

ENVIRONMENTAL IMPACT ANALYSIS BASED ON SUSTAINABLE BEHAVIOR, SOURCES AND USES OF ENERGY. CASE STUDY IN A MEXICAN EJIDO

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ABSTRACT

The study aims to explain the relationship between environmental impact from the variables of energy use priorities, sources of information on energy, relevant factors of life, and energy and sustainable behavior, based on the perception of ejidatarios and communal farmers of Ejido Cruz Colorada, located in the municipality of Chignahuapan, in the state of Puebla, Mexico. For that, a questionnaire was designed based on an on-site investigation, in which characteristics of ejidatarios and community members were identified with respect to age, level of education and tasks performed. The design of the items was based on a literature review and a reflexive design was used to measure the variables. The instrument was applied to 123 ejidatarios and community members, and the results obtained confirm the presence of convergent and discriminant validity of the latent variables. The relationships between these variables were tested using the partial least squares (PLS) model. The results indicated that the variables of energy use and energy information sources have a positive and significant effect on sustainable behavior, in addition, sustainable behavior has a negative and significant effect on the variable of environmental impact. Specifically, it is observed that energy information sources have a small effect (0.127) on energy behavior, while energy use has a moderate effect (0.210) on sustainable behavior; in turn, sustainable behavior has a large effect (0.337) on the environmental impact dimension. The constructs of sustainable behavior and information sources explain 35.5% of the variance of the endogenous construct called environmental impact.

Key words: communal property, energy consumption, geothermal, rural communities, sustainability.

INTRODUCTION

The decision-making processes of most governments are inherently intertwined with economic considerations. Consequently, due to the relatively modest contribution of primary economic sectors, such as agriculture, livestock, forestry, and fisheries, to the overall gross domestic product (GDP),

Citation: López-Torres VG, Moreno-Moreno LR, Jiménez-Terrazas CP, Valenzuela-Montoya MM. 2025. Environmental impact analysis based on sustainable behavior, sources and uses of energy. Case study in a mexican ejido. Agricultura, Sociedad y Desarrollo <https://doi.org/10.22231/asyd.v22i2.1607>

ASyD(22): 141-158

Editor in Chief:
Dr. Benito Ramírez Valverde

Received: May 18, 2023.
Approved: August 14, 2023.

Estimated publication date:
March 20, 2025.

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policymakers and public policy strategies have gradually diverted their focus away from rural areas. This shift has resulted in pronounced disparities between rural and urban regions (Rincón *et al.*, 2021). In Mexico, the concept of the ejido was conceived to foster rural development, functioning as a social enterprise guided by a business model that prioritizes social benefits over monetary gains (Romo *et al.*, 2016; Rubalcava and Zerón, 2020).

These territories have different resources –forests, woodlands, pastures, mine banks or stone material, grazing lands, among others– that are jointly exploited by ‘*ejidatarios*’ and comuneros (‘*comuneros*’) (Goyas, 2019). The territory that corresponds to this analysis has forests, agricultural land, and a geothermal resource, which can be exploited to produce electricity and, in the same way, heat for different activities –heating, greenhouses, etc.-. It should be noted that economic and anthropogenic activity within a territory is what generates different impacts, and specifically, in the environmental case, these are observed mainly in the modifications to the natural landscape (Agatón *et al.*, 2022).

Based on this, studies of environmental problems, have become a topic of global attention in recent years, and despite this, their effects on causal reasoning, *i.e.* how lifestyle and consequently, decisions on how to manage what is done and how it is done within the territory contribute to its sustainability, have not been investigated; in the particular case of the this study, the relevance of nature is highlighted given that natural resources are shared and depend on the individual decisions of ejidatarios and comuneros that are voiced in the Asamblea, which are the result of judgements made on the basis of their needs, the information they possess as well as their interests, so that their acts on personal property affect shared resources (Amato *et al.*, 2016).

As a corollary, households are responsible for 70% of CO₂ emissions (Niamir *et al.*, 2020), as a consequence of people lifestyles that cause environmental impacts, which have been little studied (Amato *et al.*, 2016; Pasca, 2022). In this context, this study is relevant; the objective was to explain the environmental impact based on a set of dimensions associated with relevant life factors, energy behavior, energy use priorities, sources of information on energy and sustainable behavior, based on the perception of ejidatarios and comuneros of Ejido Cruz Colorada, located in the municipality of Chignahuapan, Puebla, Mexico.

THEORETICAL FRAMEWORK

Relevant life factors

According to Olmedo (2019) the new rurality refers to new interests, specializations and diversification of activities by its population. For García (2017), the social difficulties of the rural world in Latin America are made up of a series of structural problems, including social exclusion, worsening living

conditions for citizens, equitable distribution of land, and the lack of added value of productive and natural resources. As a consequence, there is a low quality of life translated into high levels of rural poverty.

The current trend in territorial development speaks of a single globalized society with heterogeneous needs, regardless of environment, the population demands the satisfaction of basic needs whose main objective is the eradication of poverty.

One of the relevant issues for the entire population is represented by health, understood as the complete state of physical, mental and social well-being, and not only as the absence of disease. In this sense, it is appropriate to point out that health institutions should not only be responsible for the provision of services to cure diseases, but also, through cross-sectoral actions, be involved in the provision of healthy and safe food, adequate housing, drinking water, a healthy environment, decent and safe working conditions, health education and citizen participation, among others. This vision, known as social determinants of health, allows health to be understood as a social product (Rodríguez y Benavides, 2016) and encompasses the different factors that the population considers relevant to life.

Sources of information on energy

The media, offer data that allow us to improve knowledge (Marín, 2017; Rodríguez and Hernández, 2018), which is why it continues to be a source of information; however, in recent years, the internet is the medium to obtain useful information either for educational or leisure purposes (Sánchez and Aranda, 2011). In this sense, academia, through the profiles of its researchers, uses the Research Gate platform –academic social network– to publicize scientific and academic production, making it not only an effective means of communication but also a source of scientific information (Orduña *et al.*, 2016). However, it is worth noting that in general young people rely more on non-conventional media –digital media, such as emails, social networks, and blogs– than on conventional media (television, press and radio) as a source of information (de la Garza and Pineda, 2020). According to Martínez and Poladian (2020), there is a prevalence of lack of information and awareness among the general population about different environmental issues. The prior is a problem, because informed people reach different conclusions when analyzing how their personal environmental impact contributes to habitat quality (Amato *et al.*, 2016).

Energy use priorities

Modernity includes electrical and electronic devices of continuous use that increase the level of electricity consumption by society (Niño *et al.*, 2021).

Anthropogenic behavior is an example of how, energy consumption is used daily for heating, lighting, cooking, water heating, cooling, and other purposes, for which various energy sources are used (Matušík and Kočí, 2019). In economic activities, energy contributes to the expansion of goods and services, helps to increase productivity by using machinery, equipment and technology in the production process, devices that often consume large amounts of energy (Salazar and Venegas, 2018).

In the context of climate change and sustainable action, emotions can drive people awareness of the urgency to act to mitigate climate change, providing a motivating basis for sustainable action (Doell *et al.*, 2021). Thus, it becomes important to design and implement strategies to change behavior on energy use, sources and time of use. In this regard, it is recognized that projects with financial benefits for consumers are attractive, and therefore, they are often for example, willing to install solar panels on their roofs rather than invest in utility projects, with self-sufficiency in mind (Horne and Huddart, 2019). It is worth noting that education and housing structural factors significantly affect household's actions in relation to energy use (Niamir *et al.*, 2020).

Energy behavior

The attitudes towards climate change, responsibility and awareness explain the behavior of inhabitants in terms of energy saving (Verachtert, 2022). Also, it is commonly agreed that citizens express support and respect for environmental protection, but when evaluating their relationship with the environment, they are reluctant to change their lifestyle and to give up the comforts that energy use provides (Kennedy and Muzzerall, 2022); in that sense, the most viable alternative to achieve an environmentally sustainable society is the gradual transformation of consumer behavior (Matušík and Kočí, 2019). Add to that, the fact that people attitudes have a considerable impact on their energy consumption, therefore the modification of those attitudes is essential to improve energy conservation (Khansari *et al.*, 2014).

Sustainable behavior

Navarro *et al.* (2020) pointed out that environmental psychology is an area within the behavioral sciences that plays a fundamental role when it comes to analyze environmental problems. Furthermore, within the concept of sustainability, there is a movement to replace the notion of pro-environmental behavior with sustainable behavior (SB), a concept that includes physical, chemical, economic, political, and social aspects of the environment.

For Tonello y Valladares (2015), research on environmental attitudes focuses on the affective-evaluative and cognitive-informative content of the positions that people express towards specific aspects or properties of the physical

environment. In that sense, pro-ecological behavior (PEB) is defined as a set of intentional and effective actions that result in the conservation of the environment, constituting one of the key components that shapes sustainable behavior; according to Tapia *et al.* (2013), sustainable behavior can be defined as the actions aimed at protecting both natural and human (social) environments. It is a deliberate (intentional) and effective (problem-solving), anticipatory behavior: it is future-oriented.

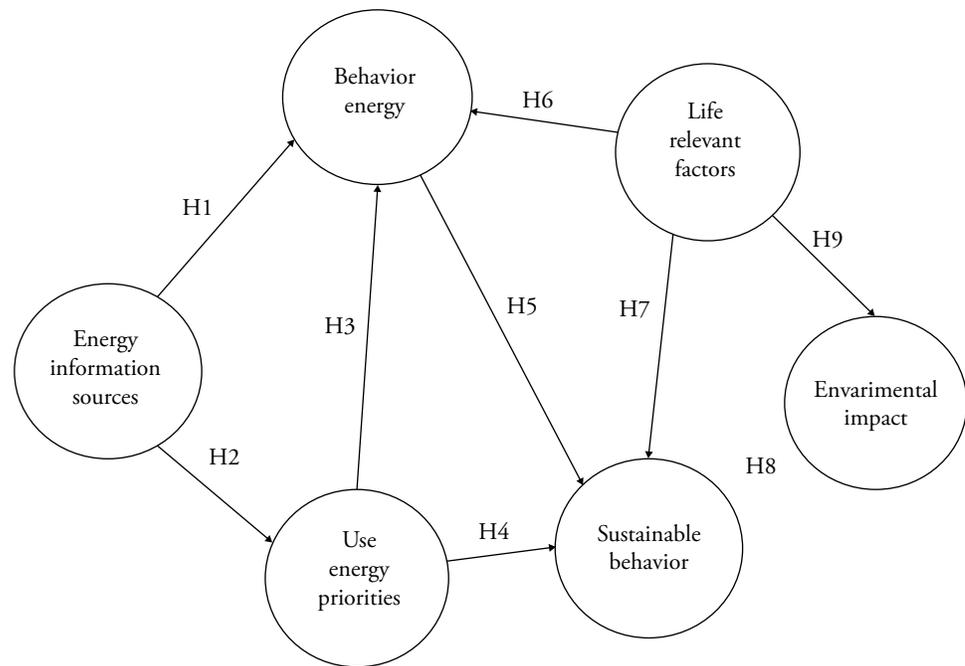
Sustainable energy behavior refers to energy behavior, which considers the set of individual actions that influence energy consumption and production (Lopes *et al.*, 2019). This requires undertaking a sustainable energy transition as a vehicle to trigger changes in a wide range of energy behaviors, including the adoption of sustainable energy resources and energy efficiency technology, investments in energy efficient measures in buildings and changes in energy use consumption. In addition, it considers the energy used to produce, transport and dispose of products (Steg *et al.*, 2015).

Environmental impact

A personal lifestyle covers a set of behaviors, each of which, in turn, carries a degree of environmental impact (Pasca, 2022). The pursuit of economic development and the generation of profits have created a series of impacts, the most serious of which are environmental. Therefore, it is necessary to reduce emissions of polluting gases that cause the greenhouse effect, *i.e.* pollution, while improving energy efficiency, as well as the conservation of resources and biodiversity (Severo *et al.*, 2021).

Based on these theoretical references, the research model shown in Figure 1 is proposed and the hypotheses to be tested are as follows:

- H1: energy information sources positively and significantly affect energy behavior;
- H2: energy information sources positively and significantly affect energy use priorities;
- H3: energy use priorities positively and significantly affect energy behavior;
- H4: energy use priorities positively and significantly affect sustainable behavior;
- H5: energy Behavior positively and significantly affects sustainable behavior;
- H6: relevant life factors positively and significantly affect energy behavior;
- H7: relevant life factors positively and significantly affect sustainable behavior;
- H8: sustainable behavior positively and significantly affects environmental impact;
- H9: relevant life factors positively and significantly affect environmental impact.



Source: own elaboration based on literature.

Figure 1. Theoretical model.

METHODOLOGY

The study territory is the Ejido Cruz Colorada, located in the municipality of Chignahuapan, Puebla (Mexico). It is a rural locality with a high degree of marginalization. The average schooling level of the population is 5.5 years. The area is forested and has an international Forest Stewardship Council (FSC) certification for good forest management. Annual harvesting includes pine, fir ('oyamel'), and oak, which together account for 3.8 million cubic meters of total tree trunks.

A quantitative, cross-sectional, exploratory, non-experimental research approach was used. To collect the data, a questionnaire designed by Contini *et al.* (2020) was applied through on-site visits. This data collection instrument is composed of seven sections that allow an equal number of variables to be measured (Table 1).

In six of the seven variables a five-point Likert scale was used; for the variable of Sustainable Behavior the response options were: never, rarely, sometimes, very often and always; in regard to the variables of Relevant Life Factors and Energy Use priorities we used: totally unimportant, unimportant, neither important/nor unimportant, important, totally important. In the Sources

Table 1. Questionnaire variables measured.

Energy uses and sources	Identification of geothermal resource
Sustainable behavior	Relevant life factors o Issues of social relevance
Energy Information Sources and Trust	Energy behavior
Energy use (production and use) priorities	Environmental impact

Source: Contini *et al.* (2020).

of information energy variable, the options were: totally untrustworthy, untrustworthy, neither untrustworthy/nor trustworthy, trustworthy, totally trustworthy; and lastly, for the Environmental impact variable, the respond options were: strongly disagree, disagree, neither disagree/nor agree, agree and strongly agree. The Energy behavior variable is quantitative and discrete represented by hours of use; in terms of measurement, the items represent a reflective measurement model.

For data analysis, a partial least squares structural equation model (PLS-SEM) was used as a statistical technique. Such technique is considered useful for exploring and predicting models, as well as for the development of theories that are in early stages of study.

To determine the sample size, the recommendations of Hair *et al.* (2017) were considered. The maximum number of predictor variables included in the proposed model is three (Figure 1). For this condition, 103 observations are required if what is sought is to detect R2 values of at least 0.10, with a significance level of 5%, and a statistical power level of 80%. The sample consisted of 102 people randomly selected (a response rate of 99%, which is considered acceptable), composed by 55% women and 45% men; 42% 'ejidatarios' and 58% 'avecindados' (people living in the community, but with no official record entitlement as part of the Ejido).

Also, it is necessary to comment that no previous values associated with the reliability of the questionnaire were obtained. In this sense, the instrument was translated to Spanish and then applied to a subsample of the local population, obtaining a global value of Cronbach's alpha greater than 0.7. Once we did that, the field work was carried out and the questionnaire was applied to all the people in the sample, and again, the Cronbach's alpha was calculated obtaining the values that appear in Table 2.

RESULTS

Descriptive analysis

The territory mainly uses two sources of energy: firewood obtained from the forest for cooking, water and house heating in cold days, and electricity for lighting and the use of electrical devices (mainly household appliances,

Table 2. Reliability and convergent validity of the measurement model.

Construct	Items	Factor loadings	Cronbach's alpha	rho_A	Composite reliability	AVE
Energy behavior	A1	0.974	0.876	1.153	0.936	0.881
	A2	0.902				
Sustainable behavior	B1	0.572	0.673	0.615	0.771	0.534
	B2	0.793				
	B3	0.805				
Relevant life factors	C1	0.767	0.837	1.063	0.896	0.743
	C2	0.954				
	C3	0.854				
Sources of energy information	D1	0.675	0.691	0.705	0.810	0.517
	D2	0.807				
	D3	0.700				
	D4	0.688				
Environmental impact	E1	0.848	0.948	0.951	0.960	0.828
	E2	0.870				
	E3	0.954				
	E4	0.930				
	E5	0.944				
Energy use priorities	F1	0.808	0.840	0.919	0.865	0.523
	F2	0.689				
	F3	0.719				
	F4	0.478				
	F5	0.862				
	F6	0.724				

Source: own elaboration based on Smart PLS 3.3.2 results.

refrigerators, radios and televisions). The home is the main energy consumer, which is used for cooking (30%), lighting (30%), house (15%) and water heating (10%), and 15% for other uses. Daily customs denote a rootedness to sustainable traditions resulting from the transmission of knowledge (tacit knowledge) and not from environmental education. With respect to the issues of importance to the population, health care and work, stand out in order of relevance, followed by public safety, education and environmental protection.

Inferential Analysis

The environmental impact model proposed is shown in Figure 1. This model is tested using the SMARTPLS 3.3.7 software. Also, the measurement model evaluated were the structural and global model.

Measurement model

To evaluate the measurement model, a distinction must be made between formative and reflective variables; the measurement model of the present research was made up of reflective variables. The reflective measurement

model was analyzed by running the PLS algorithm to verify construct reliability, convergent validity and discriminant validity (Sarstedt *et al.*, 2014). The first step consisted of reviewing the estimation and statistical significance of the loadings. In that sense, it is recommended that the items exhibit factor loadings equal to or greater than 0.708 (Hair *et al.*, 2020). As shown in Table 2, most of the items exhibit factor loadings greater than this threshold and, in all cases, they are statistically significant. It is worth mentioning that six items with factor loadings less than 0.708 were included, as a result of the test of relevance of the loadings, considering this is a new scale, and the elimination of the items decreases the composite reliability, and in that case, the reflective indicator is maintained (Hair *et al.*, 2020).

Regarding the composite reliability of the constructs, both Cronbach's alpha and composite reliability values, meet the recommended minimum and maximum cut-off points of 0.60 and 0.95. In relation to the average variance extracted analysis (AVE), the final measurement model complies with what was suggested, given that the values of the constructs for this indicator are greater than 0.50 (Fornell and Larcker, 1981).

Table 2 shows the items with which each variable was measured in the final version of the model, as well as their loadings, Cronbach's Alpha coefficient, Dijkstra-Henseler value (rho_A) and composite reliability; these last three indicated adequate construct reliability (Hair *et al.*, 2017).

The discriminant validity of the model was established with the Heterotrait-Monotrait ratio (HTMT) of the correlations. This indicator reflects the average value of the correlations of the indicators between different constructs, in relation to the geometric mean of the average correlations of the indicators measuring the same construct (Ringle *et al.*, 2020). Discriminant validity exists when the HTMT ratio is less than 0.85 (related constructs) or 0.90 (distinct constructs) (Hair *et al.*, 2020). The HTMT ratios of the model are presented in Table 3.

In all cases, the HTMT ratios are lower than the maximum recommended cut-off points, indicating that there is discriminant validity in the measurement model.

Table 3. Discriminant validity.

	1	2	3	4	5
1 Behavior energy					
2 Energy information sources	0.135				
3 Environmental impact	0.205	0.425			
4 Life relevant factors	0.204	0.503	0.116		
5 Sustainable behavior	0.365	0.672	0.638	0.275	
6 Use energy priorities	0.279	0.458	0.215	0.655	0.416

Source: own elaboration based on Smart PLS 3.3.2 results.

It is also possible to evaluate discriminant validity with the Fornell-Larcker Criterion (Table 4), where the value corresponding to the square root of the AVE is compared with the correlations of the construct, hoping that the square root of the AVE is greater, and in that way, confirm discriminant validity (Fornell and Larcker, 1981).

Structural model

The evaluation of the structural model comprises the assessment of the predictive relevance with the values of the coefficient of determination (R²), the Stone-Geisser value (Q²), the assessment of the effect size (f²), the assessment of collinearity and the determination of the path coefficients (Ringle *et al.*, 2020). As part of the assessment of the structural model, the path coefficients were evaluated as well as the relationships between the variables representing the hypotheses established in the study. Figure 2 and Table 5 present the results obtained from the evaluation of the structural model. Hypotheses H1, H2 and H8 whose value was significant, the p-value was less than 0.05, are accepted. Hypotheses H3, H4, H5, H6, H7 and H9 are not accepted.

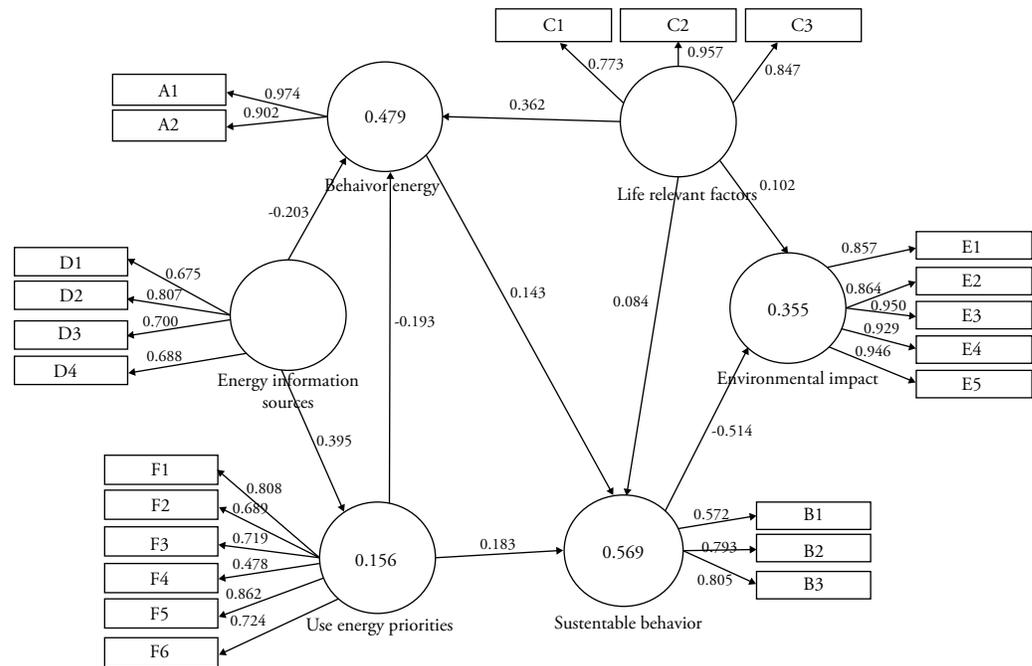
Structural Paths and Variance Inflation Values (VIF)

As presented in Table 5, three of the nine postulated hypotheses were validated. The results indicate that in the context studied, energy information sources indirectly, negatively and significantly affect energy behavior (-0.203, t=2.824); likewise, they positively and significantly affect energy use priorities (0.395, t=3.440). In addition, they show that sustainable behavior indirectly, negatively and significantly affects environmental impact (-0.514, t=10.131). Likewise, the variance inflation values (VIF) of the model were reviewed to verify the non-existence of multicollinearity. In this case, it is recommended that VIF be less than 3.0 (Hair *et al.*, 2017). None of the VIF values of the constructs exceeded that cut-off point (behavior energy-sustainable behavior, VIF=1.054; energy information sources-behavior energy, VIF=1.236; energy information

Table 4. Fornell-Larcker criterion.

Latent variable	1	2	3	4	5	6
1 Energy behavior	0.938					
2 Energy information sources	-0.065	0.719				
3 Environmental impact	-0.207	-0.356	0.910			
4 Relevant life factors	0.196	0.379	-0.009	0.862		
5 Sustainable behavior	0.197	0.464	-0.492	0.216	0.731	
6 Use energy priorities	0.206	0.395	-0.172	0.571	0.260	0.723

Note: the square root of the AVE value is in the bold diagonal.
 Source: own elaboration based on Smart PLS 3.3.2 results.



Source: smart PLS 3.3.2 results.

Figure 2. Contrasted model.

sources-use energy priorities, VIF=1.000; life relevant factors-behavior energy, VIF=1.549; life relevant factors-environmental impact, VIF=1.049; life relevant factors-sustainable behavior, VIF=1.499; use energy priorities-behavior energy, VIF=1.572; use energy priorities-sustainable behavior, VIF=1.505).

Coefficient of determination (R²)

This coefficient measures the degree to which the structural model explains the data; with this, it is possible to determine its predictive quality (Seidel and Back, 2009). From its magnitude, it is possible to state whether the explanation of the construct is substantial (R²=0.67), moderate (R²=0.35), or weak (R²=0.19) (Henseler *et al.*, 2009). As shown in Figure 2, the structural model obtained moderately explains environmental impact (R²=0.355), behavior energy (R²=0.479), and sustainable behavior (R²=0.569), and also explains, albeit weakly, use energy priorities (R²=0.156).

Level of model prediction

Stone Geisser's Q² indicator allows us to determine the level of prediction of the structural model. When this indicator exhibits values greater than zero, the model has the ability to predict (Chin, 2010). In this research work, the Q²

Table 5. Results of the structural model.

Hypothesis	Path coefficient	t-value	Decision
H1: Sources of energy information negatively and significantly affect energy behavior	-0.203	2.824	No rejection
H2: Energy information sources positively and significantly affect energy use priorities	0.395	3.440	No rejection
H3: Energy use priorities positively and significantly affect energy behavior	0.193	0.704	Rejection
H4: Energy use priorities positively and significantly affect sustainable behavior	0.183	1.112	Rejection
H5: Energy behavior positively and significantly affects sustainable behavior	0.143	0.858	Rejection
H6: Life relevant factors positively and significantly affect energy behavior	0.362	1.146	Rejection
H7: Life relevant factors positively and significantly affect sustainable behavior	0.084	0.643	Rejection
H8: Sustainable behavior negatively and significantly affects environmental impact	-0.514	10.131	No rejection
H9: Life relevant factors positively and significantly affect environmental impact	0.102	1.149	Rejection

Source: own elaboration based on Smart PLS 3.3.2 results.

values of the endogenous variables are greater than zero, which evidences the predictive relevance of the proposed model. Table 6 presents the prediction levels obtained for the constructs under analysis.

DISCUSSION

One of the primary drivers exacerbating pollution and exerting pressure on our dwindling natural resources stems from a significant lack of awareness among consumers regarding the potential ramifications of high energy consumption. Compounding this issue is the inadequacy of public policies, both at the national and state levels, which further exacerbates the problem. Consumers

Table 6. Q² indicators of the model.

Construct	SSO	SSE	Q ^{2*}
Energy behavior	204	183.21	0.101
Energy information sources	408	408.00	
Environmental impact	510	406.37	0.203
Relevant life factors	306	306.00	
Sustainable behavior	306	274.59	0.102
Energy use priorities	612	550.81	0.099

*Q² (=1-SSE/SSO).

Source: own elaboration based on Smart PLS 3.3.2 results.

are often ill-informed about diverse energy sources, household energy usage, associated costs, and potential economic savings. Given these circumstances, we firmly agree with the assertion that there is a significant lack of knowledge and awareness among the public regarding various environmental issues stemming from the increasing demand for energy. (Martinez y Poladian, 2020). This concern holds paramount importance because well-informed consumers possess the capacity to comprehend how their lifestyle choices and environmental behaviors can exert a profound and enduring influence on habitat quality (Amato *et al.*, 2016). Moreover, this influence invariably extends to individual health, underscoring the pivotal role that physicians should assume as strategic advocates in disseminating information about the adverse effects of a degraded environment on personal well-being. In doing so, they can raise awareness and encourage pro-environmental behaviors (André *et al.*, 2022).

Moreover, the majority of attitudes towards climate change, responsibility, and environmental consciousness can be attributed to the energy-saving behaviors of residents. It's worth noting that citizens often express support and reverence for environmental protection, yet they simultaneously hesitate to alter their lifestyles or relinquish the conveniences that energy consumption affords them (Verachtert, 2022; Kennedy and Muzzerall, 2022). Considering this, the challenge lies in gradually transforming consumer behavior if the goal is to attain a sustainable society (Matušík and Kočí, 2019).

Our findings reveal that the variable of energy information sources significantly and negatively impacts energy behavior. Conversely, this same variable has a positive and significant effect on energy use priorities. These outcomes align with those reported by Martinez y Poladian (2020) and Khansari *et al.* (2014). According to these authors, improved access to information about energy consumption prompts residents to make more conscientious energy choices, ultimately leading to greater sustainability within their communities.

Within the studied context, the sources of energy information predominantly manifest as trust in community representatives as the primary source of information regarding energy matters in Mexico, encompassing production, supply, and cost considerations. Meanwhile, energy behavior is most prominently reflected in the hours of daily lighting usage during winter, and energy usage priorities predominantly revolve around the use of electricity as the primary energy source within the community.

Furthermore, it was postulated that sustainable behavior exhibits a significantly negative influence on environmental impact. Our findings corroborate this hypothesis and align with the research of Gherheş and Fărcaşiu (2021), who emphasize that consumer behavior plays a pivotal role in formulating strategies that foster awareness of electricity conservation in households, thereby mitigating their environmental footprint.

In the context under examination, sustainable behavior manifests itself through practices such as reduced water consumption during showering or bathing, while the environmental impact is evident in the reduction of waste generated, which significantly affects households in terms of energy use and production. It is crucial to emphasize that identifying the unique aspects of human behavior, which are shaped by both physical and psychosocial aspects of the environment, as well as cultural influences, plays a vital role in shaping individuals' identities and, consequently, their environmental perceptions and attachment to their surroundings.

This understanding contributes significantly to the formulation of more effective strategic actions and the development of an environmental policy that aligns with the realities of Mexico. In this regard, it appears that a gradual shift towards a sustainable relationship between individuals and the environment is taking shape, albeit at a deliberate pace (Zacarias and Higuchi, 2017).

Conversely, it is imperative to consider that rural areas in Mexico confront a multitude of structural challenges, chief among them being the scarcity of resources and essential services such as education and healthcare. Consequently, sustainability often takes a backseat on the local population's list of priorities. As posited by Valero *et al.* (2022), rural areas grapple with social exclusion, and their inhabitants face pronounced vulnerabilities in areas like employment, healthcare, caregiving requirements, as well as their living and working conditions. Consequently, their foremost focus centers on addressing these pressing needs, relegating sustainability to a secondary concern. Nonetheless, research by Kuai *et al.* (2022) underscores the potential for heightened environmental awareness to catalyze energy conservation efforts, particularly within rural households led by young men. Notably, education and income exhibit a synergistic moderating influence on the relationship between environmental consciousness and energy conservation. In light of these findings, the task of instilling sustainable behaviors in the populace of Ejido Cruz Colorada poses a formidable challenge.

CONCLUSIONS

This analysis introduces a novel scale designed to evaluate environmental impact, specifically in its concise version, which assesses the relevance of alterations in air quality, odor, water pollution, indoor and outdoor air conditions, along with waste production, at the household level in relation to energy use or production. The measurement model results affirm the suitability of these components for gauging the variable of environmental impact. As a result, this study contributes a fresh approach to measuring this construct and enhances our comprehension of the intricate interplay among

environmental impacts, critical life factors, energy-related behaviors, sources of energy information, energy use priorities, and sustainable conduct.

The study conclusively establishes that sustainable behavior serves as a key determinant of environmental impact. These findings yield valuable insights into the perception of environmental impact within rural areas primarily engaged in fundamental activities like agriculture and forestry. This, in turn, generates novel knowledge for policymakers, aiding them in crafting effective strategies and actions to alleviate environmental impact. Notably, this study stands out for its exploration of previously unexamined factors influencing the perception of environmental impact within ejidos in Mexico.

As a prospective avenue for further research, it is advisable to replicate this study in other rural regions to validate the results and ascertain their reproducibility. Additionally, expanding the questionnaire to encompass the definition of sustainable behavior, wherein pro-social and pro-environmental behaviors are complemented by self-care behaviors, presents an intriguing opportunity. Ultimately, before we can effectively care for society or the environment, it is imperative that we first attend to our own well-being.

Furthermore, there is significant potential to augment the role of biomass-supported electricity within rural communities, particularly those heavily reliant on forest-related activities for their livelihoods.

Although economic activity in the region remains minimal, largely encompassing a few grocery stores and primary sectors such as agriculture, livestock, and forestry, it is apparent that these organizations do not currently exhibit sustainable behaviors. In this context, we posit that the adoption of sustainability as an organizational value is a product of the surrounding environment, wherein social norms exert a profound influence on the populace's conduct. Consequently, it becomes imperative for the government to formulate and implement public policies aimed at fostering sustainability.

In light of this perspective, we propose the development of a causal model designed to gauge sustainable behavior. This model would draw from variables related to environmental challenges, organizational values, institutional norms, environmental knowledge, and environmental conduct. Such an endeavor holds promise as a potential avenue for future research.

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