it is located within the cultural or interpretative anthropology of Geertz (1973). As it is an investigation that starts from the educational inclusion in the school context of the experiences of Haitian migrant children and youth in the city of Tapachula Chiapas, it was approached from the perspective of educational[3] Anthropology or school ethnography. According to Wolcott (1999):

> Most so-called school ethnography is really a quick description (not to be confused with "dense description"), the purpose of which is to reveal weaknesses, point out needs, or pave the way for change and reform. At best, this is a utilitarian, pragmatic, *ad hoc* ethnography (p. 142).

In the ethnographic exploration that was used in the fieldwork, as Rockwell (2018) pointed out, it was considered important to attend school as a result of a permanent social construction where "life in schools responds to an active, creative process, linked to the changing character of the cultural order" (p. 36). Thus, the approach was to the school culture, the space, and the academic community, mediated by the interpretation of their relationships and conceptions of educational work.

In this sense, the role of the educational ethnographer was assumed in the multiplicity of situations and human relationships of daily school life in the understanding that:

> One of the challenges of the educational ethnographer is to understand, from within and in specific situations, the social representations - official and unofficial, written or oral, informed or founded on public opinion - that make up the cultural fabric of schooled education. (Bertely, 2000, p. 34)

Regarding field research, the analysis was based on a school ethnography study (participant observation, open interviews, case follow-up), between April and June in open interviews with managers, teachers, parents, Haitian children, and representatives of international organizations. A total of 40 people were interviewed: 10 Haitian children in an age range of 6 to 12 years, including 6 girls and 4 boys; 4 mothers; 2 fathers; 15 teachers; 5 managers; 2 USAER teachers; and 2 USAER interns.

3 George Spindler, together with his wife Louise, founded at Stanford University the studies in the Anthropology of Education (1982).

The research work was carried out in basic education schools at the primary level that met the selection criteria: located on the outskirts of the city, in shelters for migrants and asylum seekers, in migratory instances, as well as in areas where the settlement of the migrant population has been registered.

The study focused on learning about daily school life from educational experiences, as suggested by Rockwell (2018) and Mercado (1997). This proximity made it possible to understand the school process as "a complex plot in which historical traditions, regional variations, political, administrative, and bureaucratic decisions interact" (Mercado, 1997, p. 16), all these situations act as a set of institutionalized relationships and practices, which connected in a school political system, help to understand how teaching and educational inclusion is organized.

In this sense, understanding the daily reality of the educational experience lived by migrant children involved approaching the knowledge, values, and ways of assuming social relationships and integrating. In this way, distinguishing the internal order of the school in its formal (official) curriculum, beyond the school rules, allowed observing from its operation the way of doing "school inclusion practice", or at least, what is understood about it (hidden curriculum). Therefore, below is an overview of the structural (institutional) didactic and pedagogical barriers, which were identified by what the school inclusion of migrant children has gone through in daily school life and the socio-educational context in the Tapachulteco scenario.

Institutional barrier. School inclusion in Tapachula between discourses and practices

On the field trip I took in March as part of the research diagnosis, I visited 10 elementary schools. According to the delimitation of the object of study, I focused on 2 institutions, the Venustiano Carranza School and the Primero de Mayo Primary School, located in the center and periphery of the city. The criterion for delimiting the object of the research was based on the greater number of Haitian children in school spaces. During those visits, I engaged in open conversations with managers. In them, I identified how one of the main barriers that Haitian families face in the process of registering their children is the institutional one. It was argued that this admission generates problems in the increases or decreases in enrollment:

> They are asked to present the age of the child and their academic level, if they do not know it, they take a grade evaluation according to their age. As they are a floating population, sometimes children come, register, stay a month or sometimes less than a month, and leave, I have that space occupied because a child cannot be discharged if a parent does not request it. The father of the family leaves and says goodbye! (Executive, personal communication, April 27, 2022)

As for the problem that enrollment and discharges imply for managers, this situation is handled as an administrative burden. According to them, this generates more work for them and they consider it a lost space for the national child. An interesting fact of the observation was to identify that in front of the school is the neighborhood "La Flora" (set of departments), where 60% of the families that inhabit it are Haitians. Despite that, no Haitian girls or boys are registered in this school year.

> They are not denied the right to education, but they need to meet the registration requirements, because then the problem is for me. After all, the documentation does not match, and of course, if there is a place, they are welcome. (Executive, personal communication, April 28, 2022)

The institutional rejection as a structural barrier faced by Haitian parents and children is evidence of the intolerance of cultural diversity present in Tapachula. Racism and xenophobia in the school context are rooted in the institutional monoculturalism that managers and teachers develop according to their unique ways of understanding school culture and identities, which is very accentuated in the locality. In such a way, the stereotypes on which the judgment of what is acceptable is based, permeate sectarian, racist, exclusive, and xenophobic criteria, by an institutional racism that is understood as a discriminatory service "through involuntary prejudice, ignorance, thoughtlessness, and racist stereotypes, which disadvantages people belonging to ethnic minorities" (Booth & Ainscow, 2011, p. 47).

In addition to the limitation of school registration that occurs in some institutions, if the girl or boy is accepted, she is assigned to the evening shift. Of the 10 schools observed, only 2 accepted Haitian children in both shifts. They argue that the morning shift is occupied faster, therefore, the remaining spaces are for the afternoon shift. The allocation, for the most part, is to children from countries such as Guatemala, Salvador, Honduras, and Haiti, along with those of special attention.

> Here we have always been inclusive, I do not know if because it is an afternoon shift, we accept all students, and we do not put obstacles. We always accept all migrants. (Executive, personal communication, June 6, 2022)

On the other hand, it is necessary to point out the existence of schools that admit Haitian children and make the requirements and study shifts more flexible. In conversations with managers, I was able to corroborate that the treatment of parents and children in general consists of guiding, understanding, and helping. As an example, in May 2022 the fifth caravan of the year was organized, and many Haitian parents presented themselves to the school to

formally dismiss their daughter or son. Teachers and managers, on the other hand, guided the dismissal process:

> I remove them from SAECH [Educational Administration System of Chiapas], I give them sheets like these [grades, their dissmisal], say thank you! and they leave. With that document, they are unenrolled wherever they go, wherever they go. So, they go to a school and they are easily enrolled because, with the student number they can already access the educational system of another state, and the data of the child and the father appear (Director, personal communication, April 28, 2022)

Schools that consider the right of children and their access to school in the morning shift, ask as the only identity document the passport to register, as well as the grade location, so that, through a diagnostic evaluation, they enroll the child:

> We know that they do not even bring a birth certificate, let alone an educational document from home. So, only the official document is the passport that we ask them for. We have never discriminated against children, here everyone integrates into everything: in physical education, working in teams, working in pairs, and participating in the classroom; here we have Haitian children from first to sixth grade. (Executive, personal communication, April 27, 2022)

The complex educational reality of the Chiapas context in southern Mexico confronts the discourse of educational inclusion with practice. In this process, there is still a lack of awareness of children's rights to free access to education and of a protocol that allows for inclusive education. Although most managers "assume" to be inclusive, few favor administrative procedures. In my opinion, these limitations of an institutional political nature clearly fit with one of the 4 major dimensions of the barriers that Haitian children cross: structural, cultural, social, and economic. I highlight the structural one as part of the institutional requirements.

I must point out that to do the interviews and have access to the school space, 2 managers of the 10 interviewees made a series of administrative excuses for the observations such as presenting an institutional letter, consulting with their teachers, making known the objective of the work and then waiting for their permission. Finally, they agreed to the observations and talks, except for a principal who always said she was busy with administrative matters due to the end of the year.

It is then recognized that the institutional barrier is the first element that hinders access to education from the moment certain administrative limitations are put in place, as well as access to a certain shift or not.

According to Booth and Ainscow (2011), this situation is part of institutional discrimination that revolves around perceptions of cultures, so many times the answers given are negative. These identified points are:

a) Lack of access, no space.
b) Identification documents, often from an academic institution.
c) If accepted, the evening shift is granted.
d) They are integrated, not included.

Figure 2. Cultural diversity in the classroom

Figure 3. Haitian children, another school reality

Language barrier. The myth in the daily school life of Haitian children

According to the explanations that teachers made to the group about the presence of Haitian children in school spaces, they pointed out that, in the period from September 2021 to February 2022, the basic education schools in Tapachula, Chiapas registered significant numbers of migrant children, several had a total of 26, 18, and 15 girls and boys enrolled. From March to June 2022, school dropouts increased due to migrant caravans. Many families enlisted to reach cities like Monterrey and Tijuana. From then on, the population of Haitian children in schools was 3 to 5 Haitian children.

Regarding the presence of Haitian children in the school context, the teaching staff spoke about the uncertainty that the admission presented for them:

> When they told me that they would give me three Haitian children, I was like "-Hey!, and now, what do I do?". I imagined that they did not speak Spanish, and my surprise was that one did speak Spanish and the other two did nothing, I did not understand them, only with signs, I felt like a deaf mute, and when the child began to read, the mother thanked me. I thought they weren't going to learn anything, so I said, "—no, let's see what I can do." I remember that on one occasion I started writing vowels and consonants and joining words, I saw

> that they liked that activity. The next day, he asked me to put words together and he wanted to do that activity every day because he was learning (Teacher, personal communication, May 6, 2022)

With the arrival of Haitian children, many myths that accompanied their presence were founded on a social imaginary in the Tapachula society by the local yellow press. At first, it was thought that they would be carriers of disease and cultural contamination. At school, the main barrier that was considered was linguistics, as a consequence, there would be a misunderstanding of school contents. This myth, as we shall see, faded in practice:

> At first, I felt uncertain, because I said: "—how am I going to work with this child if he is not going to understand me or I am not going to understand him? It comes with another language, it's going to be a little bit difficult. I was surprised that the child speaks Spanish and we put the educational situation into practice, perhaps with some difficulties, because they bring another learning style (Teacher, personal communication, May 6, 2022)

Although Haitian children were considered non-Spanish speakers, it should be noted that most of them come from South American countries (Chile, Peru, Bolivia, Dominican Republic). From the large migratory flows that have occurred for years in Haiti, many couples and pregnant women come to have their children in these countries. That is, most are Spanish speakers. Thus, the children are Chilean, Peruvian, and Brazilian, while the parents are Haitian. In such a way, that schools are composed of Chilean-Haitian, Peruvian-Haitian, and Brazilian-Haitian children, we then speak of multinational families (Fernández, 2022). Some more come from Brazil, and although they speak Portuguese they understand Spanish, a smaller population comes from Haiti.

Regarding pedagogical practice, the teaching staff, for the most part, resorts to a pedagogy by association (Bandura) to strengthen meaningful learning and thus encourage communication in the classroom. They consider that focusing on the socialization of children is the priority. They argue that children need to strengthen the affective part after going through long migratory processes, in addition to the fact that due to the classroom contextual need, they cannot be taught other content without first taking into consideration school needs.

> I see that for migrant children, school serves them beyond learning topics, it is more in coexistence, in the socio-cultural question. They come to socialize with the children at our school. We do not advance in topics, I see general topics, and they sometimes understand me and sometimes they don't, because in

> communication we do not call things the same way, it is very difficult to refer to something. (Teacher, personal communication, April 17, 2022)

Despite this limitation that responds to cultural regionalisms, Haitian children show an enormous commitment to school activities. They bring the school activities done, they wear the school uniform, and bring supplies and breakfast. The teaching staff points out as necessary to strengthen the sociocultural learning (Lev Vygotsky) of children as a priority, so recreational activities such as physical education, art, and culture, allow them to develop those skills.

> I was surprised Jean because he spoke Spanish very well! He had good fluency, he was trying to tell me the indication or something. It was a pretty pleasant experience working with them, they were very smart guys, especially in sports, the teacher told me: "They are very skilled! How they run!" They are very good runners and fast workers, they are very smart!, I was fortunate to meet very smart children (Teacher, personal communication, May 12, 2022).

Although in theory, the presence of Haitian children represented a linguistic challenge for the teaching staff, in school life, this apparent barrier was overcome in pedagogical practice. The significant number of Spanish-speaking children, who came from Chile and Peru, favored the internal dynamics of the classroom with companionship. Between them, they translated the activities and instructions into *Creole* and then presented them in Spanish. In this sense, the linguistic exchange was recurrent.

The same was true for Haitian parents who came to the school for the first time to enroll their children. The managers used one of their Haitian students as an interpreter.

> Fortunately, like these children, others speak Spanish well. We had a girl here who spoke four languages and served as a translator for both the other children and their parents (Director, personal communication, June 6, 2022).

It is interesting to identify that this role of the interpreter on the part of Haitian children was not only characteristic of school spaces but also served the parents in their migratory procedures at the National Migration Institute, as well as at COMAR and UNHCR since many of them speak only Creole, some Portuguese and very little Spanish, their children support them in their migratory processes as translators.

Regarding the academic performance of the Haitian children, the recognition of their language skills and competencies by teachers and managers was positive. It is noteworthy that the good results in their school activities were specifically attributed to the children coming from Chile.

On the other hand, at the crossroads of situations and pedagogical perspectives that led to an understanding of daily school life, several teachers pointed out that they have no training in the inclusive education approach. What little they know comes from the support that international organizations such as *Save the Children* and UNHCR provides them with school furniture and training for parents.

In the schools, the teachers who make up the various Regular Education Support Service Units (USAER) train teachers in the new pedagogical approaches. Regarding the process of building the foundations for educational inclusion, they pointed out that the first barrier they encounter is their peers:

> We, as USAER, have had the first challenge with the teaching staff. It's been several years in our USAER number 28. Despite this, there are still barriers with the teaching staff, we are in our infancy when it comes to educational integration. Yes, there are the children, but they just enroll them, even though this issue has been going on for years, the teaching staff is not 100% involved, at first glance we have this problem, but it is the lack of knowledge and awareness of the staff involved. (USAER teacher, personal communication, June 8, 2022).

The theoretical ignorance is visible in practice since many of the activities are reduced to a simulated pedagogy, pretending to teach and fulfill the institutional objectives by resorting to entertainment:

> In the classroom, the teacher only asks to borrow something to entertain the child. They are not tailoring the activities to him. That is not inclusion, but entertainment (USAER teacher, personal communication, June 8, 2022).

On the other hand, there is resistance to change; it is assumed that educational inclusion is the exclusive responsibility of USAER teachers so this thinking obstructs in practice the implementation of new strategies, which is why teachers perceive it as an overload of activities.

> I had to deal with schools that did not accept me because I was an inclusive education teacher, to give practice, because they felt that it was more work for a child to have a disability or speak another language. They have the idea that the student is USAER's responsibility, e.g., “he is not my student, he is USAER's”; there is a label. That inclusion is nothing more than enrolling them in school, but they do not work with him; it is integration. There is no school content to learn, just the basic words. (Bachelor's Degree in Educational Inclusion student, personal communication, June 8, 2022).

Indeed, the pedagogical gap that exists between educational policy discourse and teaching practice is very distant in terms of educational inclusion. This ignorance of the real to the practical is installed in whether the teacher conceives the pedagogical task and cultural diversity. In this sense, it is assumed that teaching knowledge is another of the barriers that must be faced in daily school life on the southern border of Mexico, where a traditional pedagogy with serious theoretical and didactic gaps stands out.

Pedagogical barriers: teachers' knowledge and inclusive schools

Even though the daily life of basic education in Tapachula takes place in a diverse classroom with children from Guatemala, Honduras, Salvador, and Nicaragua as regular children, this situation has not implied the development of an inclusive pedagogy or inclusive classroom projects (Ainscow, 2001).

The multiple conversations that took place with the teaching staff focused on learning about the strengths and weaknesses including the self-reflection of teaching knowledge and pedagogical work, better known as SWOT.[4] In this regard, they pointed out that despite the challenge they faced in dealing with the school reality of migrant children, much of their uncertainty stemmed from a lack of teacher training on the part of the SEP.

> The government has not prepared us for 10 years; no courses, no training of any kind. They don't give diplomas, and it's like a broken telephone: “Go take it”, and if someone sends it to me, they send it to me until it reaches the schools. The magisterium is not prepared, we face it as best we can. (Teacher, personal communication, April 17, 2022)

The lack of teacher training in terms of courses, methodologies, pedagogical approaches, and didactics by the Ministry of Public Education (SEP) contributes to the increase in the backwardness of the country's schools. According to INEGI data in 2019, it was found at the national level that “30 million people in an age range of 15 years or more do not reach the basic educational level” (INEGI, 2019). Currently, this situation drastically increased the out-of-school population three times over, further aggravating the education crisis and the national project (CONEVAL, 2020).

4 These acronyms derive from the term SWOT (strengths, weaknesses, opportunities, threats); a business methodology applied to understand the real situation of a company, institution, or project, based on recognizing the Strengths, Weaknesses, Opportunities, Threats, (SWOT), also applied to the school context.

The reinstatement of teachers in schools as part of the hybrid educational model in the post-pandemic period established a working schedule of Monday through Thursday from 8 a.m. to 12 p.m. for the morning shift and from 2 to 5 p.m. for the evening shift. Fridays were set aside exclusively for teachers' meetings. Even so, labor absences were visible, so the situation is still adverse for children's education, which takes place in an unequal environment, coupled with internal union struggles that hinder any educational proposal that does not fit with their interests and political goals.

Thus, much of the teaching knowledge is based on traditional pedagogy, which makes the work with diversity distant, with routine activities. Few were the teachers who resorted to the approach of a constructivist or critical pedagogy that adheres to the guidelines of the humanistic school as part of the current educational approach (SEP, 2017). Although teachers are making an effort to cope with the situation, they assume that the primary challenge of classroom needs is based on self-questioning and the commitment to make collaborative learning effective, in addition to including ICT and new pedagogies that incorporate a focus on gender, equity, inclusive language, and inclusive education.

By referring to teaching knowledge as a cultural and institutional barrier, it implies a social knowledge that is collectively constructed and shared with teachers and students in the same social space: the school. This space, being traversed by methods, techniques, programs, and rules, that is, the *curriculum*, implies as a critical and autonomous exercise the reflection of pedagogical practice. In this regard, according to Tardif (2014), that same social space of the school, in its encounters, negotiations, and sharing of experiences, teaching knowledge makes sense among what is known and unknown, as well as what has to be learned:

> What a teacher knows also depends on what he does not know, on what he is not supposed to know, on what others know in his place and on his behalf, on the knowledge that others oppose or attribute to him [...] This means that, in the trades and professions, there is no knowledge without social recognition (p. 12).

In such a way that this knowledge is exposed to changes and readjustments due to its very nature as a social construction. The school, therefore, also adds to this totality, since it is the underlying academic culture, a culture of the students within the school social community, in addition to the fact that the student's culture is the reflection of an immediate local culture closely linked to the context.

> In the meetings that we have as a school board, it has been commented that if we are going to be receiving foreign children, we should be trained or look for

> a person to talk to us about the languages, it is very broad what we have to look for in tools to be able to face this migratory phenomenon. We are totally overwhelmed by the situation. (Teacher, personal communication, May 6, 2022)

According to Gimeno Sacristán (2008), the school should promote socialization mechanisms that meet academic needs, allowing in turn "to foster the plurality of ways of living, thinking, feeling, stimulating pluralism, and cultivating the originality of individual differences as the most genuine expression of the richness of the human community and social tolerance" (p. 30). This plural knowledge of diversity is also the knowledge of social deconstruction that must be used to redefine teaching practice as it is presented:

> We should be better prepared. For me, it is a challenge to have a child from any other country, because you learn from them and also because you cannot close the door to children, since public education is for everyone. We must be better prepared to have better communication with those who come since they arrive from the conflict, and if we close the doors to them, they will practically see that our country would be the same. That's why we open our doors to them, even though there are schools that close their doors to these children. (Teacher, personal communication, May 6, 2022)

Inclusion in this environment is a process that attends to diversity in ways of learning and living with it; to a certain extent, as Giroux (1990) pointed out, "working in classrooms implies learning to live in a multitude" (p. 75), so that the person working in the classroom has a moral commitment to assist, participate, and reflect with children; otherwise, his or her teaching knowledge is based on traditional pedagogical models in a complex and changing reality such as that of southern Mexico. In this way, educational inclusion translates into a false interpretation of educational policy mediated by theoretical ignorance in practice.

FINAL THOUGHTS

Based on the above analysis, I will highlight some conclusions. It is evident that the process of educational inclusion in the southern border of Mexico, specifically in Tapachula, Chiapas, presents serious pedagogical challenges that are viewed from three sides: a) Political (contradictory regulations); b) Cultural (conceptual and attitudinal); and c) Didactic (teaching-learning). These dimensions include the structural, cultural, and social barriers faced by Haitian children, in addition to the economic barriers affecting their parents.

Although it is true that the proposal of UNHCR and the Chiapas state government, through the School Access Route for Refugees and Asylum

Seekers, has as its central objective to serve the population in mobility, the pedagogical needs must be addressed immediately, such as teacher training.

The role played by the teacher within the educational universe is essential, not only because he/she is the mediator of educational policies and the context, but also because he/she is how the curriculum makes sense in practice. This is not an argument that points to the teacher as the one directly responsible for school inclusion, but it is an agent that favors or hinders the educational proposal that inevitably makes it a support or a barrier. Teachers as social actors make up the educational universe from the pedagogical operationalization, therefore, to be sensitive to the social reality presented to them, is to put in contact the theory of school inclusion with educational practice. This political and educational commitment implies a search for solutions in the school context, by creating a pedagogical environment that responds to classroom needs, beyond a simulated pedagogy, i.e., promoting contextualized or adapted education (Wang, 2001). In this sense, the improvement of the school environment is the primary challenge of the entire educational skeleton.

The implementation of an inclusive education proposal requires other ways of thinking about pedagogy; it is necessary to redefine teaching knowledge by identifying needs, active planning, contextualized methods and strategies, curriculum flexibility, collaborative approach, and creation of school communities, as well as strengthening teacher training courses and developing a critical pedagogy within the emerging pedagogies that overcomes traditional practices, which are so deeply rooted.

In short, although the road to educational inclusion is a rough one, many of the needs identified in the demystified idea of assuming educational inclusion remain at the level of social integration; therefore, the challenge lies in assuming multiculturalism not only in the city but also in the classroom, which will provide guidelines for thinking about emerging intercultural projects and overcoming institutional monoculturalism. The proposal is underway, but multiple initiatives from the school community are needed to make it possible.

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Current Potential Distribution of el Dorado (*Coryphaena hippurus*) in the Pelagic Ecosystem of the Southeast Coast of the Mexican Pacific Ocean

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— Abstract—

Anthropogenic activities have led to accelerated global warming that is raising the average temperature of the Earth's atmosphere and oceans; the poor management of productive activities in the oceans results in environmental problems, such as overfishing and pollution, negatively affecting the distribution and population dynamics of many marine fauna species. One of the important species in the pelagic ecosystem is the Mahi-Mahi (*Coryphaena hippurus*), one of the main marine predators whose ecological function is to control the populations of herbivorous fish and thereby maintain the balance of the food web; therefore, the extinction of this fish can produce a "top-down" imbalance in the pelagic ecosystem. The present research aims, for the first time, to model the current potential distribution of Mahi-Mahi (*C. hippurus*) along the entire Mexican Pacific coast (using the Maximum Entropy algorithm or MaxEnt), based on the contrast of ecological and climatic factors with the species' records reported in scientific databases such as SNIB-CONABIO (National System of Information on Biodiversity-National Commission for the Use and Knowledge of Biodiversity) and Gbif. The results suggest that Mahi-Mahi (*C. hippurus*) is distributed along the entire Mexican Pacific coast, expanding the distribution area previously reported in the scientific literature to the north coast of the United States of America. The three variables that most contributed to explaining the potential distribution model were Maximum Temperature at Minimum Depth, Minimum Temperature at Medium Depth, and Nitrate with a Range at Maximum Depth. These results provide key information to determine the priority conservation areas (sustainable management) of Mahi-Mahi (*C. hippurus*) on the Mexican coast and the environmental variables that influence its distribution.

Keywords:

Distribution; sustainable management; modeling; fishes; geographic information systems

The ocean is the cradle of life on our planet and also represents the most extensive habitat in the biosphere. Oceans have a great biodiversity (Duarte, 2006). At a fundamental level, marine life contributes to determining the very nature of the planet, since marine organisms produce much of the oxygen we breathe (Pérez, 2020).

Anthropogenic activities have led to accelerated global warming that is raising the average temperature of the Earth's atmosphere and that of the oceans. The planet's surface temperatures are increasing at a great rate, since in the last 100 years, the global average temperature has increased by 0,76 ºC (Pérez, 2020; Agustín, 2023). In addition, the mismanagement of productive activities in the oceans has resulted in serious environmental problems, such as overfishing, uncontrolled tourism activities, and pollution; these problems have negatively affected the distribution and population dynamics of a large number of species of marine fauna, including fish (Olson & Magaña, 2002).

El Dorado (C. hippurus) is a fish considered one of the main predators of the pelagic marine ecosystem, so it is very important to control the population of herbivorous fish and maintain the balance of the food web; its extinction would hurt the local and regional trophic cascade (Verheye et al., 1998). On the other hand, this species plays an important role not only in commercial fisheries (widely consumed in Mexico) but especially in sport fishing along the entire Pacific coast in North America (CONAPESCA, 2016).

According to Palko et al. (1982), historically, this species has been distributed in tropical and subtropical waters. However, Salvadeo et al. (2020) recorded its potential distribution along the northern Pacific Ocean, from the northern United States of America to the state of Baja California Sur in Mexico, its potential distribution along the rest of the Mexican Pacific coast is currently unknown.

Therefore, the objective of the present study was to determine the current potential distribution of dorado (*C. hippurus*) in the Mexican Pacific pelagic ecosystem, using the Maximum Entropy algorithm (MaxEnt), based on the contrast of ecological and climatic factors with the records of the species reported in scientific databases such as SNIB-CONABIO (National Biodiversity Information System - National Commission for the Use and Knowledge of Biodiversity) and Gbif. (Guisan & Thuiller, 2005). This information will be key to identifying not only priority conservation areas (sustainable management), but also to identify which environmental variables influence the distribution of this species, and thus propose future sustainable management plans for commercial and sport fishing of this fish along the Mexican Pacific coast (Botsford, 1997; Fonteneau & Tellería, 2012).

METHOD

Study Area

The study area covered the entire Pacific coast of Mexico, between the coordinates of 14°33'15 "N 92°15'37 'E and 32°28'48 'N 117°06'20 "E. This coastal region is made up of eleven of the thirty-two states in the country, concentrating 46% of the municipalities in all of Mexico. Overall, the study area covered an area of 804,000 km, that is, 41% of the national territory, and has a coastline of 7,828 km of the Pacific Ocean (70% of the total Mexican coastline; López, 2018; Figure 1). Not only is 80% of Mexican fishing potential located in this area, but it also concentrates the greatest fishing activity of massive species of high commercial value, such as shrimp, oyster, sardine, lobster, anchovy, tuna, abalone, and sargassum (Poo et al., 2002).

Database of C. hippurus records and marine environmental variables

The presence records of the species were downloaded from the scientific databases SNIB-CONABIO (National Biodiversity Information System-National Commission for the Use and Knowledge of Biodiversity) (CONABIO, 2008), and Gbif (GBIF, 2022); only records with clear coordinates were used. To eliminate any errors in the modeling, the records were debugged in the Qgis software (QGIS.org, 2022), eliminating all those with doubtful or repetitive data, and those that were found over the continental area or within 500 m. At the end of this first cleaning, there were a total of 18,728 records of *C. hippurus* (obtained from 2000 to 2022). Subsequently, a second cleaning was carried out to eliminate the spatial autocorrelation, considering the size of the species' home environment, which consists of 40 km/day in horizontal movements (Merten, 2014). This process was carried out with the R-Studio software (RStudio, 2022) and the "spThin" package (Aiello et al., 2015; R Core Team, 2022). Finally, we worked with a total of 726 presences of the species.

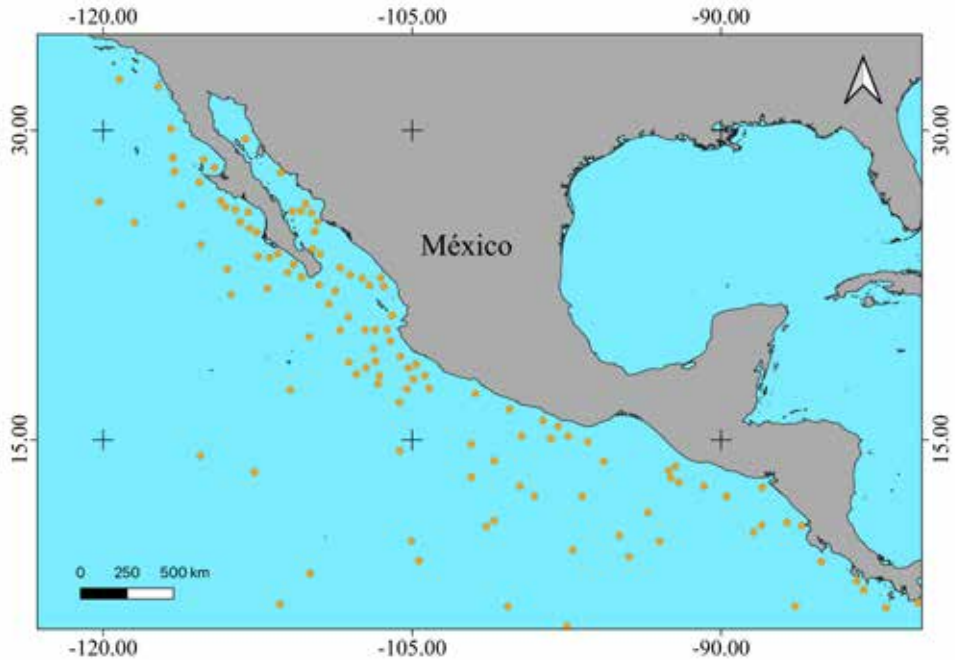

Figure 1. Records of the presence of Coryphaena hippurus on the coast of Mexico, available in scientific databases

On the other hand, 76 environmental layers (each corresponding to an environmental variable) of the marine system were obtained from the Bio-ORACLE v2.0 website (Tyberghein et al., 2012), among which some can be mentioned such as the number of nitrates, primary productivity, temperature, chlorophyll concentration, and water speed, just to name a few. These environmental layers are presented in the form of raster that provide geophysical, biotic, and environmental data for the benthic and surface marine kingdoms. They are projected with spatial resolutions of 5 arc minutes (~9 km per side) and are updated and available for download in the 2017 version. The layers were trimmed to cover the entire Mexican coastline.

Current Potential Distribution

For the current potential distribution modeling of el dorado (*C. hippurus*), the Maximum Entropy algorithm (MaxEnt) was used, which has a precise mathematical formulation, whose basic idea is to estimate (approximate) the probability of unknown distribution of a species (Phillips et al., 2006). The technique first forces the distribution model to group certain features (environmental layers) of empirical data (presence data), to choose the probability condition that satisfies these limitations (Buehler & Ungar, 2001). Thus, MaxEnt contrasts ecological and climatic factors and relates them to the occurrences (records) of the species (Guisan & Thuiller, 2005).

Once the inputs (species records and environmental layers) were ready, MaxEn was run using the default attributes for the model configuration. 10 replicates were run, and using a Jackknife analysis in the calibration stage of the model, the percentage of contribution of the rest of the uncorrelated variables was evaluated. Finally, those variables with the greatest contribution to the model and with the greatest biological contribution were selected, according to the scientific literature (Zúñiga-Flores, 2008).

The final mapping of the current potential distribution map was carried out using the QGIS software (QGIS.org, 2022), based on the result of the MaxEnt algorithm.

RESULTS

Current Potential Distribution

The model result indicated that el dorado (*C. hippurus*) is distributed along the entire Mexican Pacific coast, having a higher probability of presence (0.8862) in the areas near the coasts of the states of Sinaloa, Baja California, Baja California Sur, Nayarit, Chiapas, and the lower part of Sonora (Figure 2).

According to the model, nine environmental variables explained 80% of the probability of potential distribution of el dorado (*C. hippurus*): Maximum temperature at minimum depth, Minimum temperature at medium depth, Nitrate with a range at maximum depth, Maximum temperature at maximum depth, Maximum chlorophyll concentration at maximum depth, Water speed with a range at maximum depth, Minimum temperature at minimum depth, Temperature with a range at medium depth, and Minimum nitrate at medium depth. The three variables that contributed the most were the Maximum to Minimum Depth Temperature, the Minimum Temperature at medium depth, and Nitrate with a range at maximum depth (Table 1).

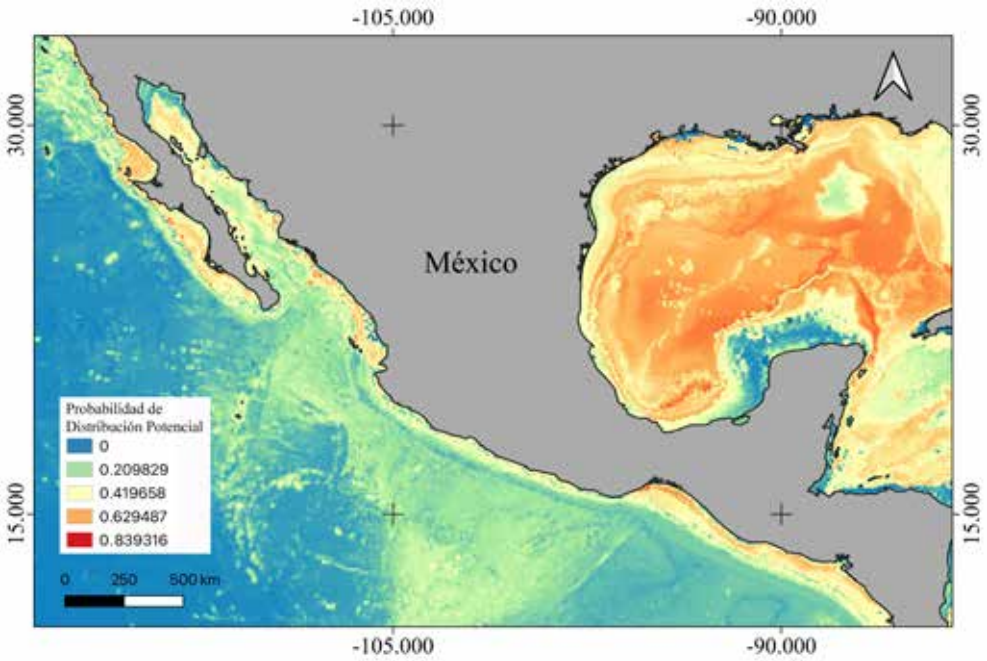

Figure 2. Current potential distribution of el dorado (Coryphaena hippurus), in the pelagic ecosystem of the Mexican Pacific coast

Table 1
Variables that helped explain the distribution model of el dorado (C. hippurus)

Variables	Percentage of contribution (%)
Maximum temperature at minimum depth	39.2
Minimum temperature at medium depth	10.4
Nitrate with a range at maximum depth	6.6
Maximum temperature at maximum depth	5.8
Maximum chlorophyll concentration at maximum depth	5.1
Water speed with a range at maximum depth	4
Minimum temperature at minimum depth	3.9
Temperature with a range to medium depth	3.6
Minimum nitrates at medium depth	3.3

DISCUSSION

The current potential distribution model makes it clear that the appropriate environmental conditions for the presence of el dorado (*C. hippurus*) are located along the entire Mexican Pacific coast, from the coast of Baja California Norte (coinciding with reports by Salvadeo et al. in 2020 in their study conducted for the coast of the United States of America) to the coast of Chiapas. Our results also coincide with the historical distribution of the

species reported by Palko et al. (1982), who stated that this species is distributed in tropical and subtropical waters, both in coastal waters and in the open sea, since the MaxEnt model indicated that there are also areas suitable for the presence of el dorado (*C. hippurus*) in open sea areas around the Revillagigedo islands and other Mexican Pacific islets.

Our results are likely explained by the fact that the abiotic (temperature, depth, nitrates) and biotic (food, mates) factors necessary for el dorado feeding and reproduction are found along the entire Mexican Pacific coast, as well as in the areas close to these islands (*C. hippurus*); that according to Jonsen et al. (2003), the distribution of organisms in the oceans is determined by complex interactions between these factors, which are essential for species fitness. Hernández (2015) stated that, on the coast of Baja California Sur, the horizontal (distance to the coast) and vertical movements of el dorado (*C. hippurus*) are related to their feeding habits and these, in turn, are influenced by oceanographic and geographic variables (thermocline-depth), moving away from the coast up to an average of 38 km and diving deeper at night to hunt their prey. In addition, Gibbs and Collete (1959) pointed out that the appropriate conditions for the presence of this fish are located in isotherms of 20 °C.

The three variables that contributed most to explaining the potential distribution pattern of el dorado (*C. hippurus*) were Maximum Temperature at Minimum Depth, Minimum Temperature at Medium Depth, and Nitrate with a Range at Maximum Depth. These variables are of great importance for the population dynamics and, therefore, for the distribution of many species of epipelagic predatory fishes, even in different parts of the world, in oceanographic regions and thermal structures similar and different from those of el dorado (*C. hippurus*), have shown a similarity in their preference for warm surface and average temperatures (Chiang et al., 2011). Clear examples of this are the blue marlin (*Makaira Nigricans*) in Hawaii, which spends much of its time in depths of no more than 10 m with warm waters ranging from 26°C to 27°C (Block et al..., 1992); or in juvenile bluefin tuna (*Thunnus thynnus*) in the western North Atlantic, which prefer to spend most of their time in waters above 15 m, with temperatures of 20 °C (Brill et al., 2002). For el dorado (*C. hippurus*), being a pelagic predator, surface and mid-depth temperatures are very important, since as pointed out by Hernández (2015), this fish moves during the day at the surface, but dives to greater depths during the night to obtain its food. However, Merten et al. (2014) explained that there is a direct relationship between abiotic factors such as temperature and the possible movements of fish prey, while Lasso and Zapata (1999) stated that pelagic fish prey such as el dorado (C. hippurus) are composed of epipelagic species, although there are also records of mesopelagic species distributed at medium depths. Zuñiga et al. (2009) and Farrel

et al. (2014) suggested that surface and mean sea temperature plays a key role in the reproductive cycle of this fish, as they point out that the reproductive activity of el dorado (*C. hippurus*) occurs in a temperature range from 21 °C to 30 °C, with maximum activity in females and reproductive males at 25 °C and above, which intensifies as the temperature rises. This is confirmed by García-Melgar (1995), who pointed out that the coast of Baja California Norte and Baja California Sur corresponds to an important breeding, refuge, and feeding area for el dorado (*C. hippurus*). Along the entire Mexican Pacific coast, average sea surface temperatures range from 19 °C to temperatures greater than 28 °C, thus possessing optimal temperatures for feeding and reproduction of this species (López, 2018).

Regarding the presence of nitrates (the third predictive variable of the potential distribution model of el dorado), it is important to note that the spatiotemporal distribution of this compound is key for food webs in the oceans, it is a basic and fundamental nutrient for the functioning of these marine ecosystems (Paparazzo et al., 2013). Nitrate is a compound that is naturally present in the environment as a consequence of the nitrogen cycle (Moreno et al., 2015); and in aquatic environments, the nitrogen uptake process is mainly exerted by phytoplankton and bacterioplankton (primary producers) in the euphotic layer, so the conversion of inorganic to organic nitrogen is one of the most relevant biogeochemical processes in the environment associated with these groups (Cabrita et al., 1999). Being a top predatory fish in its ecosystem, el dorado (*C. hippurus*) feeds mainly on herbivorous fish (Briones et al., 2017), which in turn feed on that phytoplankton, so the existence of nitrate on the Mexican Pacific coast is an excellent indicator that the food web, of which the el dorado (C. hippurus) belongs to, works well, i.e., there are not only primary producers, but the preys of el dorado (*C. hippurus*) and, therefore, is an excellent indicator of the potential distribution of this fish.

Thus, the present study determines for the first time the current potential distribution of el dorado (*C. hippurus*) on the Mexican Pacific coast, which is of great relevance not only because it is a species of great ecological importance (Varghese et al., 2003), but also because it is reserved for sport fishing in Mexico (DOF, 1995). This information will provide data to establish priority conservation areas (sustainable management) and protocols for monitoring their populations and predictive variables of their potential distribution along the Mexican coast.

CONCLUSIONS

The entire Mexican Pacific coast, from Baja California Norte to Chiapas, has suitable environmental conditions for the current potential distribution of el dorado (C. hippurus). The three variables that contributed most to explaining the potential distribution pattern of el dorado (C. hippurus) were Maximum Temperature at Minimum Depth, Minimum Temperature at Medium Depth, and Nitrate with a Range at Maximum Depth. These environmental variables are excellent indicators of suitable conditions for the feeding and reproduction of this fish and, therefore, are determinants of its potential distribution.

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Water Management and Governance in Yashanal and Tzajalchen, Tenejapa, Chiapas (2015-2020)

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— Abstract—

The use of water in Mexican towns for domestic, backyard and agricultural activities demands modern forms of governance according to the circumstances of each one. Therefore, this study analyzes the settlements of Yashanal and Tzajalchen, in the municipality of Tenejapa, Chiapas, with respect to their management of the resource coming from the spring located in the Yashana territory, sacred for the Mayan ancestors and of current community use, concretized with agreements that result in a viable structure for the beneficiaries. As noted, the differences block the distribution of the element.

Water is treated as a public good through the concepts of governance, community governance, actors and management, comparing how it is managed in the two settlements to evaluate the efficiency in the establishment of norms. The struggles between localities are analyzed, observing the behavior of public and private actors, whose decisions are complicated by the fact that they have not established rules of interaction due to cultural and organizational changes.

Keywords:

Governance; community governance; water management; Yashanal and Tzajalchen; Tenejapa; Chiapas

The use of natural resources is of interest to all societies and is an especially relevant issue in the municipalities of Chiapas. Water is essential for human survival, a promoter of development and sustainability in social, economic, and environmental ecosystems, and fundamental for health, productive activities, energy, education, and territorial projection. According to the National Water Commission ([CONAGUA], 2015):

> In Mexico, water is recognized as a strategic and national security issue, today it has become a central element of environmental policy, and even more, a key factor of social development policy and economic policy; its availability conditions the possibility of development of some regions of the country and its quality is a determining factor for the health and well-being of the population (p. 4).

The access, supply, sanitation, use, and ownership of water require adequate management and administration, which is why management involves the participation of public and private actors, both at the local and federal levels, based on the consensus of the beneficiaries. Human rights, collective management, and governance are fundamental to ensure an equitable distribution of water among indigenous peoples, practicing norms and terms. This research examines how these practices develop in the two localities, compares their organization, and how local actors engage through social and power relations between the city and particular heterogeneous practices.

This article contains four sections. The first addresses the theoretical framework of the concepts of governance and community governance, analyzing the categories raised by Naser (2021), Raw (2005), Guy and Pierre (2005), Prats (2005), Rhodes (2005), World Bank (2022), and Shiva (2007) to link the two cases and explain the interaction of public and private agencies, as well as describe the geography of Yashanal and Tzajalchen. In the second, the work methodology is presented and details the distribution possibilities obtained in the field and cabinet work. In the third, the results and discussion are presented, where the actors involved, the community rules and the functions of the resource operators are shown; and finally, in the fourth, the conclusion.

THEORETICAL FRAMEWORK

Community Governance and Governance

Local development in the Yashanal and Tzajalchen communities of the municipality of Tenejapa is analyzed through the theoretical concepts of governance and community governance. In social research, the term gover-

nance is used to express conflicts in which private, public, and social actors intervene in the management of public affairs. According to the Royal Spanish Academy ([RAE], 1992) governance is "the art or way of governing that aims to achieve lasting economic, social, and institutional development, promoting a healthy balance between the State, civil society, and the market economy" (Rae, 1992, p. 8). For Naser (2021), governance is understood as:

> The realization of relationships between various actors involved in the process of deciding, executing, and evaluating matters of public interest, a process that can be characterized by competition and cooperation where they coexist as possible rules; and that includes both formal and informal institutions (citizenship and its different mechanisms of temporary and/or spontaneous organization). The form and interaction between the various actors reflect the quality of the system and affect each of its components as well as the system as a whole (e.g. 14).

Governance means cooperation between public and private actors to deal with public affairs. It is also a social process in which authorities assume positions, interests, objectives, values, beliefs, or needs in a territory, which sometimes generates conflicts due to cultural, economic, social, and political factors. In addition, this concept applies to both public and private institutions. According to Raw (2005), the central government has lost the ability to govern and now acts as the one who authorizes interaction to resolve public affairs.

> Governance presents a complicated situation, in modern society, the government remains responsible, but, in turn, is less able to act alone. It is interesting to see that the new governance, which displaces political power much more than the new governance does, does not have much difficulty in solving these problems. In the new public management, citizens can demand accountability through channels other than traditional ones; for example, through the free choice of the consumer or stakeholders (Guy & Pierre, 2005, p. 54).

Regarding the responsibilities assigned to the government in this process, Rhodes (2005) and Prats (2005) mentioned:

> In a world where governance increasingly operates with less government involvement, where lines of authority are increasingly informal rather than formal, and where legitimacy is increasingly marked by ambiguity, citizens are increasingly able to defend themselves knowing when, where, and how to take part in collective action (Rhodes, 2005, p. 118).
>
> The key to governance is to know how to organize a deliberative public space based on procedural rules that feedback and confidence in the structure of interdependence. Today we know that no one has enough knowledge to

> unilaterally resolve complex issues. Aware of the limits of our knowledge, we know that we must interact to seek interim solutions following procedures that allow us to learn permanently and adapt to learning outcomes (Prats, 2005, p. 159).

Regarding water

This section analyzes how communities process the use of the resource, considering the degree of scarcity and the distance to the sources of the liquid. Governance appears when you try to improve the capacities of civil society through dialogue and practice of their rights, contributing to the construction, monitoring, and audit of public policies. Meaning conceptual alternatives. According to The World Bank (2022), it defined:

> Impartial and transparent management of public affairs, through the creation of a system of rules accepted as constituting legitimate authority, to promote and value matters desired by individuals and groups (p. 18).

Shiva (2007) pointed out that water management appears as a social alternative when the inhabitants become actors in the process, that is, indigenous communities, peasant organizations, neighborhood groups in urban areas or civil society, recovering community practices or abiding by rules to meet the needs of the resource without the logic of corporate governance.

Geography of Yashanal and Tzajalchen

According to the National Institute of Statistics and Geography ([INEGI], 2020), in Chiapas there were 1,459,648 people over the age of three speaking the original language; where the Tseltals make up the largest group; secondly, the Tsotsiles; in third place, the Choles; and in fourth, the Tojolabales.

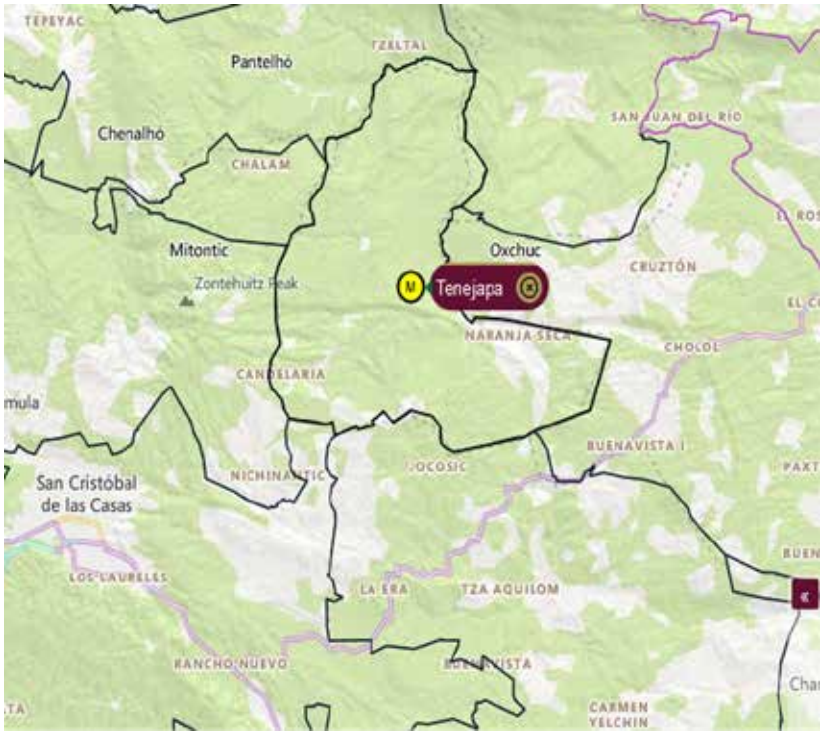
The original groups inhabit diverse biophysical environments that produce knowledge, customs, and beliefs. In this case, the main activity of the Tseltal communities is agriculture, although not as a main source of income, since seasonal wage labor is essential for the social reproduction of many families (Rodríguez, 2014, p. 92).

In Nahuatl, *Tenejapa* means "calcareous river", and in Tseltal it translates as *Tenel japal* (surrounded by mountains with a flat surface), according to the State Committee for Statistical and Geographical Information ([CEIEG], 2017).

The Population and Housing Census (2020) reported 48,162 inhabitants in the municipality; of which 51.6% are women, with 24,854; and 48.4% are men, that is 23,308. The most numerous age levels are 5 to 9 years (6,928), 0 to 4 years (6,606), and 10 to 14 years (6,403). These ranks make up 41.4% of the total.

From San Cristóbal de Las Casas you can access Tenejapa by the state road and the branches to San Juan Cancuc and Oxchuc. Radio communication covers 66 localities and rural telephony has little availability, but satellite internet antennas connect them to the world.

Yashanal and Tzajalchen are located in the municipality of Tenejapa, as shown in Figures 1, 2, and 3. The first community has 2,125 inhabitants, occupying the fifth place in population among all the communities of the municipality, and is located at an altitude of 1,737 meters. The second has 2,962 inhabitants, is the second most populous community in the ranking, and is located at 1,556 meters high (CEIEG, 2017).



Note. Chiapas State Government Chiapas Geographic Map, 2022.

Figure 1. Location of the municipality of Tenejapa, Chiapas

Note. Taken from Google Earth. https://windmap.gosur.com/es/mexico/?ll=16.825756305601118,92.453 69804636493&z=15.455495555861784&t=satellite

Figure 2. Overview of Yashanal, Tenejapa

Note. Taken from Google Earth. https://windmap.gosur.com/es/mexico/?ll=16.841364731705752,92.460 73129725983&z=15.568949024853994&t=satellite.

Figure 3. Overview of Tzajalchen, Tenejapa

Tenejapa is a traditional community where a high percentage of its inhabitants practice ancestral beliefs. As in other regions of the Chiapas Highlands, the office system plays an important role that gives prestige and social ranks.

> Some people who have risen in religious political rank are called principals, and these people continue to have almost the same social roles, but yes, each administration is looking for a new position in the City Council because of the experience they already have. Usually, this group is made up of people of reasonable age and surround themselves with the cultural context of the

inhabitants of Tenejapa. The main ones constitute the most respected, consistent, and moral hierarchy group that acts as mediators when there are internal problems in the localities (CEIEG, 2017).

The municipality of Tenejapa is located between the sub-basins of the Chakté current, in the vicinity of the Grijalva river basin and the sub-basins of the Tzaconejá and the Azul, which flow into the Lacantún riverbed (Chiapas Geographical Map, 2021), as shown in Figure 4. Its tributaries are Jomanichim, Paktetón, Majosik, Tzajalchen, Yashanal, Río Banul Kanal, Río Agua de Cal, Arrollo Suyul, Los Chorros, Río Yaxgemel, and Yochi´b (San Juan Cancuc).

Note. Taken from the State Committee for Statistical and Geographical Information [CEIEG], Government of the State of Chiapas. Regional Maps, 2022.

Figure 4. Waterbodies in Tenejapa, Chiapas

A large area of the territory is located in the Grijalva drainage sub-basin, which feeds the tributaries to the Yochi'b River, on the limits between Oxchuc and San Juan Cancuc.

There are 715 inhabitants.[1] in Yashanal and 800 in Tzajalchen. Both have schools, a health home, and churches, being the communities with the largest infrastructures in the municipality. Four councilors make up the city council. In addition, they are conservative localities that inherit land only from men.

1 Cooperante: Persona con derecho a servicios como agua y luz, apoyos municipales y servicios comunitarios.

METHODOLOGY

The perspectives of the actors were investigated through qualitative research and direct observation in the area of the spring. Through field trips, it was verified that the communities organize themselves in community assemblies to choose their representative each year.

In February and March 2022, the drinking water committees interviewed a total of 15 people. In each community, 30 questionnaires were applied. Two field trips were made: one in the Yashanal basin; and another, in Tzajalchen, where pipes were observed crossing the lands of the inhabitants. A meeting with the Partido Verde committee was also scheduled Ecologist from Mexico Tzajalchen. Key players in this community have been City Council officials, such as a young man who works at the Casa de la Cultura, who introduced us to those who could inform us about rules and mechanisms regarding water management.

The documentary research was based on the bibliographic review of academic foundations and statistical databases.

DISCUSSION AND RESULTS

Participants in water management in Yashanal and Tzajalchen and levels of governance

In the towns of the municipality of Tenejapa, community assemblies are the highest authority, made up of cooperators who act as representatives of families, usually men, although female participation is increasing. This is how decisions are made on the issues that the community considers, analyzing the ideas. Ordinary meetings are held every two months. Whoever assumes the highest hierarchy as committee president, requires prestige and years of service to the community. Those who do not continue with their studies begin community work at age 12 and stop at age 50. The tasks of the Water Committee are to manage, maintain pipelines, inform, and organize the needs of users. The community assembly delegates management responsibilities to the Education Committee and the Drinking Water, Road, and Light boards, with specific tasks in services for the cooperators, such as connections to the electricity and water network systems, opening roads, and verifying liquid leaks in the network. All positions are temporary, usually with a duration of one year; and during their management, the person does not receive a salary, it is free community work. By assuming their functions as authorities, people abandon their economic activities and spend their savings or go into debt to support their families.

For this reason, the actions of the actors of the towns from 2015 to 2020 were analyzed. This period was chosen because there was a management that in the end became a dispute between both localities and state news. Through interviews with the authorities of Yashanal and Tzajalchen, the activities in water management were known, where the main sources are, the forms of distribution and organization, and the rules of use.

In Yashanal they are organized to deal with the access and maintenance of the spring, for which they build and preserve the hydraulic works. Each locality controls the resource according to the levels of organization. With the data collected from actors over the age of 60, stories were recreated about the study area to identify those who were members of the water committees, treasurers, and some who worked in the City Council.

Regarding the range of players, the practices, interests, and commitments of those involved in water management processes were considered. In Yashanal, a former municipal president and a former construction director, now a servant at the City Council, were interviewed. In Tzajalchen, key figures were identified, such as members of the National Action Party committee and an official from the Welfare Secretariat. These actors were asked what their sources of income are when they perform community service or public office. In this way, the actions of the two settlements regarding water management were analyzed. For example, in Yashanal every May 3, the authorities hold a Mayan ceremony to thank nature for the abundance of water. Thus, the role of each player in the cult was identified, as can be seen in Figure 5. Knowing the hydraulic infrastructure, it was verified that the houses have storage tanks.

Note. Based on direct observation.

Figure 5. Participants organization in Yashanal, Tenejapa

In Tzajalchen, six traditional councilors elected by the Community Assembly represent the population. Its Water Committee is composed of a president, a secretary, a treasurer, and four members. In the lands of the inhabitants, the pipes of the 17 communities pass through. To get to the spring, one needs to cross the settlement.

Upon assuming a position, relationships are established with the local, state, and federal levels to process economic resources and infrastructure. The identification of players aims to observe who is involved and identify their strategies, how they abide by and enforce the rules about use, rights, obligations, and application of fines and sanctions for not complying with them. Non-governmental organizations cease to be and do not act on the matter. According to users, they no longer care about creating alternatives to distribute and conserve the resource, since during the period analyzed there was no investment in this regard.

In this case study the resource is abundant, as the spring satisfies productive activities and human consumption, although access rights through inter- and intra-community negotiation processes are unstable, causing poor coordination and contention among the operating committees in the communities. Consensus is negotiated in an assembly with rules for efficient management.

The horizontal method of the actors is positive in the management of a public matter, in which transparency and accountability of those in charge condition the community decision. Good governance transforms the procedures for using a resource and meeting objectives through consensus among players toward appropriate management that will be passed on to future generations.

One of Tzajalchen's achievements was the completion of a project to modernize the potable water distribution system, which has been underway since 1998. To this end, the Tzajalchen committees went to Yashanal, where the spring is located, meeting with the community authorities and presidents of the Education, Drinking Water, and Road committees. Following customs and traditions, they carried soft drinks with Coca-Cola glass containers, bread, and pox. Once they met, they agreed to undertake the work in the spring, but Yashanal asked Tzajalchen to install a "three-phase" transformer to extend the distribution of energy because the intake is in their territory, which was denied because it would lower the power of the service in the houses of their community, undoing the approval.

The conflict worsened in Tzajalchen on November 26, 2015. The president of the Drinking Water Committee noticed at night that he had no liquid in his house. The next day he discovered that the people of Yashanal had cut off their supply, so he summoned all the inhabitants to an extraordinary meeting. The absent cooperant would be fined.

The issue occurred when Tzajalchen did not allow the extension of the network. In retaliation, Yashanal suspended their water supply for 20 days and Tzajalchen cut off their power and blocked the road so that they could not transport their products. The companies that supplied the small grocery stores could not enter.

On December 15, 2015, at 10:50 a.m., residents of Tzajalchen arrived at the municipal presidency and took two officials (councilor and liaison) to pressure the Partido Revolucionario Institucional (PRI) mayor to address the problem. The detainees were held at the community center.

The municipality sent pipes to Tzajalchen while the parties negotiated, but more than 800 cooperants (one per family) needed to be supplied. In Yashanal, primary and secondary school students were affected because classes were suspended, as teachers were unable to reach their work centers due to the road blockade. The community governance between the two localities could not find a solution and it was easy to blame the municipal and state authorities because there was a lot of tension after more than 20 days without drinking water and electricity.

The authorities of Tzajalchen were trying to solve the conflict peacefully, but as they saw no way out they called a press conference on December 17, 2015, setting an ultimatum to the government bodies of 24 hours to address the issue, arguing that in their territory pass the pipes of 17 other localities, including the municipality of San Juan Cancuc, and threatening to suspend drinking water.

After 20 days of water and electricity shortages, the public and private actors of both towns agreed that Yashanal would not extend its electricity system to its users and that Tzajalchen would have its water supply. There was multilevel governance of the institutions and the problem-solving capacity and legitimacy of each actor was noted. Once the conflict was resolved, Yashanal thought about how to modernize the electric power system so that coffee growers, balcony workers, carpenters, and those with nixtamal mills and grocery stores could work properly. In Jerusalem, a nearby community, it was agreed to extend the service.

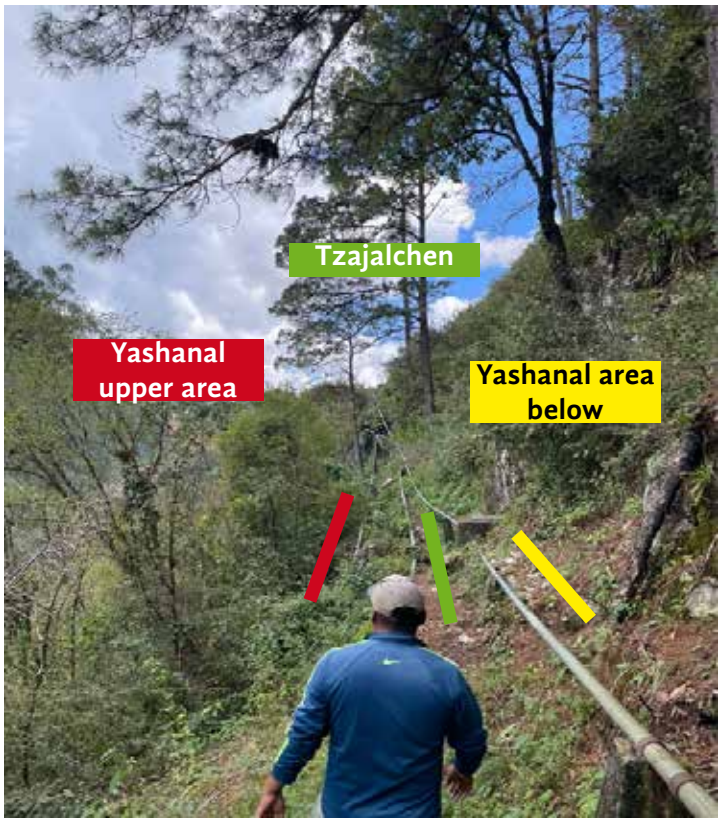
Since pack animals and people were still being used for transportation to the roadside, the road from Yashanal to Naranja Seca was built to transport personnel, materials, and agricultural products in vehicles, as shown in Figure 6. The scarce participation of federal, state, and municipal actors in the management of public affairs left the task to the communities, but the alternatives were insufficient and provoked inter-community conflicts with the interference of churches and political parties.

Note. Taken from Autónoma de Pedro Girón López, on February 18, 2022.

Figure 6. Road opening from Yashanal to Naranja Seca

As the spring is sacred to the communities, only people from the municipality and the drinking water committees can access the site. It is approximately 45 minutes away, on a muddy and rocky bridle path, and is difficult to travel in rainy weather.

There are three hydraulic lines, as shown in Figure 7.



Note. Taken by Carlos Manuel Girón Guzmán, Yashanal, Tenejapa, on February 18, 2022.

Figure 7. Description of case study pipelines

The one marked with a red arrow supplied Yashanal and Tzajalchen, but the fights caused the former to divide into two groups and the latter to determine its supply. The lack of coordination among the Water Committees led to problems, such as with the small works at the source. In a single line, it would be economical and the supervision and maintenance time would be reduced, but, as observed, they place concrete bases on the pipelines and mobilize more human resources for repairs. Water from the spring is conveyed by gravity through the slopes of the land, with an adequate flow and reducing costs. Inspection is required.

The spring flow *Bo't K'in Ja* of Yashanal connects with that of the Red River (*Tsajal Ukum*) at Yaalchuc. As shown in Figure 7, the liquid is taken from the source of the stream because it is cleaner. A member of the Water Committee pointed out strategic points in rivers and streams where they filled their amphorae to take to the houses, a task commonly done by women as a division of labor.

Later, a tank was built with concrete and stones to supply the houses of the two towns with a network of hoses, but the struggles between the

groups from the lower and upper parts of Yashanal and Tzajalchen caused the system to stop working. Next to that tank, there is another cylinder-shaped tank with a capacity of 5,000 liters donated in 2013 by Misión Integral para el Desarrollo de México, A. C., a civil organization whose purpose is to improve the living conditions and the environment of the neediest sectors in Los Altos de Chiapas. Erecting joint tanks and distribution systems caused problems between localities, although they had sufficient capacity to satisfy users.

According to the interviews, those who boil water consider that they affect nature because they consume more firewood and pollute, so sometimes, despite the risks, they choose not to do so because the process involves a high cost and they are aware that in the long term they will have health problems.

One question in the user questionnaire was: Is the water you drink treated? Most of them answered that they do not accept disinfection with chlorine because of the change in taste and odor, a matter for the institutions to attend to since they suffer from gastrointestinal infections due to drinking contaminated water. Many do not boil the water, arguing that it comes from the spring and its quality is very good. Interviewee 2, a member of the Water Committee, commented that the Secretariat of Social Development (Sedesol) used to train women in health and family planning, among other topics, but with the change of government the assistance disappeared and the work was abandoned.

The two localities have 24-hour access to the resource for consumption by backyard animals, family gardens, during the coffee harvesting season, and for basic family use. Septic tanks are available for sewage treatment. They have better services than other towns in the municipality due to the number of inhabitants and the management power of their community authorities. They are in short supply from February to May, but not very much. The supply is constant, although with low pressure due to the low capacity of the source. To solve this problem, they use plastic tanks or concrete tanks.

CONCLUSION

The federal, state, and municipal governments are not obligated to provide piped water to rural communities or to manage and modernize the systems. In this case, the populations studied resolve their needs through community organization, establishing informal rules for the disposal of the resource, and governance faces obstacles to achieving supply, especially when the sources are not in their territory because the communities recognize the spring as their property and not that of the nation, and access to its flow requires solid agreements.

The intervention of public actors is marginal in water management because CONAGUA cannot give away concessions. The state government has no budget for the service systems and the municipality, whose constitutional obligation is to set up the operating agencies, fails to perform this function in rural communities. The case study shows how, due to religious and political differences, the agreements to share the storage tanks that supplied the two communities did not come to fruition and three groups were formed to manage the service, complicating access to the spring, which requires permanent negotiation. The tanks stopped working and this affected drinking water users in the treatment, causing gastrointestinal infections, cholera, and salmonellosis.

Because of the division between the communities, public resources were wasted as the pipelines ceased to serve. Installing a water distribution system in each town was once again an expense for the users, disregarding the historical efforts of the cooperators in the foundation and maintenance of the network. Improving water governance is complex because it involves the participation of public and private actors, and communication, interests, and responsibilities are often unclear between government and local agencies, resulting in struggles over the management and use of the resource source.

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Econometric Determination of Factors Affecting the Performance of Dis semination Activities. The Case of the JC/CUC DAIA Science Club

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— Abstract—

Scientific dissemination programs or projects, like any activity that pursues an objective, can be evaluated. The objective of this research is to evaluate the scientific dissemination activities carried out by the members of a Science Club during the most critical phase of confinement derived from the COVID-19 pandemic. These activities took place in 20 different communities, 8 towns in the state of Tabasco and 4 towns in the state of Chiapas. The evaluation research was developed by applying methodology for program evaluation and a general linear statistical model to determine the factors that influence the performance of scientific dissemination activities. The statistical model that justifies the conclusions of this research was chosen according to the criteria of correct statistical specification and statistical significance of the variables. Using a correctly specified model, we identified that the factors that had a positive and statistically significant effect on the disseminator's performance were: sex, the number of experiments successfully carried out during the activity, the level of interest of the attendees perceived by the disseminator and the number of close relatives of the disseminator with university studies in science.

Keywords:
Program evaluation, econometric modeling, determinants factors, dissemination

RESEARCH BACKGROUND

The frame of reference that we identified in the specialized literature shows that the generation of evaluations for scientific dissemination programs or projects is a relatively understudied area. Below, we briefly review some of the research in which evaluations of outreach-related programs are presented.

The work of Barahona et al. (2020) aims to investigate the impact of a set of math communication activities in public spaces on strengthening the social fabric and improving the perception of security. The attendees answered a questionnaire composed of 10 Likert-type[1] reagents and 5 categorical questions regarding their socio-demographic profile. With the data obtained, the authors performed a descriptive statistical analysis and an inferential analysis that consisted of 2 statistical methods: analysis of main components and model of structural equations. They evaluated the validity and reliability of the information collection instrument through three indicators: Cronbach's alpha, Guttman's lambda, and the Inter-class Correlation Coefficient. Through their data analysis, the authors concluded that as the project was developed, information was collected on an increase in the perception of safety and higher levels of neighborhood integration in the community, in addition, they showed evidence in favor of the communication of mathematics in public spaces contributed to improving the perception of safety and strengthening the social fabric of the Chamilpa community.

Another research that aimed to *evaluate a workshop* was presented by Pulido (2017). The workshop whose information was analyzed had as its theme the *preservation of air quality in closed places* and was developed with 128 university students from the degrees of Nursing and Business Sciences of the Universidad de Papaloapan, Oaxaca. The author conducted four Likert-type questionnaires as a means of evaluation for each construct[2] and as a measure of reliability and validity conducted a reagent discrimination analysis.[3]

Statistical analysis of student responses before and after the workshop, the author concluded that, in the nursing group, the workshop had a positive impact on most of the constructs assessed. However, in the business sciences group, the changes before and after the workshop were not significant.

Gallardo's thesis (2014) was another research work in which a study was carried out to evaluate the constitutive elements of the online educa-

1 Type of ordinal scale intended to measure the attitude of respondents on a given topic. Developed in 1932 by Rensis Likert.
2 Theoretical construction to understand a given problem.
3 Also known as item discrimination analysis.

tional process from the perspective of the students of the bachelor's degree in nursing of the SUAyED-ENEO (Open University and Distance Education System-National School of Nursing and Obstetrics) of the UNAM. The study consists of a descriptive, cross-sectional, and observational analysis carried out with information from 119 students. The statistical methodology used was a one-factor analysis of variance. The working hypothesis was that the online learning process (which would act as the dependent variable) is based on: age, sex, number of jobs, hours of study per week, basic computer skills, and previous courses online or at the student's headquarters. In the study, the author used Pearson's correlation coefficient between some variables that he considered relevant to understand the student's learning process. Finally, the author concluded that only the *student's home* variable was significant for the study.

In the research of Sánchez (2008), statistical validation of the entrance exam to the online course for reading comprehension in English was carried out and applied to 213 students. The objective of this research was to validate a construct related to a hypothetical model through mathematical models. The author applied a data collection instrument to observe and identify the factors that determine efficient learning in text comprehension. The statistical methodologies used in the research were: representative mathematical models of item response theory (IRT) and Cronbach's alpha internal consistency analysis, causal models, and multivariate statistical techniques such as factor analysis, path analysis, multiple regression analysis, and structural equation modeling. The author evaluated the assumptions of normality, homoscedasticity, and linearity of the applied methodology to ensure convergence towards a feasible solution. Finally, according to the previous analysis and due to the quality of goodness of fit, the author concluded that there was insufficient evidence to affirm that the model does not collect the variability in the data.

Finally, Álvaro et al. (1990), in their work *Hacia un modelo causal del rendimiento académico*, evaluate some models that influence academic performance. The research was developed around two objectives: to arrive at an explanatory model of academic performance and to choose the most appropriate analysis technique to test that model.

Consequently, they used statistical methods for data analysis such as principal component analysis, maximum likelihood factor analysis, path analysis, and analysis of LISREL (Linear Structural Relations) models, in addition to applying goodness-of-fit measures such as χ^2, Goodness-of-fit Index GFI, among others. Through the use of different exploratory and confirmatory analyses, Álvaro et al. (1990) justified a reduction from 89 variables to 14. Thus, the model that they determined best explained the phenomenon of interest was the one in which the values of the adjustment

indicators (χ^2 and GFI) met the required limits and the multiple correlations squared of the two variables used were very high.

From their statistical analysis, the authors highlighted 3 conclusions: i) the best predictor for performance is aptitudes; ii) through a general aptitude (composed of a verbal factor, another numerical factor, and logical reasoning) performance in mathematics can be better predicted than in language; iii) the cultural level of the parents has a causal relationship with aptitudes, that is, a high cultural level in the family is conducive to greater aptitude development, consequently, the expected performance in basic instrumental areas such as language and mathematics will be higher.

CONCEPTUAL FRAMEWORK OF THE PROGRAM EVALUATION PROCESS

Evaluation can be defined as the process of systematically collecting information on the activities, characteristics, and results of a program (set of steps that are carried out to achieve an objective) to reduce uncertainty, improve effectiveness, and decisions regarding the achievement of objectives (Jean-Michel & Benot, 2017).

On the other hand, according to the glossary of the main terms on evaluation and results-based management of the Organization for Economic Cooperation and Development (OECD, 2010), the evaluation of a project, program, or policy in progress or concluded is the systematic and objective appreciation of its design, its implementation, and its results. Therefore, we can define evaluation as the process of systematically collecting information on the activities, characteristics, and results of programs, to reduce uncertainty, and improve effectiveness, and decision-making.

Note that an evaluation not only analyzes whether or not the program is effective but also provides information to determine if the program is the most appropriate way to achieve its objectives and if there are other elements to consider.

When carrying out an evaluation process for a program, there are key points that we must keep clear, such as the purpose of the evaluation, the time at which the program will be evaluated, the model with which it will be evaluated, the instrumentation that will assist said evaluation, the institution or professionals in charge of carrying out the evaluation and the reference framework within which the evaluation of the program will be carried out. The points mentioned above are intended to outline a feasible, methodical, objective, transparent, and verifiable evaluation process.

On the other hand, Jean-Michel and Benot (2017) describe a program in terms of needs, design, inputs, and outputs, short- and long-term results. In addition, an assessment program can be represented as a sequence of four phases:

I. **Context analysis**: involves gathering information about what constitutes the problem, who it affects, and how they perceive it, to determine their needs. It relies on descriptive and inferential statistical tools to point out issues that need to be addressed. Actions:

- Describe the social, economic, and institutional context in which the program will be implemented.
- Identify needs, determine their scope, and define the target population (cross-sectional, longitudinal, or panel data study).
- Make a distinction between descriptive statistics and inferential statistics, to identify patterns in the sample.
- Distinguish between univariate, bivariate, and multivariate analyses, depending on the number of variables examined.
- Visualize the status of the population, if the identified needs were met.

II. **Ex-ante evaluation**: It tries to assess aspects that allow us to fine-tune the decisions around the implementation of the program. When a program or project has the evaluation, it influences the improvement of the decision-making on its implementation, in the identification of areas of improvement that, if not observed and corrected, could generate unnecessary costs and inefficiencies in the implementation stage.

At this stage, it is critical to determine the goals and objectives of the program before conducting an evaluation. Alternative strategies for addressing program objectives must be compared based on all relevant dimensions (technological, institutional, environmental, financial, social, and economic). The methods can be:

- Financial Assessment
- Budget impact analysis
- Cost-benefit analysis.
- Cost-effectiveness analysis.
- Multi-criteria decision analysis.

III. **Implementation**: This stage is responsible for designing a monitoring system to help project leaders or managers implement the program.

The construction of a well-documented data management system is essential, for which indicators can be used to measure inputs, outputs, or relate resources to services-products:

- Media indicators (operating expenses, donations received, number of agents).
- Performance indicators (number of beneficiaries or users).
- Management and accounting indicators (operating expenses per user, number of agents per user).

These indicators can be used to report progress and alert program managers to issues, and can also be used subsequently for evaluation purposes.

IV. **Ex-post evaluation**: It seeks to fine-tune elements of the evaluated program, which can be grouped according to the particular type of evaluation in question.

This stage measures what has happened as a direct result of the execution of the program. Consequently, effectiveness has to do with the level of outcomes and whether or not the intervention was successful in reaching the desired goal. This phase also identifies the main factors behind success or failure. Commonly used assessment techniques are:

- Random case follow-up.
- Benchmarking analysis.
- Quasi-experiment.

It is important to mention that we must not forget that:

1. The choice of the method to be used depends mainly on the context of the analysis. For example, random assignment is not always possible in legal, technical, or ethical terms.
2. The choice of the time frame in which to conduct the evaluation is a difficulty since the information needed to assess program outcomes is sometimes available only several years after program completion.

Generally, the results are classified as:

- Short term: if they are immediate effects on the individuals' state.
- Long-term: environmental, social, and economic changes

PHASES OF PROGRAM EVALUATION. THE CASE OF WORKSHOPS AS A MEANS OF SCIENTIFIC DISSEMINATION

The following is an application of the four phases of evaluation: context analysis, evaluation ex ante, implementation, and evaluation ex post, to a student science outreach program.

The *context* of the scientific dissemination activities carried out by a group of students who make up the Science Clubs (CUC's) of the Universidad Juárez Autónoma de Tabasco [UJAT] has been developed for approximately 15 years, through workshops aimed at audiences of different educational levels in university spaces, educational campuses, museums, or public spaces in the state of Tabasco. These activities represent a work of university social retribution, since, in many cases, the members of the clubs perform their social service in scientific dissemination activities to promote and foster scientific culture in society.

The *natural* evaluation of a scientific dissemination program represented by the activities of the CUC's, consists of measuring the impact that these activities have on the scholastic or integral performance of the beneficiaries of the program, that is, of the audiences, or rather, on the young university students who provide these activities. Therefore, it is possible to measure the effect that science outreach activities have on the people who receive the workshops and on the lecturers themselves. It is also possible to carry out an evaluation to identify the factors that influence the performance of the lecturers.

Before implementing a program, the direction of the desired outcome should be defined in a general way, such as demonstrating that outreach activities are a pillar of the educational institution's substantive activities. Or, a specific objective, such as increasing general knowledge on a specific topic.

Let's suppose that the program's *objective* is to disseminate knowledge about a particular subject in a didactic and entertaining way for children.

As part of the *ex-ante* evaluation, it is advisable to think about whether:

- Are the selected outreach strategies consistent with the overall program objective?
- Are outreach strategies suitable for children?
- Will the activity generate new scientific knowledge in the public?
- Do the strategies cover all program objectives?
- Are there any programs with the same or similar objectives?

To achieve a more efficient program, it is advisable to analyze:

- Are the necessary resources available to develop the outreach activity?
- Are existing resources adequate?
- Is the outreach program profitable for the academic development of the participants?
- Will the cost of the outreach program be commensurate with the effectiveness?

When *implementing* the program, it is important to follow each phase of the previously designed strategy, as well as to be careful when collecting the information that will be used to construct the indicators.

Subsequently, as part of the *ex-post* evaluation, we must measure the effects that the program had on the higher education institution's students or audiences, using the method(s) that best suit the program and the type of evaluation. Therefore, it is necessary to identify in the outreach program what the short-term and long-term results are:

Short-Term Results

- Were any effects identified among the outreach students (lecturers) on their academic performance?
- Did the students achieve educational growth?
- Did the students achieve personal growth?
- Were the resources sufficient for the program?
- Did the program meet its goals?

Long-Term Results:

- Is science dissemination a substantive activity for the institution?
- Did the program manage to produce and/or increase knowledge?
- Did the activity contribute to improving the public's relationship with the topics covered?
- Did the program awaken in the students the vocation of science communicator?

Finally, the responsible authorities will make the most appropriate decisions (instrument, strengthen, continue; as the case may be), based on the results of the program evaluation. That is why, from an institutional perspective, evaluations are valuable as an instrument for proper decision-making.

EVALUATION OF OUTREACH EFFORTS

The JC/CUC DAIA Science Club

The Science Club "Youth for Science" of the DAIA of the UJAT began its activities in 2006, and its main activity is to carry out scientific dissemination activities. The club is typically composed of students from degrees in Architecture, Civil Engineering, Electrical and Electronic Engineering, Chemical Engineering, and Electrical Mechanical Engineering who fulfill their social service, professional internship, or volunteering. The activities

carried out at the club are dissemination workshops, participation in scientific events, and research projects, among others.

Since the Science Club was founded, it has made significant achievements in outreach. However, they did not have the opportunity to assess the impact of their activities on the population or the club participants themselves. To meet this need, we carried out a first evaluation exercise, to identify the factors that influence the good performance of the members of the Science Club in science outreach activities. The evaluation presented was part of a work carried out as a professional internship and subsequently presented by two of the authors as a thesis work to obtain the degree of Bachelor in Actuary.[4]

The framework for the evaluation was the workshop *¡Más fuerte qué Hercules!*, which consisted of the presentation of three experiments related to the surface tension of water, aimed at a child audience.

Due to sanitary restrictions, the workshop was conducted by each member of the club in the community in which they live, with a child audience. This resulted in the presentation of the workshop in 20 different communities, which belong to 8 municipalities in the state of Tabasco and 4 municipalities in the state of Chiapas. Figure 1 shows some of the club members conducting the ¡Más fuerte que Hércules! Workshop.

Figure 1. ¡Más fuerte que Hércules! workshop

4 Actuarial professionals are those who apply mathematical, statistical, economic, and computational methods to the calculation of financial risks arising from uncertainty when they are covered by a contract, such as insurance, bonds, pensions, social security, labor liabilities, and credit, investment, and derivative financial instruments. However, their skills can be oriented to other tasks such as the evaluation of different types of programs.

METHODOLOGY

Instrument design and database creation

Statistical information to model the performance of Science Club members in the "¡Más fuerte que Hércules!" outreach workshop was collected through a Google Forms questionnaire consisting of 3 sections. The first contained 4 questions dedicated to the collection of general data, such as gender, age, or grade point average in their program of study. The second was focused on measuring the degree to which the lecturers perceived the performance of their presentation, it was integrated with 18 questions, 8 of them were Likert-type with 4 values (Likert-type surveys are psychometric instruments where the respondent must indicate their agreement or disagreement on a statement or item, which is done through an ordinal and unidimensional scale (Matas 2018), which sought to extract information about how the lecturers perceived the audience and their performance.[5] The third and last section consisted of 6 questions, which sought to collect data on the academic profile of the family members of the surveyed Science Club members.

Table 1 below shows the 28 variables generated to study the performance of the workshop participants in their presentations, of which 27 were obtained from the questionnaire, and were treated as independent variables. The remaining variable, labeled CaliTaller, is the score obtained as a qualification in the workshop and was treated as the dependent variable in our modeling. This rating was awarded by academics with experience in disclosure based on the evidence, photos, or videos reported. Finally, the study was conducted with information from 23 lecturers and members of the club.

5 The reader may note that we do not present the results of Cronbach's alpha, which allows us to quantify the level of reliability of a measurement scale for the unobservable magnitude constructed from the n observed variables. This is because it is desirable, to create a reliable scale of a quality that is not directly observable, that the items be highly correlated with each other. In our case, the n observable variables we use are used to model the variability of the response variable that is observable and has a measurement scale. Therefore, we do not use Cronbach's alpha as a measure of the reliability of measurement scales.

Table 1

28 variables were generated to study the lecturer's performance in their presentations.

Variable	Variable name	Description
Y	**Workshop grade**	*Grade obtained at the end of the workshop awarded by competent personalities with experience in dissemination.*
		Section 1: Personal information
	Lecturer's name	*Lecturer's full name*
X_1	**Gender**	*Lecturer's gender*
X_2	**Age**	*Lecturer's age at the time of answering this survey.*
X_3	**PromCali**	*Lecturer's grade point average*
		Section 2: Perception of the lecturer's presentation performance.
X_4	**PE**	*Lecturer's current study program.*
X_5	**DomTema**	*Level of mastery that the lecturer felt about the workshop subject.*
X_6	**Autoper**	*Adjective that best described the lecturer's perception of himself/herself at the time of the workshop.*
X_7	**Seg**	*Level of security felt by the lecturer at the time of the workshop.*
X_8	**Nervio**	*Level of nervousness felt by the lecturer while conducting the workshop.*
X_9	**DisTaller**	*Level of fun or enjoyment that the lecturer felt while doing the workshop.*
X_{10}	**Ninv**	*Number of children invited to the workshop by the lecturer.*
X_{11}	**Nasis**	*Number of children attending the workshop.*
X_{12}	**Niños**	*Indicates if the lecturer frequently spends time with children.*
X_{13}	**TiemEst**	*Minutes that the lecturer spent studying before the workshop.*
X_{14}	**EnsExp**	*Number of times the lecturer rehearsed the experiments before conducting the workshop.*
X_{15}	**TiemEns**	*Minutes that the workshop leader spent rehearsing the experiments before the presentation.*
X_{16}	**ExpExitosos**	*Number of experiments that the lecturer successfully performed during the workshop.*
X_{17}	**InteresAsist**	*Level of interest of the attendees during the workshop as perceived by the lecturer.*
X_{18}	**GustoAsist**	*Level of satisfaction of the attendees with the workshop according to the lecturer's perception.*
X_{19}	**NivSatis**	*Level of satisfaction that the lecturer obtained from the attendees' response while conducting the workshop.*
X_{20}	**TiemEvi**	*Minutes that the workshop leader invested in preparing the workshop evidence.*
X_{21}	**Tsufi**	*Indicates whether the workshop leader felt he/she had enough time to organize the workshop.*
		Section 3: Academic profile of the lecturers' family members
X_{22}	**Beca**	*Indicates whether the lecturer had a scholarship during the period in which the workshop was held.*
X_{23}	**EstPadre**	*Degree obtained by the lecturer's father or guardian.*
X_{24}	**EstMadre**	*Degree obtained by the lecturer's mother or guardian.*
X_{25}	**FamCDuras**	*Number of the leader's close relatives who have university studies related to the hard sciences.*
X_{26}	**FamCSyH**	*Number of the lecturer's close relatives who have university studies related to the social sciences and humanities.*
X_{27}	**FamCEyA**	*Number of the lecturer's close relatives who have university studies related to administrative economic sciences.*

STATISTICAL METHODOLOGY

In this research, we apply *the theory of probabilistic reduction* (Spanos, 1986) developed within the framework of the probabilistic approach of econometrics. This consists of rigorously evaluating the assumptions about the vector of observable variables, to obtain a simplified and acceptable probabilistic structure. This method consists of i) defining the experiment design that relates a theoretical model to the data in a probabilistic scheme through the specification of the statistical model; ii) the verification of the statistical assumptions underlying the specification; and iii) the respecification of the model to establish a correctly specified model to contrast the hypotheses to establish statistically reliable conclusions in the light of the data.

Specifically, the study was performed using a linear regression model (general linear model), given by the equation, $y_i = \beta_o + \boldsymbol{\beta}'\boldsymbol{x}_i + u_i,\ i \in n$, whose probabilistic structure is presented in Table 2 using two distinct approaches.

Table 2
Probabilistic structure with two different approaches

	Supuestos del modelo de regresión lineal	
	Enfoque probabilístico	**Enfoque tradicional**
1 normalcy	$(y_i \mid X_i = x_i) \sim N(\cdot,\cdot)$	$u_i \sim N(\cdot,\cdot)$
2 linearity	$E(y_i \mid X_i = x_i) = \beta_o + \boldsymbol{\beta}'\boldsymbol{x}_i$	$E(u_i \mid X_i = x_i) = 0$
3 homoscedasticity	$Var(y_i \mid X_i = x_i) = \sigma^2$	$Var(u_i \mid X_i = x_i) = \sigma^2$
4 constant parameters	$\beta_o, \boldsymbol{\beta}', \sigma^2$	$\beta_o, \boldsymbol{\beta}', \sigma^2$
5 independence	$\{(y_i \mid \boldsymbol{X}_i = \boldsymbol{x}_i), i \in I\}$	$\{(u_i u_s \mid \boldsymbol{X}_i = \boldsymbol{x}_i) = 0,\ i \neq s, i \in I\}$

The probabilistic approach of the multiple linear regression model, which was based on De Jesús (2016), is intended to highlight why it is necessary to satisfy each assumption in Table 2 with the modeled data and the implications of not complying with them.

Probabilistic approach to multiple linear regression modeling

With the following economic relationship of interest:

$$Y_i = f\left(X_{1,i}, X_{2,i}, \ldots, X_{k,i}\right), \qquad i = 1, 2, \ldots, n \qquad \ldots(1)$$

where Y_i denotes the dependent variable, and $X_j\ j = 1, 2, \ldots, k$ denotes the j-th independent variable. The following shows how the statistical model of multiple linear regression

$$y_i = \alpha + \boldsymbol{\beta}' \boldsymbol{x}_i + u_i, u_i \sim N(0, \sigma^2), \ldots(2)$$

with parameter vector $\boldsymbol{\theta} = (\alpha, \boldsymbol{\beta}, \widetilde{\boldsymbol{\Sigma}})$ and under the assumptions in Table 2, is a parameterization of the joint density of all observable variables $X_{1,i}, X_{2,i}, \ldots, X_{k,i}$ under the following assumptions: normal distribution, independence, and identical distribution.

By the assumption of independence and identical distribution of $\boldsymbol{X}_i$, the assumption of normal distribution of $\boldsymbol{X}_i$, and exogeneity of the variables $\boldsymbol{X}_{i,j}$ for j = 1,2, ...,k, we know that Y_i given the values of the random vector $\boldsymbol{X}_i$=$\boldsymbol{x}_i$ is distributed as a normal random variable,

$$Y_i \mid \boldsymbol{X}_i = \boldsymbol{x}_i \sim N_m\left(\alpha + \boldsymbol{\beta}' \boldsymbol{X},\ \widetilde{\boldsymbol{\Sigma}}\right) \quad \ldots(3)$$

where $\alpha = \mu_Y - \boldsymbol{\beta}' \mu_X, \boldsymbol{\beta} = \boldsymbol{\Sigma}_{XX}^{-1} \boldsymbol{\Sigma}_{XY}$ and $\widetilde{\boldsymbol{\Sigma}} = \boldsymbol{\Sigma}_{YY} - \boldsymbol{\Sigma}_{YX} \boldsymbol{\Sigma}_{XX}^{-1} \boldsymbol{\Sigma}_{XY}$.

This result shows that there is a linear relationship between Y_i and $\boldsymbol{X}_i$, of the following type

$$Y_i = E(y_i \mid \boldsymbol{X}_i = \boldsymbol{x}_i) + u_i, i = 1, 2, \ldots, n,$$

where the error term $u_i = y_i - E(y_i \mid \boldsymbol{X}_i = \boldsymbol{x}_i)$ is not autonomous, its probabilistic structure is completely determined by (3). The assumptions of the statistical model can be expressed in terms of u_i, as in Table 2.

As usual, to determine the most probable values of the parameters of the statistical model, $\boldsymbol{\theta} = (\alpha, \boldsymbol{\beta}, \widetilde{\boldsymbol{\Sigma}})$,, when the random process $\{\boldsymbol{X}_i\}_{i=1}^n$ has been observed, we maximize the logarithm of the likelihood function concerning $\boldsymbol{\theta}$. But since the likelihood function is the joint density of the observed process $\boldsymbol{x}$= $(\boldsymbol{x}_1, \boldsymbol{x}_2, \ldots, \boldsymbol{x}_n)$ conditional on $\boldsymbol{\theta}$ then:

$$\mathrm{L}(\boldsymbol{y}, \boldsymbol{x} \mid \boldsymbol{\theta}) = \prod_{i=1}^{n} D(y_i \mid \boldsymbol{x}_i; \psi_1)$$

where $D(y_i \mid \boldsymbol{x}_i; \psi_1)$ is the multivariate normal density given by (3). Therefore, the probabilistic properties of the maximum likelihood estimators, of any test statistic, and goodness-of-fit measure, will be completely determined by (3).

If the linear regression model fails to meet any of the probabilistic assumptions in Table 2 *vis-à-vis the data*, then the density $D(y_i \mid \boldsymbol{x}_i; \psi_1)$ will be misspecified and will invalidate the probabilistic properties of any statistic derived from it. This not only implies that the statistical inference, goodness-of-fit measures, and forecasts made from the statistical model are unreliable, but also that the entire model will be in question as a *process generating the observed data*.

Note that assumptions 1-3 in Table 2 depend on the normal distribution assumption of X_i. However, it is also one of the most difficult assumptions to meet. According to Hoover et al. (2009); and Hoover (2012), the hypothesis of multivariate normality of economic data is not a characteristic that we expect to be met, it is rather a hypothesis that allows us to ensure that both *unusual* events, which are adequately described by the normal distribution, and *unusual* events that tend to fall outside the range of the normal distribution, have been considered. Such extraordinary events are often the cause of skewness or excess kurtosis in the distribution of the data and, therefore, of the rejection of the normality assumption of u_i. In other cases, inadequate modeling of such events may be the cause of autocorrelation among errors, bias in estimators, and inaccuracy in inferences. The assumption of normality also depends on the linearity, of variables and parameters, of the statistical model. Therefore, if it is detected that the normality assumption is not met, the functional form of the model will also be questioned.

In the probabilistic approach to econometrics, the error term should capture all the factors influencing the phenomenon that were not considered by the empirical model, of course, these factors should be many more than those considered in the model. So, if such factors are independent, the errors could be distributed approximately as normal random variables by the central limit theorem.

The independence assumption of $\boldsymbol{X}_i,\ i = 1, 2, \ldots, n,$, in the observable process of economic variables, has also been questioned (assumption 4 of Table 2) it is very frequent to observe that the process $\{\boldsymbol{X}_i\}_{i=1}^{n}$ shows some kind of dependence especially in the analysis of time series, where the heterogeneity of these variables induces that both the expectation and the variance and covariance matrix of the observable process are a function of time.

Thus, the only correct strategy to achieve valid and reliable inferences is to adopt a statistical model whose probabilistic assumptions are valid *vis-à-vis* the data before making any inference. Therefore, before testing the hypotheses about the phenomenon of interest with the model (2), it is necessary to *verify* that the statistical model satisfies the complete list of probabilistic assumptions underlying the chosen specification with the sample data $\boldsymbol{x}$. Such verification ensures the reliability of any inference based on the model. Note that when the model is **incorrectly** specified,

in the sense that any of the model assumptions were rejected, then the distribution $D(\cdot\,;\boldsymbol{\theta})$ will be misspecified for sample x and will invalidate the distribution of estimators, test statistics, and any statistics obtained from it.

Model (2) should be *re-specified*, choosing a new specification that takes into account regularities in the data not explained by an incorrectly specified model. Having done this, once again it must be evaluated that the data, $\boldsymbol{x}$, does not reject the assumptions of this new specification. This procedure should be repeated until a specification is identified that satisfies all assumptions with the data, from which reliable inferences can be made.

RESULTS

After analyzing different statistical methods and models with the data from the 23 lecturers for the 27 variables obtained, we determined, by the criteria of correct statistical specification and significance of the variables, that the general linear specification given by the following equation captured well the variability of the variable Y_i which measures the lecturers' performance.

$$\hat{Y}_i = 6.5522 + 0.6934x_{1i} + 0.3925x_{16i} + 0.3376x_{17i} + 0.2241x_{25i}$$

where the statistically significant variables were:
$\boldsymbol{x}_1$: Lecturer's gender
$\boldsymbol{x}_{16}$: Number of successful experiments during the lecturer's presentation.
$\boldsymbol{x}_{17}$: Level of interest perceived by the lecturer from the attendees.
$\boldsymbol{x}_{25}$: Lecturer's relatives with university studies in hard sciences (Mathematics, Physics, Chemistry, even Engineering).

We observed that the effect of all the variables included in the model is positive on the lecturer's performance.

Before interpreting the estimated coefficients and evaluating the significance of the variables in the model, we proceed with the evaluation of the correct specification of the estimated model. That is, to verify whether it complies with the assumptions of the general linear model.

Verification of correct specification

The correct specification of the model was determined using statistical tests to evaluate the normal distribution of the estimated errors, the *hetero* and *hetero-X* tests that evaluate whether the errors have constant

variance, and, finally, the *reset2* test that evaluates whether the linear relationship does not omit relevant variables.[6]

At the significance level α=0.05, i.e., with 95% confidence we cannot reject the null hypothesis that the errors follow a normal distribution. In other words, there is sufficient statistical evidence not to reject the null hypothesis that the data follow a normal distribution (*p-value*=0.7605).

To evaluate whether the estimated model errors are homoscedastic, i.e., that the variance of the estimated errors is constant, the following tests were performed: *hetero* and *hetero-X*. Once both tests were performed, we obtained in the *hetero* test a *p-value=0.309* and in the *hetero-X* test a *p-value=0.435*. In both cases, we can conclude that there is sufficient statistical evidence not to reject the null hypothesis that the estimated errors of the regression model have constant variance.

Finally, the *reset test23* was performed to evaluate whether the linear model of the nonlinear combinations of the explanatory variables could explain the response variable. The null hypothesis of the test is that the model is well-specified. The *p-value* of the test was *p=0.291*. With which we can conclude that there is sufficient statistical evidence not to reject the null hypothesis, that is, the linear statistical model is correctly specified.

The graphs in the following Figure 2 shows in the first panel, the values that the variable y (performance) and the estimated values $\hat{y}$ (estimated performance), the model residuals graph, and the residual histogram. It can be seen, as with the statistical tests, that the fit using the linear model is statistically adequate.

In summary, we observe that our estimated model meets the statistical and probabilistic assumptions of the general linear model, so it is statistically valid and solid to perform inferential analyses such as that of the individual and joint significance of the explanatory variables.

6 All estimations and statistical evaluations were performed in Stata software. Conclusions from statistical tests of misspecification are taken under the decision criterion, according to which if the p-value is greater than the significance level α=.05, the null hypothesis that the probabilistic assumption is satisfied with the model data is not rejected. The p-value is calculated as $P(X \geq x)$ where X denotes a random variable that has a probability distribution equal to that followed by the test statistic under the null hypothesis and x denotes the observed value of the test statistic obtained. Note that, depending on the assumption evaluated, the test statistic follows a specific probability distribution.

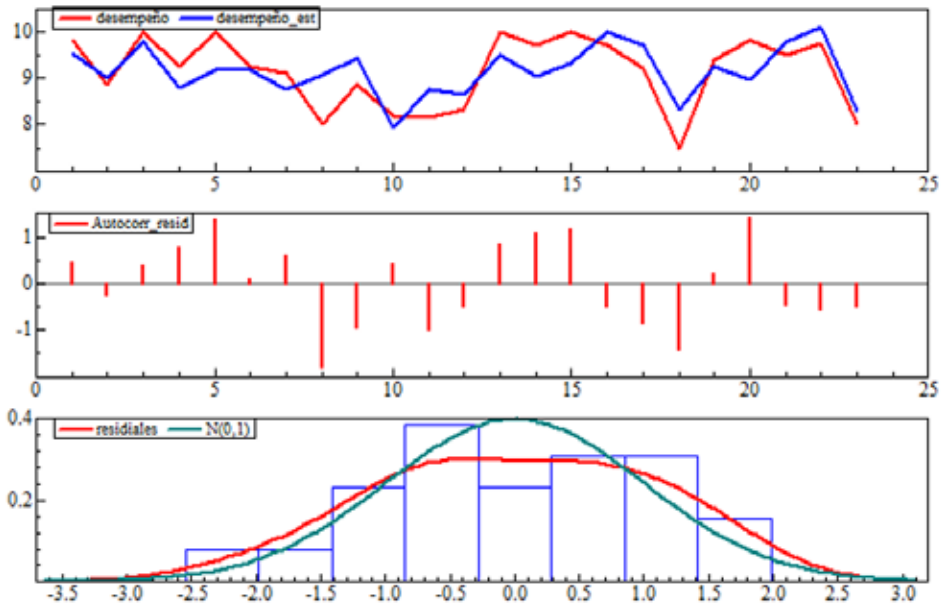

Figure 2. Graphic analysis of correct specification

To verify the significance of the regression parameters, we performed the joint significance test and the individual significance tests in the Stata software.

In the joint significance test, a test statistic was obtained whose statistic follows Fisher's *F* distribution, which took the value of *F=4.70* and a *p-value=0.009*,[7] these data allow us to conclude with 95% confidence that there is sufficient statistical evidence to reject the null hypothesis that the parameters estimated in the model are equal to zero.

On the other hand, the results of the individual significance test of each variable in the regression show that the t-test statistics are outside the non-rejection region of the null hypothesis, [-1.73, 1.73], at 95% confidence and the *p-values* are less than 0.05. Therefore, there is sufficient statistical evidence to reject the null hypothesis that the estimated parameters are equal to zero, that is, the variables x_1, x_{16}, x_{17} and x_{25} are significant for the model.

Therefore, the estimated model indicates that: the measure of performance of the lecturer (rating obtained from each lecturer) has a variation of

7 In the case of the global hypothesis test, the test statistic is calculated as follows

$$F = \frac{(Suma\ de\ cuadrados\ de\ la\ regresión)/(k-1)}{Suma\ de\ cuadrados\ de\ los\ erroes/(n-k)}$$

where *n* is the number of observations and *k* is the number of parameters in the regression equation. In this case, the *p-value* is calculated as $P(X \geq x)$ where *X* denotes a random variable having a probability distribution *F* with degrees of freedom *(k-1,n-k)* and *x* denotes the value of the test statistic obtained. The interval of values of the t distribution with 18 degrees of freedom for which the null hypothesis, H_0:β_i=0, is not rejected at 95% confidence is defined as all those values between the quantile 0.025 and the quantile 0.975 of that distribution, i.e., the interval [-1.73, 1.73].

0.34 when the perception of the lecturers about the interest of the attendees improves, in addition, a variation of 0.22 in the rating of the workshop's performance for each lecturer's close relative who has university studies related to hard sciences. A variation of 0.39 is also observed on the lecturer's performance measure for each successful experiment performed during the presentation. Finally, there is a difference in favor of the lecturers, that is, there is statistical evidence that performance improves by 0.69 when the workshop is run by a woman.

FINAL THOUGHTS

The research we present is a first statistical exercise to identify the variables that influence good performance in Science Club outreach activities. Likewise, the review of the specialized literature on dissemination allows us to recognize that research constitutes a frame of reference to generate information on potential factors and factors that, according to our model, have a statistically significant impact on the performance of dissemination activities.

Likewise, we emphasize that the variables that do not appear in the statistical model were not statistically significant in our model. This does not mean that they generally do not influence performance in outreach activities. Rather, it means that, before ruling out its possible influence on other evaluation exercises, it is necessary to pay special attention to measuring and quantifying such influence.

In this sense, variables such as enjoying the presentation of the workshop, the level of nervousness, the mastery of the topic, or the time spent rehearsing the experiments; which in principle seemed to us that they should exert some influence, were not statistically significant in the model. We assume that this fact constitutes an area of opportunity to capture its influence in future evaluation exercises.

Additionally, we could refine the method of information collection and the expansion of our exercise to other outreach groups or consider more than one outreach activity, which would give us the possibility of implementing other statistical modeling methodologies.

The evaluation of the performance of the activities of the JC/CUC DAIA Science Club is evidence of an initiative to recognize and enhance the factors that would improve the performance of the members of the club in scientific outreach work and to reassess the benefits of outreach as a substantive activity within universities.

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A C A D E M I C

P A P E R

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Challenges of Female Scientists at the Universidad Central "Marta Abreu" Las Villas

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— Abstract—

This research was carried out at the "Marta Abreu" Central University of Las Villas with women scientists of different ages. General objective: Diagnose the needs and potential of women researchers at the "Marta Abreu" Central University of Las Villas through an interpretive case study. The research methods and techniques are document analysis, participant observation, researcher diary, in-depth interviews, activity reports, and role plays. For this purpose, it had 4 units of study according to the ages of the participants. In turn, the research has 3 phases: pre-active, interactive, and post-active. Artificial intelligence (AI) was used to determine categories and subcategories as a specialist criterion to efficiently measure the research and find theoretical links in the scenario. They threw themselves into the following regularities: Cuban women have a social-historical context that facilitates their professional development although they recognize obstacles in the family and economic environment that delayed their professional development. Middle-aged female scientists suffer the dilemma of family consolidation and the development of full motherhood and the academic training of women scientists has an imbalance between the exact and humanistic sciences, opting for the latter in the vast majority.

Keywords:
Female scientist; case study; artificial intelligence

The difference between men and women in science is present to a small or large extent throughout the entire social and work environment. The role of Cuban female researchers, on the other hand, does not have this distinction, since the biological difference does not affect the intellect. Gender is not a barrier to collaboration and mutual support in a variety of projects. However, women are also mothers and daughters. A fruitful career and successful research projects require your undivided attention and care, leaving little or nothing for parenting. This is how family development hinders research development.

As for age, the most successful researchers indeed come from experience and systematic education, and promising young women lack the same research skills, but we should not think that this is something unrelated to gender, young people, in general, have to work twice as hard to receive the same recognition.

Artificial Intelligence (AI) is a powerful tool in the scientific production of society. The female researcher in Cuba is allowed access to the available information and the laws are applied to her as to any male researcher. Women receive active protection from their work or social circle, both consciously on the part of the state and unconsciously on the part of their male colleagues.

With VOSviewer software, a bibliometric analysis (Figure 1) was carried out with the Dimensions database over 10 years, with journals indexed in the Scopus database. This showed the most recurrent investigations, such as those related to health, identity, and legality. While the education and training of a female researcher from an early age is insufficient.

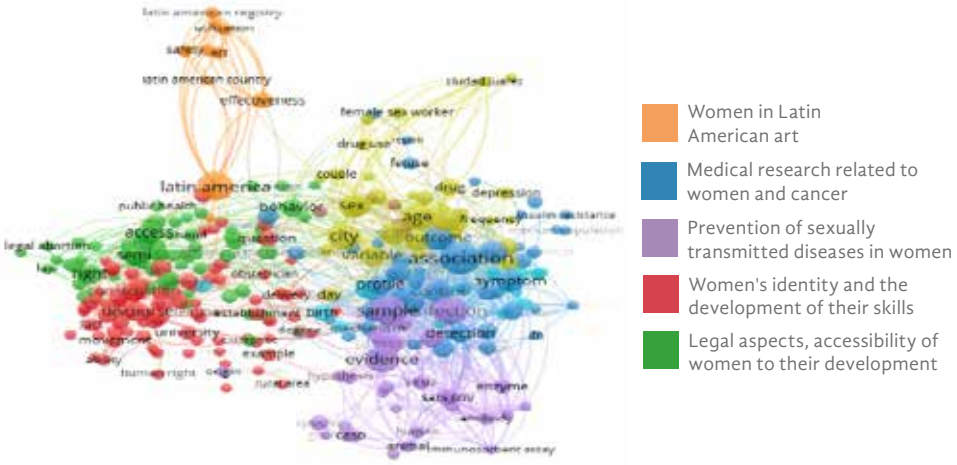

Figure 1. Bibliometric analysis of research conducted by women in Cuba

Different methods and techniques were applied at the Universidad Central "Marta Abreu" de Las Villas with female scientists of different ages through a case study, which yielded the following information:

- Insufficient preparation of women scientists in AI to determine categories.
- There is a cognitive bias concerning AIs, evidenced by the type of question.
- Girls are educated under a patriarchal regime that limits them at home to pre-established role-playing as “girls.”
- There is a tendency toward consumerism and superficiality with unattainable beauty standards for Latina women and future researchers.
- Underrepresented in degrees such as engineering.
- Women are self-limited by their role as mothers and daughters in terms of participation and representation in management and administrative positions.
- Female scientists over 60 years have the role of caregivers of elderly parents and younger children, which makes it difficult for them to play a leading role.

The general objective of this research was to diagnose the needs and potentialities of women scientists at the Universidad Central “Marta Abreu” de Las Villas, through an interpretative case study.

METHODOLOGY

IThe path followed in the research is qualitative, the course of a participatory-action-research based on the following:

> It is based on the notion of a self-reflection spiral of cycles of planning, action, observation, and reflection, with an interpretive case study. With three phases: pre-active, interactive, and post-active. It expresses a commitment to the improvement of practices and is collaborative (Creswell et al., 2007).

The study corresponds to qualitative research of a transformative and evaluative nature, taking into account the interconnection established between the epistemological and methodological processes, where the subjectivities of the participants in the contextualized practice and the qualification of the data that emerge from the different stages of the research process itself are taken into account. The following research methods and techniques were used:

- Document analysis, aimed at assessing the theoretical links and regularities of female researchers.

- Participant observation, to collect data in the scenario for future girls researchers, families, teachers, and Chat GPT. It allows the recording of the data obtained from the observations made in a systematic way, focusing on the categories and subcategories emanating from the first stage.
- The researcher's journal collects detailed qualitative data at each of the investigation stages.
- In-depth interviews with women and men who study science at university, teachers, and Chat GPT to collect enough information about their needs and potential; according to the established units of analysis.
- Product of the activity and role plays with the future female researchers.

The researcher simply seeks to become familiar with the nature and scope of the area under study and is oriented towards achieving a basic knowledge of the phenomenon, as well as the fundamental issues and problems involved in it. Participants were selected, units of analysis were determined, and categories and subcategories were designed with the use of artificial intelligence.

Four units of analysis were taken into account to carry out this research:

First unit of analysis: five girls between 10 and 17 years old, who are contestants in subjects such as mathematics and physics at the provincial level, relatives of the authors of this research, which allowed the data to be taken on stage.

Second unit of analysis: six young girls between 17 and 25 years old, students and recent graduates of the degrees of economic sciences of the Universidad Marta Abreu de Las Villas, five women, and one man hold a gold title, with an academic index of five points; three titles to scientific merit that are awarded to students who participate in national and international events and publish their scientific results in indexed journals.

Third unit of analysis: six female researchers between the ages of 30 and 50 of whom one has a bachelor's degree, four have a master's, and one a doctorate degree, all professors at the Universidad Marta Abreu de Las Villas.

Fourth unit of analysis: five female researchers between 50 and 75 years old, all with a doctorate, degree coordinators, managing international projects, editors, and judges of indexed journals; scientists recognized in their branch nationally and internationally.

DEVELOPMENT

Pre-Active Phase

This phase takes into account the preconceptions about the research topic, the previous information, the intended objectives, the case selection criteria, and the influences of interactions of the context; the materials, resources, and techniques are determined.

To collect the data in the scenario, three researchers from the age groups of the analysis units were selected. A study of the categories and subcategories was done for this research. With this in mind, the use of artificial intelligence is a specialist criterion.

ChatGPT is a language model developed by OpenAI that uses natural language processing techniques to generate coherent and natural responses in real-time and has been trained on a wide variety of tasks. This system is an artificial intelligence that has been having a huge impact on society since mid-December 2022, and it seems that it will continue in the short and medium term. Faced with this circumstance, as researchers, we must find ways to incorporate this AI into our research routines (Lopezosa & Codina, 2023).

The objective of the stage was to determine categories and subcategories with the use of AI as a specialist criterion to efficiently measure research, as well as find theoretical links in the scenario.

The methods and techniques applied were document analysis and in-depth interviews with women and AI.

The needs that arose were:

- Insufficient AI preparation to determine categories.
- Cognitive bias concerning AI, which is evidenced by the type of question.
- Connectivity needs.

The potential was:

- Female researchers are committed to studying and analyzing their reality.
- Extensive information search.

The contextual category and subcategory of female researchers were:

a) Historical and social context of female scientists. This refers to the analysis of the conditions, challenges, opportunities, and contribu-

tions of female scientists in different times and places, as well as their relationships with gender, culture, politics, and the economy.

b) The academic and professional trajectory of female scientists. This subcategory refers to the analysis of the factors that influence the access, permanence, development, and recognition of female scientists in the educational and labor fields.

The category and procedural subcategories of female researchers were:

a) Challenges and opportunities for women in academia and research. It explores the barriers and benefits women face in academia and science, such as discrimination, harassment, the pay gap, family balance, access to resources, recognition, and leadership.
b) Participation and representation of women in academia and research. Here we analyze the percentage and profile of women engaged in science and higher education, as well as their distribution by areas and levels.
c) Training and development of women in academia and research. Here we study the factors that influence women's choice and performance in scientific and academic degrees, such as education, guidance, motivation, creativity, innovation, and collaboration.

The attitudinal category and subcategories of female researchers were:

a) Intellectual curiosity and restlessness. It was measured by the desire to learn, explore, discover, and understand the world and its phenomena, as well as to solve scientific problems, challenges, and enigmas.
b) Vocation and personal satisfaction. The feeling that science is the activity that most closely matches personal skills, tastes, and values, as well as the source of fulfillment, pleasure, and well-being, was analyzed.
c) Recognition and prestige. Appreciation, respect, and admiration of peers, institutions, and society for the scientific work carried out, as well as access to opportunities for professional and academic development, were taken into account.

This interaction with AI allowed the researchers to excel in areas not sufficiently addressed so far.

Interactive Phase

In this phase, the data was obtained according to the units of analysis of the future researchers within the family from 2022-2023.

First unit of analysis: five girls between 10 and 17 years old, who aspire to become researchers.

The methods and techniques applied were: document analysis, in-depth interviews, and participant observation. The objective of the stage was to measure categories and subcategories emanating from the previous stage and reach partial conclusions.

The needs arising from the observation of the girls were:

- Girls are educated under a patriarchal regime that limits them at home to pre-established role-playing as “girls.”
- Young women are hindered in love relationships compared to the male gender and are stimulated to improve.

The potential emanating from the observation of the girls were:

- Girls are stimulated to communicate their feelings: "They can cry"; manifestations that are forbidden to boys, which will influence them to opt for humanities degrees in adulthood, being insufficient in engineering careers.
- They are stimulated to perform household chores which will allow them to validate themselves in adulthood.
- Women present a social burden in overcoming the feeling of “standing out” to men in terms of knowledge.
- Society insists on the idea of "you have to be somebody" which exerts psychological pressure to excel.

Characterization of the social-historical context of women researchers at the Universidad Central "Marta Abreu" de Las Villas, Villa Clara, Cuba 2023:

> The Universidad Central "Marta Abreu" de Las Villas is a public university located in Santa Clara, Cuba, inaugurated on November 30, 1952. The university demonstrates its category of excellence by being positioned as the number one university in Cuba and the 240th in Latin America in the Universities Web Ranking. It currently has 12 faculties and more than 50 undergraduate programs. It has 7 active diploma programs, 30 training programs, 519 postgraduate courses, 43 master's degrees, 4 postgraduate specialties, and 20 doctorate degrees. Of

the total number of participants, 7700 are women, which is 55.7% (Calderón, 2022). This is evidence of the prominence of women in science.

Second unit of analysis: Six young women between the ages of 17 and 25. The needs that emerged from the in-depth interviews with teachers were:

- In the social sphere, they perceive verbal violence towards women, devaluing them, which is not the case in the university environment. Gender-based violence against women in Cuba is related to the patriarchal Cuban cultures of specific geographic spaces. There are few publications in Cuba on gender issues, it is possible to identify the phenomenon of invisibility of the already existing and recognized feminist academics in the rest of the universities and scientific institutions of the country (Hernández, 2019).
- There is a tendency to consumerism and superficiality with unattainable beauty standards for the Latina woman and future researcher:

> The importance of fashion in Cuban society and its role as a distributor and creator of social content and modern consumer images at the same time evidences the rational and gender tensions that are transferred to changes in aesthetic models and good taste (...) Lesbia Soravilla criticizes the frivolity of this mass and consumer culture that enslaves women as objects of Cuban consumption subjected to an international market (Ruiz, 2013).

- Underrepresented in degrees such as engineering. In science, progress toward gender equality cannot be taken for granted. Progress is being made on the issue of discrimination, but women still cannot fully develop in a scientific career on an equal footing with men. Science and engineering are professions that show less progress toward gender equality than other highly skilled professions, such as lawyers and doctors (Peláiz, 2020).
- They consciously sacrifice their recreation because they possess high metacognitions. They are capable of projecting themselves in time as future researchers.

The potential observed from the in-depth interviews were:

- In our country, they are exempted from compulsory military service, which they consider an advantage over men of the same age.
- They have the same equal rights and duties in the university environment, being leaders in youth organizations:

The results show that women in Cuba face several barriers that restrict their political participation, such as limited access to political information and lower confidence in their political abilities, compounded by limited social support and the prevalence of political coercion. (Vara, 2023)

Third unit of analysis: Six female researchers aged 30 to 50 years.
The needs that emerged from the in-depth interviews with teachers were:

- As for participation and representation in management and administrative positions, they are self-limited by the role of mothers and daughters:

Women may face a more limited social support environment in terms of encouraging and promoting their political participation. Gender discrimination and traditional gender norms can lead to a lack of social support for women's political participation. (Vara, 2023)

- These women feel that motherhood can affect their professional performance, since:

In Cuba, 13% of births occur in teen mothers who should be dedicated to studying and preparing for life, so teenage pregnancy is a social phenomenon of high proportions. (Cortés et al., 2015)

Therefore, women scientists in many cases delay motherhood for fear that their career may be affected, using contraceptive methods as part of family planning, which could lead to sterility problems and, in turn, contribute to the low birth rate in the country. Taking into account that:

Procreation and having offspring have meanings for women, it is usually synonymous with the development of their maternal function, protection, affection, and education; while for men it tends to have a meaning more aimed at feelings of power, patriarchy, protection, and provide. Beyond biological reproduction, it is social reproduction and the spaces where it occurs that ultimately determine individual and collective perceptions of reproductive function and infertility. (Díaz Bernal & García Jordá, 2010)

The potentialities emanating from the in-depth interviews are:

- Women perceive that they have equal opportunities in research and are valued by their male co-workers.

- They have equal economic and social remuneration for the work they do.
- They are competent women and are emotionally satisfied, as they have reached their professional goals at a young age.

Fourth unit of analysis: Five female researchers between 50 and 75 years old.

This age group is the most represented in the country. Active aging recognizes factors and sectors and implies continuity in socially productive activities and rewarding work. It is determined by different factors. Social factors: Education, human rights, social support, among others. Personal factors: Biology and genetics, adaptability, health, and social services. Factors of the physical environment: Urban and rural areas, housing, injury prevention. Economic factors: Income, work, social protection. Behavioral factors: Physical activity, healthy eating, smoking cessation, among others. (Kindelan & Valle, 2019).

The needs that emerged from the in-depth interviews with teachers were:

- They have the role of caregivers of elderly parents and minor children. Which hinders their spotlight.

> Not infrequently, women find important scenarios of social and professional development, but they maintain an internal contradiction between the public and the private due to the leading role they play in the care of children, the sick, and the elderly in the family environment, so they must continue advancing to achieve a more leading role in the field of decision making. (Díaz et al., 2017)

- They are not sufficiently accompanied by their husbands to carry out household chores in an equitable manner, which would allow for greater professional development.

DISCUSSION

Post-active Phase

We drafted the discussion from the initial report, recorded and transcribed the discussion interview of the initial report, and after its analysis, the final report and the critical reflection on the results were written. Cuban women have a historical and social context that facilitates their professional development. They have participated in educational improvement due to the socialist process in Cuba, which enhanced culture and raised the educational level since the country provides free and quality education.

These women are encouraged in the workplace and their community context, being awarded for their professional performance.

The women surveyed recognized obstacles in the social and economic spheres that affected or slowed their professional development. They have had an emotional intelligence that has allowed them to face these difficulties and obtain the scientific and teaching categories they expected.

Middle-aged women scientists were faced with the dilemma of family consolidation and the development of full motherhood.

They are undisputed leaders in their work environment, performing under equal conditions, salaries, and opportunities as men.

In the academic training of female scientists, there is an imbalance between the exact and humanistic sciences, with the vast majority opting for the latter.

The female researchers were artificially prepared for the realization of this research, feeling motivated to use them for future research.

CONCLUSIONS

Analyzing the background and theoretical research on female scientists, first of all, it was appreciated how there are challenges for them that are currently unresolved. The study carried out revealed, with the use of artificial intelligence, the categories and subcategories that were taken into account to carry out the research at the Universidad Central “Marta Abreu” de Las Villas.

In the results of the studies carried out in the field of scientific women, units of analysis were determined that made it possible to analyze the data in the scenario and to carry out an interpretative case study at the Universidad Central “Marta Abreu” de Las Villas.

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