# SUSTAINABILITY AND RESILIENCE AT THE PALMAR DE CANDELARIA HEALTH CENTER: INNOVATIVE SOLUTIONS FOR THE SUPPLY OF ENERGY AND WATER IN THE MOKANÁ COMMUNITY


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## SUMMARY

The Palmar De Candelaria health center, located in the Mokaná indigenous community in the department of Atlántico, faces serious deficiencies in the supply of energy and drinking water, which directly affects the quality of the health care service and puts the lives of the inhabitants at risk. This study aims to analyse the energy and water needs of the centre, and to propose sustainable solutions to improve its functionality. The research combines qualitative and quantitative analyses, including initial diagnoses, community surveys and technical design of innovative systems. The proposed solutions include the installation of solar panels and rainwater harvesting systems, which will allow a continuous supply of essential resources. Expected outcomes include a significant positive impact on quality of care, reduction of diseases related to unsanitary conditions, and improvement in medication preservation. This project stands out as a model of sustainability and resilience, contributing to overcoming historical inequalities and improving the quality of life of the Mokaná community.


## INTRODUCTION

Palmar De Candelaria, a Mokaná indigenous community in the department of Atlántico, Colombia, faces enormous challenges due to its geographical location and socioeconomic conditions. This community is made up of approximately 100 families who depend mainly on agriculture, informal trade and other low-income livelihoods. The lack of access to basic services and development opportunities represents the constant struggle of many indigenous populations to overcome structural poverty and historical exclusion. Agricultural activities, although critical to the local economy, are often carried out under difficult conditions and with limited access to advanced technologies, which impedes sustainable development. In addition, informal trade, while vital, does not provide stable or sufficient income to meet the basic needs of these

families, who face a severe lack of access to adequate health infrastructure. The local health center is the only option for medical services, but it is in precarious conditions, with significant problems in the supply of electricity and drinking water, essential factors to ensure efficient and safe medical care. The precariousness of health infrastructures affects not only physical health, but also mental health, generating constant concern among residents for their well-being and that of their loved ones.

The department of Atlántico, where Palmar De Candelaria is located, has historically been a region with inequalities in the distribution of resources and access to essential services. Indigenous communities, in particular, have been relegated in terms of public policies, which has aggravated their situation of vulnerability. The lack of basic services at the Palmar De Candelaria health center not only directly affects the quality of life of the inhabitants, but also limits the community's possibilities to break the cycle of poverty and improve their overall well-being. This situation highlights the need for an inclusive and equitable approach in policy-making and resource allocation, so that the most disadvantaged communities receive the necessary support for their development.

The lack of access to reliable electricity has forced the health center to resort to inefficient and polluting methods, such as the use of kerosene lamps for night lighting and deteriorated polystyrene refrigerators for the conservation of vaccines. Not only are these practices environmentally unsustainable, but they also pose serious health risks to patients and medical staff. Power outages can critically impact the

facility's ability to provide treatments and perform medical procedures with the necessary efficiency and safety. On the other hand, the lack of an adequate supply of drinking water complicates the basic operations of the health center, such as the hygiene of the toilets and the cleanliness of the health care areas. This increases the likelihood of infections and reduces the effectiveness of medical treatments, endangering the health and lives of the most vulnerable patients. The lack of clean water also affects the community at large, exacerbating public health and general well-being problems.

This study focuses on addressing these problems through sustainable solutions that guarantee a continuous supply of energy and water in the health center of Palmar De Candelaria. One of the main proposals is the implementation of solar panels, which provide a renewable and reliable source of energy. Not only would the solar panels ensure a steady supply of electricity for the center's needs, but they would also reduce dependence on fossil fuels and the community's carbon footprint. In addition, the installation of rainwater harvesting systems could supply the need for drinking water. These systems would collect rainwater, which would then be filtered and purified for use in the health center. This solution would not only improve the sanitary conditions of the center, but also provide an additional source of water for the community at large, partially relieving the pressure on local water resources.

The positive impact of these sustainable solutions would extend beyond the health center, benefiting the entire community of Palmar De Candelaria. The availability of electricity and drinking water would have a multiplier effect, improving not

only health care, but also other aspects of the inhabitants' daily lives, such as education, commerce, and general welfare. The successful implementation of these projects could serve as a model for other indigenous communities in Colombia and Latin America facing similar challenges. For these solutions to be effective and sustainable in the long term, it is crucial to involve the community at all stages of the process, from planning to implementation and maintenance. Community participation ensures that solutions are appropriate to the local context and that people feel ownership of the projects, which is critical to their success and sustainability. Training community members in the use and maintenance of solar energy and rainwater harvesting systems will also foster a sense of responsibility and empowerment among residents.

In addition, collaboration with non-governmental organizations, government entities and the private sector can provide the financial and technical support needed to carry out these initiatives. These partnerships can also help promote awareness and sensitization about the importance of sustainability and the use of renewable resources in vulnerable communities. The Mokaná indigenous community of Palmar De Candelaria faces significant challenges related to the lack of access to basic services such as electricity and drinking water. However, through the implementation of sustainable solutions such as solar panels and rainwater harvesting systems, it is possible to improve the conditions of the local health center and, therefore, the quality of life of its inhabitants. Active community participation and collaboration with various entities are key elements for the success of these initiatives. Thus, Palmar De Candelaria will not only be able to overcome some of its most critical challenges, but will also become an example of resilience and sustainability for other indigenous communities in Colombia and beyond.

PROBLEM

The Palmar De Candelaria health center, the only place available for

community health care, faces multiple challenges that compromise its ability to provide basic health services. This situation directly affects a population of approximately 100 Mokaná indigenous families, who depend on these facilities to meet their health needs. One of the most critical problems is the lack of access to reliable electricity. Currently, the center uses eight kerosene lamps to illuminate the rooms at night, a method that is not only insufficient, but also harmful to health due to the toxic emissions they generate. In addition, the dilapidated polystyrene coolers used to store vaccines have repeatedly led to the loss of essential medicines, compromising the center's ability to prevent disease.

The lack of drinking water further aggravates this situation. The bathrooms of the health center do not have running water, which makes it difficult to maintain adequate hygienic conditions. This deficiency increases the risk of infection for both patients and medical staff. Healthcare areas also lack water to perform basic procedures, severely limiting the effectiveness of the services offered. The impact of these conditions is reflected in the community's alarming mortality rates. According to the latest death report, 55% of the deaths registered in the health center were due to respiratory diseases, mosquito-borne diseases such as dengue and chikungunya, and poisoning from snakebites. These figures show the urgent need to improve the conditions of the center to guarantee adequate medical care and reduce mortality rates. Another significant challenge is the lack of adequate transportation for medical emergencies. Patients who require specialized care must travel to Cartagena, a journey that can take up to three hours on foot on roads in poor

condition. This delay in medical care is often fatal, especially in cases of emergency. The current situation of the Palmar De Candelaria health center not only puts patients' lives at risk, but also perpetuates a cycle of poverty and inequality by limiting the community's access to essential basic services. This problem requires urgent and sustainable intervention to improve the living conditions of the inhabitants of Palmar De Candelaria and guarantee their right to health. These challenges not only endanger the physical health of the inhabitants, but also their mental and emotional well-being, as they constantly live in an environment that does not provide them with the minimum conditions necessary for a healthy life. In addition, the lack of resources and adequate medical care generates mistrust and hopelessness in the community, perpetuating a cycle of inequality and lack of opportunities that affects entire generations. Therefore, it is essential not only to address the material shortages of the health center, but also to work on the construction of a more equitable and accessible health system for all the inhabitants of Palmar De Candelaria.

## GENERAL OBJECTIVES

1. Guarantee sustainable access to electricity and drinking water in the Palmar De Candelaria health center to improve the quality of health services and the well-being of the community.
2. Promote the adoption of sustainable technological solutions that contribute to community resilience and the reduction of environmental impact.

## SPECIFIC OBJECTIVES

1. Implement a solar panel system to ensure a continuous supply of electricity in the health center.
2. Design and install a rainwater harvesting and storage system to ensure the availability of drinking water.
3. Train medical personnel in the handling and maintenance of the new technologies installed.

4. Reduce the use of polluting methods such as kerosene lamps and polystyrene coolers.
5. Evaluate the social, environmental, and health impact of the solutions implemented to replicate them in other vulnerable communities.

## THEORETICAL FRAMEWORK

### Photovoltaic Energy

Photovoltaic energy is a way of obtaining electrical energy from solar radiation through the use of photovoltaic panels, which convert sunlight into electricity through the photoelectric effect. This technology has undergone remarkable development in recent decades, becoming a viable and sustainable alternative for the generation of electricity, especially in areas with a high level of solar radiation such as Colombia (Institute of Hydrology, Meteorology and Environmental Studies IDEAM, 2020).

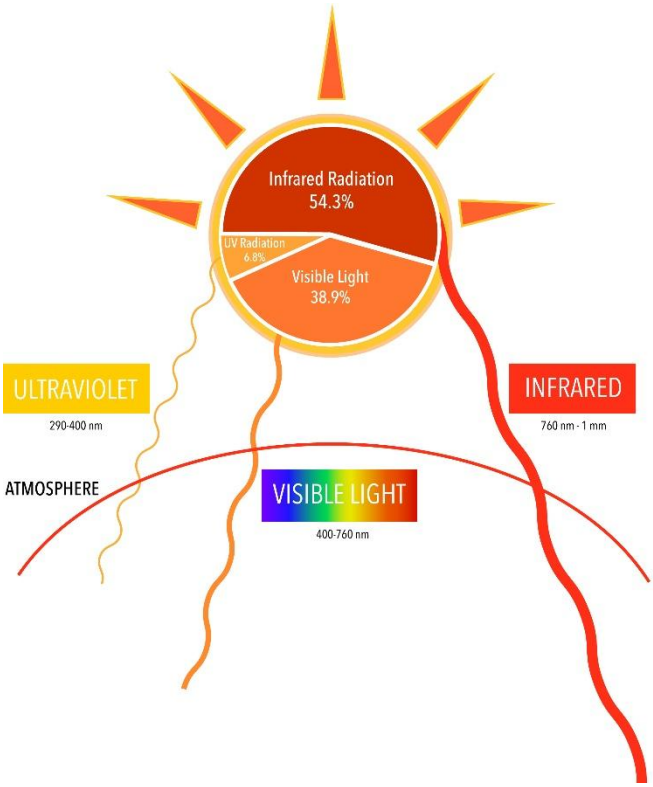
### Solar Panels

Solar panels are the intermediary that makes sunlight serve as energy. Its design is simple, very effective and allows self-consumption, which promotes sustainability. In the near future, the panels will generate electricity even at night. A single hour of sunshine would be enough to supply humanity's energy demands for a whole year. The statement is not exaggerated and explains better than any graph would, the importance of that human beings are capable, through different processes, of converting into electrical energy what the sun gives. Solar energy as an alternative for the future of humanity. And, specifically, through the efficiency of solar panels It is a rectangular structure with a basic unit of transformation that is the solar cell and that measures approximately 10 square centimeters. A panel joins several of these cells on a plate, which are covered with a plastic called EVA. This plastic can withstand extreme conditions and temperatures and, in addition, allows light to pass through, but not ultraviolet rays, which are more harmful to the skin. They also

have an essential element which is the inverter, capable of transforming the current so that we can use that energy. (BBVA, 2023).

Solar radiation

Solar radiation is the energy emitted by the Sun, which propagates in all directions through space by electromagnetic waves. That energy is the engine that determines the dynamics of atmospheric processes and climate. The energy from the Sun is electromagnetic radiation provided by the reactions of hydrogen in the Sun's core by nuclear fusion and emitted by the solar surface.




Measuring solar radiation is important for a wide range of applications, mainly as an alternative source of energy in electricity generation and the design and use of water heating systems, also in the agricultural sector, engineering, among others, highlighting plant growth monitoring, evaporation analysis and irrigation. architecture and design of buildings and infrastructure, health implications (e.g. skin cancer), weather and climate prediction models and many other applications (IDEAM, 2024)

Sustainable Construction

The methods used in the creation of buildings with an important characteristic: they seek to minimize or zero harmful impact on the environment, in order to contribute to the care of the planet. From the time the project is being planned, until it is finally concluded, sustainability is present, as this is another important characteristic that this type of construction seeks to take environmental care to the maximum (Puertas Artumex, 2020).

Sustainability

This sustainability in healthcare facilities involves the adoption of practices and technologies that minimize environmental impact, reduce operating costs, and improve energy efficiency. This includes the use of eco-friendly materials, the optimization of resources such as water and energy, as well as the implementation of waste management systems (World Health Organization WHO, 2019).

Urban Sustainability

Urban sustainability is the search for sustainable urban development that does not degrade the environment and provides quality of life to citizens. Without renouncing economic development, it must contribute to solving the two main complications caused by today's economy: social inequality and ecological degradation. As a viable paradigm, it provides a new vision for urban planning, as it aims to integrate the protection of ecosystems, social participation and equitable economic development. Given the overwhelming growth of urban centers and the great demand for environmental goods and services that this generates, it is one of the main ways to ensure livability in cities (Aguilera Rodríguez, Ana Rosa, 2021).

Energy Transition

The energy transition consists of abandoning the use of these fossil fuels to replace them with an energy model based on renewable energies, such as wind, hydro, solar, geothermal, among others. The implementation of this process would mitigate the effects of climate change such as warming, the increase in the frequency and intensity of rainfall and meteorological phenomena, among other natural manifestations, in addition to the implications on human health such as the risk of respiratory and cardiovascular diseases. In the case of Colombia, one of the

advantages it has when carrying out an energy transition is the great natural wealth and variety of renewable energy resources it has, however, it also faces the difficulties mentioned above, among other challenges that delay this process (Torres, 2023).

It is about achieving a change in the energy matrix that combines all sources and gradually replaces fossil fuels with clean technologies, that uses data and analytics for environmental monitoring and operational decision-making so that it is aimed at sustainability, but, fundamentally, for regeneration. It is not easy, and for this reason it should not be taken lightly (Idi Amin Isaac-Millán, 2022)

Sustainable development

The concept of sustainable development was first formulated in 1987 in a document known as the Brundtland Report (Brundtland, 1987), where it was described as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This definition is complemented by the contribution of the World Conservation Union of Nature in stating that "sustainable development implies the improvement of the quality of life within the boundaries of ecosystems" (UNEP, 1991).

There is a topic of great relevance in the field of solar energy that is constantly progressing: the sustainability of the materials used in the manufacture of solar panels. As the demand for solar energy increases, the need arises to ensure that the materials used are as eco-friendly as possible.

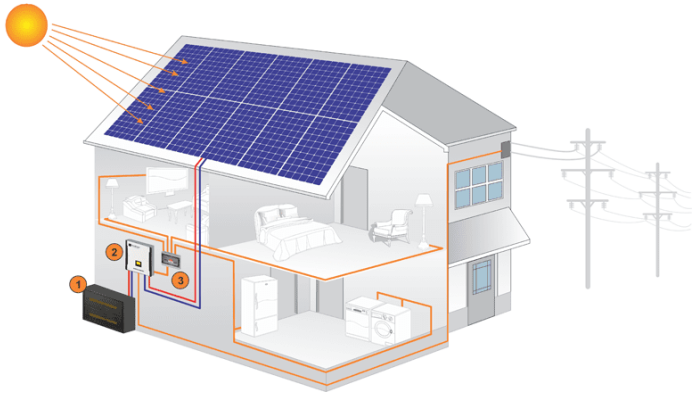
In the production of solar panels, various materials are used. Extracting silicon, the most common material, requires a great deal of energy and

resources, although more efficient and sustainable techniques for its production are being developed. In addition to silicon, materials such as cadmium tellurium (CdTe) and Copper Indium Gallium Selenium (CIGS) are used in the manufacture of thin-film plates. These materials are toxic (although CIGS is to a lesser extent), so investment is being made in the search for safer extraction methods.

The solar industry continues to work to improve the sustainability of the materials needed for photovoltaic panels and solar self-consumption systems. This continuous improvement is not only limited to production, but also encompasses the recycling of materials. Regulations and standards are also moving forward with the aim of promoting more sustainable practices throughout the solar energy supply chain.

Hybrid Solar Panel

A hybrid solar panel is the combination of photovoltaic and thermal technologies in a single module; In contrast to the photovoltaic panels that are installed separately, the hybrid solar panel emerges, capable of simultaneously generating electricity and heat. This is due to the ability of the hybrid solar panel to be able to take advantage of the entire spectrum of existing light, unlike photovoltaic and thermal panels, which capture ultraviolet and infrared light respectively. Photovoltaic solar energy and solar thermal energy are used at the same time.




Although it is an existing product since the 70s, it has not been until now that this technology has begun to be installed in more and more places.

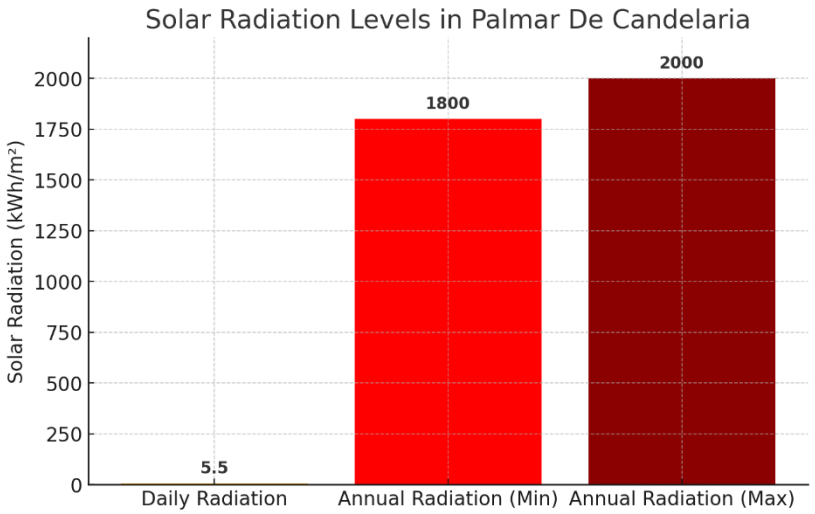
Their versatility, their high degree of innovation and the multiple advantages that hybrid solar panels have over conventional technology have made this type of solar panels increasingly in demand in all types of

sectors and for all kinds of locations. (ENDEF, 2020)

METHODOLOGY

1. Diagnosis and initial planning

- Needs assessment: A detailed analysis of the current conditions of the health centre will be carried out, identifying specific energy and water needs. This will include an inventory of the required electrical equipment (refrigerators, fans, lighting, etc.) and an analysis of estimated energy consumption to determine the total capacity of the system.
- Solar radiation study: Palmar De Candelaria has exceptional climatic conditions for solar energy generation, with an average daily radiation of 5.5 kWh/m²/day and an annual solar radiation of approximately 1,800 to 2,000 kWh/m²/year. This ensures that a well-sized PV system can meet the energy demand of the healthcare facility efficiently and sustainably.




- Calculation of required capacity: A daily energy consumption of approximately 8.1 kWh will be estimated. This includes the operation of 2 refrigerators (1.2 kWh/day), 10 LED flashlights (0.5 kWh/day), 5 fans (2.5 kWh/day), 15 charging stations (0.5 kWh/day), and a 1 HP motor pump that requires approximately 0.75 kWh per hour of operation, assuming a daily use of 4 hours (3 kWh/day). If the 10 400W solar panels do not meet these needs, more panels will be added to the system.

- Community engagement: Workshops will be organized with leaders and residents to inform the project, ensure its alignment with community expectations, and foster long-term sustainability.

2. Installation of the photovoltaic system

- Site preparation: A location with maximum sun exposure will be chosen for the panels. The metal structures will be designed to support the panels at optimal angles and resist corrosion due to the humidity of the region.
- Mounting the solar panels: Initially, 10 monocrystalline solar panels of 400 W each will be installed. In the event that the required production of 8.1 kWh/day is not achieved, up to 4 additional panels will be added, reaching a maximum capacity of 5.6 kW under optimal conditions.


- Energy storage system: 6 x 200 Ah batteries will be installed to store the energy generated and provide supply during cloudy nights or days. If more panels are added, it will be considered an additional storage system.


- Inverters and controllers: A solar inverter suitable for the capacity of the system will be implemented, in addition to charge controllers that

optimize the performance of the system and extend the life of the batteries.

- Wiring and distribution: Electrical systems will be connected to ensure an uninterrupted supply to all essential equipment in the health centre.

3. Installation of the rainwater system

- Rainwater collection: 4 galvanized steel gutters will be installed on the roofs of the health center, redirecting the water to PVC pipes that flow into a 10,000-liter underground tank.
- Filtration and purification: A reverse osmosis filtration system will be implemented to ensure that the water is suitable for human consumption and medical uses.
- 1 HP motor pump: An electric pump will be installed to distribute the stored water to all points of the health center. The required power of 1 HP is equivalent to an energy consumption of approximately 0.75 kWh per hour, which will be integrated into the photovoltaic system to guarantee its continuous operation.

4. Community Training and Sustainability

- Technical training: Health center staff and community leaders will receive training in the use and maintenance of photovoltaic and rainwater systems.
- Maintenance Committee: A community supervision group will be formed to monitor and perform periodic maintenance.
- Awareness-raising workshops: Educational activities will be organised to promote the efficient and responsible use of installed resources.

5. Monitoring and evaluation

- Initial follow-up: During the first 6 months, regular inspections will be carried out to ensure the correct functioning of the systems.
- Impact evaluation: Key indicators will be measured, such as increased health care, reduction of pollution-related illnesses, and improved access to clean water.
- Periodic reports: Quarterly reports will be prepared and shared with the community and funders to ensure the transparency of the project.

JUSTIFICATION

The decision to implement a solar panel system at the Palmar De Candelaria health center is a bold step towards a more sustainable and resilient future. In a world that is increasingly aware of environmental challenges, this project stands as a beacon of hope, demonstrating that it is possible to reconcile development with the protection of the planet.

The growing demand for energy and the effects of climate change have highlighted the urgent need to diversify energy sources and reduce our dependence on fossil fuels. Solar panels, by taking advantage of the sun's energy, an inexhaustible and free source, offer a clean and efficient solution to this problem.

By adopting this technology, the Palmar De Candelaria health center not only meets its own energy needs, but also contributes to mitigating the effects of climate change. Solar power generation avoids the emission of greenhouse gases, which helps reduce the institution's carbon footprint and curb global warming. This commitment to the environment

is aligned with the United Nations Sustainable Development Goals and positions the health center as a benchmark in terms of sustainability.

Beyond the environmental benefits, the implementation of solar panels entails a series of economic advantages. By reducing dependence on the conventional power grid, the healthcare facility significantly decreases its energy costs in the long run. In addition, PV systems have a long lifespan and require little maintenance, resulting in a medium-term return on investment.

Another noteworthy aspect of this project is its contribution to the resilience of the health center. Power outages are becoming more frequent due to extreme weather events and unstable power grids. By having its own energy generation system, the health center guarantees the continuity of its services, which is essential to meet the needs of the community, especially in emergency situations.

The installation of solar panels also has a positive impact on the perception of the institution by the community. By demonstrating a commitment to sustainability and care for the environment, the health center positions itself as a reliable and responsible entity. This strengthens the bond between the institution and the community, generating greater trust and support.

In addition to the solar panels, the implementation of a rainwater harvesting system complements this sustainable initiative. The water captured from rainfall can be used for a variety of purposes, including watering gardens, washing medical equipment, and supplying non-potable water. This measure not only reduces the consumption of drinking water, but also contributes to the conservation of this vital resource.

The installation of solar panels and a rainwater harvesting system at the Palmar De Candelaria health center represents a significant step towards a more sustainable and resilient future. This project not only benefits the institution, but also has a positive impact on the community and the environment. By adopting this initiative, the health center becomes an example to follow for other institutions and communities, demonstrating that it is possible to reconcile development with the protection of the planet.

EXPECTED RESULTS

1. Improvement in the supply of electricity:

With the installation of solar panels, it is expected that the Palmar De Candelaria health center will have a continuous and reliable supply of electricity. This will allow essential medical equipment, such as vaccine storage refrigerators, lighting and ventilation systems, to operate without interruption, which is crucial to ensure efficient and safe healthcare. In addition, the use of kerosene lamps, which are not only inefficient, but also harmful to health due to the toxic emissions they generate, will be eliminated. Reducing the use of dilapidated polystyrene coolers will also prevent the loss of medicines and vaccines, improving the centre's ability to prevent and treat disease.

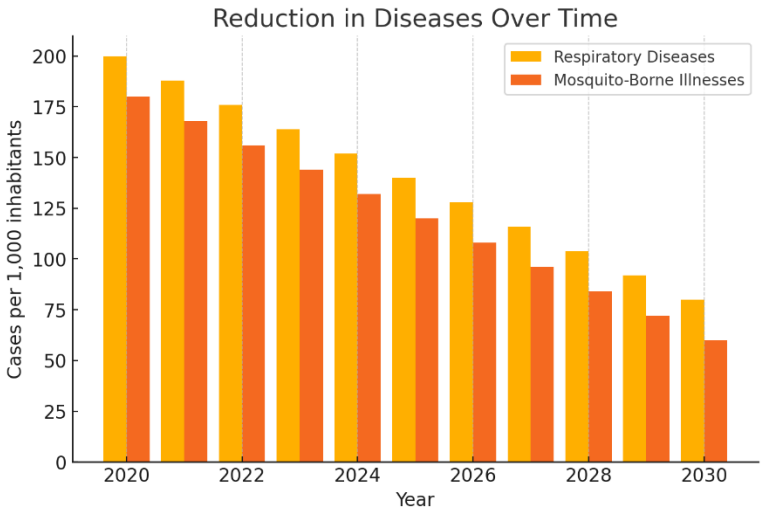
2. Guaranteed access to drinking water:

The rainwater harvesting system will provide an additional source of drinking water, which will significantly improve the hygienic conditions of the health center. The water collected and purified through a reverse osmosis filtration system will be used for medical procedures, cleaning of care areas and human consumption. This will reduce the risk of infections and improve the quality of healthcare. In addition, the stormwater system will

relieve pressure on local water resources, contributing to the conservation of this vital resource.

3. Reduction of diseases related to the lack of basic services:

A significant decrease in the rates of respiratory diseases, infections and other conditions related to the lack of drinking water and electricity is expected. The improvement in the hygienic conditions of the health center, together with the availability of energy for the conservation of medicines and vaccines, will contribute to greater effectiveness in the prevention and treatment of diseases. This will have a direct impact on reducing mortality and morbidity in the community, especially in vulnerable groups such as children, the elderly and people with chronic diseases.




4. Positive environmental impact:

The implementation of solar panels and rainwater harvesting systems will reduce the carbon footprint of the health center by eliminating the use of fossil fuels and polluting methods. The generation of solar energy will avoid the emission of greenhouse gases, which will contribute to mitigating the effects of climate change. In addition, the use of rainwater will reduce dependence on external sources of water, which will help conserve local water resources and promote more sustainable use of this resource.

5. Community empowerment:

The community will be trained to operate and maintain the installed systems, which will foster a sense of responsibility and ownership over the project. Technical training of medical staff and community leaders in the management and maintenance of photovoltaic and rainwater systems will ensure that the community takes ownership of the project and keeps it functional in the future. In addition, an increase in community trust and participation in sustainable

development initiatives is expected, which will strengthen the social fabric and promote community resilience.

6. Replicable model:

The success of this project will serve as a model for other indigenous and vulnerable communities in Colombia and Latin America, demonstrating that it is possible to implement sustainable solutions in resource-poor contexts. The experience gained in Palmar De Candelaria can be shared with other communities facing similar challenges, which will contribute to the replication of these solutions in other regions. This project will not only benefit the local community, but will also have a wider impact by promoting the adoption of sustainable technologies in other areas.

7. Improvement in quality of life:

The availability of energy and drinking water will have a positive impact on the quality of life of the inhabitants, not only in the field of health, but also in education, commerce and general welfare. Access to electricity will allow children to study at night, local businesses to operate more efficiently, and families to have a safer and more comfortable environment. In addition, the improvement in the sanitary conditions of the health center will reduce the burden of diseases in the community, which will allow the inhabitants to devote more time and resources to productive activities and personal development.

## CONCLUSION

The study on the energy and water needs of the Palmar De Candelaria Health Center has identified a critical problem that affects not only the quality of medical care, but also the health and well-being of the entire Mokaná indigenous community. The lack of access to reliable electricity and drinking water has generated unsanitary conditions that put the lives of the inhabitants at risk and perpetuate a cycle of poverty and inequality. These shortcomings have limited the health centre's ability to provide adequate medical services, which has had a negative impact on the physical and mental health of the community.

The implementation of sustainable solutions, such as the installation of solar panels and rainwater harvesting systems, represents an effective and viable response to these challenges. These technologies will not only ensure a continuous supply of essential resources, but will also contribute to the reduction of environmental impact and the improvement of the quality of life of the community. Solar energy will provide a clean, renewable source of energy, while the stormwater system will ensure a steady supply of drinking water, improving sanitary conditions and reducing the risk of disease.

In addition, this project highlights the importance of community participation and collaboration with various entities to ensure long-term sustainability. Training medical staff and community leaders in the management and maintenance of the installed systems ensures that the community takes ownership of the project and keeps it functional in the future. Technical training and the creation of a community maintenance committee will foster a sense of responsibility and empowerment among the inhabitants, which will be key to the success and sustainability of the project.

In conclusion, this study not only addresses the material shortcomings of the health center, but also lays the foundations for a more equitable and sustainable development in Palmar De Candelaria. The implementation of these solutions will not only improve community health conditions, but will also serve as a model of resilience and sustainability for other indigenous and vulnerable communities in Colombia and beyond. This project is a crucial step towards overcoming historical inequalities and building a fairer and more sustainable future for all. By adopting these initiatives, the Palmar De Candelaria health center becomes an example of how communities can face critical challenges through innovative and sustainable solutions, thus contributing to a more inclusive and equitable development.

REFERENCES

1. World Health Organization (WHO). (2019). *Water, Sanitation, and Hygiene in Health Care Facilities: Practical Steps to Achieve Universal Access to Quality Care*.
2. United Nations Development Programme (UNDP). (2020). *Sustainable Energy for Health: Solar Power Solutions for Health Facilities in Remote Areas*.
3. Inter-American Development Bank (IDB). (2018). *Rainwater Harvesting Systems for Rural Communities in Latin America*.
4. Pan American Health Organization (PAHO). (2021). *Improving Health Care Infrastructure in Indigenous Communities: Challenges and Solutions*.
5. International Renewable Energy Agency (IRENA). (2020). *Renewable Energy for Health Care: Solar Photovoltaic Systems in Developing Countries*.
6. UNICEF. (2017). *Water, Sanitation, and Hygiene in Health Care Facilities: Status in Low- and Middle-Income Countries*.
7. Gómez, M. F., & Silveira, S. (2015). *Rural Electrification of the Brazilian Amazon: Achievements and Lessons*. *Energy Policy*, 86, 135-146.
8. Thomas, E., & Magilvy, J. K. (2011). *Qualitative Rigor or Research Validity in Qualitative Research*. *Journal for Specialists in Pediatric Nursing*, 16(2), 151-155.
9. Mekonnen, M. M., & Hoekstra, A. Y. (2016). *Four Billion People Facing Severe Water Scarcity*. *Science Advances*, 2(2), e1500323.
10. Alazraque-Cherni, J. (2008). *Renewable Energy for Rural Sustainability in Developing Countries*. *Bulletin of Science, Technology & Society*, 28(2), 105