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RINOE Journal-Urban-Rural and Regional Economy

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The works must be unpublished and refer to topics of General regional economy: Analysis of growth, Development, and Changes, Size and spatial distributions of regional economic activity, General equilibrium and welfare economic analysis of regional economies, Land use patterns, Econometric and Input-Output models; Household analysis: Housing demand, Other Demand, Regional migration, Regional labor markets, Population; Production analysis and firm location: Housing supply and markets, Other production and pricing analysis, Nonagricultural and nonresidential real estate markets, Input demand analysis, Government policies; Transportation systems: Transportation, Government and private investment analysis, Government pricing; Regional government analysis: Finance in urban and rural economies, Land use and other regulations, Public facility location analysis, Public investment and capital stock, Regional development policy and other topics related to Humanities and Behavioral Sciences.

Presentation of the Content

In the first chapter we present, *Formative research, POL and the influence of the teacher-researcher in the production of science and technology: Integrative project cases* by VILLALOBOS-ALONZO, María de los Ángeles, ROMO-GONZÁLEZ, Ana Eugenia and CABRERA-VILLASEÑO, Héctor Ulises, with adscription in the Universidad Tecnológica de Jalisco, as the following article we present, *Technological Adaptation Model; an integrated application process to the productive chain in MyPyMES* by PEÑA-MONTES DE OCA, Adriana Isela, OROZCO-MAGALLANES, Rubén Ulises and MACÍAS BRAMBILA, Rubén Hassem, with adscription in the Universidad Tecnológica de Jalisco, as the following article we present, *Hurdles to the adoption of solar energy technologies in the Comcaac nation, Desemboque, Sonora, México, a case study* by SOTELO-MEDINA, Demetrio, LEÓN-BALDERRAMA, Jorge and CABANILLAS-LÓPEZ, Rafael, with adscription in the Food and Development Research Center, as the last article we present, *Community land use planning in la Gloria community*, by MUÑOZ-ROJAS, Marco Antonio, VÁZQUEZ-HERNÁNDEZ, Gabriel, PÉREZ-ESTEBAN, Guillermo and LEGUIZAMO-HERNÁNDEZ, Miriam, with adscription in the Instituto Tecnológico Superior de la Sierra Norte de Puebla.

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Formative research, POL and the influence of the teacher-researcher in the production of science and technology: Integrative project cases

Investigación formativa, AOP y la influencia del docente-investigador en la producción de ciencia y tecnología: Casos proyecto integrador

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Abstract

In a context of active and constructive teaching, the role of the teacher-researcher takes on crucial meaning, as a mediator in the formalization and promotion of research skills in university students, as demonstrated in this research project. From didactics and pedagogy, the Project Oriented Learning (AOP) strategy was used to articulate scientific theoretical knowledge with practice, which provides solutions to needs and problems of various kinds. In this sense, a compilation of integrative projects is presented as a training strategy within the framework of the training research of the Technological University of Jalisco in the periods 2020 and 2021, where the students integrated theoretical, conceptual and methodological knowledge, as well as own skills of their discipline – Maintenance Industrial area, Mechatronics Automation area and Information Technologies Multiplatform Software Development area, which help to strengthen technical, scientific, communicative, teamwork and cognitive skills, which materialized in the construction of technological prototypes and reports scientists where the processes and results achieved are made explicit as evidence of their investigative skills and, in turn, allowed a better evaluation of the academic performance of the students.

Formative research, Project Oriented Learning (POL), Teacher-researcher, Scientific and technological productio

Resumen

En un contexto de enseñanza activa y constructiva el rol del docente-investigador toma sentido crucial, como mediador en la formalización y promoción de competencias investigativas en estudiantes de orden universitario como se demuestra en este proyecto de investigación. Desde la didáctica y pedagogía se utilizó la estrategia de Aprendizaje Orientado en Proyectos (AOP) para articular los conocimientos teóricos científicos con la práctica, que den solución a necesidades y problemáticas de diversa índole. En este sentido, se presenta una recopilación de proyectos integradores como estrategia formativa en el marco de la investigación formativa de la Universidad Tecnológica de Jalisco en los periodos 2020 y 2021, dónde los estudiantes integraron saberes teóricos, conceptuales y metodológicos, así como habilidades propias de su disciplina –Mantenimiento área Industrial, Mecatrónica área Automatización y Tecnologías de la Información área Desarrollo de Software Multiplataforma, que coadyuban a fortalecer habilidades técnicas, científicas, comunicativas, de trabajo en equipo y cognitivas, que se materializaron en la construcción de prototipos tecnológicos e informes científicos donde se explicitan los procesos y resultados alcanzados como evidencia de sus habilidades investigativas y a su vez, evaluar de una mejor forma el desempeño académico de los estudiantes.

Investigación formativa, Aprendizaje Orientado en Proyectos (AOP), Docente-investigador, Producción científica y tecnológica

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†Researcher contributing as first author.

Introduction

The present research belongs to the field of political science in the discipline of didactic pedagogy and curriculum, in the subdiscipline of teaching, by documenting the articulating process of Formative Inquiry (FI), Project-Oriented Learning (PLO) and the mediation of the teacher-researcher, which are materialized through a compilation of integrative cases that promote science and technology. The Educational Programs (PE) of Higher University Technician that were part of the study are: Maintenance Industrial Area, Mechatronics Automation Area and Information Technologies Multiplatform Software Development Area.

In order to provide the reader with a structure, this article is divided into four sections: 1) conceptual framework, which is subdivided into science and technology policies, formative research, the teacher-researcher, project-oriented learning and the integrating project. 2) the qualitative methodology approached in the study, 3) the results and the description of the cases by PE and 4) the conclusions.

1. In the framework of science and technology policies.

In such dynamic, complex and changing social and economic contexts, governments and developing and industrialized countries see universities as playing an active role in the performance and contribution to sustained economic growth, based on activities related to teaching, research and the dissemination of science and technology, which respond to socioeconomic needs and problems and thus have an impact on the production of goods and services.

Developing the scientific and technological potential, have been central aspects of the scientific and technological policy in Mexico, as framed in the Institutional Program 2020-2024 of the National Council of Science and Technology in the priority objective 6 "Expand the impact of Sciences, Humanities and Technologies, through the articulation, collaboration and definition of standards between HEIs, research centers and government agencies, improving with scientific bases the national public policies for social welfare" (DOF, 2020).

In this context, the Technological University of Jalisco is aligned with the institutional plan of the Ministry of Innovation, Science and Technology (2018-2024) by "Strengthening training of scientific, technological and innovative talent of the state university system, with world-class programs" (p. 56). So that, it is related to the intentions in the guidelines of the Institutional Development Program 2020-2025 in Axis 3. Applied Research and Technology Transfer aims to establish a model for applied research conducted at UTJ, as a complementary process to the academy, through innovative lines and technological development related to its educational programs (p. 84).

As part of the complementary process to the academy, the Technological University of Jalisco promotes educational training based on the competency-based model and the dual model (university-business), establishing actions from 1) curriculum, 2) pedagogical and didactic resources such as teaching-learning strategies focused on problem-based learning, project-based learning and case studies and 4) research from the perspective of Formative Research (FI). Consequently, this orientation of efforts is intended to build a set of competencies in the Higher Technical University students, to solve problems from science and research in various fields; social, technological, environmental, economic and organizational that face the regions, states and the country. With a reflective and assertive perspective to contribute with proposals, interventions and projects that mean a real change for the benefit of all.

2. Formative research and the teacher-researcher

In particular, research is one of the fundamental functions of the University, since it is part of the educational process and promotes learning and the generation of knowledge. This action is known as "teaching through research or research teaching" (Parra, 2004) gives foundation to formative research. Puig, (2014) mentions that: "From the epistemological theory of constructivism, formative research refers to the process of learning by doing research or teaching using the research method, a training space that through the development of the set of activities related to research provides students with the necessary skills for academic production and professional development" (p. 1116).

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For the purposes of the study, the proposal is of interest for the development of research skills in students and the conjugation of formative research, as a pedagogical strategy, which integrates three important elements: "1) didactic techniques that favor the development of autonomous and meaningful learning, 2) teaching style where the teacher also assumes his own role as an expert guide, who knows how and with what to "equip" the student so that he can successfully advance along that path and 3) specific training purpose, which should serve to help the student acquire a set of attitudes, skills and competencies, sufficient to appropriate the theoretical, practical and technical knowledge necessary for the qualified exercise of a professional or academic activity" (Parra, 2004, p. 72-73).

The research teacher who uses research as a teaching strategy should at least have "basic training in research methodology: concept of research, types of research, research techniques and instruments. This first approach can be of a theoretical-descriptive nature, with the purpose of bringing students closer to the terminology of scientific research, its modes and uses" (Parra, 2004, p. 74), as well as didactic strategies. 74), as well as didactic strategies Project-Oriented Learning (PLO) and Team-Based Learning (TBL) and managing projects through the good practices of the international standard of the PMI (Project Management Institute), thus acting as a facilitator or mediator of learning, by offering an integrated range of contents of any subject for teaching about projects, which are an example of the continuity of "education and life, of knowing and doing" (UNESCO 1996).

3. Project-Oriented Learning

Project-Oriented Learning is a form of student-centered teaching with constructivist conceptual bases, Urgos-Leiva, et al, (2021, p. 1) cite: "that learning is context-specific, learners actively participate in the learning process and achieve their goals through social interactions and the exchange of knowledge and understanding (Kokotsaki et al, 2016). It can be considered a particular type of inquiry-based learning where the context of learning is provided through authentic questions and problems within real-world practices that lead to meaningful learning experiences" (Wurdinger et al, 2007).

For its part, the Technological University of Jalisco, in an effort to have an impact on the development of research competencies, establishes didactic strategies such as Project-Oriented Learning and the Integrating Project as a methodology to formalize scientific knowledge, so that students become involved in a more responsible, autonomous and active way, by carrying out activities that solve problems or needs of the educational, professional and industrial context in a pertinent and coherent manner. The integrative project is provided by a series of concrete activities of start, development and end type, oriented to generate a service or product. In the case of Project-Oriented Learning they have their own characteristics such as:

1. The duration according to the four-monthly modality.
2. It must be student-oriented and student-directed.
3. Establish a time schedule and defined start and end activities.
4. Selecting the project based on significant interests for them.
5. Definition of a determined disciplinary line (Engineering and technology).
6. The prototype or service must provide a solution to real problems.
7. Encourage the research process.
8. In addition, tangible products such as prototypes and scientific papers; technical reports and dissertations are built.

4. Integrating Project

According to Arnáez, (2014) An integrative task "is an activity, it can be a project, a problem, a research, among others, that the teacher, the faculty or the academy design for the student to practically demonstrate what has been learned in a thematic unit. Therefore, in this research it will be understood as an integrating project, an activity that can be a project or the resolution of a problem, that its formulation has different origins; the academic one designed by the teacher or the academy or by the detection of needs and real problems of the context of interest of the students, to demonstrate in an applicative and practical way what has been learned in one or several subjects, also as a result of the integrating subjects.

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Methodology

It is a qualitative research with a focus on participatory action research. It is divided into five moments:

Diagnosis: An analysis of the curricular mesh of the educational programs Higher University Technician in Maintenance Industrial area, Mechatronics Automation area and Information Technologies Multiplatform Software Development area was performed, with the direction of the Academic Body UTJAL09 Applications and systems in virtual environments and teachers' colleges to determine the strategy of integrative projects by disciplinary areas.

Hypothesis of action: The question formulated How the application of a formative research model using the didactic strategy of Project-Oriented Learning under the leadership of one or more teachers with research training allows the development of integrative projects in students of TSU educational programs as part of their academic and professional training, in addition that they contribute to the construction of science and technology?

As a result of the diagnosis it was established:

a. Actors involved in this research training process: students, teachers, researchers, academic bodies and businessmen of the productive sector.
b. Definition of projects according to the lines of research of the CA's.
c. The didactic strategy of Project-Oriented Learning and integrating projects is chosen as a tool that makes possible the combination of curricular contents.
d. The core subjects of the integrating project are the subjects of Integrator II (First phase and second phase of the multidisciplinary project Integrator II of Engineering level).
e. The starting point will be the description of the problems as part of the integrating project, applying the methodology of scientific research and the methodology of project management, to verify the development process and the evaluation of the progress of the project and the learning.
f. Students will receive feedback and evaluation in the Integrator subject sessions, which through analysis will establish changes in the action process.

Planning the pilot test of the Integrator Project: In this phase the needs and problems to be addressed were identified according to the term, the educational program, the competencies and objectives pursued by the integrator project. Also, the chronogram, the agenda of activities for its execution and the definition of the subjects that will participate in the integrating project Table 1.

Educational Program	Código	Asignaturas (Eje, Enlace)	Tipo de asignatura	Función del docente (Líder, Asesor)
Industrial Area Maintenance	18MAI-INT2	Integrator II	Axis	Leader
	18MAI-AROB	Automation and robotics	Link	Subject Matter Advisor
	18MAI-FSC4	Sociocultural Training IV	Link	Subject Matter Advisor
	18MAI-EOE2	Oral and Written Expression II	Link	Subject Matter Advisor
	18MAI-INGV	English V	Link	Subject Matter Advisor
Mechatronics Automation area	18MEC-INT	Integrator II	Axis	Leader
	18MEC-MICR	Microcontrollers	Link	Subject Matter Advisor
	18MEC-PVIS	Visual Programming	Link	Subject Matter Advisor
Information Technologies area Multiplatform Software Development	18TIS-PPLO	Principles for IoT	Axis	Leader
	18TIS-DSPP	App Design	Link	Subject Matter Advisor

Table 1 List of subjects participating in the integrative project in the 5th quarter
Source: Own Elaboration

Execution and development: The first phase of the implementation of the integrator project (Figure 1) was carried out in 2020 and 2021, starting with TSU students. The Integrator I and Integrator II subjects support the scientific and PMI training process of the technology-based integrator project. It is accompanied by teachers who are experts in research to refine, guide, advise and motivate the student in the achievement of the prototype and the scientific report.

Presentation of the results and socialization of learning: This is the culmination and presentation of the project.

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The results obtained are demonstrated by delivering the project report, the functional prototype and the socialization of the results through an oral presentation to the teachers involved in the final evaluation of the project. At this stage, the learning experiences are recovered and the competencies developed are evaluated through a comprehensive individual and project team evaluation.

Results

As part of the preliminary results of the first phase of the Formative Research Model in the educational programs of TSU in Maintenance Industrial Area, Mechatronics Automation Area and Information Technologies Multiplatform Software Development Area, a compilation of integrating projects product of the periods 2020-2021 is presented in relation to the subjects described in Table 1, with the intention of disseminating what was produced in the classrooms and laboratories through the intellectual and creative construction of students who gave answers to needs and problems of various kinds as a result of learning from the project-oriented strategy, as well as the accompaniment of the Academic Body UTJAL-CA-9 Development of applications and Systems in virtual environments.

Description of cases:

1. Industrial area maintenance 2.

1. Liquid and semi-liquid packaging machine. A packaging machine was designed and manufactured through innovation and optimization of the functions integrated with sensors, actuators and indicators. This helped to make 30% more efficient a procedure in companies where a liquid and semi-liquid packaging process is required.

2. Wireless electrical load control. Implement a device that is able to control the switching on and off of different electrical loads wirelessly, using Bluetooth and IoT technology from any Smartphone that has this technology.

3. Prototype for an automated egg incubator with touch screen. This project presents novel ideas since it implements the use of an LCD touch screen, controlled by MikroC, therefore, the variables for optimal egg hatching are observed, the percentage of hatching in relation to other incubators previously created are higher, therefore, it is a viable option for poultry producers of medium-sized companies. The construction process of this prototype is to contribute to the response to the egg demand that exists due to quarantine. Therefore, for its construction, quotes for materials, construction planning and evaluation were carried out to verify optimal operation. In conclusion, the final prototype was satisfactorily achieved by responding to the control and programming tests.

4. Satirizing booth. An automated prototype of an inexpensive satirizing booth for domestic use was designed.

5. CNC Arduino Prototype. Implement a CNC prototype controlled by Arduino to manufacture parts for industrial machinery. This project consisted of making a prototype based on the Arduino UNO board, to be able to machine parts in wood, plastic and soft metals such as aluminum.

2. Mechatronics Automation Area

System prototypes:

6. Liquid packaging production line. A production line was designed for filling and packaging containers automatically, using two pistons, two sensors and a liquid dispenser, this will help to increase the amount of products produced and require less personnel to keep the line working at 90%, also thanks to the use of sensors, pistons and the dispenser the filling of the container will be maintained at an optimum level and without any alteration.

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7. Gear hobbing machine. A car gear cutting machine was manufactured with an excellent performance working in conjunction with Siemens three-phase motors, with the cooler pump is intended to finish the job quickly and adding the different sets of change is more utilitarian this machine to make different gear positions.

8. Separator pieces by color in automatic. Design an automatic machine for the classification of parts by color, in relation to ISO quality standards and safety standards of the machine.

9. Potato washing machine. A potato washing machine was designed using a conveyor belt, a water tank, a boiler, a presence detector and boxes for transporting the potatoes.

10. Filling of a tank. It consisted of automating a process with a PID control of the product level in a tank, this level should be provided by the user. The objective was to maintain the product inside the tank at a certain level, thus facilitating the process.

11. Vision sensor for parts separation. Automate the separation of raw material with two different colors (green and blue) of a conveyor belt using an artificial vision sensor type Cognex Omron, this process is done in order to optimize and reduce separation times made by production and quality personnel; also avoid unnecessary waste or mismanagement of resources by the machine, solve process errors by wrong or modified material by production personnel.

12. Conveyor belt (Weight measuring function). The project consists of a conveyor belt that has an analog input with which it will operate to measure the weight of the box. The boxes of lower weight will be placed on the right side and those of higher weight will be placed on the left side, this using a distributing device.

13. Box palletizer with speed control. The palletizing process was automated by controlling a box palletizer and its speed using a SIEMENS 1200 PLC, in order to reduce its execution time. The analogical variable of the PLC was used by means of the PID control, to vary the speed of the distribution bands of boxes for the palletizer using a potentiometer as control. A retro-reflective sensor was implemented which is in charge of sending signals to the counter to indicate the palletizer the next step to be performed by programming the PLC.

14. Automated tank for filling jugs with filtered water. To help the easy purification of water through an automated system that allows the filling of containers, improving productivity and costs as opposed to a totally manual system.

15. Automatic system for the control of an elevator. It focused on designing an automatic system for the control of an elevator, which through simulation allows observing the different maneuvering control systems existing in an elevator depending on the location and flow of people or objects. As well as the design and simulation in other softwares for a better visualization of the electrical installation and the automatic control of the elevator.

3. Information Technologies area Multiplatform Software Development

Internet of things prototypes:

1. Embedded system for clothing store. A mobile application and website were developed to improve the point of sale and interaction with customers. Generating the applications, the procedure manual and scientific report.

2. Integral system for the control of patients in a self-destructive behavior treatment center. An integral system for the control of patients in a self-destructive behavior treatment center was designed through tools such as the creation, design and implementation of a database together with a web page.

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3. Sales platform (Cremeria). This project automated the sales-cashing process for a creamery. By creating software to automate the way in which customer service is provided from the store (in person) or online, the option that best suits the customer to save time and convenience; This is achieved with a web application combined with a database where you can check the products that are offered in general, showing that at the time are in stock.

4. Medical office adjacent to the pharmacy. Software was developed and implemented to automate the processes of sales and inventory management, patient registration, user and administrator entry, and real-time access to information through a database and a remote server (Mysql). This software will be usable for Derma Skin users through a mobile application and a web application; the mobile application will be in charge of managing general patient processes. The web application will manage product sales and inventory processes. This software will be implemented in Derma Skin's facilities in a maximum period of 7 days after its completion.

5. Embedded system (shoe store). A product was developed using multiple tools and software to cover the areas established within the current marketing. A web page developed in sublime text will be designed together with a mobile application developed in Android studio that will be used for the sale, sample and section of shoes. For its administration, data collection and distribution a database developed in My SQL Server will be used, for an efficient link, it will be implemented in a XAMPP server.

6. Membership control system for a health and fitness club. A web application system developed in Visual Studio Code linked to a SQL Server database was created with the main function of keeping proper control of club members. In addition to including a mobile application developed in Android Studio and linked to the same database for the use and convenience of members and employees of the club.

Conclusions

The experience of promoting applied and technological research projects in the first phase of the research training model at the University has been gratifying, since it has strengthened the improvement of specializing, transversal and investigative competencies linked to formative research.

By putting Project-Oriented Learning into practice, and in conjunction with the process of scientific research, the students have gained depth in the knowledge acquired and, consequently, they have been able to use it to create new knowledge and, in particular, to provide solutions to the needs or problems of the local business or industrial sector.

At the same time, they develop planning skills (what they will research), identification of professional or productive sector problems, understanding of the scientific process that will allow them to guide their research efforts, navigate and select in the knowledge economy, develop cognitive abilities to analyze and interpret information, work collaboratively and reflect on their own learning.

The accompaniment and influence of the teacher-researcher in the production of science and technology should be directed in two key ways: the instrumentalization of teaching-learning strategies as a route of practical training for the development of research competencies and the installation of spaces where research skills are exchanged and shared in a bidirectional way between experts and novices.

Finally, we can conclude that encouraging learning through the integrative project is explicitly manifested positive effects in the promotion of formative research in university students.

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Technological Adaptation Model; an integrated application process to the productive chain in MyPyMES

Modelo de Adaptación Tecnológica; un proceso de aplicación integrada a la cadena productiva en MyPyMES

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Abstract

The purpose of this work is to develop a new analysis proposal an integrate the tools in the management of productive technological evolution projects in the industrial area, through a technological and procedural assurance plan for change management, focused on the creation of value and innovation, in order to face the challenges of globalized competition, respond to a productive logic with characteristics of the so-called smart factory and thus close the technological gap. Among the significant tasks, the review and analysis of the means of integration was developed, to associate them with the existing knowledge generated in the interaction, with practical purposes in decision-making activities, for the construction of strategies, and daring actions to face challenges, that promote the change to contemporary technologies, rapid methodologies, for the design and management of engineering and industrial automation projects, in order to generate competitive advantage in MyPyMES. The results allowed the construction of a Technological Adaptation Model that supports MyPyMES.

Industrial Evolution, Technologial Adaptation, Industrial Project

Resumen

El propósito del presente trabajo es desarrollar una nueva propuesta de análisis e integrar las herramientas en la dirección de proyectos de evolución tecnológica productiva en el tema industrial, a través de un plan de aseguramiento tecnológico y procedimental para la gestión de cambio, enfocado hacia la creación de valor e innovación, con la finalidad de hacer frente a los desafíos de la competencia globalizada, responder a una lógica productiva con características de la denominada fábrica inteligente y así cerrar la brecha tecnológica. Entre las tareas significativas se desarrolló la revisión y análisis de los medios de integración, para asociarlos con los conocimientos existentes en el entorno y considerar aquellos conocimientos generados en la interacción, con fines prácticos en las actividades de toma de decisiones, para la construcción de estrategias y acciones atrevidas para enfrentar retos, que impulsen el cambio a tecnologías contemporáneas, metodologías rápidas, para el diseño y gestión de proyectos de ingeniería y automatización industrial, en pro de generar ventaja competitiva en MyPyMES. Los resultados permitieron la construcción de un Modelo de Adaptación Tecnológica que apoye a las MyPyMES.

Evolución Industrial, Adaptación Tecnológica, Proyectos Industriales

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Introduction

In Mexico, the Mexican industry has not been studied in depth, so it is interesting to start from internal processes of information and knowledge; associate it with the existing knowledge in the environment and consider the knowledge generated in the interaction, the concept refers to the processes, practices and decision-making activities for the construction of strategies and bold actions in relation to risks, which drive change, in favour of innovation, in order to generate competitive advantage (Lumpkin and Dess, 1996; George and Marino, 2011).

MSMEs in hostile environments have consistently and creatively developed new processes, products or services, increasing their competitiveness, enabling them to compete in international circuits. However, in most studies it has been observed that small firms have strong difficulties in generating sustained profitability, increasing or developing commercial opportunities and transforming them into sales (Andreeva and Ritala, 2016; Teece, 2016; Guesala et al., 2018).

Mexico is attractive for foreign investment because of its labour force, its geographical location and its commitment to the formation of technological capabilities through foreign trade and the entry of foreign capital (Solleiro-Rebolledo and Castañón-Ibarrra, 2014); it currently has a favourable outlook in terms of innovation according to the Global Competitiveness Index 2018 of the World Economic Forum, ranking 50th out of 140 countries in terms of innovative capacity to generate new goods and services.

There is still much to be done in terms of linking technology companies in projects with universities, consultancies, suppliers and other specialist bodies for the development or integration of industrial solutions with technological applications.

Thus, an improvement in the organisation's performance can be explained through the company's ability to constantly renew itself by identifying and exploiting new opportunities in response to customer demands and continuous improvement.

In the context of organisational growth, entrepreneurship is identified among the capabilities of greatest interest, given that it is a factor that leads to the development of innovation capabilities and the achievement of sustainable competitive advantages (Porter and Kramer, 2011; Barney, Ketchen and Wright, 2011; Marvek, Davis and Sproul, 2016).

The aim of this paper is to integrate the tools in the management of productive technological evolution projects in the industrial sector, through a technological and procedural assurance plan for change management, focused on value creation and innovation. The importance of this research is based on the fact that, to the author's knowledge, there are no instruments in Spanish that evaluate the features and interactions, which has aroused concern through the literature and because of its transcendence in the economic development of the country; with the purpose of achieving the correct adjustment between the environment and the capacities that organisations must adopt to promote efficient practices in the daily production of any product, by means of automated manufacturing cells, given the inexistence of human-machine and machine-machine communication processes which allow an intelligence capable of significantly improving the entire production line of any product in such a way that it drives business innovation, through the generation of competitive advantages in MySMEs. The second section of the paper presents the conceptual framework, as well as a review of the literature and empirical studies related to technological and procedural assurance for change management, with a focus on value creation and innovation. The third section describes the methodology employed, while the analysis and results are presented in the fourth section, and finally conclusions, limitations and implications for future research are presented and discussed.

Theoretical framework

In recent decades, studies have tended to reveal the impulses that allow resources to be transformed creatively, maintaining the quality of the products developed and produced, while complying with Good Applicable Practices; given that the operating principles of each automation approach differ, as they include standards and operating regulations, linked to different models, contexts or different times.

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These requirements are imposed on industrial processes for the purposes of performance, quality and flexibility, making it necessary to use new technologies for control and monitoring. PLC's are born with the purpose of offering solutions and greater safety in automated equipment; as they have software for their programming, they facilitate the Human-Machine Interface (HMI).

The Human-Machine Interface HMI (Human Machine Interface), depending on the producing company, offers different versions of software, customised tools for the design of interfaces at a basic level of work environment, capturing field signals through PLCs using standardised communication means and protocols by means of industrial network links.

The purpose of the automation of production processes is to facilitate the operator's task; for the purposes of monitoring and follow-up, as well as for the establishment of criteria for adjustments and/or changes within the process (Barzaga-Martell et al., 2016).

Analogue instrumentation (pressure gauges and thermometers) has become only indicative, giving its place of importance to transmitters, such as pressure and temperature indicators, which by means of a Programmable Logic Controller (PLC), these devices obtain data and execute actions that through a technological architecture focused on the analysis of signals and systems are based on mathematical control models. Its task is to respond to stimuli captured by sensors by sending signals to actuators such as valves, pistons, motors, with regard to this technology applies the principle of open and closed loop control systems, the most used is the closed loop in order to generate a feedback of information to develop stable control process perform automatic control of the process.

Of the different supervision systems that exist, the most widely used are called SCADA (Supervisory Control and Data Acquisition), which is a set of supervision and control software applications, specially designed to allow access to plant or process data through digital communication with the instruments and actuators in interaction with the operator (high-level graphic interface) together with data acquisition.

At the next stage of the pyramid are the Manufacturing Execution System MES (Manufacturing Execution Systems), computer programmes used mainly to obtain information from the different stages of the production process from the supply chain, document the transformation of raw materials into finished products, so that they serve to analyse and evaluate the internal needs of a plant.

Finally, Enterprise Resource Planning ERP (Enterprise Resource Planning Systems) tools are resource management systems necessary to carry out business tasks, which integrate and manage a large amount of information associated with the production and distribution of the product as a commodity with which decisions are made at the executive level, which affect the previous levels of the automation pyramid and whose repercussions are noticeable throughout the plant.

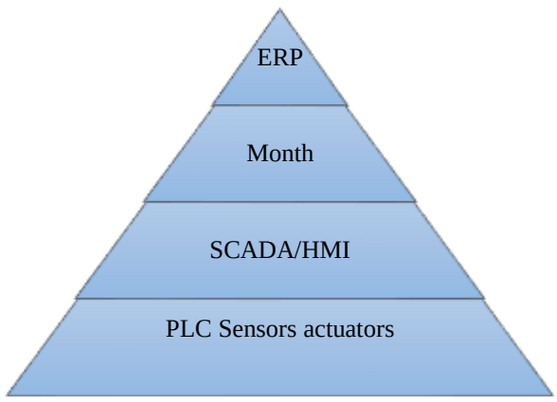

Figure 1 Model of the automation pyramid according to ISA-95 standard

Many are the antecedents that are identified in the literature as ideas and determining factors to include analysis technologies and improvements in production processes, such as HMI/SCADA, achieve a large amount of information about the processes, although with poor analytical processing for the intelligent use of information in executive decision making and/or their interactions for the generation of better production processes, better products or services and better forms of organisation.

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Methodology

The research refers to the development of an analysis methodology to improve business transformation processes through technological evolution, acquiring or adapting existing equipment, which can be automated to improve the performance of the production plant and the capacity for innovation in MSMEs, therefore, the design used is experimental, quantitative, cross-sectional and correlational (Hernández, Fernández and Baptista, 2010).

The scope of the research is exploratory in nature, as it approaches the problem of relatively unknown studies and in turn suggests verifiable statements in order to generate knowledge that will contribute to research on the subject.

Being considered as an evolutionary adaptation in terms of field elements in the production hardware, significant modifications are made in the machines and plant equipment, this generation of devices contemplate, forms and designs similar to those of Industry 3.0, but with control data communication functions with greater quantity or robustness at the time of transit of information, which streamlines the operation for the user, such as connection technology and fast communication IO-Link or through the OPC UA standard.

Technological integrations of IT solutions for smart grids, by means of new generation servers connected to cloud computing, once unified, allow the analysis of variables to be developed by means of KPIs or production indicators and therefore in classic control systems the feedback of information is limited compared to an Industry 4.0 system, which can generate a system of intelligent alerts.

Among the agile project methodologies, FEED or FEL (Front-End Engineering Design - Front ENd Loading) engineering is considered, consisting of defining the basic parameters of the process, determining the arrangement and sizing of equipment and ideal models, designing and specifying the system in constitution in this case of hardware, for production and processing of industrial control and sales channel software, in order to establish the specification to performance in an ideal industrial environment.

It is proposed to apply a standardisation level of operability and generation of value, by means of the integration of devices and software programmes that a system of this nature must have, among which are considered MES systems, ERP, HMI/SCADA, PLC, Field Elements or sensors, Augmented Reality systems, robotic autonomy, cyber security, vertical and horizontal integration communication, big data information processing, Internet of things as well as simulation, whose functions and interfaces are already duly installed in the devices or platforms currently marketed as conventional line products which respect the components of the ISA95 standard (Salinas, 2017).

Results

In the case of MSMEs, due to their specific characteristics, it is considered appropriate to consider interdisciplinary communication networks, favouring cooperation and diversity, to address the planning process, as well as to visualise the information necessary for execution; elements such as problems, execution time, budgets, areas involved, risks, products obtained, etc., focused on the creation of value and innovation.

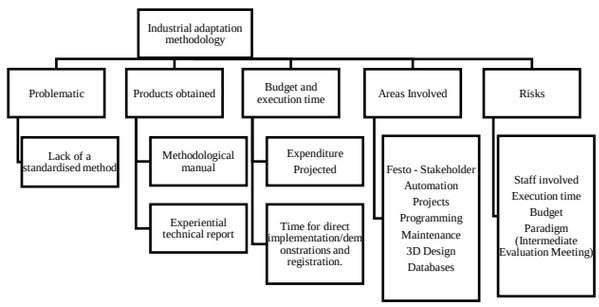

Figure 2 Proposed Model Adaptation Plan

The formulation of an engineering project, as well as its direction and development, generate the adaptation and quality factor to achieve the desired objective, through the use of agile methodologies for the creation and management of projects.

The help of a business model for innovative management, generates a solid base to frame the scope of an integration with a high impact media expectation, which also represents a considerable economic cost by attending to a high number of integrated technological media.

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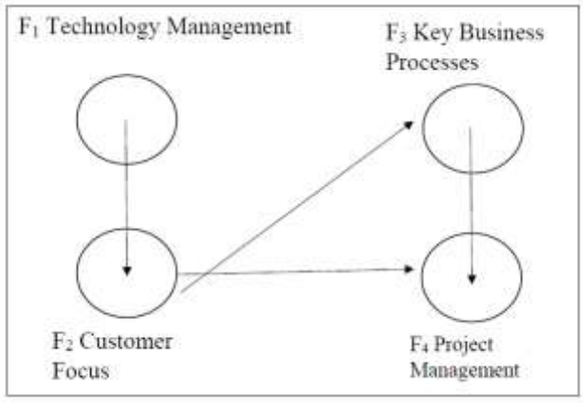

Figure 3 Graphical distribution of the Innovative Management Model of a Mexican Research and Development Technology Centre
(Martínez Ruiz, 2019)

Through modular visualisation, Technology Management takes on a highly representative place by contemplating determining factors from technological planning, implementation, assimilation processes, acquisition and development of technology, by considering process automation as a value proposition and key differentiator in a company that develops integral technical solutions.

Figure 4 Technological Adaptation Model

Faced with the challenge of developing a technological adaptation protocol, engineering principles are fundamental in the efficient and relevant diagnosis and design of the solution, from digitised design to the machining of parts, through collegial work between the members of the interdisciplinary team.

Conclusions

The study demonstrates the importance in the work of the project leader, in the initial diagnosis, the plan or design for the migration of a modern automated production system to a contemporary high-tech one, selection of parameters for implementation, as it is a high level of complexity, due to the multiplicity of variables encountered, thus, in the dynamics of innovation, organisation, technologies, sector dynamics and the response of society are interwoven (Rip, 2012).

For future work, it would be interesting to develop improvements to the system using an agile methodology such as Kamba or Scrum, fine-tuning to a linear life cycle, supported by artificial intelligence.

As Martínez Ruiz refers, in the 4th. Industrial Revolution there is a point of Disruption and Aporia, whose impact fissures the modernity of the productive nature and from the educational perspective, the generation of technical competence standards, typical of methodological management.

The present study is not free of limitations; the complete coverage of all the articles could not have been achieved, given the search procedure chosen. Therefore, there may have been papers left out that were aimed at migration or technological adaptation where a different language was used. Consequently, factors derived from the analysis need to be treated with caution.

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Hurdles to the adoption of solar energy technologies in the Comcaac nation, Desemboque, Sonora, México, a case study

Obstáculos para la introducción de tecnologías de aplicación solar en la nación Comcaac, caso Desemboque, Sonora

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Abstract

The Comcaac nation (seri) resides mainly in two towns of the State of Sonora: Desemboque and Punta Chueca. Currently, the Comcaac people face conditions of vulnerability due to the absence of water and energy. In 2020, a project with solar energy technologies was carried out in the community of Desemboque to ensure water supply and electrical energy, financed by the Honnold foundation. However, the results of this effort have not fulfilled the expectations. What happened? Through the analysis carried out by the transdisciplinary research collective, which is made up of 16 researchers from 7 institutions, national and foreign, obstacles to the development of local sustainability were identified, and the need to expand the analysis in different dimensions is recognized. This research is developed within the context of the execution of the project with funding from FORDECYT-PRONACES 315254 "Energy, water and food security for indigenous peoples in semi-arid coastal regions of Northern Mexico". (CONACYT, 2021a).

Sustainability, Transdisciplinary, Solar technology

Resumen

La nación Comcaac (seri) reside principalmente en dos localidades del Estado de Sonora: Desemboque y Punta Chueca, actualmente el pueblo Comcaac enfrenta condiciones de vulnerabilidad por la ausencia de agua y energía. Durante el año 2020 se realizó un proyecto con tecnologías de aplicación solar en la comunidad del Desemboque para asegurar el suministro de agua y energía suficiente, financiado por la fundación Honnold, sin embargo, en la comunidad no se han materializado los resultados de este esfuerzo. ¿Qué ha pasado? A través del análisis realizado por el colectivo de investigación transdiciplinario, que se conforma de 16 investigadores de 7 instituciones, nacionales y extranjeras, se identificaron obstáculos para el desarrollo de la sustentabilidad local y se reconoce la necesidad de ampliar el análisis en diferentes dimensiones. Esta investigación se desarrolla dentro del contexto de la ejecución del proyecto con financiamiento de FORDECYT-PRONACES 315254 “Seguridad energética, hídrica y alimentaria para pueblos originarios en regiones costeras semiáridas del Norte de México”. (CONACYT, 2021a).

Sustentabilidad, Transdisciplinario, Tecnología solar

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Introduction

The Comcaac nation (seri) resides mainly in two localities of the State of Sonora: Desemboque, belonging to the municipality of Pitiquito, and Punta Chueca, of the city of Hermosillo, Extreme coordinates: Latitude N: 28° 51' 00" to 29° 50' 24" Longitude W: 111° 58' 48" to 112° 39' 00", (Arriaga et al., 2000) . Its total population currently stands at 1,263, divided into 681 women and 582 men. It is part of the subgroups originating from the central coast of the Sonoran Desert. From the time of the Colony to the Porfiriato, its territory and population have almost disappeared.

It is estimated that the Comcaac may have reached up to 10,000 inhabitants before the Colonial period. By the time of Porfirio Díaz, after suffering military interventions and deportations (1904), the population was made up of only 100 inhabitants relegated to inhabit the "Tiburon" Island (Luque-Agraz et al., 2016).

According to their nomadic way of life, it is expected that, according to fishing cycles, they also reside in various fishing areas distributed throughout their territory of approximately 100 km of coastline. Other actitivies include hunting deer and collecting desert flora for food and therapeutic uses.

Within their territory, by presidential decree, they have an area of fishing exclusivity: the Infiernillo Channel, the island's coasts, and the Ejido Desemboque. The Infiernillo Channel is a Ramsar site, and Tiburon Island is part of the Protection Area of Islands Flora and Fauna of the Gulf of California (Id. ibid, 109).

The *Comcaac* territory comprises an approximate area of 211,000 ha. at sea level and is composed of a mainland and the island of Tiburón as shown in Figure 1. From the 1970s, it is when they settle most definitively in the reference localities: Miguel Alemán, Bahía de Kino, Puerto Libertad, mainly in the towns of El Desemboque de los Seris and Punta Chueca.(Arriaga et al., 2000).

Figure 1 Location of the settlements of the Comcaac community (Seri)
Source: Biocultural Complexes of Sonora Indigenous Peoples and Territories.(Luque-Agraz et al., 2016)

The extreme climatic conditions of the region prevent the development of agriculture as a way of life, coupled with the fact that it is not an activity that is part of their cultural identity. The characteristics of the desert that make up its territory do not impede for the Comcaac to take advantage of the species of flora and fauna of the region. However, fishing, carving of "palofierro" and the elaboration of "coritas" and necklaces are part of their cultural identity, and these activities are their primary sources of income.

From September to May, it is possible to carry out the fishing activity commercially, which is complemented by the sale of handicrafts (National Institute of Indigenous Peoples, 2020). Although the Comcaac territory has abundant fishing resources and excellent tourist potential, it is crucial to consider that the Comcaac do not usually leave their territory in search of work, and even within it, they hardly accept to hire themselves as salaried; they have never accepted the existence of employers, a contract by schedule and the assignment of pre-established tasks defined by others. (id.)

Water situation

From 2013 through 2018, the National Water Program indicated that the availability of water per capita at the national level had decreased: from 18,035 m^3/inhabitant/year in 1950 to 3,982 m^3/inhabitant/year, a reduction of almost five times which is attributed to the effects of the average demographic growth of the country and the increase in agricultural activity.

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The agricultural sector uses about 76% of the extractions (PNH, 2020). For 2020-2024, the PNH states that there are severe problems in the public infrastructure of health, education, rural environments, and urban peripheries for universal access to water in Mexico. Public schools' lack of safe water and sanitation mainly affects women who stop attending school. This also impacts rural areas.

The lack of services and hydraulic infrastructure becomes additional work for women and children, who are usually in charge of fetching water. Information from the National Population Council (CONAPO) suggests that to be in a position to achieve universal access to water in Mexico, it is necessary to make investments similar to those made in the second half of the last century, according to information from the 2015 Count of INEGI (National Institute of Statistics and Geography), scattered rural localities with less than 2,500 inhabitants total about 197,000.

This means that the cost of developing water and sanitation infrastructure in these communities is greater than the cost of doing the same in medium and small cities. By 2050 there will be 31 million more inhabitants in the country, representing about 25% additional to the current population, 126 million people (INEGI, 2020). According to current trends, feeding a primarily urban population requires increasing food production by around 70% (Godfray et al., 2010), implying that water withdrawals will increase by 60% by 2050. (CONAGUA, 2018, p. 214)

For the context of the water situation and its relationship with the Comcaac community, Luque-Agraz 2016 proposes to differentiate between the 'availability' of 'access' to water and the 'water for development', from the 'water for self-subsistence conceptually'. Why?, it is different that there is hydraulic infrastructure or sources of supply nearby so that you can access it. To represent the above, consider the example of the current situation (March 2021) of the community of Desemboque, where there is a well 8 km away with the infrastructure installed to supply water to the community. However, deficiencies in the supply of electricity cause failures in the pumping system.

In addition to the above, the other worrying aspect is the continuous existence of debt from the community to the Federal Electricity Commission (CFE), for energy for the pumping system of the well, which translates into suspension of the electric power service from the perspective of the CFE, this action does not correspond to 'a suspension of the water supply'; however, since there is no supply of electricity, which is essential for the operation of the pumping system, there is then no access to water. Thus, there is availability, but not constant access. It is also imperative to consider that the availability of sources of supply does not guarantee the quality or quantity of water, so it is essential to include measurement mechanisms that allow these evaluations regularly.

During the year 2020, researchers from the University of Arizona[1], who have developed programs in community leadership, conservation, biocultural education, economic development, and health with the Comcaac community for 20 years; attended a call from the Honnold Foundation[2] to finance technological proposals with renewable energies for vulnerable communities. The proposal presented by the researchers could solve the problem of the supply of electrical power for the well of the community of Desemboque.

It was thought that installing a photovoltaic system would improve the reliability of the electricity supply and that there would be significant reductions in the amounts billed by CFE. It is no coincidence that the technical proposal implements photovoltaic systems. These represent an energy solution for isolated communities and expand the possibilities in many ways, for example, the works presented in the first half of this year concerning self-consumption (Reyes-Ruiz, 2022), proposals for remote monitoring of climatic conditions (Ventura-Duque, 2022) and the use of public education spaces (Alonso Frank & Ré, 2022), all with the integration of photovoltaic systems aimed as alternatives to solve problems related to electricity access. With this in mind, phase 1, funded by Honnold, was launched. A photovoltaic system was installed with a total investment of $100,000.00 US dollars. The system's installation was carried out through a specialized company, Solarex.

[1] https://www.garynabhan.com/news/2021/03/crisis-de-agua-energia-y-alimentos-que-amenazan/
[2] https://www.honnoldfoundation.org/news/energy-justice-in-mexico

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The characteristics of the installed system: 30 photovoltaic modules of 375W, two inverters of 5kW, and the necessary support structures.

With the technology of harnessing renewable energies installed and functioning correctly, the impacts on the water supply for the community should be significant, right? Therefore, we can affirm then that an introduction of solar application technologies to reach water security is sufficient to impact the community well-being of one of the Comcaac nation localities. However, the reality of the inhabitants of Desemboque is different. To date, the water supply remains unresolved; why? If the installed solar technology is reliable and works properly.

Here, the dimensions of sustainability proposed by (Ilskog, 2008) became relevant through the identification of variables and indicators, which expand the relationships, as in this case, between the needs of the community. In addition, technological proposals, the availability of resources, social and cultural organization, and institutional relations extend the complexity of the means to solve social problems, where intervention should positively impact community well-being.

This complexity and sustainability relationships represent a new research problem, which gives rise to the integration of a group of researchers who have the purpose of forming a proposal of greater scope, which may be able to reduce the conditions of the vulnerability of the Comcaac nation. Through the national scientific development plan, the Conacyt summon 2020 is attended to prepare proposals for research and social incidence projects to transition to a socially and environmentally sustainable energy system. The group of researchers sent a proposal formulated from the experience of Phase 1 with the title "Energy, water, and food security for indigenous peoples in semi-arid coastal regions of Northern Mexico", which was approved to be financed with a seed fund for the elaboration of comprehensive proposal.

Methodology

The transdisciplinary research collective composed of 16 researchers from 7 academic institutions[3] carried out field visits to identify the main problems of the community and recognize the impact of climate change. In addition, share a direct dialogue with them to determine what obstacles exist, the priorities to face them, and reach solutions appropriate to their environment and culturally relevant. To this end, the Participatory Action Research methodology was used as a tool for dialogue through workshops, considering that the opinion and participation of the inhabitants are fundamental since they are the protagonists in achieving social change (Zapata & Rondan, 2016).

Furthermore, the structure of the workshops corresponds to the need to identify the elements that promote the lack of safety in the water, energy, and food components. Therefore, the development of the workshops includes a brief informative talk about the project, a presentation of the research team, the dynamics for the development and participation of the community in the approach of the problem from their perspective, in that sense, motivate them to participate with proposals for action to solve the issues.

The working groups are organized by component and are directed by members of the research collective according to their specialty to structure the content of the workshops and integrate the recommendation to identify problems and obstacles mentioned in the guide for the elaboration of extensive proposals for national research and social incidence projects to transition to a socially and environmentally sustainable energy system contained in terms of reference of the summon (CONACYT, 2021b) to define the questions and conduct the work tables, a work plan is drawn up with the points to follow during the development of the PAR workshops, which are made up of three stages: presentation of the purpose of the project, development of the tables, and presentation of the work done in each work table.

The following water and energy-related issues were identified:

[3] University of Sonora
Food and Development Research Center
University of Arizona
Institute of Ecology of the UNAM
The Ohio State University
Technological Institute of Sonora
Prescott College

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SOTELO-MEDINA, Demetrio, LEÓN-BALDERRAMA, Jorge and CABANILLAS-LÓPEZ, Rafael. Hurdles to the adoption of solar energy technologies in the Comcaac nation, Desemboque, Sonora, México, a case study. Journal-Urban-Rural and Regional Economy. 2022

Water	Energy
Shortage of drinking and all-purpose water	Debt with CFE accumulated, aggravated by the pandemic because there was no fishing or buyers of handicrafts
Obsolete and unserviced pipes and infrastructure: with root plugs in pipes and leaks so that the quality of the well water when it reaches the houses is no longer drinkable	The offices to pay electricity bills are in Puerto Libertad 63 km away so leaving the mouth is not easy since there is no public transport, they have to pay and sometimes wait all day for a raite or put 40 L of gasoline or walk 18 km to the truck stop and pay MXN$ 450 per round trip.
Lack of water to clean the fish they sell	Light is costly 3000 to MXN$ 5,000 bimonthly
Blackouts in Puerto Libertad that affect them in the water well	With the installation of solar panels in some houses, the saving of electricity has not been seen because they are disconnected due to debt with CFE, failures, lack of mufas, and not being able to pay procedures or transfer expenses to change owners of houses inherited by deceased parents
Lack of monetary contribution from the community to solve problems at their fingertips	The gas cylinders of MXN$ 300 for the small tank and MXN$ 800 for the large tank, have to go to the town of Kino Bay 3 hours away

Table 1 Problems identified in PAR workshops,
Source: Fieldwork 2021[4]

Figure 2 Community members are exposing water problems and obstacles.
Source: Fieldwork 2021[5]

Results

Identification of obstacles.

1. Regulatory obstacles thwart the transition to renewable energies in the Comcaac nation.

The Comcaac community lives in its situation of marginalization in social and economic aspects without reflecting the ordinances and mandates issued by the Sustainable Rural Development Law (SRDL) published in 2001 (DOF 07-12-2001, 2001) that compels the institutions of the three levels of government, to promote the sustainable development of the entire rural population in the country, through its institutions.

The Federal Electricity Commission (CFE), responsible for the national electricity grid, is also responsible for moving towards the widespread use of clean energy, through the interconnection of electrical systems, in this case, solar energy through photovoltaic panels. Therefore, it is necessary to apply rules, regulations, and obligations more flexibly towards disadvantaged users, in this case, the indigenous population, who can face the consequences of climate change in better conditions. Likewise, CFE's infrastructure can provide digital connectivity, which is fundamental for developing activities related to education and health. In addition, it would be possible to diversify and capitalize on economic movements to stop the deterioration of its natural resources.

2. Obstacles inherent in technological models face new challenges: climate change, energy, natural resources, public health, and quality of life

The Comcaac population has grown ten times in a century with the energy demands. However, adopting new technologies, including energy use and connectivity, has been slow.

[4] Annex 6.2.9 Historical reconstruction and obstacle analysis of the Extensive Proposal of the 315254 project, called "Energy, water, and food security for indigenous peoples in semi-arid coastal regions of Northern Mexico.", approved within the framework of the summon 2020-05 (FOP04-2020-01)

[5] Annex 6.2.3. Consultation and community diagnosis of the Extensive Proposal of the 315254 project, called "Energy, water, and food security for indigenous peoples in semi-arid coastal regions of Northern Mexico.", approved within the framework of the summon 2020-05 (FOP04-2020-01)

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As a result, its current productive organization is based on the use of conventional energy sources and the overexploitation of its natural resources, which make it difficult to face the challenge posed by climate change, reflected in changes in the local ecosystem. Moreover, almost no access to new technologies has made it difficult for younger people to continue their education and job preparation.

It is considered a priority to make available to the community technological tools for the diversification of the means of dissemination and sale of the productive activities they already carry out, as well as access to higher education from the community, drinking water and healthy food, essential elements for the change that threatens the survival of the Comcaac community since, as Luque affirms (Op. Cit, 335). The indigenous population in this country is one of the "most vulnerable to the global risks of climate change, water crisis and loss of biodiversity."

3. Obstacles represented by public and private actors that inhibit the energy transition

An obstacle observed and expressed by the people of both peoples is that the public actors who make decisions do not approach the people to ask them about their current problems and consult them on informed, possible, and appropriate solutions to their environment and reality. "We who were born, grow and die here know what our problems and solutions are, come and ask" comment collected in September 2021 in fieldwork[6] for the conformation of the research proposal. On the other hand, the transition to the use of renewable energies requires a robust initial investment, so it is challenging for the community to acquire them without an external source of financing. Currently, the private companies that provide clean technologies in the region are SMEs, which limits their ability to finance this type of project or does not visualize a market opportunity in vulnerable communities. Ironically for some families, spending on interrupted service surcharges, and the cost of wiring for connection on their own, would justify investing in renewable energy sources such as interconnected photovoltaic systems.

4. Obstacles of dominant thinking paradigms and energy use.

It is necessary to share the idea of the importance of new paradigms to integrate the members of the communities as allies in the implementation of renewable energy projects. Historically, these communities have been respectful of their environment. The electricity supply based on renewable energies would allow offering cheaper energy in the long term and would be within the payment capacity of the Comcaac community.

5. Obstacles generated by the actors transform their unexpected thoughts and behaviors.

Respect for the community's cultural identity can represent a factor so that the behaviors and thoughts of the same transformative actors can build solutions to their current and future problems. Therefore, a permanent participatory methodology has been implemented, which has as its guiding base the dialogue of knowledge (Luque-Agraz et al., 2016), to approach the population toward the collective interior. This dialogue seeks to understand the various problems and propose solutions together. This dialogue that in turn, combines two knowledge, one ancestral and the scientific, to reach sustainable solutions. The interdisciplinarity of the research group that makes up the work team presents obvious language barriers, differences of thought, and research interests. This requires all members to contribute to respectful dialogue with others. This means prioritizing the real and urgent needs of the community and putting aside particular research interests.

Financing

This research work has been funded by CONACYT, through the FORDECYT-PRONACES seed fund 315254 "Energy, water and food security for indigenous peoples in semi-arid coastal regions of Northern Mexico".

[6] Extensive proposal of the project 315254, called "Energy, water, and food security for indigenous peoples in semi-arid coastal regions of Northern Mexico.", approved within the framework of the summon 2020-05 (FOP04-2020-01)

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Conclusions

The case study of the Comcaac community of Desemboque shows that there is still much to be done to solve problems related to fundamental human rights, such as access to water and energy, which are part of historical debt to indigenous communities throughout the country. In the context of climate change, efforts to mitigate its effects lead to the search for technological solutions with the capacity to contribute to the improvement of living conditions. Improving practices regarding the relationship with communities, respect for their autonomy, and opinion on how to meet their needs is an advance to direct the requirements of community well-being.

However, we have also learned that it is not enough to know the needs and achieve the introduction of technologies, in this case, solar application, to solve access to water and energy. That is, implementing a booming technological system is not enough on its own to achieve development or well-being. It is necessary to broaden the vision and scope of the analysis of sustainability dimensions, identify obstacles and actors, as well as develop robust methodologies in this regard; the National Council of Science and Technology, through PRONACES promotes the development of research and advocacy projects, is a step forward in the construction of a scientific system focused on solving fundamental problems of the nation, in its most vulnerable communities.

This is how the case of Desemboque has evolved from an intervention funded by the Honnold Foundation (phase 1), to a transdisciplinary analysis for the integration of a proposal (seed fund, PRONACES call) to a comprehensive proposal with three-year financing for the communities of the Comcaac Nation Punta Chueca and Desemboque, PRONAII proposal 319483(CONACYT, 2022).

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Community land use planning in la Gloria community

Ordenamiento territorial comunitario en la comunidad la Gloria

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Abstract

The environmental deterioration in the Gloria Primera Seccion community due to the traditional land use and the natural resources has generated a preoccupation in the population, who before this panorama are looking for formalize their practices. In this research were identified the problems that are present in the community, in the social, economic, and environmental ambit, this based on the article 41 of the Reglamento de la Ley General de Equilibrio Ecologico y Proteccion al ambiente en Materia de Ordenamiento Ecologico. A Community Land Use Planning was made in the Gloria Primera Seccion community, this with the goal to distribute the land use in a correct way, through a land management action plan, posing activities that entail to a sustainable human development.

Enviromental, Deterioration, Sustainable, Traditional, Formalize, Development

Resumen

El deterioro ambiental que se tiene en la comunidad debido al uso tradicional del suelo y los recursos naturales ha generado preocupación en los habitantes, quienes ante este panorama buscan formalizar el conjunto de prácticas. En esta investigación se identificaron los problemas que presenta la comunidad en los ámbitos social, económico y ambiental, esto en base al artículo 41 del Reglamento de la Ley General de Equilibrio Ecológico y Protección al ambiente en Materia de Ordenamiento Ecológico. Se realizó un Ordenamiento Territorial Comunitario (OTC) en la comunidad La Gloria Primera Sección, con el fin de distribuir el uso de suelo de forma adecuada, mediante un plan de acción de manejo del territorio, planteando actividades que conlleven a un desarrollo humano sustentable.

Ambiental, Deterioro, Sustentable, Tradicional, Formalizar, Desarrollo

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Introduction

Currently, worldwide, society has a great dependence on natural resources to satisfy industries, commerce, construction and food demand (Ramírez Hernández & Antero Arango, 2014). Population growth continues, for the case of Mexico according to the National Institute of Statistics and Geography [INEGI], (2020), in the Population and Housing Census conducted, the growth rate between 2010 and 2020 was 1.2 %, which in numbers represents that by 2010 there was a population of 112.3 million and by 2020 a little more than 126 million.

One of the basic needs to be satisfied is food security, which comes mainly from one of the most important economic activities in Mexico, agriculture, which is mostly practiced in rural areas, most of which are marginalized. Many of the farmers are not professionals in this branch, which represents an obstacle and an opportunity at the same time; empirical agricultural methods transmitted from generation to generation are used (Corona, 2016). This can lead producers to use new land, including forestry land. At the regional level (Chignahuapan - Zacatlán) the probability of a hectare of forest use changing to agricultural use ranges from 45 to 90 % and at the municipal level in Chignahuapan the probability is 60 % (Cruz-Huerta *et al*., 2015).

The project arises from the environmental problems observed in the community, the interest of the villagers in improving their farming practices, their activities in the management of natural resources and preserving the environment.

In the community of La Gloria Primera Sección, the main land use is agriculture, and there is moderate use of other resources, such as firewood extraction. The objective was to develop a proposal for community land use planning in the community, that is, to create an instrument through social participation. This proposal is a land use plan that will allow reorienting productive activities, thus minimizing the impact of society on natural resources and promoting sustainable development, guaranteeing the improvement of the living conditions of the inhabitants.

Materials and Methods

Location

The community La Gloria Primera Sección is located in the state of Puebla, specifically in the municipality of Chignahuapan, at UTM (Universal Transverse Mercator) coordinates 597581 E, 2200128 N; zone 14Q. It is located northwest of the center of Chignahuapan, approximately five to six kilometers (see Figure 1). The average elevation of the community is around 2,450 meters above sea level; in some parts the elevation is 2,330 meters above sea level and in others up to 2,700 meters above sea level.

The community has an area of 1,034.90 hectares, in which according to the Secretary of Social Development [SEDESOL] (2013), in its page for the year 2010 there was a registered population of 228 inhabitants, consisting of 109 men and 119 women.

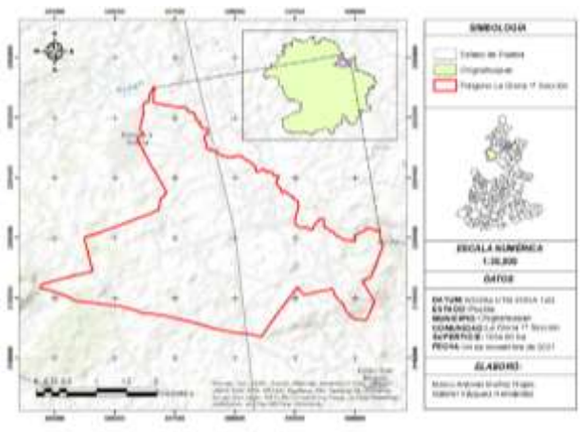

Figure 1 Macro and micro-localization of the community La Gloria Primera Sección, Chignahuapan, Puebla
Source: Own Elaboration with data obtained from georeferencing in the field

Methodology

This is a descriptive study that diagnosed the social, economic and environmental characteristics of the community, information that is the basis for determining proposals and/or actions to be carried out for the benefit of the community.

For the execution of this work, the stages indicated in Article 41 of the Regulations of the General Law of Ecological Equilibrium and Environmental Protection on Ecological Management, (2014) were followed. The stages are detailed below:

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Stage 1

Characterization: The objective is to describe the state of the environmental, social and economic components of the study area. Surveys, interviews and field tours (reconnaissance of the area) were conducted for a detailed and updated description of the community.

Stage 2

Diagnosis: The purpose was to identify and analyze the conflicts of the environmental, social and economic components. Participatory workshops were conducted, complemented with surveys and interviews.

Stage 3

Prognosis: The evolution of environmental conflicts was examined, considering natural, social and economic variables that could influence changes in the pattern of land use and occupation. Scenarios were analyzed in a temporal panorama to indicate the current state and allow for the projection of probable scenarios.

Stage 4

Proposal: The objective is to obtain a land use pattern that maximizes consensus among sectors, minimizes environmental conflicts and favors sustainable development. Through the evaluation of the community's situation in the different areas (social, environmental and economic), management units were delimited, which are the basis for the execution of the Community Land Use Planning and in a future scenario to have a sustainable human development.

Results and discussion

Environmental diagnosis

The community of La Gloria Primera Sección, Chignahuapan, Puebla is located in a plain zone, the altitudinal range goes from 2400 masl (meters above sea level) to 2650 masl in the highest parts.

The climate is denominated as C(w1), which according to Garcia et al. (1998) defines it as "Temperate, average annual temperature between 12 and 18 °C, temperature of the 14% coldest month between -3 and 18 °C and temperature of the hottest month below 22 °C, sub-humid, annual precipitation of 200 to 1800 mm and precipitation in the driest month of 0 to 40 mm; summer rainfall of 5 to 10.2% annually". Based on average annual precipitation data from meteorological stations established in Zacatlán, Pueblo Nuevo, Loma Alta and Chignahuapan (places near the community), an average for the community was estimated, resulting in 827.725 mm, with the main concentration of rainfall occurring from June to September. Average temperatures are: annual maximum of 19.6, annual average of 13.4 and annual minimum of 7.3 °C. The Agrio River runs through the community and crosses the territorial limits between the communities of Zacatlán and Chignahuapan. At the community boundary, it extends for 5.41 km.

In the community La Gloria Primera Sección belonging to Chignahuapan, four different soil types were identified. The first according to the Food and Agriculture Organization of the United Nations is recognized as Andosols, soils originated by eruptions and are restricted to the vicinity of volcanoes. They have a high potential for agricultural production; however, they are easily eroded because they are very shallow, impermeable or poorly consolidated soils (FAO, 2008). The second was defined as Cambisols, which are soils with initial differentiation of horizons in the subsoil, evident by changes in their structure, color, clay content or carbonate content. These generally constitute good agricultural land and are used intensively; in temperate zones they are among the most productive soils on earth (FAO, 2008).

The third type of soil identified is Feozems, which are dark porous soils rich in organic matter, so they are used intensively in agriculture; however, droughts and water and wind erosion are their main limitations. It is found in temperate and humid climates (INEGI, 2007). The last soil type identified was Vertisols, which are extremely clayey soils that develop in sub-humid to dry climates; they are deep, very hard in drought and muddy when wet, making them difficult to work. In addition, their fertility is intrinsically low. They have considerable agricultural potential, but with proper management (FAO, 2008).

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According to the Instituto Nacional de Estadística y Geografía (INEGI) in 2007, in its publication *Conjunto de datos Vectoriales Edafológico*, scale 1:250 000 Serie II (Continuo Nacional), Feozems, Luvisols, and Vertisols are the soils with the highest fertility and are appropriate for agricultural use. In the community there are two of these soils, Feozems and Vertisols, predominantly the Chromic Vertisol soil, however, due to the management that has been given to it, a large part of the agricultural soils, as well as the soils present in the community have been degraded due to poor management. Figures 2 and 3 show the water network and edaphology of the community la Gloria first section.

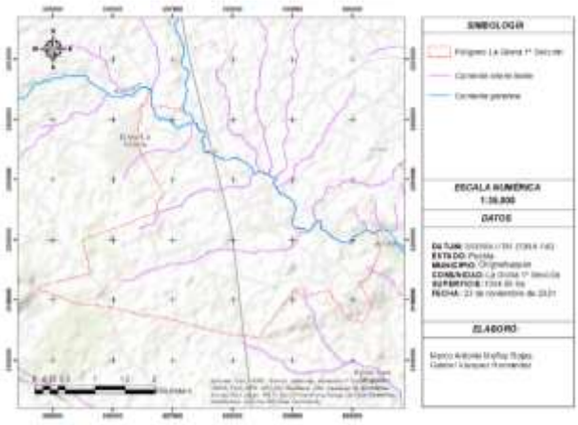

Figure 2 Water network of the community La Gloria Primera Sección, Chignahuapan, Puebla
Source: Own Elaboration with data obtained from the National Institute of Statistics and Geography

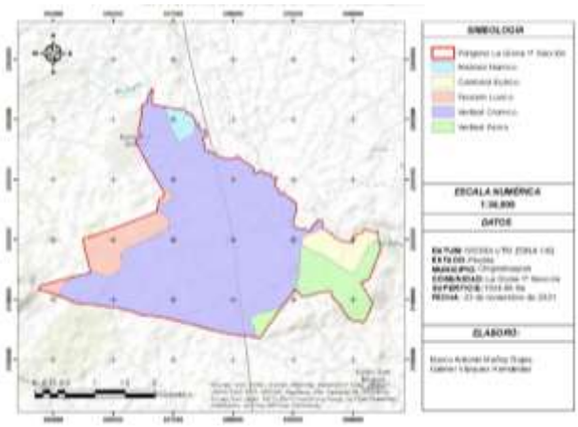

Figure 3 Soil ecology of the community La Gloria Primera Sección, Chignahuapan, Puebla
Source: Own Elaboration with data obtained from the National Institute of Statistics and Geography and the National Commission for the Knowledge and Use of Biodiversity

In the community there are three types of land use, annual seasonal agriculture is used in an area of 846.53 ha (see Table 1), while secondary vegetation is approximately 15 ha, therefore, it is inferred that agriculture is the main economic factor of the community.

Land use	Surface area (ha)	Occupancy rate (%)
ATA	846.53	81.80
F	15.13	1.46
VS	173.24	16.74
U	Dispersos	
Total	1034.9	100

ATA: Annual seasonal agriculture; F: Forestry; VS: Secondary vegetation; U: Urban

Table 1 Land use in the community La Gloria Primera Sección, Chignahuapan, Puebla
Source: Own Elaboration with data obtained from surveys

Regarding the biodiversity present in the community of La Gloria (see Table 2), it was observed that the area is mainly a pine-oak forest, and there are other species, it was observed that there is a great diversity in the ecosystem. To obtain flora and fauna species, we worked together in a *Biocomuni* monitoring (see Table 3), the tree species identified are shown below.

Scientific name	Common name	Family
Crataegus mexicana	Tejocote	Rosaceae
Pinus leiophylla	Ocote	Pinaceae
Pinus montezumae	Ocote blanco	Pinaceae
Pinus patula	Pino colorado	Pinaceae
Pinus pseudostrobus	Pino blanco	Pinaceae
Pinus teocote	Ocote chino	Pinaceae
Quercus mexicana	Encino	Fagaceae
Quercus rugosa	Encino	Fagaceae
Ageratina pazcuarensis	Raíz de serpiente	Asteraceae
Baccharis conferta	Escoba	Asteraceae
Senecio barba-johannis	Gordolobo	Asteraceae
Berberis moranensis	Ixcapul	Berberidaceae
Buddleja cordata	Tepozán	Buddlejaceae
Garrya laurifolia	Garria	Garryaceae
Juniperus deppeana	Sabino	Cupressaceae
Marrubium vulgare	Marrubio	Lamiaceae
Pinus leiophylla	Ocote	Pinaceae
Pinus montezumae	Ocote blanco	Pinaceae
Pinus patula	Pino colorado	Pinaceae
Prunus serótina	Capulín	Rosaceae
Quercus mexicana	Encino	Fagaceae
Quercus obtusata	Encino	Fagaceae
Symphoricarpos microphyllus	Huihuilan	Caprifoliaceae
Viburnum stenocalyx	Tlamahuacatl	Adoxaceae

Table 2 Biodiversity in the community La Gloria Primera Sección, Chignahuapan, Puebla
Source: Own Elaboration with experimental data

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Grupo Biológico	Family	Species	Common name	Status	NOM-059-SEMARNAT-2010
Amphibians	*Hylidae*	*Hyla eximia*	Rana arborícola de montaña	En	SC
	Anguidae	*Barisia imbricata*	Lagarto alicante del Popocatépetl	En	Pr
	Colubridae	*Thamnophis proximus*	Culebra listonada occidental	R	A
	Colubridae	*Thamnophis scaliger*	Culebra listonada de montaña cola corta	En	A
	Phrynosomatidae	*Sceloporus mucronatus*	Lagarto Hendido	En	SC
	Viperidae	*Crotalus ravus*	Víbora cascabel pigmea mexicana	En	A
Birds	*Accipitridae*	*Accipiter striatus*	Gavilán pecho rufo	R	Pr
	Accipitridae	*Buteo platypterus*	Aguililla alas anchas	R	Pr
	Accipitridae	*Buteo jamaicensis socorroensis*	Aguililla cola roja	En	Pr
	Ardeidae	*Ardea alba*	Garza Blanca	C	SC
	Ardeidae	*Egretta caerulea*	Garza Azul	C	SC
	Cardinalidae	*Piranga rubra*	Piranga roja	R	SC
	Cardinalidae	*Pheucticus melanocephalus*	pico gordo tigrillo	R	SC
	Cathartidae	*Coragyps atratus*	Zopilote común	R	SC
	Columbidae	*Streptopelia decaocto*	Paloma de collar turca	I	SC
	Fringillidae	*Spinus psaltria*	Jilguero Dominico	R	SC
	Hirundinidae	*Hirundo rustica*	Golondrina Tijereta	R	SC
	Icteridae	*Quiscalus mexicanus*	Zarate mayor	R	SC
	Mimidae	*Toxostoma curvirostre*	Cuitlacoche pico curvo	R	SC
	Passerellidae	*Oriturus superciliosus*	Zacatonero serrano	R	SC
	Passerellidae	*Pipilo maculatus*	Rascador moteado	R	SC
	Picidae	*Dryobates scalaris*	Carpintero mexicano	En	SC
	Turdidae	*Myadestes occidentalis*	Clarín Jilguero	R	Pr
	Turdidae	*Turdus migratorius confinis*	Mirlo Primavera	En	Pr
	Tyrannidae	*Empidonax minimus*	Mosquero Mínimo	R	SC
	Tyrannidae	*Pyrocephalus rubinus*	Mosquero Cardenal	R	SC
Mammals	*Canidae*	*Urocyon cinereoargenteus*	Zorra gris	C	SC
	Didelphidae	*Didelphis marsupialis*	Tlacuache común	En	SC
	Leporidae	*Sylvilagus cunicularius*	Conejo Serrano	En	SC
	Procyonidae	*Bassariscus astutus*	Cacomixtle	En	A
	Sciuridae	*Sciurus oculatus*	Ardilla de Peter	En	Pr

A: threatened, C: quasi endemic, I: introduced, R: resident, En: endemic, SC: no risk category, Pr: subject to special protection.

Table 3 Fauna of the community La Gloria Primera Sección, Chignahuapan, Puebla
Source: Own Elaboration with experimental data

Social diagnosis

According to INEGI data, (2021) the community is in a medium marginalization status, inhabited by approximately 228 people, 119 women and 109 men, surveys and interviews were applied to 12.28 % of the people of adult age to obtain quantitative and qualitative information regarding population, education, housing, health, basic services, transportation and migration. Twenty-three students and three teachers were interviewed on education only. These aspects addressed in this diagnosis are detailed below.

The locality has 228 inhabitants, the educational level of adults, with respect to the surveys is 54% studied primary school, 32% secondary school and 7% high school, the average number of children they have in the community is 3. In terms of education, there are 71 students of which 21% work, 28% study and work, 48% have a scholarship, 13% do not have any economic support and 29% are unknown.

Regarding housing, 75% have their own house, 25% are rented, the material with which the houses are made is adobe (54%) and block/brick (46%) and the average number of people living in the home is 4 to 5.

Regarding health, which is a right that everyone should have, in the community of La Gloria Primera Sección Chignahuapan, Puebla, there is a health center which is not in service to the community. And finally the basic services such as drinking water, 93% of the population has it while public lighting is only 57%, drainage only 7%, 36% of the population has telephone, only 4% has internet, there is no surveillance in the town, 93% of the population has electricity and 57% has a television.

In terms of transportation, there is a local route from La Gloria to Chignahuapan, public transportation runs 3 days a week (Monday, Tuesday and Friday) with two runs per day, being deficient in the number of schedules available for transportation, In the case of migration, the majority of the inhabitants (64%) mentioned that they have relatives, friends and/or acquaintances who have migrated, 46% stated that, if they had the possibilities, they would migrate either to another state or in their case and most commonly to another country (United States), the rest of the population commented that they would not be willing to migrate.

Economic diagnosis

The main economic activity is agriculture in conjunction with livestock practices, mainly backyard livestock, and they also mentioned that they also look for other jobs to obtain more income. The crops grown on their plots range from staple crops such as corn, beans, barley, wheat, peas, oats and a few people grow strawberries and tomatoes in greenhouses.

A projection was made of the benefit/cost ratio (see Table 4) that they would have if they sold their production, for which the production costs were obtained, including all the inputs used in the preparation and management of the land, labor and harvest. For income, the average price in the region was used, with the result that in most of the crops there is a profit (≥ 1).

However, a large part of the crops are used for self-consumption, due to the fact that their land extensions are small and only those with large extensions are the ones that commercialize their production (see Figure 4).

According to interviews and surveys, 39% earn between $1,200.00 and $2,000.00, 36% earn between $2,000.00 and $2,800.00, 14% earn between $500.00 and $1,200.00 and two people who said they do not farm earn more than $2,800.00.

Figure 4 Agricultural work in the community of La Gloria Primera Sección
Source: Captured in the field

Cultivation	PRO	R (T/Ha)	PV ($/T)	IN/Ha ($)	C/Ha ($)	IN/T ($)	RL B/C
Corn		3	6,200	18,600	18,101	499	1.03
	✓	3	6,200	18,600	17,101	1,499	1.09
Barley		2.5	4,700	11,750	11,966	-216	0.98
	✓	2.5	4,700	11,750	10,966	784	1.07
Bean		0.5	26,000	13,000	15,066	-2,066	0.86
	✓	0.5	26,000	13,000	14,066	-1,066	0.92
Wheat		3	4,700	14,100	11,730	2,370	1.20
	✓	3	4,700	14,100	10,730	3,370	1.31
Haba		0.5	30,500	15,250	13,416	1,834	1.14
	✓	0.5	30,500	15,250	12,416	2,834	1.23
Alverjon		2.5	12,500	31,250	11,930	19,320	2.62
	✓	2.5	12,500	31,250	10,930	20,320	2.86
Avena		3	4,500	13,500	11,875	1,625	1.14
	✓	3	4,500	13,500	10,875	2,625	1.24

Where PRO: PROCAMPO; R: Yield; PV: Sales price; IN: Net income; C: Cost; RL: Ratio; B: Profit; T: Tons; Ha: Hectare; $: Mexican pesos.

Table 4 Projection of the benefit/cost ratio of possible agricultural production in the community La Gloria Primera Sección
Source: Own Elaboration with experimental data

Land Use Planning Model (MOT)

As part of the activities to be carried out in the TCO, the main problems present in the community were identified (see Table 5).

Socioeconomic		
Socioeconomic	**Cause**	**Effect**
Deficient health center.	Not enough support from the municipality and/or government.	They cannot take care of their health right there and have to go elsewhere.
Limited energy network.	Not enough support from the municipality and/or government.	Limited to one development.
Reduced drainage network for the entire community.	Not enough support from the municipality and/or government.	Those who do not have drainage must resort to other methods.
Low income from milk sales.	Lack of knowledge in the management and diversification of milk by-products.	Disinterest in continuing to produce due to the low profits generated by the activity and possible waste due to the fact that the product is not taken out.
Low livestock development.	Lack of technical advice and little support from the authorities.	Self-sufficiency livestock.
No technical assistance for agricultural production.	There is not enough support from the municipality and/or government. And if they want to have advice, it entails an economic expense.	Production is carried out with traditional knowledge, which can lead to low production; without knowing if new techniques and/or activities are required.
Street lighting is scarce and sometimes deficient.	Not enough support from the municipality and/or government.	Areas without lighting and when lighting fails, attention is usually delayed.
Lack of telephone line and internet.	Economy, high wiring costs, housing dispersion, and lack of management by the authorities.	Not everyone has some source of communication and for those who study it is difficult without the necessary resources such as the internet today.
Limited reach of the waste collection truck.	Insufficient organization on the part of the inhabitants to concentrate all the waste in the center of the community.	Garbage is burned or buried, generating environmental impacts.
Low presence of public transportation.	Not enough support from the municipality and/or government.	Enables higher and more difficult expenses, restricts community development.
Ignorance of community boundaries.	Lack of management by the authorities.	May cause problems with neighboring communities and/or ejidos.
Mistrust of strangers.	There is insufficient information on who enters.	It generates distrust and they will be aware of who enters the community.
ENVIRONMENTAL		
Change of land use.	Extension of agricultural production.	Loss of areas and environmental services provided by forest vegetation.
Decrease in the flow of the water tributary.	Need for water supply.	Loss of water resources.
Contamination of the river, as well as of forests by garbage..	The garbage truck only passes through the main street, which means that the residents who live far away from the site have to take other alternatives to dispose of their waste.	Environmental contamination.
Soil contamination.	Excessive use of chemical fertilizers and pesticides on staple crops.	It favors the loss of the physical-biological conditions of the soil, facilitating its degradation.
Firewood extraction.	Most of the villagers use firewood as fuel.	Loss of forest areas.
Wildlife hunting.	Lack of knowledge of the importance of fauna and the tradition of hunting animals, as well as fear of some of them.	Loss of fauna diversity.
Possible contamination by wastewater and solid waste from the rose greenhouses.	Rose greenhouse company, which is expanding.	Environmental pollution.

Table 5 Main socioeconomic problems in the community La Gloria Primera Sección
Source: Own Elaboration with experimental data

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Based on these problems, a proposal for territorial division was developed, which are called Environmental Management Units (UGA) accompanied by projects to be carried out for the implementation of the CTO (see Table 6 and Figure 5).

Forestry and fruit plantation: The implementation was based on the existence of unused land with forestry potential, which can be used to perpetuate ecosystem goods, in addition to the fact that they could be eligible for government support and thus obtain income. In terms of fruit production, the area is suitable and has a potential market for establishment, production and marketing.

Use with sustainable agricultural and livestock use: The current land use was used as a basis for designating this area, so the agricultural areas already defined will be conserved, since it is not possible to redefine these areas because they are already parceled out. The aim is to implement sustainable use schemes through conservation practices and soil improvement, as well as the implementation of new productive alternatives.

Backyard livestock farming is included in this unit, since the livestock sector is distributed throughout the territory, next to households and/or in the plots.

Restoration area: Includes areas covered with eroded grassland and portions of land without vegetation, susceptible to the detachment of soil particles. Actions oriented to the retention, protection, and/or conservation of soil and recovery of vegetation cover will be implemented.

Area for protection and conservation: These areas have natural vegetation cover, however, the loss of portions of vegetation is notable, therefore, this unit can be accompanied by conservation works, such as reforestation with local species that are adapted to the conditions. This unit also includes the river, to which it was proposed to establish an area of influence of 15 to 20 m, in a length of 5.41 km.

Order	UGA	Surface area (ha)	Percentage occupied (%)
Uses	PF	75.71	7
	PFR	44.14	4
	UASA	537.10	52
Destination	AR	118.89	11
Reservation	APC	259.05	25

FP: Forest plantation; PFR: Fruit plantation; UASA: Sustainable agricultural and livestock use; RA: Restoration area; APC: Protection and conservation area.

Table 6 Environmental Management Units of the community La Gloria Primera Sección, Chignahuapan Puebla
Source: Own Elaboration with experimental data

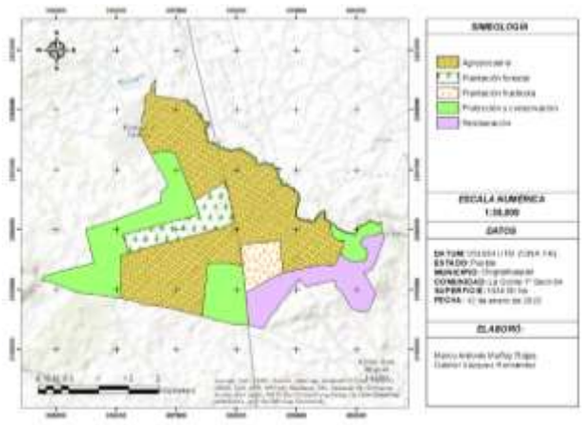

Figure 5 Environmental Management Units of the community La Gloria Primera Sección, Chignahuapan, Puebla
Source: Own elaboration with data obtained from the National Institute of Statistics and Geography and the National Commission for the Knowledge and Use of Biodiversity

The following are the actions proposed for implementation as part of the CTO (see Table 7), these come from the problems detected, which are economic income and the importance of caring for the environment. In the execution of the projects, investment amounts ranging from $5,000.00 to $300,000.00 are estimated, depending on the project.

However, there are governmental agencies such as the presidency of the municipality, CONAFOR, SEMARNAT, SADER, private agencies, and the support of the groups in the community, from the community itself groups formed in the same community, from which they can get support to execute the projects.

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In addition to the above, projects of social interest for the benefit of the community were detected, these are: the extension of the waste collection truck route and introduction of garbage containers, implementation of an internet network in the school, rehabilitation of the health center, improvement of the public transportation network and the extension of the drainage and electricity networks.

	Project
Short-term actions	Production of other forest species in the nursery.
	Rainwater harvesting and storage.
	Vegetable production in backyard gardens.
	Training in the diversification of dairy products.
	Backyard poultry management (chickens and turkeys).
	Technical training in crop production.
Medium-term actions	Establishment of forest plantation.
	Establishment of fruit plantation.
	Sheep fattening and marketing.
	Establishment of an area of influence along the river.
Long-term actions	Reforestation of wooded areas in the community.
	Restoration of degraded soils.

Table 7 Land use planning model project in La Gloria First Section
Source: Own Elaboration with experimental data

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Conclusions and recommendations

The methodology proposed in this study covers important areas that not only concern ejidos, but also communities where there is no natural resource management, degradation and loss of natural resources, and it is even more worrying because in recent years the overexploitation of resources has been increasing not only in Mexico but globally.

The general objective of this work, which was the elaboration of a CTO, was achieved. However, the execution of this work requires time to see the results; consequently, the community will have to follow up in subsequent years. According to the specific objectives of this research, they were fully met. Since the polygon of the community was delimited, interviews, surveys, visits and workshops were carried out; activities that gave way to the determination of the problems of the community in the social, economic and environmental fields, same that gave guideline to propose a plan of action that leads the community to a sustainable human development.

La Gloria Primera Sección is a marginalized community, the majority of the population is adults dedicated to agriculture with minimal income and the minors attend school, although there are some who also work. The school has three educational levels (kindergarten, primary and secondary) with 30 students and 3 teachers. Basic services are available (electricity, water and sewage), but they are deficient. Finally, the health center is not functioning.

The area is dominated by a natural pine-oak forest, where there is a diversity of flora and fauna species, including eleven families of trees and shrubs, and twenty-three families of birds, mammals, amphibians and reptiles.

The problems affecting the development of the community La Gloria Primera Sección were divided into two areas. The first is socioeconomic, which in general includes the deficiency of basic services, low income, lack of collective organization, lack of interest in activities that bring long-term benefits and lack of technical agricultural advice, limiting their ability to process some products. The second area is environmental, where the soil, water resources and the diversity of flora and fauna are affected.

Based on the diagnosis and identification of the problems, the Land Management Model (MOT) was detailed, in which the territory was zoned with Environmental Management Units (UGA's), and within each of them, short, medium and long term projects and/or activities were proposed, which should be carried out if the community decides to implement the OTC.

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With this research work, it is possible to involve the population in decision making and/or actions that lead to a better quality of life in balance with an adequate use of natural resources. Finally, this work resulted in a CTO proposal that is not being implemented; however, the document was left in the hands of the community, who will have the final decision to apply it or not.

It is recommended that the community support the implementation of the CTO, form working groups within the community and establish a monitoring system for the CTO.

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Abstract (In English, 150-200 words)

Objectives
Methodology
Contribution

Abstract (In Spanish, 150-200 words)

Objectives
Methodology
Contribution

Keywords (In English)

Indicate 3 keywords in Times New Roman and Bold No. 10

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* Correspondence to Author (example@example.org)
† Researcher contributing as first author.

Introduction

Text in Times New Roman No.12, single space.

General explanation of the subject and explain why it is important.

What is your added value with respect to other techniques?

Clearly focus each of its features

Clearly explain the problem to be solved and the central hypothesis.

Explanation of sections Article.

Development of headings and subheadings of the article with subsequent numbers

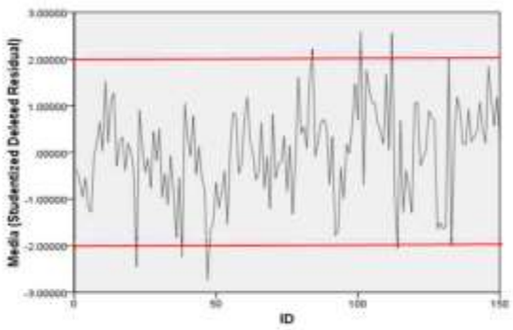
[Title No.12 in Times New Roman, single spaced and Bold]

Products in development No.12 Times New Roman, single spaced.

Including graphs, figures and tables-Editable

In the article content any graphic, table and figure should be editable formats that can change size, type and number of letter, for the purposes of edition, these must be high quality, not pixelated and should be noticeable even reducing image scale.

[Indicating the title at the bottom with No.10 and Times New Roman Bold]



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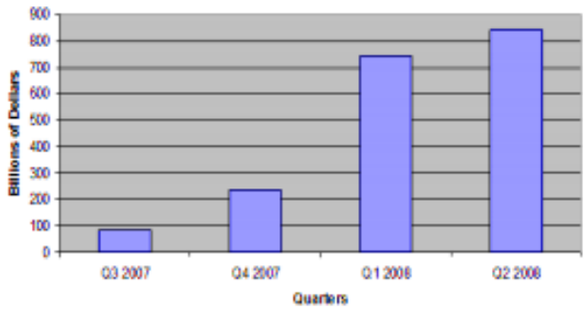

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Each Article shall present separately in **3 folders**: a) Figures, b) Charts and c) Tables in .JPG format, indicating the number and sequential Bold Title.

For the use of equations, noted as follows:

$$Y_{ij} = \alpha + \sum_{h=1}^{r} \beta_h X_{hij} + u_j + e_{ij} \qquad (1)$$

They must be editable and number aligned on the right side.

Methodology

Develop give the meaning of the variables in linear writing and important is the comparison of the used criteria.

Results

The results shall be by section of the Article.

Annexes

Tables and adequate sources

Thanks

Indicate if they were financed by any institution, University or company.

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Conclusions

Explain clearly the results and possibilities of improvement.

References

Use APA system. Should not be numbered, nor with bullets, however if necessary numbering will be because reference or mention is made somewhere in the Article.

Use Roman Alphabet, all references you have used must be in the Roman Alphabet, even if you have quoted an Article, book in any of the official languages of the United Nations (English, French, German, Chinese, Russian, Portuguese, Italian, Spanish, Arabic), you must write the reference in Roman script and not in any of the official languages.

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Each Article must submit your dates into a Word document (.docx):

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Article sections, for example:

1. Introduction
2. Description of the method
3. Analysis from the regression demand curve
4. Results
5. Thanks
6. Conclusions
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