

SOLAR COOKERS ASSEMBLED ON-SITE AS A STRATEGY TO STIMULATE SOCIAL PARTICIPATION IN RENEWABLE ENERGY PROJECTS FOR RURAL DEVELOPMENT

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ABSTRACT

For the development of this work, workshops on drying and solar cooking techniques were carried out in rural communities in the state of Nayarit, Mexico, as a strategy to encourage social participation and promote the development of rural productive projects based on renewable energies. We use posters, brochures, and stories to transmit scientific and technical information and participatory dynamics with a transdisciplinary approach designed and defined for each target audience to achieve good integration and encourage the participation of all people from different age groups. The workshops aim to get people to know, accept, and then appropriate the knowledge about drying processes and solar cooking to promote the development of community-based productive projects. Through the workshops, we create links with each community and spaces for the exchange of ideas. We articulate all the knowledge during the construction of solar stoves in situ as a social participation strategy, which allows us to introduce new ideas generated by all the people around the use of solar energy. During the waiting times for the cooking, dialogue and the exchange of knowledge, recipes, tastes, and culinary traditions were encouraged. The leading group could always talk about the science in each of these processes so that the community received the new knowledge in a relaxed and comfortable environment, hence the ease of engaging in dialogues of expertise, of accepting and giving new meaning to this new knowledge. This epistemic process made visible other essential dimensions of using solar energy and its usefulness. Based on the exit surveys, we valued the acceptance of the technologies. Cooking had greater acceptance in all cases and communities since it means something helpful that solves a daily problem: cooking.

KEYWORDS

Sustainable energy, solar powered farm production, solar powered farm produce processing, rural communities, rural development, solar cooking, solar drying.

INTRODUCTION

Local Development: Is an application of endogenous development theories that emerged in the 1970s as a response to events that destabilized traditional systems and production models. It encompasses social and institutional development as well as environmental sustainability. In the social and institutional dimension, it focuses on mobilizing the local population, fostering cooperation between public and private actors, and promoting a local entrepreneurial culture. In the environmental dimension, it seeks to integrate the local environment as a fundamental asset and enhance natural and cultural heritage to add value and enhance territorial competitiveness. Hence, sustainable local development of rural communities is a challenge that requires the integration of transdisciplinary approaches and community participation. Rural regions in Mexico frequently lack essential infrastructure services, such as access to energy, which constrains the agricultural production, transportation, processing, preservation, and transformation of agricultural products. In this context, energy emerges as a pivotal factor for the successful rural development.

Energy for sustainable rural development: Despite efforts of the global community to promote access to clean energy and technologies for cooking and other household needs, overreliance on solid fuels sources of energy, specifically firewood and charcoal is still a big development challenge [1]. The Energy Progress Report 2023 shows that about 2.3 billion people in rural areas worldwide rely on solid fuels for household energy needs, including cooking. The implementation of solar cookers in Mexico has been complex and we lack scientific studies of the levels of use and the adoption process in the few documented cases. Also, there are only a few documented studies on adopting solar cookers. One case took place in a community in Michoacán-México, where the commercial HotPot solar cooker was introduced. The assessment of the adoption process conducted there quantified approximately 20% of the use of those solar devices. A second study in an Indigenous community in Michoacán-México found that only approximately 8% of the devices installed were being used [2]. Top-down approach to the creation, advancement, and execution of rural renewable energy technologies holds challenges worldwide as well [3]. Mexico has immense potential to harness solar energy for rural development. The average daily solar energy availability (insolation) of 5.5 kWh/m² over much of its territory, of nearly 1.97 million km², makes it feasible to implement solar energy technologies nationwide. A previous study proposed that solar technologies can help achieve sustainable development in rural agricultural communities of Mexico and those

worldwide through solar dryers in the agriculture of small rural producers, which is seen as a strategy for sustainable local development [4]. However, rural communities lack awareness about these technologies, hindering their adoption. Hence, energy technologies should respond to the needs of communities and not be imposed vertically.

Community Participation: The contemporary challenges within the energy sector demand extensive fieldwork to construct models rooted in ethical values and enriched by epistemic qualities across the realms of environmental, social, academic, business, and governmental dimensions [5]. Focusing on local context and fostering active community participation in energy solutions is essential for aligning initiatives with values, aspirations, and long-term development goals. Understanding the complex dynamics between energy, social movements, and environmental conservation can help develop more holistic and social approaches to sustainable energy development [6]. Participatory workshop is a dynamic space where two or three focus groups operate simultaneously. This technique is highly relevant in participatory action research, as it allows for a comprehensive and participatory approach to addressing social issues and facilitating necessary changes. It serves as a platform for experiencing, reflecting, and gathering information, beginning with the description of the study problem within a specific context [7]. Mexico's National Development Plan 2019-2024 emphasizes the importance of community involvement in decision-making for technological projects, fostering real solutions to socio-environmental challenges, and promoting shared responsibilities [8].

Present Study: This work focuses on developing the technology based on local resources and introduces a methodology for presenting solar dryers to the community through participatory workshops. The workshops emphasize the importance of reducing food loss on farms for global food security. During these events, posters, brochures, and stories were created to gauge the community's interest in adopting solar technologies. The discussions that prevailed during these interactions helped build energy literacy. Community management plays a pivotal role in executing these activities independently, as it facilitates the provision of superior products. The workshops were conducted on solar drying and cooking were designed to introduce these technologies and generate interest in the community for their social appropriation. This, in turn, generates new employment opportunities that boost economic well-being, enhancing the overall societal quality of life and creating a sustainable future through the community's own initiative and involvement. The potential for financial return and sustainable socio-economic development through these activities generates genuine hope in the community.

METHOD

The participative workshops on solar drying and cooking were a way to educate people on energy topics. The goal is to stimulate community-scale rural development projects that promote wealth and well-being through the integration of solar energy technologies. The workshops were carried on in several rural communities in Nayarit State- Mexico, during 2022 and 2024. The workshops sequence is described below:

1. **Pre-Workshop Meeting:** The research team collaborates with local stakeholders to plan the workshop, finalize the agenda, and ensure all necessary materials are secured. A suitable public and open space is selected that includes washing facilities and a room equipped for effective communication among participants.
2. **Project Introduction:** The project's significance is presented in clear, accessible language, highlighting its relevance to the community.
3. **Solar Energy Concepts:** The team provides information on solar drying and related energy concepts, tailored to the community's understanding.
4. **On site assembled solar cookers to stimulate social participation:** Participants learn to build solar stoves using designs available at [Solar Cookers](#). Participants are encouraged to bring their own products for drying and cooking and experiencing the benefits of solar energy firsthand.
5. **Feedback Meeting:** The research team and local stakeholders review and discuss feedback to evaluate the workshop's effectiveness and areas for improvement. Surveys, Deep- Interviews and Participatory Methodologies are used to feedback to assess the community's appreciation of the food and their views on solar technology.

RESULTS AND DISCUSSION

1.- Pre-Workshop Meeting: The establishment of a transdisciplinary working group, composed of academics from various disciplines, community leaders, and rural producers, was essential for the project's development. This working group, also known as the core group, is responsible for implementing the project, making it crucial for all members to get to know each other, understand their roles, and align with the project's objectives and scope. The transdisciplinary working group arrives in each community a day before the workshop to engage in dialogue with different community groups and organize the activities. To break the ice, the core group, starts the conversation with community's members by asking about the daily work, the crafts they create, the typical food, what they enjoy most about living in the

area, their festivals, and other related topics. To address the issues related to training in solar drying and cooking, participatory action research (PAR) techniques are used. These techniques promote democratic, cooperative, genuine, and effective methods of researching and intervening in the transformation of communities' social realities. They also help us understand the living conditions of rural communities and indigenous peoples. Through knowledge exchange and collaboration, guided by transdisciplinary approaches, we identify the root causes of social and environmental problems in each community. A suitable public space should be identified, which is open, free to receive wind and solar radiation, and equipped with facilities for washing and disinfecting food and utensils. Additionally, the location should facilitate effective dialogue and communication among participants. After presenting the project, surveys were administered to all core group members to gather the opinions of all social actors and understand their expectations. Some questions of the survey and responses are presented in Table 1.

Table 1. Questionnaire applied to the core working group

Questions	Responses
What do you understand by transdisciplinary?	Plural participation with diverse knowledge to achieve objectives of light in the social sphere.
What does participate in the project mean to you?	It meant connecting the social reality of my community with the technological and scientific part of the University. It also meant revaluing everyday community knowledge and practices. Community actor.
Where do you recognize strengths or areas of opportunity for working on a transdisciplinary project?	Everyone's knowledge makes it possible to provide more responsible and transformative community services.
In what way did the exchange of knowledge, expertise, and experiences foster transdisciplinary?	Through conversation, discussion, and feedback, each person was able to contribute from their knowledge and experiences, drawing on what was experienced before, during, and after each event. This allowed for the creation of a web of invaluable knowledge.

2.- Project Introduction: All these activities are part of a project aimed at implementing a transdisciplinary model to generate well-being in agricultural and rural communities through the incorporation of solar technologies to meet energy needs, add value to agricultural products,

improve agricultural productivity, and produce high-quality goods without losses (<https://conahcyt.mx/pronaces/pronaces-energia-y-cambio-climatico/energia/bienestar-agricola-en-nayarit-mediante-tecnologia-solar>), supported by CONAHCYT (PRONACES Grant 319456). The project is introduced to community members using straightforward, accessible language, highlighting the community's crucial role in achieving the project's objectives. Participants introduce themselves and share their interests and expectations.

3.- Solar Energy Concepts: The transdisciplinary team presents content on solar drying and related energy and environmental concepts in a manner that is easily understandable for the community. Posters, brochures, stories, and records are used during the workshops to provide technical knowledge to rural producers on harnessing solar energy and implementing solar technologies to add value to their agricultural production. Figure 1, depicting some of the items utilized during workshops: Poster, brochures and stories.

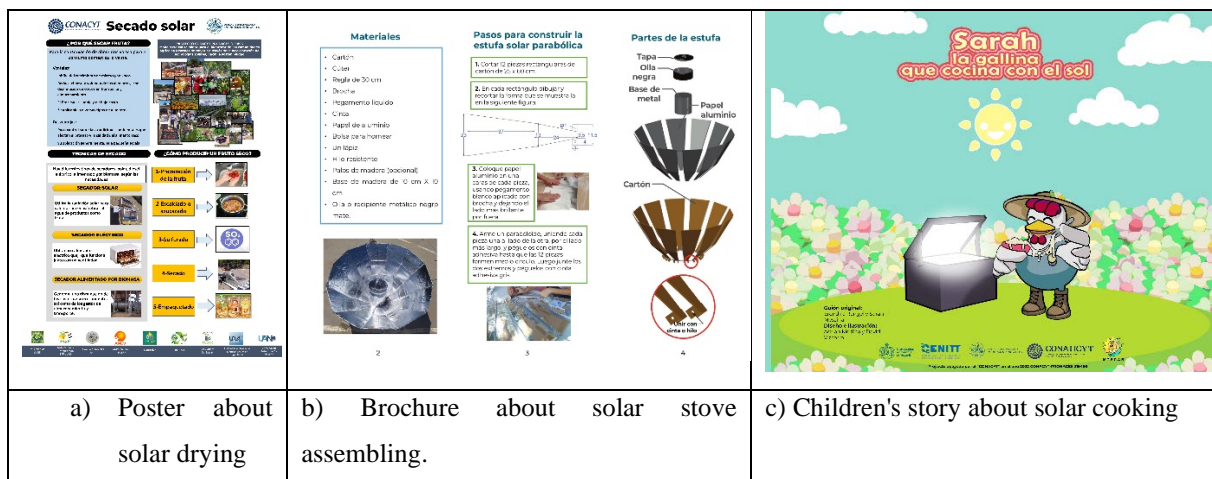


Figure 1. Didactic items utilized during workshops to solar drying and cooking literacy.

4.- On site assembled solar cookers to stimulate social participation: Using designs provided by <http://solarcooking.org/plans/> participants construct solar stoves, with the assistance of posters and leaflets tailored to their specific audience, native language, or community. In Figure 2 pictures of the workshops are depicted.



a) Solar stove assembling workshop in a rural community.	b) Solar stove assembling workshop given to technician for reply to rural communities.	c) Solar drying and cooking workshop in an indigenous community
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Figure 1. Pictures during the participative workshops on solar drying and cooking.

They are supplied with materials and tools such as adhesive tape, and aluminium foil. The low-cost solar cookers, made from foldable paper cartons lined with aluminium foil, were given to the communities to experiment with. This allows them to become familiar with the technology and develop solar cooking schedules suited to their local food habits. After cooking for two to four hours under optimal solar radiation, the food is taken out of the solar stoves and served to participants for tasting. This hands-on experience showcases the advantages of solar energy for cooking, providing participants with a firsthand understanding of its effectiveness and benefits. Additionally, solar cookers quickly captured attention during the workshops.

5.- Feedback Meeting: The transdisciplinary research team and key community stakeholders meet to review and discuss feedback on the workshop's effectiveness and outcomes. Surveys are conducted to assess participants' appreciation of the food's sensory qualities and their views on using solar technologies for community-based productive projects. Field notes were collected, and in-depth interviews were conducted with key actors. Among the key points highlighted from these interviews was: “The learning experience about solar drying and cooking created an opportunity to reorganize community groups. The novelty and qualities of the project also revitalized organized groups from other communities, which aligned and self-managed new projects, such as agritourism and community tourism. This opened the possibility of integrating other energy sources, thereby creating collaborative synergies”

CONCLUSION

We present a method to promote the use of on-site assembled solar cookers as an effective strategy to encourage social participation in renewable energy projects. These devices not only offer a practical and eco-friendly solution for cooking in rural areas, but they also serve as catalysts for community empowerment. By involving community members through a transdisciplinary approach in the assembly and implementation process of solar cookers, a sense of ownership and responsibility towards renewable energy initiatives is fostered. This strategy not only enhances the acceptance and use of clean technologies but also contributes to the sustainable economic and social development of rural areas. We employed posters, brochures, and logbook records to effectively convey technical knowledge on harnessing solar energy and implementing technologies that enhance agricultural production. However, fieldwork

unequivocally demonstrated that the most impactful experience is achieved through the development of training workshops on solar drying and cooking. These workshops not only facilitate a practical understanding of the processes but also empower the community to internalize the knowledge through hands-on experience, fostering a robust exchange of ideas between society and academia within a framework of trust and respect.

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