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Journal-Law and Economy

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Support the international scientific community in its written production Science, Technology and Innovation in the Field of Social Sciences, in Subdisciplines of Basic areas of law: Property law, Contract law, Tort law and Product liability, Criminal Law; Regulation and Business Law: Antitrust Law, Corporation and Securities Law, Regulated Industries and Administrative Law; Other Substantive Areas of Law: Labor Law, Environmental, Health, and Safety Law, International Law, Tax Law; Legal Procedure, the Legal system, and Illegal behavior: Litigation process, Illegal behavior and the Enforcement of law.

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Presentation of the content

In the first article we present, *Corn as an alternative method for contributing to the country's public policies in terms of health, sustainable economy and food security, accordance with the 2030 Agenda and FAO*, by Mina, Susana del Carmen and Quintana-Garrido, Juan Diego with adscripcion in the Universidad Tecnológica del Sureste de Veracruz, in the next article we present, *Joint mechanism of institutions of higher education for the creation a Social Innovation Ecosystem in Istmo de Tehuantepec, México*, by Landa-Torres, Iris Adriana, with adscripcion in the Universidad Veracruzana, in the next article we present, *Social impact of renewable energy: Women as agents of change from the family environment in Tamaulipas*, by González-Graziano, Augusto Federico, Picazo-Galán, Karina Alejandra, Graciano-Casas, Lucía and Hernández-Ilizaliturri, Alma Amalia with adscripcion in the Universidad Autónoma de Tamaulipas, in the last article we present, *Sustainability and Environmental Care: Social Responsibility*, by Lira-Mejía, María Carmen a, Landeros-Guerra, Martha Soledad, Villegas-Torres, María del Sagrario c and Ortiz-Rayas, Ana María, with adscripcion in the Universidad Tecnológica del Norte de Guanajuato.

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Corn as an alternative method for contributing to the country's public policies in terms of health, sustainable economy and food security, accordance with the 2030 Agenda and FAO

El maíz como método alternativo para la contribución de las políticas públicas del país en materia de salud, economía sostenible y seguridad alimentaria, acorde a la Agenda 2030 y a la FAO

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Abstract











The general objective is to determine the viability of corn as an alternative method for contributing to the country's public policies in terms of health, sustainable economy and food security, in accordance with the 2030 Agenda and the FAO, through its sowing, harvesting and processing, until it becomes a coffee substitute with a similar aroma, smell and taste to coffee, for its proof of concept. This project provides an alternative to reduce poverty through the sowing of corn, promoting the reactivation of the countryside and sustainable agriculture. Food security would be promoted with a product that is friendly to the environment and health; it would support sustained, inclusive and sustainable economic growth, full and productive employment for the sale and distribution of the product; consequently, products of this type can contribute favorably to the public policies of the country and the world.

Resumen

El objetivo general consiste en determinar la viabilidad del maíz como método alternativo para la contribución de las políticas públicas del país en materia de salud, economía sostenible y seguridad alimentaria, acorde a la Agenda 2030 y a la FAO, mediante su siembra, cosecha y procesamiento, hasta convertirlo en un sustituto de café con aroma, olor y sabor similar a éste, para su prueba de concepto. Este proyecto aporta una alternativa para disminuir la pobreza mediante la siembra de maíz, propiciando la reactivación del campo y una agricultura sostenible. Se promovería la seguridad alimentaria con un producto amigable con el medio ambiente y con la salud; apoyaría en un crecimiento económico sostenido, inclusivo y sostenible, el empleo pleno y productivo para la venta y distribución del producto, en consecuencia, productos de este tipo pueden contribuir de forma favorable en las políticas públicas del país y del mundo.

			
Objetivo: Determinar la viabilidad del maíz, acorde a la Agenda 2030 y a la FAO.	Contribución:		
			
Metodología: Naturaleza Cualitativa. Investigación de campo, documental y multidisciplinaria.			
			

Public policies, Agenda 2030, Corn

			
Objective: To determine the viability of corn, in accordance with the 2030 Agenda and the FAO.	Contributions:		
			
Methodology: Qualitative Nature. Field, documentary and multidisciplinary research.			
			

Políticas públicas, Agenda 2030, Maíz

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Peer review under the responsibility of the Scientific Committee MARVID® in the contribution to the scientific, technological and innovation Peer Review Process through the training of Human Resources for the continuity in the Critical Analysis of International Research.



Introduction

Maize is present in the country with a variety of uses, but even so, agriculture has been declining and generating migration to other cities in search of sources of employment, which is why it is a priority to find alternatives that allow this situation to be halted or diminished.

To be sustainable, agriculture must satisfy the needs of present and future generations, and at the same time guarantee profitability, environmental health, and social and economic equity; therefore, a varied use of maize would be to use it to make a drink that replaces coffee, with a smell, colour and flavour similar to coffee; A 100% natural product, free of preservatives and without artificial sweeteners that has a favourable impact on the health and food security of the population; a product that can last up to 9 months in storage without losing its quality; which would also mean that maize is required to produce the coffee substitute, so that the reactivation of the countryside in areas with fertile capacity for planting and harvesting would contribute to the sustainable economic growth of the region.

Therefore, the general objective of this paper is to determine the viability of maize as an alternative method for contributing to the country's public policies on health, sustainable economy and food security, in accordance with the 2030 Agenda and the FAO, through its planting, harvesting and processing, until it becomes a coffee substitute with aroma, smell and taste similar to coffee, for its proof of concept.

This article presents the specific objectives, the background of the project and maize, the hypotheses proposed and the methodology used to acquire the necessary results for their respective analysis.

Specific objectives

1. To search for, locate and choose a piece of land suitable for planting maize grains.
2. To fallow the land for the subsequent sowing of maize grains.
3. To sow the maize grains on a plot of land located in Ixhuatlán del Sureste for subsequent processing.

4. Harvest the main raw material.
5. Process the maize for the elaboration of the coffee substitute, for the sample of the product in a real environment (Ixhuatlán del Sureste, Ver.).
6. Produce a coffee substitute with a smell, taste and colour similar to coffee without using any chemical components.
7. Conduct interviews with people involved in agriculture on the subject.
8. Develop the proof of concept.

Background on maize

Maize is a central food in the daily consumption of most Mexicans, being a reference of history, culture and economic development in our country.

This grain belongs to the Poaceae or Gramineae family and is one of the oldest known food grains. It is considered that maize was cultivated approximately 10,000 years ago B.C.

The oldest evidence we have is from 6,250 years ago, evidence found in the cave of Guila Naquitz, in Oaxaca, a few kilometres from Mitla.

There are two theories as to the origin of maize:

1. Maize with multicentric origin, i.e., the existence of several domestication centres from different teocintle populations around 8,000 years ago, and
2. the single domestication event theory (unicentric), which proposes that populations of the teocintle of the Balsas race or subspecies *parviglumis* located in the centre of the Balsas basin (eastern Michoacán, southwestern Mexico state and northern Guerrero) gave rise to maize.

These two theories are associated with how maize originated and diversified in its different forms to adapt to specific environmental conditions and cultures.

Maize in Mexico

Mexican government intervention in the grain market dates back to 1937, when the Comité Regulador del Mercado del Trigo was founded, replaced in 1938 by the Comité Regulador del Mercado de las Subsistencias Populares, and in 1941 by the Nacional Reguladora y Distribuidora. In 1943, a consortium was created comprising the Banco Nacional de Crédito Agrícola, the Banco de Crédito Ejidal, the Comité de Aforos and the Nacional Distribuidora y Reguladora. In 1950, the Compañía Exportadora e Importadora Mexicana (CEIMSA) was founded.

The total sown area registered in 2003 in the Minatitlán-Coatzacoalcos zone was 95,055 ha, which represents 9.33% of the total area of the zone.

The main annual crops are maize, beans and grain sorghum; coffee, rubber and copra are also recognised.

Maize production and marketing in Mexico

In addition to being the grain with the highest consumption among Mexicans, in economic terms it represents a relevant issue for both market participants and public policy, due to the proportion of sown area that the grain represents, as well as the dependence on imports to satisfy domestic consumption, the market positioning of large companies and the international negotiations that have repercussions on the price of the grain.

In the case of maize, the gap between producers has widened, with the smallest stratum being the most disadvantaged, as farmers who have not disappeared have been transformed into self-consumption producers.

Project background

Since 2018 and to date, on an annual basis I plan and coordinate the Local Fair of Goods and Services, an event developed in the Multipurpose Hall of the Technological University of Southeast Veracruz (University located in the southeast of the state of Veracruz).

In which students from the Higher University Technical Education Programme in Human Capital Management presented innovative ideas, with projects that can really generate a positive footprint in the community, impacting the Sustainable Development Goals (SDGs) of the 2030 Agenda and that allow them during the course of the semester to acquire the skills, abilities and attitudes derived from the professional competencies to which the subject contributes, thus achieving a comprehensive training.

As a result of the above, field research was carried out through the Marketing subject during the period September - December 2021, to identify the feasibility of producing a beverage, this being a coffee substitute, using corn as the main raw material.

In December 2021 we participated in the 4th. Local Fair of Goods and Services at the Technological University of Southeast Veracruz, where the product was shown for the first time to the general public and some basic adaptations were shown, in accordance with the field research carried out.

In May 2022, we participated in the Local Innovation and Entrepreneurship Competition, obtaining 2nd. Place, producing a market summary and a technical-economic summary.

The project was presented at the State Week of Science and Technology on 8 and 9 November of the same year at the UT del Sureste de Veracruz sub-site.

In turn, in October 2022 the project participated in the 'SECOND CALL FOR SCIENTIFIC RESEARCH AND TECHNOLOGICAL DEVELOPMENT PROJECTS' of the Veracruz Council for Scientific Research and Technological Development (COVEICYDET), being approved in July 2023 for funding with resource allocation agreement CP 1111 1508/2023; with the above there is a project schedule from 26 October 2023 to 15 November 2024. Finally, from 26 to 29 September 2023, the product was presented at the Kaná Museum during the State Week of Science and Technology Veracruz 2023 'Dialoguing for peace: science unites us'. People of different ages tried the product and the response was extremely favourable.

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Normative Framework

United Nations (UN)

Officially established on 24 October 1945. Currently, 193 member states are represented in the General Assembly, the only place on Earth where all the nations of the world can come together and find shared solutions that benefit humanity.

Food and Agriculture Organization (FAO)

The Food and Agriculture Organization. At the heart of the United Nations development system, it leads efforts to address the world's most pressing food and agriculture challenges.

To fulfil its mandate to end hunger, FAO works closely with other UN agencies, funds and programmes, and builds on the strengths and comparative advantages of each of them.

Agenda 2030

Adopted in September 2015 by the United Nations General Assembly, it sets out a transformative vision towards economic, social and environmental sustainability for the 193 Member States that signed up to it.

It has a universal approach and is integrated with 17 Sustainable Development Goals.

Sustainable Development Goals (SDGs)

They are a planning and monitoring tool for countries, both at national and local level. Thanks to their long-term vision, they will support each country on its path towards sustained, inclusive and environmentally sound development, through public policies and instruments for planning, budgeting, monitoring and evaluation.

The SDGs are:

1. End Poverty.
2. Zero Hunger.
3. Health and Well-being.
4. Education and Quality.
5. Gender Equality.
6. Clean Water and Sanitation.
7. Affordable and Clean Energy.
8. Decent Work and Economic Growth.

9. Industry, Innovation and Infrastructure.
10. Reducing inequalities.
11. Sustainable cities and communities.
12. Responsible production and consumption.
13. Climate action.
14. Underwater life.
15. Life of terrestrial ecosystems.
16. Peace, justice and strong institutions.
17. Partnerships to achieve the goals.

Previous research

A thorough documentary research is carried out through the databases of high quality scientific and editorial journals, which can be used as documentary support for the present document, locating the following (table 1, 2 and 3):

Box 1

Table 1

Investigación previa 1

Title:	Maize in Mexico: biodiversity and changes in consumption
Authors:	Massieu Trigo, Yolanda; Lechuga Montenegro, Jesús
Magazine:	Economic Analysis
Year:	(2002)

Own elaboration

Box 2

Table 2

Preliminary research 2

Title:	Importance of Mexico's native maize in the national diet. An indispensable review
Authors:	Rocío Fernández Suárez, Luis A. Morales Chávez y Amanda Gálvez Mariscal.
Magazine:	Fitotecnia mexicana
Year:	(2013)

Own elaboration

Box 3

Table 3

Previous research 3

Title:	Analysis of the maize market in Mexico from a price perspective.
Authors:	Ester Reyes Santiago, Fidel Bautista Mayorga, José Alberto García Salazar.
Magazine:	Acta Universitaria
Year:	(2022)

Own elaboration

Hypothesis

Hi: The planting and cultivation of maize for subsequent processing and sale as a coffee substitute represents an effective and alternative method for the contribution of the country's public policies on health, sustainable economy and food security, in line with the 2030 Agenda and the FAO.

Ho: The planting and cultivation of maize for its subsequent transformation and sale as a coffee substitute does not represent an effective and alternative method for the contribution of the country's public policies in terms of health, sustainable economy and food security, in line with the 2030 Agenda and the FAO.

Methodology

- Nature of the research: Qualitative.
- Type of research: Documentary, experimental and field research.
- Research modality: Scientific.
- Knowledge areas: Multidisciplinary research.
- Areas of development: Agricultural food chain, environment and natural resources.
- Data collection technique: Observation and interview.
- Data collection instrument: Questionnaire.
- Representative sample of the farmer sector: for the selection of the representative sample for the feasibility study among farmers, the universe was taken as a reference, which will be the people actively involved in economic activities, between the ages of 18 and over, using the equation of probabilistic samples of Dr. Sampiere in the sixth edition of Dr. Sampiere. Sampiere in the sixth edition of his book *Research Methodology*, with a margin of error of 30% and a confidence level of 95%, which will be 132 economically active people in the agricultural sector in the Municipality of Ixhuatlán del Sureste between the ages of 18 and over.
- The experimental research and proof of concept was carried out in Ixhuatlán del Sureste, Ver., where the maize was planted and harvested.

- The processing was carried out in the facilities of the Technological University of Southeast Veracruz.

Impact area

Agenda 2030 of the UN General Assembly, FAO (Food and Agriculture Organization), public policies of the country immersed in the National Development Plan and the Veracruz Development Plan.

Sustainable Development Goals of the 2030 Agenda implemented:

SDG 1. End poverty in all its forms everywhere.

1.1 By 2030, eradicate extreme poverty for all people everywhere (extreme poverty is currently defined as people living on less than US\$1.25 a day).

SDG 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture

2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, livestock keepers and fishers, including through secure and equitable access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and off-farm employment.

SDG 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment.

8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation.

Resource requirements

The research will be carried out in a period from 26 October 2023 to 25 August 2024, with the support of three students of the Bachelor's Degree in Human Capital Management Educational Programme, who will have as deliverable the completion of their internship report, as well as the collaboration of two to three day workers, depending on the quarter.

Also required as a technological resource is a roaster and a mill for the transformation of corn, as well as a drone and a laptop to record data. In terms of operating expenses, the following are included: Triton 22 maize, Zinflow fertiliser, Quicelum growth regulator, Jacto Manual sprayer, Dragocson herbicide and Foley Rey insecticide.

Results

During the first quarter of work from 26 October to 25 January 2024, we looked for people who are dedicated to and have experience in agricultural work, especially in maize cultivation; after that, we searched for, located and chose a piece of land in the city of Ixhuatlán del Sureste that was suitable for maize cultivation and where the planting area would not be flooded (figure 1).

A piece of land with high and low areas was detected, where the people who will carry out the following indicated the suitability of the land for planting, so this was chosen to carry out the follow-up of the project.

Box 4



Figure 1

Land search

In the meantime, according to institutional guidelines, suppliers that meet the specifications requested for each of the required equipment are reviewed; for the purchase of each piece of equipment (roaster and mill), at least three suppliers that offer the same or similar equipment to what is required are investigated.

During this quarter, the land was fallowed, where the agricultural workers proceeded to clean the land: clearing the weeds, cutting dry trunks, removing and replanting those that prevent sunlight from entering the planting area and preparing the land for the subsequent planting of maize.

For the second quarter, from 26 January to 25 April, the overgrown weeds caused by the rains of the season and the passage of time were cleared so that the soil would be clean at the time of planting; Dragocson was also used to control the weeds.

Inputs for weed control and planting care were purchased. Traditional maize (white) and hybrid maize (Triton 22) were also purchased to compare the two crops for processing.

During the quarter, the purchased maize was planted (figure 2) and after ten days, according to the instructions provided, it was sprayed with Zinc Flow fertiliser (figure 3).

Box 5



Figure 2

Maize planting

Box 6



Figure 3

Fertiliser spraying

Source: [own elaboration]

The field was kept under constant surveillance to prevent any pests from damaging the sowing and manual watering was carried out to prevent the sowing from drying out (figure 4).

Box 7**Figure 4**

Manual water irrigation

During this period, the roaster and the mill purchased from the supplier Casa Salazar in the previous period were received (figure 5).

Box 8**Figure 5**

Roaster and mill

However, during the period from 26 April to 25 July, the field was also kept under constant care to avoid the proliferation of pests (figure 6).

Box 9**Figure 6**

Care of the land

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The plants were watered daily, as the heat waves at the beginning of sowing were atypical because the temperatures were significantly higher than expected, both in terms of intensity and duration. For this purpose, a hose with a pump was installed to draw water from the well in the area (figure 7).

Box 10**Figure 7**

Hydraulic pump installation

During this period, the roaster and mill were installed in a space within the Innovation and Creativity 4.0 Centre at the University, where the roasting and grinding process takes place. In addition, the electrical installation necessary for its function was carried out (figure 8).

Box 11**Figure 8**

Electrical installation of the toaster

For the fourth quarter, only the first month is considered for this research, from 26 July to 25 August, when the maize was harvested (Figure 9) and taken to the University facilities for processing, i.e. roasting and milling (Figure 10 and 11).

Box 12



Figure 9

Maize harvesting

Box 13



Figure 10

Roast

Box 14



Figure 11

Grinding

During this period, interviews were conducted with the agricultural sector in the municipality of Ixhuatlán del Sureste, in the state of Veracruz, obtaining the following data:

- The length of time they have been cultivating maize is 25 years.
- The youngest farmers have been farming for five years.
- Most of the interviewees have their own land, which they call ranchos.
- Some farmers make lease agreements for certain amounts of hectares, where they plant, and this agreement is renewed from time to time.

We had the opportunity to know how each one of them carries out the planting process from clearing the land to harvesting, they mention that they use fertilisers to nourish the soil and some of them prefer organic fertiliser as a second option.

The interviewees sow 2 to 3 times a year depending on the weather, after sowing it takes them approximately 5 to 6 months to harvest the cobs, and when harvesting they tend to lose 5 to 8 sacks of maize.

They all agree that growing maize is a viable business because growing maize has been their livelihood for years, although they have only done it to sell it in nearby markets and businesses; however, they showed interest in having a new option, to sell it so that it can become a substitute for coffee.

Conclusions

Developing a project focused on health, sustainable economy and food security, fundamental pillars of the Sustainable Development Goals of the 2030 Agenda, requires to a large extent the reactivation of the countryside through the planting and processing of maize.

For this reason, this project conducted the experimental study in situ in Ixhuatlán del Sureste, Veracruz, a city where 50.9% of the population lives in poverty, 36.2% is considered a vulnerable population due to social deprivation and 3.0% is considered a vulnerable population due to income.

Mina, Susana del Carmen and Quintana-Garrido, Juan Diego. [2024]. Corn as an alternative method for contributing to the country's public policies in terms of health, sustainable economy and food security, accordance with the 2030 Agenda and FAO. Journal-Law and Economy. 8[14]1-10: e1814110. <https://doi.org/10.35429/JLE.2024.8.14.1.10>

As for the occupations of the people living in this city, they are mostly domestic workers, construction support workers, sales employees, shop assistants and shop assistants, drivers, catalogue sellers, corn and bean growers, among others.

At this point it is taken into consideration that only 1.26% of the people are engaged in maize or bean cultivation, leaving land uncultivated due to the lack of farmers to do so, as young people decide to migrate to other cities to work mainly in maquilas.

The present study with the planting, harvesting and processing of maize, as well as the respective proof of concept, allowed for a ten-month analysis of the impact on health, sustainable economy and food security of the society in that region, initially and later replicated in other entities.

Interviews were also conducted with farmers in the area, who responded favourably, showing optimism that maize can be used as an alternative to coffee and that they can plant something that will actually be bought.

Now, as for the impacts that the project can generate, they are: related to health, referring to the fact that normally people who consume coffee suffer from high blood pressure, irritability, nervousness or insomnia, among others; while the consumption of this coffee substitute does not cause the above, containing a base of roasted corn grains and cinnamon, an innovative element that helps to improve circulation and blood pressure.

In terms of food safety, we know that corn provides great benefits such as Contains B vitamins and beta-carotene (provitamin A), which can give a feeling of satiety and prevents constipation.

At the same time, a sustainable economy is presented, where what is required is sown and processed for packaging and subsequent sale; without compromising future generations, as the maize continues to be sown to obtain the raw material necessary to convert it into a coffee substitute. This project would provide an alternative to reduce poverty through the sowing of maize, which in turn would promote the reactivation of the countryside and sustainable agriculture.

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It would promote food security with a product that is environmentally and health friendly. It would also support sustained, inclusive and sustainable economic growth, full and productive employment for the sale and distribution of the product, and consequently, products of this type can contribute favourably to public policies in the country and the world.

Declarations

Conflict of interest

There is no conflict of interest, nor are there any known competing financial interests or personal relationships that might have appeared to influence the article reported herein.

Authors' contribution

Mina, Susana del Carmen: Generated the idea, identifying the need, methodology and phases of the project.

Quintana-Garrido, Juan Diego: The co-author contributed to the Policy Framework, linking the SDGs to the project.

Availability of data and materials

The data obtained in this research is available for reading and citation.

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To my students who know that they can be a fundamental part in generating positive changes in society, in the environment and in the economy.

To Finita, my mother.

Abbreviations

FAO	Food and Agriculture Organization
ODS	Sustainable Development Goals
ONU	United Nations

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Background

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Joint mechanism of institutions of higher education for the creation a Social Innovation Ecosystem in Istmo de Tehuantepec, México

Propuesta de mecanismo de articulación entre Instituciones de Educación Superior para impulsar primer Ecosistema de Innovación Social en el Istmo de Tehuantepec, México

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Abstract



In 2023, was announced the Universidad Tecnológica del Sureste de Veracruz (UTSV) as the host of the first Industrial Innovation Center of the Isthmus of Tehuantepec. Since then, we develop mechanisms that facilitate the establishment of the first Social Innovation Ecosystem. The objective of this article is to describes the efforts made concerning the proposal and designing a Social Innovation Ecosystem. The first stage, the implementation of “The IES Articulation Mechanism” as an action complementary to the promotion of the Program for the Development of the Isthmus of Tehuantepec and the Interoceanic Corridor of the Isthmus of Tehuantepec. A critical path and articulation mechanism were designed based on the loose coupling proposal. The contribution of this article is the documentation of mechanisms for collaborative work to promote social innovation among Higher Education Institutions to achieve local development.

Resumen

En 2023 se anunció que la Universidad Tecnológica del Sureste de Veracruz sería sede del primer Centro de Innovación Industrial del Istmo de Tehuantepec. Desde entonces se ha trabajado en desarrollar instrumentos que faciliten la instauración del primer Ecosistema de Innovación social. El objetivo de este artículo es describir los esfuerzos realizados para operacionalizar la propuesta y diseñar un Ecosistema de Innovación Social en el Istmo de Tehuantepec y la puesta en marcha de una primera etapa “El Mecanismo de Articulación IES” como acción complementaria para el impulso del Programa para el Desarrollo del Istmo de Tehuantepec y el Corredor Interoceánico del Istmo de Tehuantepec. Se diseñó una un mecanismo de articulación basado en la propuesta organizacional de los acoplamientos flojos. La contribución de esta ponencia es la documentación de mecanismos de trabajo colaborativo para impulsar la innovación social entre las Instituciones de Educación Superior e impulsar el desarrollo local.

Propuesta de mecanismo de articulación entre Instituciones de Educación Superior para impulsar primer Ecosistema de Innovación Social en el Istmo de Tehuantepec, México.		
Aim	Methodology	Conclusions
Describes the proposal and desing of a Social Innovación System in the Isthmus of Tehuantepec 	The design of a critical route for the first stage of a Joint Mechanism 	Loosely coupled joint ↓ Coordinated according to Leyton ↓ Development according to Löwit ↓ (agreements, training, commitment letter, equipment)

Social Innovation Ecosystem, Joint Mecanism, Istmo de Tehuantepec

Propuesta de mecanismo de articulación entre Instituciones de Educación Superior para impulsar primer Ecosistema de Innovación Social en el Istmo de Tehuantepec, México.		
Objetivo	Metodología	Conclusiones
Describir el primer Ecosistema de innovación social en el Istmo de Tehuantepec 	Elaboración de una ruta crítica para un mecanismo de articulación 	Articulación flojamente acoplada ↓ Coordinación nivel según Leyton ↓ En desarrollo según nivel de maduración de LÖwik ↓ (Acuerdos, Formación, Carta compromiso, catálogos de

Ecosistema de innovación social, Mecanismo de articulación, Corredor Interoceánico del Istmo de Tehuantepec

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Peer review under the responsibility of the Scientific Committee **MARVID**[®]- in the contribution to the scientific, technological and innovation **Peer Review Process** through the training of Human Resources for the continuity in the Critical Analysis of International Research.



Introducción

The Isthmus of Tehuantepec is located between the states of Oaxaca and Veracruz, is the narrowest land area in North America, between the Pacific Ocean and the Gulf of Mexico has a distance of 300km, which makes it a very attractive and competitive space in the field of global logistics platforms. (Programa Istmo, 2023).

This region is an opportunity for the creation of a multimodal platform that offers new maritime routes and rail connections to reduce travel times, as well as the opportunity to develop regional cabotage and connect local, national and international markets. Finally, the Isthmus region is rich in natural, human, energy and water resources, making it an integral and attractive space to promote regional development and economic growth.

For centuries, the Isthmus has attracted countless governments, companies and projects that have been interested in installing infrastructure to take advantage of its competitive and comparative advantages. It was during the current federal government (2019-2024) that the Interoceanic Corridor of the Isthmus of Tehuantepec (CIIT) project was presented, the backbone of a broader planning process headed by the Programme for the Development of the Isthmus of Tehuantepec (PDIT).

The PDIT is an integrated project that is based on the CIIT but seeks to promote other complementary strategies, including the Poles of Development for Wellbeing (PODEBIS) that have proposed the creation of an Industrial Production Ecosystem, aimed at developing industrial corridors that promote the productive vocations of the region (agro-industry, food, metals, wood, transport equipment, petrochemicals, textiles, chemicals, plastics and rubber, and machinery and equipment) to include the communities of the region and trigger regional development.

On the other hand, the Technological University of Southeast Veracruz (UTSV) is strategically located in the city of Nanchital, Veracruz, right in the middle of 4 PODEBIS, with physical spaces, specialised laboratories, recognised researchers and the political disposition to collaborate hand in hand with the Isthmus Programme.

On 22 August 2023, the UTSV officially announced the creation of the first Centre for Industrial Innovation in the Isthmus of Tehuantepec (CEIIT), the first of a 'Network of Industrial Innovation Centres of the Isthmus of Tehuantepec' as an initiative to strengthen human capital with the aim of 'raising regional competitiveness, the attraction of investment and the development of jobs with greater added value, enabling a cutting-edge, collaborative and innovative technological environment, operated on a triple helix strategy but with a penta helix implementation, which supports entrepreneurs, as well as micro, small and medium enterprises, to strengthen their capacity for innovation, technological adoption and digital transformation; favouring the consolidation of the regional innovation ecosystem'.

The CEIIT is directly linked to Priority Objective 2 of the Tehuantepec Isthmus Development Programme 'Promote a new model of economic growth for development for the benefit of the entire population of the Isthmus of Tehuantepec', Specific Action 2.1.3 'Promote the development of innovation in the agricultural and livestock sectors, processing industry and services to increase the welfare of the population of the Isthmus of Tehuantepec'.

The Innovation Centre to be installed in the UTSV will focus on meeting the technological and training needs, particularly those generated within the development poles in:

- Coatzacoalcos I
- Coatzacoalcos II
- Jáltipan
- Texistepec

The Centre's mission is 'to be a reliable mechanism for the articulation of penta-helix efforts that promote innovative and endogenous development of the productive chains of the Isthmus of Tehuantepec region'; its general objective is 'to contribute to the development of the productive chains of the Isthmus of Tehuantepec region, through the training of local talent and attention to technological needs for the acceleration of technological adoption processes and the increase of innovation capacities for the development of products with greater added value'.

The first specific objective consists of ‘Implementing an Industrial Innovation Centre that contributes to increasing regional competitiveness, attracting investment and the development of jobs with higher added value, particularly for entrepreneurship and MSMEs’, the goal of this objective being ‘Design, installation and implementation of an Industrial Innovation Centre of the Isthmus of Tehuantepec Campus Coatzacoalcos at the Technological University of Southeast Veracruz equipped with 4.0 technologies’; being the Higher Education Institutions (HEI) a strategic actor for the processes of Innovation and Technological Development, the development of Human Talent and Technological Adoption.

Although the first Industrial Incubation Centre is planned at the UTSV, it has been indicated that this effort requires collaboration and inter-institutional cooperation with other HEIs in the region, in a first stage, to later connect with other innovation centres in other parts of the country and the world.

In the medium term, the participation and collaboration of the private initiative and business organisations is also projected, which in a first stage were brought together in the framework of the Collaboration Agreement for the ‘Strengthening of knowledge for productive activity and human development in the Isthmus of Tehuantepec’ signed on 19 December 2021.

This effort faces the challenge of moving from the design to the implementation of the Industrial Innovation Centre, as well as achieving an effective communication mechanism to establish clear and precise channels for inter-institutional collaboration.

Thus, this article presents the documentation and proposal of an articulation mechanism and the critical path for the implementation of the Industrial Innovation Centre at UTSV.

Ensuring that the Innovation Centre is the core of a social Innovation Ecosystem that drives industrial development, as well as the inclusion of the community to achieve local development.

Theoretical Foundations

Social Innovation Ecosystems

Social innovation is understood as the ‘development and implementation of new ideas for the satisfaction of social needs and the creation of new social partnerships, which are not only concerned with the provision of goods, but also with the development of the capabilities of individuals’. ([Foro Consultivo Científico y Tecnológico AC, 2017](#)), this implies that social innovation generates:

- Social value and contributes to human development and well-being,
- Collectively builds the future of a community, establishes new ways of doing things and
- It establishes new ways of doing things and achieves better outcomes
- Offers cost efficiencies
- Strengthens the participation of the community itself and the beneficiaries; and
- Generates citizen actors of democracy.

Social innovation must be managed from a systemic approach that is preferably generated in intersectoral spaces, so these exchanges and flow of work and information generate social innovation ecosystems. A social innovation ecosystem is considered to be:

[...] a living entity in which diverse actors interact is also the set of relationships and flows of resources and knowledge, which allows their assimilation in all aspects, giving rise to the emergence of entrepreneurship ([Foro Consultivo Científico y Tecnológico AC, 2017, pág. 41](#)).

According to the report Mapping the World of Social Innovation, an ecosystem of social innovation requires certain enabling factors, including: active civil society, financing, new technologies, networks and cooperation platforms between different strategic actors, a supportive legal framework and the political will to drive change. ([Sotelo Marquez, 2018](#)). The importance of generating a social Innovation Ecosystem is the capacity to generate strong interconnections that end up in new hybrid and flexible organisational models that facilitate communication, work and the achievement of established objectives and goals, above all, it promotes the incorporation and inclusion of different actors of a community, benefiting everyone equally.

From the theoretical review of Innovation Ecosystems, the priority of generating organisational models that allow articulation to facilitate communication and the flow of ideas and information stands out. Therefore, in the first stages for the creation of the Social Innovation Ecosystem of the Isthmus of Tehuantepec, a mechanism of articulation between Higher Education Institutions (HEIs) was proposed to ensure prompt and coordinated responses to the needs of the region in terms of industrial development, innovation, development of productive projects and the solution of needs and problems of the Isthmus region.

Loosely Coupled Organisms

As the HEIs are a strategic actor to consolidate the implementation of the first Centre for Industrial Innovation in the Isthmus of Tehuantepec (CEIIT), there must be a strategy that facilitates communication, synergy and collaborative work that leads to the achievement of the main objectives and goals established by the CEIIT. This implies an effort to eliminate individualism in decision-making and to consolidate a loosely coupled articulation, understanding this idea as “the image that coupling events gives answers, but that each event also retains its own identity and some evidence of its physical or logical separation” (Weick, Caldera- González, & Ortega-Carrillo, 2009, pág. 95). The advantages of those organisations that opt for loose couplings are (See figure 1):

Box 1

Can provide a sensitive detection mechanism	perception is more precise when a medium perceives a thing and the medium contains many independent elements that can be delimited on the outside.
May be good for localized adaptation	If all the elements in a large system are loosely coupled together then any one element can adapt and modify a single local contingency without affecting the entire system. These local adaptations can be rapid, relatively inexpensive and substantial.
A greater number of mutations and novel solutions can be retained	Greater “cultural security is preserved, which is called upon in times of radical change, providing solutions to problems and greater diversity for adaptation.
Quickly adaptable to unique local conditions and problems	If there is a breakdown in any part of the system, this breakdown is closed and does not affect other parts of the organization.
Should be relatively inexpensive to get up and running	The reduction in the need for coordination results in fewer confluences, fewer inconsistencies between activities, fewer discrepancies between categories, and the activity “keeps coordination costs to a minimum.”

Figura 1

Advantages of loosely coupled organisations. Elaborated with information from Weick, Caldera-González & Ortega-Carrillo (2009).

Loose couplings can take advantage of the combination of other methodologies and articulation processes, however, Weick, Caldera-González, & Ortega-Carrillo (2009) identify certain elements for the generation of an agenda for loose coupling between organisations (See Figure 2).

Box 2

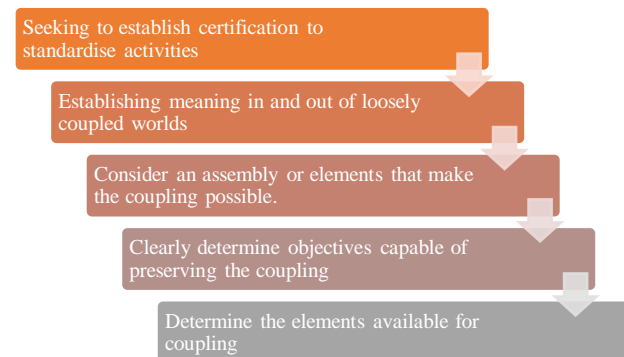


Figura 2

Loose coupling agenda. Elaborated with information from Weick, Caldera-González & Ortega-Carrillo (2009).

Loose coupling is a basic proposal for the construction of articulation mechanisms, understanding articulation as the synergy that results in the joint action of two or more actors, and whose value exceeds their simple sum. Leyton (2018) citing Corbett and Noyes recognises that articulations can reach up to six levels of intensity (see Figure 3).

Box 3

Communication	• Information is discussed and exchanged
Cooperation	• Working groups or committees are established to provide general support and exchange information on each other's programmes, services and objectives.
Coordination	• It is characterised by the presence of formal intra-institutional agreements to coordinate, and where agencies and individuals engage in joint planning and coordination of agendas, activities, objectives and events.
Collaboration	• Agencies, individuals or groups voluntarily give up a part of their autonomy in order to achieve mutual gains or results, which implies centralised functional management.
Convergence	• Real restructuring of services, programmes, membership, budgets, missions, objectives and staff with contractual provisions for reallocation of funds, shared resources and a lead agency.
Co-solidation	• There are multi-agency and multi-disciplinary plans and budgets, inter-agency teams for continuous service delivery, merged planning, shared human capital and fixed assets.

Figura 3

Levels of articulation. Elaborated with information from Leyton (2018)

According to Löwik, Oude Alink, & Pulles (2017) in an innovation campus, defined by the author as a new innovation ecosystem that is located in a specific geographical space, with a building equipped with high quality technology, which houses innovation practices among residents and partners, which is oriented to business development; there are levels of maturity, which may vary depending on the specific characteristics of the project, complexity and participants. In general, an innovation campus understood as an ecosystem or a living lab according to Schuurman, Herregodts, Georges & Rits (2019) has four stages in its life cycle: birth, growth, maturation and adaptation; in each stage, the articulation requirements vary, in figure 4 the levels of maturity in an innovation campus can be visualised.

Box 4

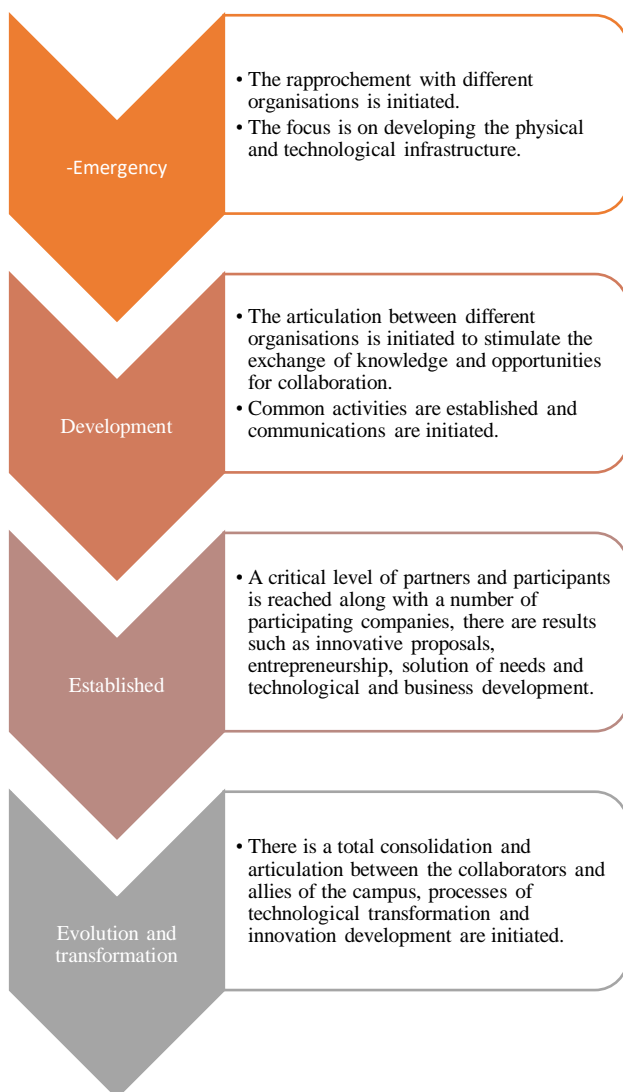


Figura 4

Levels of maturity in an innovation campus. Own elaboration with information from Löwik, Oude Alink & Pulles (2017)

Marco Normative

The proposal to create Social Innovation Ecosystems is aligned with the National Development Plan 2019-2024 (Gobierno de México, 2019), the Education Sector Plan 2019-2024 (Diario Oficial de la Federación, 2020), the Regional Programme of the Isthmus of Tehuantepec 2020-2024 (Diario Oficial de la Federación, 2020a), the Isthmus Programme 2023-2024 (Diario Oficial de la Federación, 2023), the Veracruz Development Plan 2019-2024 (PVD) (Gaceta Oficial, 2019) and the 2030 Agenda (Naciones Unidas, 2015).

With respect to the NDP 2019-2024 it is aligned to:

Axis 1. Policy and Government

- i. Ensuring employment, education, health and welfare.
- ii. Ethical regeneration of institutions and society
- iii. Specific strategies

Axis 2. Social policy

- i. Potentiators of welfare programmes

Axis 3. Economy

- i. Detonating growth
- ii. Regional Programmes

2. Programme for the Development of the Isthmus of Tehuantepec

The education sector plan is aligned to:

- Priority Strategy 2.7 Guarantee the right of the population in Mexico to enjoy the benefits of the development of science and technological innovation, by promoting scientific, humanistic and technological research.
- Specific action 2.7.5 Develop programmes in emerging areas to contribute to the sustainable solution of national and regional technological problems.
- Specific action 2.7.6 Establish regional research and postgraduate centres, laboratories and social innovation networks operating as consortia of HEIs, with emphasis on the less developed areas of the country, in particular the Central-South and South-South-East regions.

- Specific action 2.7.7 Encourage the social commitment of HEIs to form skilled, responsible and honest citizens, as well as projects that offer sustainable solutions to the challenges of their communities and the country.
- Priority Strategy 6.4 Strengthen vertical and horizontal coordination for the implementation of the new National Education Agreement.
- 6.4.6 Define effective mechanisms for state linkages between HEIs, government bodies, business organisations and civil society organisations for the relevance of the educational offer, scientific and technological innovation and its application in the territories.

In relation to the Isthmus Programme

Priority objectives

1. Strengthen social and productive infrastructure in the Isthmus of Tehuantepec region.
- Priority Strategy 1.3 Strengthen social infrastructure in terms of basic services in urban and rural networks and equipment for health, culture, education and public spaces to ensure the integral development and well-being of the population in the Isthmus of Tehuantepec region.
 - Specific activity 1.3.4 To build and improve urban and rural equipment in the sectors of health, culture, education and public spaces for the urban and rural localities of the Isthmus of Tehuantepec.
- 6.2 Promote a new model of economic growth for the development for the benefit of the population of the Isthmus of Tehuantepec.
- Priority Strategy 2.1 Design and implement, based on the productive holidays of the Isthmus of Tehuantepec, programmes that generate productive linkages with regional value chains that favour the increase of productivity in all sectors of the Isthmus of Tehuantepec.
 - Specific activity. 2.1.3 Promote the development of innovation in the agricultural and livestock sectors, the processing industry and services to increase the wellbeing of the population of the Isthmus of Tehuantepec.

6.3 Ensure the articulation of emerging actions for the population living in extreme poverty in the Isthmus of Tehuantepec.

- Priority strategy 3.1 Link the Mexican Government's public policy to increase the scope of attention to the vulnerable population of the Isthmus of Tehuantepec.
- Specific action 3.1.1 Take steps to ensure that agencies and other public institutions analyse schemes to focus resources from budgetary programmes on the 79 municipalities of the Isthmus of Tehuantepec, especially those with the highest incidence of extreme poverty.

The Veracruz Development Plan contributes to the axes of Economic Policy, Education and Human Development, particularly to the strategy that seeks to reduce poverty, inequality and social vulnerability through work that stimulates productivity in the communities.

Finally, the CEIITs also contribute to the 2030 Agenda, in particular to SDG 9 'Industry, innovation and infrastructure', which promotes the construction of infrastructure and promotes inclusive, sustainable and innovative industrialisation. It also indirectly aligns to SDGs 1, 2, 4, 8 and 10.

Methodology

Based on the rationale of the Social Innovation Ecosystem and the importance of articulation for the correct flow of ideas, information and collaboration, as well as its alignment with the national legal framework and the 2030 Agenda.

It was recognised that for the first CEIIT to be installed at UTSV it was necessary to implement methodologies that would establish the first steps of strategic planning.

To this end, a critical path for the implementation of an HEI articulation mechanism in the Isthmus region was implemented.

The 'critical path' is a methodology that identifies the activities to be carried out within a process. In this case, the process to be addressed by this critical path is the implementation of the Social Innovation Ecosystem of the Isthmus of Tehuantepec.

The colours established in the route correspond to a traffic light system where green means activity in process, yellow means activity in design, orange means activity in research process and red means activity not started.

In addition to the critical route, the first steps of an articulation mechanism between HEIs in the Isthmus region were designed based on Weick's proposal with loosely coupled organisations, Leyton (2018) to measure the degree of articulation and Löwik, Oude Alink & Pulles (2017) on innovation campuses.

Results

The critical path established the need for at least 6 first steps for the implementation of the first CEIIT within the UTSV facilities, by the second quarter of 2024, the first step has been fully achieved and is therefore in green, the next two steps have been advanced through meetings, discussion forums and agreements in working tables; steps 4 and 5 are in orange as they have started the design of the coordination, The last two steps are in red because they have not started their work (See figure 5).

Box 5

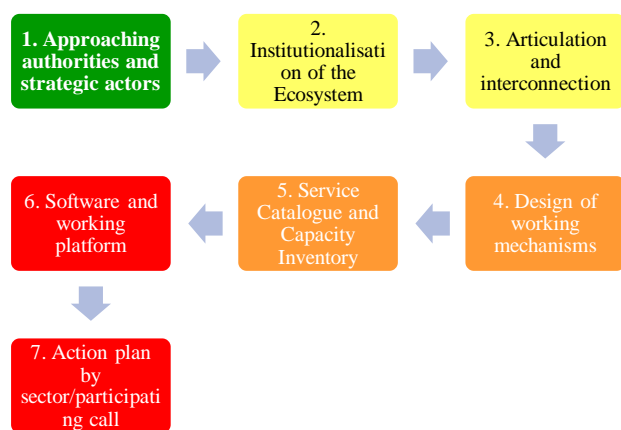


Figure 5

Critical path CEIIT

Own elaboration

Step 3 "Articulation and interconnection" resulted in the articulation proposal which takes up the idea of loosely coupled articulations, since HEIs and Research Centres respond to different legal constitutions and types of organisations, the idea of loose coupling allows them to collaborate, coordinate and cooperate without losing their individuality, nor violating any normative framework governing them.

Thus, Figure 6 presents the proposal for an articulation mechanism recognising that loose coupling will allow for a "coordination" level of articulation, i.e. formal inter-institutional agreements are presumed to allow for coordination between the entities, this level of coordination will entail joint planning, coordination of agendas, objectives and activities.

This mechanism is in a stage of development and the most important achievements are the proposal of a "Training of trainers" training, the signing of a letter of commitment for collaboration and a "Catalogue of laboratory equipment" has been initiated to measure the capacities of HEIs, making it clear that UTSV will function as headquarters and as an articulating node (see figure 6).

Box 6

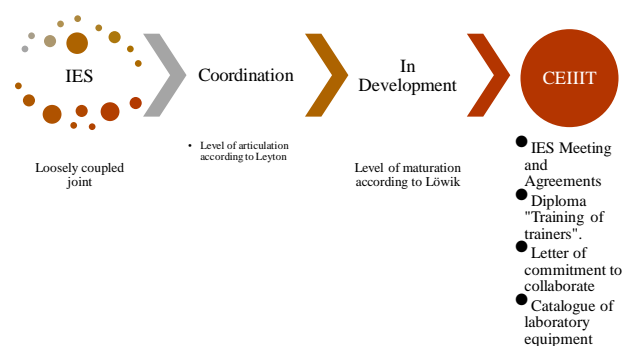


Figure 6

Proposed articulation mechanism. Own elaboration

Figure 7 shows the composition of the first CEIIT based at UTSV, in addition to working under the paradigm of the Penta-helix, it would seek the complementation of efforts by aligning and integrating information through a Development Observatory, promoting Programmes and Public Policies, the alignment and cooperation of the different Incubation Centres, Growth Nodes, Innovation Centres, Innovation Centres, Academic and Institutional Networks of Higher Education, all this linked and in coordination with different Chambers of Commerce, governmental agencies, PODEBIS and those companies that would be installed in the CIIT.

This composition would also imply the efficient and effective use of technological and frontier resources, the advances in the different lines of research and the work carried out according to the region's vocations. In addition to the work models that the Technological Universities and the Polytechnics particularly keep, such as the Dual Model, Language certification, training for work through CONOCER, and the NODOS.

Box 7

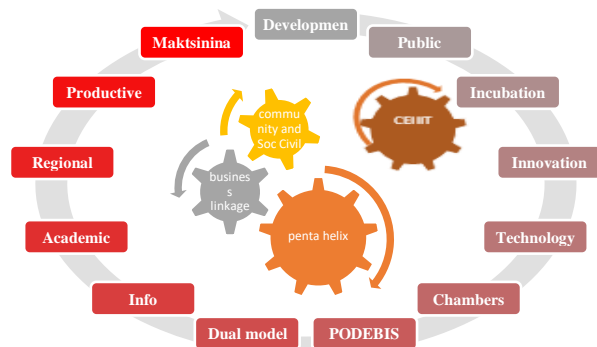


Figure 7

Composition of the first CEIIT

Own elaboration

Conclusions

Loose coupling is considered to give certainty to the institutional independence of each of the participants, while at the same time offering spaces for collaboration and the generation of innovative knowledge in an economical and efficient way. Finally, loose coupling will also allow other institutions to join or leave the alliance in the medium term, as well as to adapt to the needs of the environment.

It will be necessary to determine the ideal or desired level of articulation for the CEIIT, however, it is possible to start with the first 4 levels based on specific mechanisms that facilitate the articulation process.

From the description of the levels of maturity it is possible to determine that CEIIT is in transition between the level of emergence and development, since there is a multidisciplinary group for the strengthening of human and productive talent in the region, as well as space, infrastructure and strategic allies.

And we initiated a process of articulation mainly between HEIs to be able to respond to the needs and challenges that the implementation of the CEIIT implies.

At present, the speed of coupling between HEIs and the coordination of the work is on hold due to the campaigns and the presidential election that took place in recent months, as well as the upcoming change of federal government. The CIIT and the PODEBIS are expected to have a high chance of continuity, and CEIIT also has the opportunity to remain within the programmes and public policies of the next federal government.

In order to achieve a complete articulation, implementation and proper functioning of the CEIIT, some opportunities must be seized and certain challenges that have arisen must be addressed.

One of the most important opportunities is the political will that existed during the government of President Andrés Manuel López Obrador and that the incoming president Claudia Sheinbaum Pardo has mentioned will continue in relation to promoting the Isthmus Programme and the CIIT.

In addition, the Inter-institutional Group for Human Strengthening in the Isthmus of Tehuantepec, which has been in session for the last three years, has been in constant communication and has signed letters of commitment. The HEIs and academic bodies that have participated in the inter-institutional groups are represented by leaders and agents of change committed to the Isthmus region and to the regional development and well-being of the Isthmian population.

The main challenges include institutionalising agreements to give continuity to the articulation mechanism, achieving individual and joint budgets to consolidate the first CEIIT and collaborative work, strengthening communication systems, digital platforms as channels of communication and information flow, and identifying capacities to address the problems of Industry 4.0 that will be installed in the PODEBIS of the Interoceanic Corridor of the Isthmus of Tehuantepec.

In conclusion, the implementation of the first Industrial Innovation Centre of the Isthmus of Tehuantepec has the opportunity to be consolidated and strengthened, the articulation mechanisms and the critical path documented in this article were validated by the inter-institutional groups, so its execution is possible, relevant, replicable and scalable.

Declarations

Conflict of interest

The author declares that she has no conflict of interest. She has no known competing financial interest or personal relationship that would have appeared to influence the article reported in this article.

Author contribution

Landa-Torres, Iris Adriana. I contribute to the idea, research, development, and the conclusions. The complete article was designed, written and reviewed by my self.

Availability of data and materials

The datasets used or analyzed during the current study are available from the corresponding author upon reasonable request.

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Abbreviations

CEIITT Industrial Innovation Centre of the Isthmus of Tehuantepec

CIIT Isthmus of Tehuantepec Interoceanic Corridor

IES Higher Education Institutions

PDIT Programme for the Development of the Isthmus of Tehuantepec

UTSV Technological University of Southeastern Veracruz

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Social impact of renewable energy: Women as agents of change from the family environment in Tamaulipas

Impacto social de las energías renovables: Las mujeres como agentes de cambio desde el entorno familiar en Tamaulipas.

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Abstract

The research on the potential of renewable energy to empower women in Tamaulipas is crucial in the current social context. By addressing the integration of values, technologies, and socio-emotional education, this study proposes a comprehensive approach to improve quality of life and foster peace in rural and indigenous communities. Implementing renewable energy not only generates economic opportunities for women but also promotes social cohesion and sustainable development. Moreover, this research highlights the need for public policies supporting training, access to financing, and gender equality in the energy sector. Including critical reflections and empirical analyses, the study provides a practical guide to transform the educational and energy systems, benefiting both women and their families in Tamaulipas.

Objective	Methodology	Conclusion
This study proposes a comprehensive approach to improve the quality of life and foster peace in rural and indigenous communities.	The implementation of renewable energies not only generates economic opportunities for women, but also promotes social cohesion and sustainable development.	The study provides a practical guide to transform the education and energy system, benefiting both women and their families in Tamaulipas.

Renewable energy, Women empowerment, Public policies

Resumen

La investigación sobre el potencial de las energías renovables para empoderar a las mujeres en Tamaulipas es crucial en el contexto social actual. Al abordar la integración de valores, tecnologías y educación socioemocional, este estudio propone un enfoque integral para mejorar la calidad de vida y fomentar la paz en las comunidades rurales e indígenas. La implementación de energías renovables no solo genera oportunidades económicas para las mujeres, sino que también promueve la cohesión social y el desarrollo sostenible. Además, esta investigación resalta la necesidad de políticas públicas que apoyen la capacitación, el acceso a financiamiento y la igualdad de género en el sector energético. Al incluir reflexiones críticas y análisis empíricos, el estudio proporciona una guía práctica para transformar el sistema educativo y energético, beneficiando tanto a las mujeres como a sus familias en Tamaulipas.

Objetivo	Metodología	Conclusión
Este estudio propone un enfoque integral para mejorar la calidad de vida y fomentar la paz en las comunidades rurales e indígenas.	La implementación de energías renovables no solo genera oportunidades económicas para las mujeres, sino que también promueve la cohesión social y el desarrollo sostenible.	El estudio proporciona una guía práctica para transformar el sistema educativo y energético, beneficiando tanto a las mujeres como a sus familias en Tamaulipas.

Energías renovables, Empoderamiento de mujeres, Políticas públicas

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Importance and Relevance of Research: Renewable Energy for the Empowerment of Women and Families in Tamaulipas

Research on the potential of renewable energy to empower women in Tamaulipas, especially in rural areas and indigenous communities, is of vital importance in the current social context. This study not only addresses an urgent need for energy sustainability but also focuses on the positive social and economic impact it can have on women and their families, fostering values and a culture of peace in Mexican and Latin American society.

Social Context and Relevance

The implementation of renewable energies in Tamaulipas can be a powerful tool for the economic and social empowerment of women. In rural and indigenous communities, where economic opportunities are limited, renewable energy can open new income streams and improve quality of life. The inclusion of women in this sector not only promotes gender equality but also strengthens family and community structures, contributing to social cohesion and sustainable development.

Impact on Women and Families

Access to renewable energy enables women to start businesses related to solar and wind energy, from installing and maintaining solar panels to selling energy equipment. This not only creates jobs but also fosters women's economic independence, reducing the gender gap in the labor market. Additionally, renewable energy can provide reliable and affordable electricity in remote areas, improving health, education, and overall family well-being (Mileva et al., 2016; Sovacool et al., 2019).

Fostering Values and a Culture of Peace

Promoting renewable energies and the active participation of women in this sector can become a catalyst for teaching values such as solidarity, sustainability, and social responsibility. Education in these values, integrated with technical training in renewable energies, can transform communities, creating a more equitable and peaceful environment.

Women, by assuming leadership roles in renewable energy projects, can inspire future generations to value peace and cooperation over competition and exclusion (Tanner & Allouche, 2011).

Public Policies and Recommendations

To maximize the benefits of renewable energy in empowering women and families, it is essential to implement public policies that support this goal. These policies should include:

1. **Training and Education:** Technical training programs in renewable energies for women in rural and indigenous areas, also integrating the teaching of business and leadership skills.
2. **Access to Financing:** Facilitate access to credits and subsidies for renewable energy projects led by women, supporting both entrepreneurs and community cooperatives.
3. **Incentives and Subsidies:** Provide tax incentives and subsidies for renewable energy projects that include the active participation of women, ensuring the sustainability and expansion of these projects.
4. **Promotion of Gender Equality:** Develop awareness and sensitization campaigns on the importance of gender equality in the energy sector, promoting the inclusion of women at all levels of the renewable energy value chain (IRENA, 2019).

Research on renewable energies and their impact on the empowerment of women and families in Tamaulipas is innovative and relevant, offering a comprehensive approach that combines energy sustainability with social and economic development.

The empirical data and critical reflections presented in this study underscore the importance of considering renewable energies not only as a technological solution but also as a powerful tool for social transformation and the promotion of peace. Implementing public policies that support this vision can transform the energy system and significantly contribute to the well-being of Mexican and Latin American society.

Importance and Relevance of the Research: Empowering Women through Renewable Energy in Tamaulipas

Legal and Regulatory Framework

The Energy Transition Law and the Electric Industry Law of Mexico provide a robust framework for the development of renewable energies, setting ambitious goals for the production of clean energy and encouraging private investment (DOF, 2015). The Sustainable Economic Development Law of Tamaulipas reinforces these initiatives with specific measures to promote the use of renewable energies, complemented by the State Climate Change Program and Renewable Energy Strategy, which outline the objectives and plans for their implementation in the region (Government of the State of Tamaulipas, 2019).

Despite the favorable legal framework, obstacles must be addressed to facilitate the growth of renewable energies in Tamaulipas. These include simplifying administrative procedures to expedite investment in renewable energy projects and the need to ensure transparency and competition in bidding and award processes (OECD, 2017). Additionally, it is crucial to improve the electrical infrastructure to integrate large-scale renewable energy, ensuring the stability and reliability of the energy system (IEA, 2020).

Women's Emancipation

Renewable energies present a unique opportunity for the economic and social empowerment of women in Tamaulipas, especially in rural areas and indigenous communities. Women's participation in this sector can open new job opportunities, both in the construction and operation of facilities and in training, education, and research activities (IRENA, 2019). Furthermore, women can start businesses related to renewable energies, increasing their economic independence and contributing to local development (UN Women, 2018).

To maximize these opportunities, it is essential to implement strategies that encourage women's participation in the renewable energy sector.

These strategies include offering training and technical education in areas such as the installation and maintenance of solar panels, wind energy project management, and bioenergy. It is also important to facilitate access to financing through specific programs and preferential credit lines, as well as establish support and mentoring networks for women working in this sector (World Bank, 2020).

Family Impacts

The implementation of renewable energies in Tamaulipas can have significant effects on family structure and dynamics. Job creation in the renewable energy field can improve the economic situation of families, providing greater access to basic goods and services (Sovacool et al., 2019).

Additionally, access to clean and affordable energy in rural areas can improve the quality of life, health, and education of families, contributing to overall well-being and social cohesion (Mileva et al., 2016).

Research on the impact of renewable energies on the empowerment of women and families in Tamaulipas is innovative and relevant. By addressing legal, social, and economic challenges, this study provides a practical guide for implementing public policies that promote gender equality and sustainable development.

The promotion of renewable energies not only benefits the environment but also empowers women, improves the quality of life for families, and fosters a culture of peace and values in Mexican and Latin American society.

1. Historical Background and Impacts of Renewable Energy in Tamaulipas

1.1 Historical Background in Law

The historical background of the impact of renewable energies in Tamaulipas in the legal field reflects a significant evolution in state and national energy policies:

1. Establishment of the CFE (1975): The Federal Electricity Commission (CFE) was established as the sole entity for the generation, transmission, and distribution of electricity in Mexico.

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This monopoly lasted until the 1992 energy reform, which allowed private companies to enter the sector (CFE, 2015).

2. **Electricity Public Service Law (1980):** This law consolidated the authority of the CFE and defined the public electricity service as essential, establishing the CFE's obligation to provide energy continuously and efficiently to meet the population's demands (DOF, 1980).
3. **Reform to the Electric Industry Law (2008):** This reform significantly boosted the development of renewable energies in Mexico, encouraging the generation of wind and solar energy, attracting private investment, and reducing greenhouse gas emissions (SENER, 2008).
4. **Law for the Use of Renewable Energies and Energy Transition (2012):** This law established a comprehensive legal framework for the development of renewable energies, promoting a more sustainable and professional energy model in Mexico and Tamaulipas (DOF, 2012).
5. **General Law on Climate Change (2014):** This law represents a milestone in Mexico's fight against climate change, setting objectives and strategies for emission reductions and promoting sustainable energies (DOF, 2014).

1.2 Historical Background in Women's Empowerment

Women in Tamaulipas have played a crucial role in the development of renewable energies, both academically and in the industrial and governmental sectors. Women such as Dr. María Guadalupe López Martínez and Dr. Carmen Alicia González Martínez have conducted pioneering research in solar and wind energy since the early 21st century, laying the foundation for the development of the sector in the state (INEGI, 2020).

Entrepreneurial women like Ms. Guadalupe González García have created companies and cooperatives that promote the use of renewable energies at the local level, while influential figures such as Lic. María Isabel Gómez Garza and Dr. María Luisa López González have driven public policies to foster a sustainable energy model in Tamaulipas from within the government (CONACYT, 2019).

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Despite these advances, women have faced significant obstacles, including the gender pay gap and work-family balance. Women in the renewable energy sector earned less than their male counterparts and often faced difficulties balancing their work and family responsibilities due to a lack of childcare services and the unequal distribution of domestic tasks (UN Women, 2018).

The legacy of these women is measured not only by their tangible achievements but also by the inspiration they have provided to new generations to build a more sustainable and inclusive future. Public policies must continue to support the inclusion of women in the energy sector, ensuring equal opportunities and eliminating gender barriers (World Bank, 2020).

Research on the impact of renewable energies on the empowerment of women and families in Tamaulipas is essential to promoting social and economic transformation in the region.

The implementation of public policies that support technical training, access to financing, and gender equality can maximize the benefits of renewable energies, promoting sustainability and inclusive development. This research, based on critical reflections and empirical analyses, provides a practical guide to improving the quality of life for women and their families, fostering a culture of peace and values in Mexican and Latin American society.

1.3 Historical Background of Renewable Energy in Tamaulipas in Families

The history of renewable energies in Tamaulipas unfolds not only in academic, industrial, or governmental spheres but also intertwines within the heart of Tamaulipas families. In numerous Tamaulipas families, environmental commitment and efficient use of natural resources are passed down from generation to generation, promoting increasing participation of women in the field of renewable energies.

Currently, many women have academic support and the backing of their families, fundamental elements for their development in the energy sector.

However, these supports have not always existed. Throughout history, women have faced numerous barriers to access and thrive in this field. Family and community support has been crucial for women to overcome these barriers and contribute significantly to the development of renewable energies in Tamaulipas.

In the rural areas of Tamaulipas, women have inherited ancestral knowledge about the use of renewable energies, such as solar energy for food preservation or wind energy for water transportation. This knowledge has been passed down from generation to generation and has been complemented with new technologies to enhance its use.

Women working in this field have been fundamental in raising awareness among their families about the importance of protecting the environment and adopting a more sustainable lifestyle.

Access to clean and renewable energy sources has improved the quality of life for many Tamaulipas families, reducing energy costs and enhancing the health and well-being of their members. The experience of women in renewable energies in Tamaulipas is narrated not only in academic institutions or textbooks but also at the heart of Tamaulipas communities.

Their responsibility towards sustainability and the progress of quality of life has left an indelible mark in the energy field and can serve as an inspiration for future generations.

2. Current Situation of Renewable Energy Impacts in Tamaulipas

2.1 Impact on Legal Framework

Currently, Tamaulipas has a legal framework that promotes the development of renewable energies. The Energy Development Law for the State of Tamaulipas establishes measures to encourage investment in this sector.

Current benefits include tax incentives for companies investing in renewable energy projects, public auctions for renewable energy procurement, and investment support programs such as the Renewable Energy Development Program (PRODER).

However, despite this favorable legal framework, there are challenges that need to be addressed to facilitate the growth of renewable energies. Simplifying administrative procedures to expedite investment and ensuring transparency and competition in project bidding and award processes are necessary.

Additionally, investing in the modernization and expansion of electrical infrastructure is crucial to ensure system stability and reliability.

2.2 Impact on Women

The implementation of renewable energies in Tamaulipas has significantly impacted the lives of women, generating numerous economic and social opportunities. Women's participation in renewable energy projects, whether as workers, entrepreneurs, researchers, or in governmental roles, has allowed them to access new sources of income and strengthen their economic independence. This has contributed to reducing gender disparity in the workplace and improved the quality of life for many women and their families.

Renewable energies have provided women with opportunities to develop their skills and knowledge in technical and scientific fields traditionally dominated by men. This has enabled them to access positions of greater responsibility and leadership in the energy sector. Moreover, women play a crucial role in teaching sustainable values to new generations, promoting a culture of care and respect for the environment.

However, challenges such as gender wage gaps and balancing work and family life persist. Despite progress, many women still face discrimination and difficulties in being recognized for their capabilities and contributions in the renewable energy sector. It is essential to implement policies and programs that address these inequalities and promote an inclusive and equitable work environment.

2.3 Impact on Families

The adoption of renewable energies in Tamaulipas has had both positive and negative impacts on families. On one hand, it has improved quality of life by providing access to electricity in rural communities that previously lacked this basic service.

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This has enabled families to reduce energy costs and improve their health and well-being. Additionally, integrating renewable energies contributes to environmental sustainability, benefiting current and future generations.

However, challenges such as the high initial costs of renewable technologies can be a barrier for low-income families. It is essential to develop policies that facilitate equitable access to these technologies, ensuring that all families can benefit from clean and sustainable energies.

3. How to Improve the Situation

3.1 Legal Improvements

To improve the situation of renewable energy impacts in Tamaulipas from a legal perspective, it is necessary to create more specific and clear laws regulating this sector. This includes:

1. **Clarifying legal ambiguities:** Clarifying and unifying laws and regulations related to renewable energies at both state and federal levels.
2. **Facilitating and digitalizing administrative processes:** Simplifying procedures for obtaining permits and authorizations, accelerating project implementation, and promoting investment.
3. **Ensuring transparency and competition:** Ensuring that bidding processes are transparent and competitive, fostering investor confidence.
4. **Involving local communities:** Allowing communities to have a voice in decision-making processes regarding projects affecting their environment, ensuring that their needs and concerns are considered.

3.2 Improvements for Women

To advance the protection and empowerment of women in the renewable energy sector, various strategies should be implemented:

- **Training and education:** Offering training programs in technical and administrative areas related to renewable energies.
- **Entrepreneurial support:** Facilitating access to financing and advice for women wishing to start businesses in this sector.
- **Recognition of achievements:** Celebrating and highlighting women's achievements in the sector, promoting role models for new generations.
- **Inclusive work environments:** Creating safe and discrimination-free workspaces.
- **Participation in decision-making:** Ensuring that women have a voice and vote in the planning and execution processes of renewable energy projects.

3.3 Improvements for Families

Research into the implementation of renewable energies in Tamaulipas is essential not only from a technical and economic perspective but also from a social and family perspective. The transition to sustainable energies can empower women, improve the quality of life for families, and foster a culture of peace in Mexican and Latin American society.

1. Work-Life Balance

To facilitate women's participation in the renewable energy sector, it's crucial to implement measures that allow for better work-life balance. This includes creating accessible childcare facilities and implementing flexible work hours. These measures will not only enable more women to engage in the sector but also increase household income and foster greater participation in renewable energy discussions. According to a study by the International Labour Organization (ILO), work-life balance policies are fundamental to increasing women's participation in the labor market (ILO, 2018).

2. Access to Renewable Energy Technologies for Low-Income Families

Providing access to renewable energy technologies, such as small-scale solar panels and wind turbines, to low-income families can have a significant impact.

These technologies not only reduce energy costs but also educate family members about sustainable resource use. According to the International Renewable Energy Agency (IRENA), access to renewable energies can considerably improve quality of life in marginalized communities (IRENA, 2020).

3. Technical and Educational Support

Offering technical and educational support to families is essential for them to install and manage their own renewable energy systems. This support can include community workshops, practical guides, and technical assistance. When families feel government support in adopting technologies like solar panels, there is an increase in their implementation. According to the National Commission for the Efficient Use of Energy (CONUEE), education and technical support are key to the successful adoption of renewable technologies (CONUEE, 2019).

4. Investments and Cost Reduction

Implementing policies that encourage investments in renewable energy technologies can help reduce initial adoption costs for families. This includes tax incentives, subsidies, and financing programs. According to the United Nations (UN), investments in renewable energies not only promote sustainability but also generate long-term economic benefits for communities (UN, 2019).

5. Community Participation in Decision-Making

It is essential to ensure that local communities have a voice and vote in decision-making regarding renewable energy projects that may affect their environment. This involves conducting community consultations and providing clear and accessible information about the benefits and potential impacts of such projects.

Community participation ensures that decisions are more equitable and reflect the needs and concerns of families. According to the International Association for Public Participation (IAP2), community participation is essential for the success of sustainable development projects (IAP2, 2018).

In summary, the transition to renewable energies in Tamaulipas offers a unique opportunity to empower women and improve the quality of life for families.

Implementing measures that facilitate work-life balance, provide access to renewable energy technologies, offer technical and educational support, promote investments, and ensure community participation are crucial steps to maximizing the benefits of this transition.

This research highlights the importance of considering the social and family context when developing public policies in the energy sector, thereby promoting values and a culture of peace in our society.

Conclusions

Conclusion 1: Legal Framework for Renewable Energy Development

In Tamaulipas, having a solid, stable, and clear legal framework is essential to facilitate the development of renewable energy projects, protect the rights of communities, and attract investments.

An effective regulatory framework not only streamlines the necessary procedures and authorizations for project implementation but also ensures that projects are conducted transparently and fairly. Social participation must be a cornerstone in decision-making, ensuring that local communities have a significant voice and vote in projects affecting their environment.

This collaborative approach not only strengthens the legitimacy of projects but also promotes sustainability and social cohesion. According to the International Renewable Energy Agency (IRENA), a clear and transparent regulatory environment is essential to attract investments and foster the growth of the sustainable energy sector (IRENA, 2020).

Conclusion 2: Economic Empowerment of Women

Renewable energies offer a unique opportunity for the economic empowerment of women in Tamaulipas, especially in rural areas and indigenous communities.

Through job creation, entrepreneurship, and training in technical areas, renewable energies can help close the gender gap in the labor market. It is crucial to eliminate barriers that hinder full women's participation, such as discrimination and wage inequality.

Policies and actions in the renewable energy sector must integrate a gender perspective, ensuring that the specific needs and challenges of women are considered. Studies by the International Labour Organization (ILO) highlight the importance of promoting gender equality in all sectors to enhance economic and social development (ILO, 2019).

Conclusion 3: Improvement of Family Quality of Life

Access to renewable energies has the potential to significantly improve the quality of life for families in Tamaulipas by reducing energy costs, improving health, and increasing access to basic services. However, it is crucial to mitigate the potential negative impacts of renewable energy projects on local communities, protecting the environment and fostering social participation. Environmental education and awareness are essential to promote responsible energy use and build a sustainable energy future.

The National Commission for the Efficient Use of Energy (CONUEE) emphasizes the importance of education and community participation in adopting sustainable energy technologies (CONUEE, 2019).

Declarations

Conflict of interest

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

Authors' Contribution

González-Graziano, Augusto Federico: Led the research conception and design, offering expertise in law and social sciences to structure the study's framework. He contributed to the theoretical analysis of the socio-legal implications of renewable energy on gender empowerment and directed the integration of empirical evidence throughout the study.

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Picazo-Galán, Karina Alejandra: Participated in data collection and supported the analysis of socio-economic factors impacting women in rural communities. Her research focused on the role of women as change agents in the family context and contributed to drafting sections related to the impact on family well-being and quality of life.

Graciano-Casas, Lucía: Contributed her expertise in human ecology and social sciences, focusing on the study's ecological aspects. She provided critical insights into the educational and environmental values linked to renewable energy adoption and collaborated on policy recommendations to enhance gender equality in the renewable energy sector.

Hernández-Ilizaliturri, Alma Amalia: Oversaw the methodological approach, advising on empirical analysis and data interpretation. Her work emphasized sustainable development strategies and gender inclusion, which formed the basis of the study's recommendations for public policy to promote renewable energy and women's empowerment in Tamaulipas.

Availability of Data and Materials

The data obtained in this research is available upon direct request to the authors, following confidentiality and ethical use guidelines.

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Sustainability and Environmental Care: Social Responsibility




Sustentabilidad y Cuidado Ambiental: Responsabilidad Social

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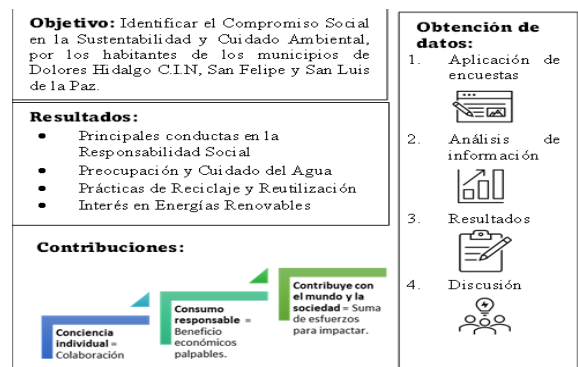
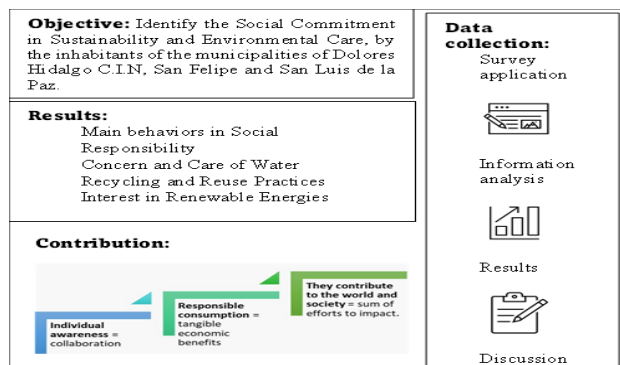
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Abstract

The climate crisis is worsening as greenhouse gas emissions continue to increase; the availability of drinking water for the population; "Day 0" makes it more present; you practice it in agriculture and other economic activities; As the growth of the national population increases in urban areas where water conditions are overexploited, all of this compromises the availability of natural resources for future generations. The challenge we face to transform environmental conditions with individual activities is not impossible, political leaders and public institutions should unite all stakeholders to focus on the SDGs to strengthen collaboration, while building trust and accountability. In search of actions that make course, government institutions at state and federal level has the Legislative Strategy for the 2030 Agenda, the awareness of citizens in the state of Guanajuato and in the municipalities was given the installation and implementation of the Bodies for Monitoring and Implementation of the 2030 Agenda (OSI), clear actions, now is not the time for analysis and diagnosis, we must be aware respectful with us and with future generations.

La crisis climática está empeorando a medida que las emisiones de gases efecto invernadero continúan en incremento; la disponibilidad de agua potable para la población; el "Día 0" hace más presente, la practicas en agricultura y otras actividades económicas; así como el crecimiento de la población nacional se incrementa en zonas urbanas donde las condiciones hídricas están sobreexplotadas, todo ello compromete la disponibilidad de los recursos naturales para las generaciones futuras. El reto que tenemos por transformar las condiciones del medio ambiente con actividades individuales no es imposible, los líderes políticos y las instituciones públicas deberán unir a todas las partes interesadas para enfocarse en los ODS fortalecer la colaboración, al tiempo que generan confianza y responsabilidad. En busca de acciones que hagan rumbo, las instituciones gubernamentales a nivel estatal y federal cuenta con la Estrategia Legislativa para la Agenda 2030, la conciencia de ciudadanos en el estado de Guanajuato y en los municipios se dio la instalación y puesta en marcha de los Órganos de Seguimiento e Implementación de la Agenda 2030 (OSI), acciones claras, ahora no es momento de análisis y diagnóstico, debemos ser conscientes respetuosos con nosotros y con las generaciones futuras.



Environmental Care, Sustainability, Social responsibility

Cuidado Ambiental, Sustentabilidad, Responsabilidad

Resumen

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Peer review under the responsibility of the Scientific Committee **MARVID**[®]- in the contribution to the scientific, technological and innovation **Peer Review Process** through the training of Human Resources for the continuity in the Critical Analysis of International Research.



Introduction

Mexico is committed to developing various activities to meet the 2030 Agenda and thus the sustainability goals (SDGs) in the National Development Programme, 2019-2024 (NDP).

As a member of the MIKTA group (Mexico, Indonesia, Korea, Turkey and Australia), it is committed to promoting sustainable development worldwide and has submitted its Voluntary National Reports on at least one occasion.

The need to protect our environment, the urgency to change habits in society that allow a rational use of vital resources for the subsistence of human beings and to comply with the 2030 Agenda are increasingly visible.

For this reason, this article presents the results of the research conducted in the municipalities of Dolores Hidalgo Cuna de la Independencia Nacional, San Felipe and San Luis de la Paz, in the state of Guanajuato, on the social awareness of the inhabitants in relation to environmental care and sustainability.

Understanding that environmental care is presented through the actions that are generated to protect what nature offers us for subsistence and that as a society there is a commitment to make it last for future life.

The individual commitment to environmental care is analysed; considering this as a central axis in achieving results with a global impact with which a sustainable society can be achieved, as there is a strong interrelation between the actions that are carried out in the present to be able to make use of the resources in the future.

The main water, air and soil pollutants are investigated, as well as the actions that generate them; however, the actions carried out by the population to reduce them are also highlighted.

The strategies carried out with respect to recycling, reuse, waste separation and the degree of use of support granted by the government are presented, with them it is possible to conjecture the level of commitment that society has towards the preservation of the environment. Finally, the conclusions reached as a result of the study of this topic are presented.

Background

In the Convention on Biological Diversity, the United Nations defines biodiversity as: the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. It mentions that it encompasses cultural and economic issues, recreational and spiritual activities. Biodiversity is therefore important for the survival, well-being and development of the human species.

In the National Development Programme (PND) 2019-204 in the point of social policy, there is a specific section on Sustainable Development, which shows the commitment to promote it as an indispensable factor for well-being, with ethical, social, environmental and economic mandates that must be applied to guarantee a habitable and harmonious future, as a result of which policies and programmes are created in the social fabric, in ecology and in political and economic horizons.

The Political Constitution of the United Mexican States, in Article 3, establishes that every person has the right to education, based on respect for the dignity of persons, human rights, to develop in a harmonious way the faculties of the human being and to promote love for the homeland, respect for rights, freedom, peace and international solidarity conscience, to promote honesty and values, etc. As well as contributing to human coexistence and respect for nature, etc.

The Ministry of Education (SEP) at the national level recognises the complexity of the 2030 Agenda, which will allow for the transformation of habits by establishing clear goals to move towards a sustainable development model, which is why the National Development Plan 2019-2024, the Sectoral Education Programme 2020-2024 and Budgetary Programmes were aligned with the principles of the 2030 Agenda and its goals, with an emphasis on SDG 4 (PSE, 2024). For its part, the Environmental Report of the State of Guanajuato 2020, published on 24 March 2021, by the Ministry of Environment and Territorial Planning [SMAOT], mentions that, from an international perspective, Mexico has a mega-diverse biodiversity.

This means that it has been recognised as a country with a large number and diversity of plants and animals. It also indicates that the state of Guanajuato has optimal conditions, due to its location, relief, soils and climates, as well as mineral and water resources, for the development of biodiversity; however, the way in which humans have caused changes in the ecosystem, modes of production and the effects of climate change, cause the loss and degradation of biodiversity. In this report, the main causes of deforestation and its current situation are described below:

Deforestation due to changes in land use.

According to the SMAOT (2021), Land use determines the extent of deforestation, the degree of transformation and the time of exploitation, being the main cause of biodiversity loss in the State. According to the comparative analysis of the 2009-2018 satellite images, the dynamics of changes in the coverage of the various ecosystems present in our State can be detected. Thus, variations may be due to the loss of vegetation cover to make way for rainfed agricultural activities, as occurs in the municipalities of León and Manuel Doblado, where natural pastureland is eliminated for this activity.

Another modality is when the natural cover is eliminated and gives way to induced pasture, such as what happened in the municipality of Ocampo (elimination of natural pasture) or in **San Felipe** (oak forest with secondary vegetation was eliminated), or **San Luis de la Paz** (elimination of natural pasture), Tierra Blanca (xerophytic scrub) or Valle de Santiago (tropical deciduous forest).

Pests and diseases

In terms of pests and diseases through inter-institutional coordination between the National Forestry Commission [CONAFOR], the Ministry of Agri-Food and Rural Development [SDAyR], and the SMAOT (2021), indicate that, The municipalities where these diagnoses were carried out were Acámbaro, Atarjea, **Dolores Hidalgo Cuna de la Independencia Nacional**, Guanajuato, San Diego de la Unión, **San Felipe**, **San Luis de la Paz**, San Miguel de Allende, Tierra Blanca, Victoria, and Xichú, and they referred to diagnoses of parasitic plants (mistletoe), epiphytes (paxtle), defoliating worms and bark strippers.

Forest fires

The municipality of San Felipe stands out in this area, as it has the highest number of hectares affected, as mentioned by the SMAOT (2021).

In this period from 2018 to 2020, the municipalities that have suffered the greatest affectation by forest fires are: **San Felipe** (14 thousand 586.35 hectares), Cuerámara (1 thousand 829 hectares), Pénjamo (1 thousand 787 hectares) and Celaya (1 thousand 107 hectares), which cover more than 81 percent of the affectations .

State Context

Although actions have been taken that have allowed the state of Guanajuato to adapt to climate change, its effects continue to impact the economic-productive, social and environmental sectors; as indicated by the SMAOT (2021), it was determined that the average annual temperature in the state of Guanajuato increased between 1.07 °C and 1.11 °C, from 1901 to 2019. Recent warming has been most intense in the south and southeast regions of the state, and less so in the northeast. In relation to precipitation, total annual precipitation increased in the state between 52.0 mm and 71.9 mm over the last 20 years, mostly in the southeast and to a lesser extent in the northwest of the state.

At the same time, due to the reduction of precipitation in some months, they have intensified since the middle of the 20th century, with an extreme meteorological drought occurring in 2011 in most of the state, and in the first half of 2018 and 2019, a moderate to intense drought.

Temperatures in the state of Guanajuato, although varying by region, tend to be increasingly hotter, which affects the annual rainfall cycles, concentrating a greater amount of rain in a few days, thus causing floods that cause social and economic impacts. At the same time, the concentration of a greater volume of less frequent rainfall prolongs the periods of dry days, which increases the occurrence of droughts whose consequences are the advance of desertification, aggravation of the water crisis, increased vulnerability of the population, effects on rainfed agriculture, scarce water availability, as well as reduced vegetation due to the lack of climatic conditions for its development.

Mina, Susana del Carmen and Quintana-Garrido, Juan Diego. [2024]. Corn as an alternative method for contributing to the country's public policies in terms of health, sustainable economy and food security, accordance with the 2030 Agenda and FAO. Journal-Law and Economy. 8[14]1-10: e1814110.

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Pollution and environmental deterioration

When talking about environmental impact, solid waste pollution must be considered, according to the SMAOT (2021),

In the area of integrated solid waste management we monitor the percentage of special handling waste valorised since 2018, where 14.9 percent of valorised tons were registered, for 2019 they increased to 23.2 percent¹, which is equivalent to 1 million 649 thousand 741 tons .

Among the actions carried out by the municipalities, the programmes they have created stand out, as well as the planning for the integrated management of solid waste, according to the SMAOT (2021),

To date, the municipalities with Municipal Programmes for the Prevention and Integral Management of Urban Solid Waste published in the Official State Government Gazette are Huanímaro, León and Villagrán; the municipalities that have their planning instrument in process or without publication in the Official State Government Gazette are: Cortázar, Dr. Mora, **Dolores Hidalgo Cuna de la Independencia**, Irapuato, Ramita, Salamanca, San Diego de la Unión, **San Felipe, San Luis de la Paz**, San Miguel de Allende, Santa Cruz de Juventino Rosas, Yuriria and Tarimoro .

Air Quality

The Air Quality Monitoring System of the State of Guanajuato, does not indicate the municipalities of Dolores Hidalgo Cuna de la Independencia Nacional, San Felipe and San Luis de la Paz, as those that have exceeded the limit values of concentration in ambient air of atmospheric pollutants, but nevertheless the alteration to the atmospheric composition in the State affects living organisms and climatic conditions, the SMAOT (2021), mentions that, Air pollution has effects at local, regional and global levels. In addition to the local effects associated with poor air quality on the health of living beings and the reduction in agricultural production, at the regional level, as it affects forests and aquatic ecosystems due to acid rain, and finally at the global level, as climate change and the reduction of the thickness of the stratospheric ozone layer, which can have disastrous repercussions on health problems, material and economic losses.

Therefore, knowing what has caused a change in our ecosystems should lead to awareness-raising, thus enabling the population to take environmental responsibility.

Objective

To identify the Social Commitment to Sustainability and Environmental Care, by the inhabitants of the municipalities of Dolores Hidalgo Cuna de la Independencia Nacional, San Felipe and San Luis de la Paz, phenomenological on the actions that they individually carry out for the preservation of water, air and soil, with clear actions developed in their own contexts.

Justification

The Mexican Ministry of Public Education in its sectoral programme establishes quality education as one of the 17 goals of the 2030 Agenda for Sustainable Development, with the fulfilment of Sustainable Development Goal 4 (SDG 4) Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Curricula include current needs and challenges to achieve comprehensive education at the primary level, specifically in subjects such as the Formative Field, Ethics, Nature and Society, which involve values for the environment and biodiversity, from early childhood to higher education.

The Intergovernmental Panel on Climate Change (IPCC) in a survey conducted by popular vote among UN member countries concluded that four out of five people want their country to take stronger climate action and say they are willing to take steps to change their habits progressively.

It is a challenge that governments cannot meet unless they are joined by leaders, business leaders and their citizens.

The intention arises to know the personal performance in the investigated municipalities in the full exercise of their right as Mexicans, in terms of the preservation of biodiversity.

Theoretical framework

As time goes by and generations pass one after the other, the damage to the environment, which provides us with the necessary conditions for the survival of human beings, becomes more and more noticeable, the definition of the environment is:

It is a system formed by natural and cultural elements that interrelate with each other and are modified by human action. The environment is the surroundings that condition our way of life, however, our way of life also conditions and adapts it.

Therefore, man's intervention in the conditions in which the environment is currently found is based on his social conscience, understanding that any action carried out by human beings will have consequences and repercussions that can be positive or fatal for their subsistence in the future.

Social awareness can be defined as 'the knowledge that a person has about the state of others in his or her community. The socially conscious individual is rightly aware of how the environment can help or hinder people's development'.

A great commitment and social awareness is required to carry out actions that together ensure the sustainability of the resources provided by the environment, thinking that future generations will be able to take advantage of and enjoy them, also considering that evolutionary development will continue and surely the needs and demands will be different.

Environmental sustainability 'refers to the preservation of the environment so that society finds a balance between the supply of its needs and the rational use of natural resources, without damaging nature'.

The issue of sustainability carries with it a high degree of responsibility and participation that requires the whole population as a whole to achieve tangible results, since resources are limited in quantity and quality, so that the actions taken in the present play a fundamental role in their preservation.

On the other hand, the concept of sustainability in the Brundtland report (1987) is presented for the first time as the satisfaction of present needs without compromising the ability to satisfy the needs of future generations.

The member states of the United Nations (UN) created a plan of action for people and planet called Agenda 2030 with 17 sustainable development goals.

The 2030 development agenda is a plan of action for people, planet and prosperity, where one of the goals is to strengthen universal peace in larger freedom.

It was implemented by all countries and stakeholders through a collaborative partnership. It sets out 17 Goals with 169 integrated and indivisible targets covering the economic, social and environmental spheres, which are integrated and indivisible and combine the three dimensions of sustainable development: economic, social and environmental.

The environmental dimension is oriented towards ecologically sustainable development, emphasising the ecological conditions necessary to sustain human life in the future. The social dimension refers to the implications for the social fabric of the lack of some natural resources, the unequal use and social distribution of natural resources, and finally, the economic dimension is described as the generation of employment and the equitable distribution of the benefits of this economic outcome, often based on the natural and cultural resources of a community. Not forgetting the need to conserve resources in order to continue to make use of them, which leads to solidarity with future generations so that they can enjoy and take advantage of these options for their well-being in a future reality.

Basic dimensions for measuring impact:

- People, which involves ending poverty and hunger, guiding people to exploit their potential with equal dignity and a healthy environment.
- Planet, which involves protecting degradation through responsible consumption of natural resources and taking action on climate change.

- Prosperity refers to all human beings enjoying a full life, economic and technological progress in harmony with nature.
- Peace to achieve calm, just and inclusive societies, free from violence and freedom.
- Collective participation refers to partnerships of all stakeholders to implement and develop the 2030 Agenda in a supportive and responsive manner.

Five dimensions that are necessary to measure and understand impact.

The Intergovernmental Panel on Climate Change (IPCC) provides comprehensive assessments of the state of scientific, technical and socio-economic knowledge on climate change, potential impacts and response strategies. In its reports, the IPCC reports on the disastrous impacts we will face, such as more frequent and extreme events, loss of biodiversity, exacerbated health crises, and worsening conflicts over increasingly limited resources.

The latest IPCC publication sets out practical solutions to develop such as investment in renewable energy, responsible production and consumption, promotion of biodiversity and healthy ecosystems.

Methodology

In order to carry out the research, 282 surveys were applied in the municipalities of Dolores Hidalgo Cuna de la Independencia Nacional, San Felipe and San Luis de la Paz, belonging to the state of Guanajuato. An estimation error of 2.54% was used, which allowed us to estimate the number of surveys carried out. Likewise, the type of sampling carried out was a probability conglomerate sample.

Results

1. General data

67% of the respondents were between 18 and 23 years old, 21% between 24 and 28 years old and 12% between 29 and 34. Of the total number of respondents, 52% identify themselves as female, 47% as male and 1% preferred not to respond.

In terms of occupation, 46% are students, 16% entrepreneurs, 12% housewives, 8% labourers, 7% government employees, 6% day labourers and 5% entrepreneurs.

In terms of their place of residence, 53% live in rural areas and 47% in urban areas. 45% come from the city of Dolores Hidalgo Cuna de la Independencia Nacional, 30% from San Felipe and 25% from San Luis de la Paz.

a) Water

94% of respondents are concerned about water care, while 6% do not consider it an important issue. Among the activities that pollute water in the household, 38% mention stirring cooking oil when washing dishes, 30% the use of detergents such as fabric softeners, soap powders and bleach, 20% the use of hair products, and 12% cleaning products.

To take care of water, 44% reuse water for watering plants, 29% control the time of their showers, 23% measure their use in household chores and 4% carry out other activities. Regarding the work of government institutions in charge of drinking water, 58% rate it as good, 22% as excellent and 20% as bad.

Respondents consider that treated water is mainly used to irrigate green areas (38%), although 34% do not know its purpose. Industrial uses (16%) and for cleaning public roads (12%) are also mentioned. Regarding the benefits of treated water, 40% see it as a replacement for drinking water, 22% are not sure, 22% associate it with environmental care and 16% with the generation of energy and nutrients.

b) Air

In relation to transport, 39% use their own vehicle, 24% use a city truck, 18% use motorbikes, 11% use bicycles, 5% use other means of transport and 3% use tractors. Forty-six per cent use transport one to five times a week, 33% six to ten times a week, and 21% more than ten times a week.

The activities that increase air pollution in their municipality, according to the respondents, are mainly rubbish burning (41%), excessive use of polluting means of transport (28%), fires (17%), tobacco smoke (7%), and the use of fireplaces and cookers (6%).

To reduce air pollution, 45% avoid burning rubbish, 28% opt for cycling or walking, 16% do not smoke, 8% avoid pyrotechnics and 3% do other activities.

c) Soil

With regard to soil pollution, 47% consider littering in the streets to be the main problem, followed by the use of chemicals such as pesticides (26%), the dumping of cooking or vehicle oil (17%), and the disposal of contaminated water (8%).

To help reduce this pollution, 39% recycle waste, 26% use biodegradable products, 16% prefer reusable products, 14% avoid dumping contaminated water, and 5% do other activities.

d) Recycling

85% of respondents recycle used items, while 8% do not and 7% are not sure. The most recycled materials in the household are plastic (51%), paper and cardboard (24%), magazines, books and newspapers (14%), aluminium cans (8%), and others (3%). In terms of predominant waste, 28% mention plastic bottles and bags, 25% food waste, and other minor waste.

e) Waste separation

55% of respondents indicate that they separate inorganic waste, while 31% separate organic waste and 14% do not separate at all.

f) Re-use

80% reuse items in their household, 11% do not and 9% are not sure. The most commonly reused items are plastics (43%), paper and cardboard (26%), and magazines and newspapers (20%). Motivations for reusing include pollution reduction (46%), waste reduction (23%), and the well-being of future generations (16%).

g) Government support

54% of respondents indicate that there is support from their municipality to access renewable energy, 28% do not know and 18% say there is no support. The most mentioned supports include solar heaters (54%) and solar panels (17%).

h) Use of Solar Energy

86% have considered using solar energy and 55% have received support for this. 44% state that there are renewable energy parks in their municipality, although 33% do not know about them. 83% indicate that there are one to two parks. Regarding the impact of these parks, 40% mention reduced electricity costs, 26% less pollution, and other minor effects.

i) Promotion of Renewable Energy Use

54% believe that their municipality promotes the use of renewable energy, while 30% are not sure. The actions they take include the use of energy efficient light bulbs (25%) and switching off unused devices (37%). The benefits of adopting energy alternatives include a reduction in expenses (65%) and encouraging the use of natural light (17%).

2. Top Behaviours in Social Responsibility

Water Care and Concern

- **Behaviour:** A remarkable 94% of respondents are concerned about the responsible use of water. The main actions they take to care for water include reusing it for watering plants (44%) and controlling the timing of showers (29%).
- **Impact:** This concern reflects a widespread awareness of water scarcity and the need to preserve it, although practices that contribute to water pollution, such as the use of detergents and the dumping of oil, still persist.

Recycling and reuse practices

- **Behaviour:** 85% recycle objects and 80% reuse materials in their homes, with plastic being the most commonly recycled material (51%).
- **Impact:** These practices indicate a significant commitment to waste reduction, although separation of organic waste (31%) could still be improved. The main motivation for these actions is pollution reduction (46%).

Interest in Renewable Energy

- **Behaviour:** 86% of respondents have considered using solar energy, and 54% believe that their municipality promotes the use of renewable energy. Government support, such as solar heaters, is also well received (54%).
- **Impact:** This trend towards renewable energy adoption reflects a desire to lower electricity costs and contribute to a cleaner environment. However, there is a significant percentage (28%) who are unaware of the support available.

Discussion

Awareness of environmental care represents the conviction of a person, group or society as a whole to take care of natural resources, by protecting and using rationally what nature gives us, actions that benefit the present and future generations. According to the results obtained in the research, it is possible to observe the attitude of the citizen and the level of awareness, in front of the sustainability of environmental care and with it their participation in:

Reuse water for sanitary plants, measure shower time and water use at home, avoid throwing contaminated water into the public drainage.

Avoid burning rubbish, leaving waste on public roads.

Recycle, separate and reuse waste, mainly plastics, use biodegradable products.

Reduce waste generated at home by actions such as using paper or cloth bags, containers for shopping.

Minimise the use of fossil fuels by converting to solar heating and using bicycles or walking as a means of transport.

Use energy efficient lighting, switch off electronic devices and appliances when not in use.

Be motivated to contribute to reducing activities that reduce environmental pollution.

Educate family members about the effects of these actions.

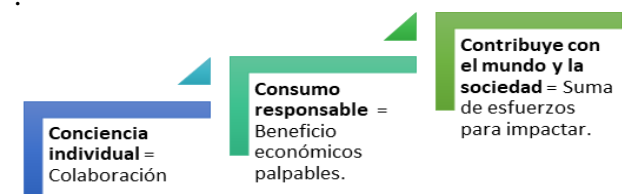
Identify government support for renewable energy, such as the purchase of solar water heaters.

State and Federal Government entities. Promote and disseminate public and social policies for the care of biodiversity and education.

Promote investment in the generation of green energies such as wind and solar parks.

Promote education plans from the earliest schooling.

We identify the impact that personal effort has when added to the efforts of the social fabric and government, to result in a massive impact on the needs of our planet, the calls that is indicating us through the different abrupt environmental phenomena, on the urgency of maintaining a balance between nature and the use of resources, with responsible consumption.



However, more timely promotion by the relevant authorities and institutions is needed in order to encourage citizen practice, bringing more forceful and massive actions that promote the sum of more universal efforts.

Conclusions

In Mexico until the year 2020 we are 126,014,024 inhabitants, in the state of Guanajuato there are 6,166,934 people, the sixth place in population in Mexico, each of these citizens have needs for nutritious food, housing, footwear and clothing, school facilities that have economic, social and environmental impacts.

The rapid pace at which society advances in search of growth and development has led to an excessive use of resources, and as a consequence, it is not the same with which alternatives are sought to protect and preserve the resources that will ensure the sustainability of life in the future.

These alternatives should consider modifying certain harmful habits and adopting actions in favour of the environment, such as the use of clean energy, recycling and reuse of materials, among others.

It is of vital importance the actions that are carried out at an individual level, the impact they can have when they are added to the collective, as this represents an example and the guidelines to follow for new generations that should have environmental care in their culture.

Declarations

Conflict of interest

The authors declare that they have no conflict of interest. They have no known financial interests or personal relationships that could have influenced the article reported in this paper.

Authors' contribution:

Lira-Mejía, María Carmen: I contributed in the idea, the development of the research, the definition of the methodology, the elaboration of the analysis, development of the discussion and elaboration of the conclusion. I also contributed to the revision and editing of the document.

Landeros-Guerra, Martha Soledad: I contributed to the development of the analysis of the information, summary, justification, discussion, conclusions, revision and editing of the document.

Villegas-Torres, María del Sagrario: I contributed to the development of the introduction, theoretical framework and conclusions.

Ortiz-Rayas, Ana María: I contributed to the development of the background and conclusions.

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Abbreviations

ODS	Sustainable Development Goals
PND	National Development Programme
OSI	Monitoring and Implementation Bodies
SEP	Secretary of Public Education
PSE	Education Sector Programme
MIKTA	Mexico, Indonesia, Korea, Turkey and Australia
ONU	United Nations
SMAOT	Secretariat for the Environment and Land Management
CANAFOR	National Forestry Commission
SDAy R	Secretariat for Agri-Food and Rural Development
IPCC	Intergovernmental Panel on Climate Change
INEGI	National Institute of Statistics, Geography and Informatics (Instituto Nacional de Estadística, Geografía e Informática)

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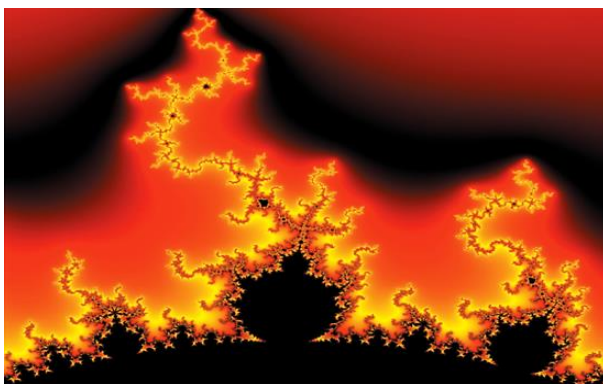


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