

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 transdisciplinario, 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 "Tiburón" 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 activities 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 Tiburón 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<sup>3</sup>/inhabitant/year in 1950 to 3,982 m<sup>3</sup>/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.

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<sup>1</sup>, 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<sup>2</sup> 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.

<sup>1</sup> <https://www.garynabhan.com/news/2021/03/crisis-de-agua-energia-y-alimentos-que-amenazan/>

<sup>2</sup> <https://www.honnoldfoundation.org/news/energy-justice-in-mexico>

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 (Iliskog, 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<sup>3</sup> 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:

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Food and Development Research Center  
University of Arizona  
Institute of Ecology of the UNAM

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<sup>4</sup>



Figure 2 Community members are exposing water problems and obstacles. Source: Fieldwork 2021<sup>5</sup>

<sup>4</sup> 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)

<sup>5</sup> 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)

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.

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<sup>6</sup> 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

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<sup>6</sup> 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)



## 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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