

## **Chapter 9 Market research to identify the viability of using solar stoves in the municipalities of Peñamiller and Jalpan de Serra, in the state of Querétaro**

### **Capítulo 9 Estudio de mercado para identificar la factibilidad de uso de las estufas solares en los municipios de Peñamiller y Jalpan de Serra, del Estado de Querétaro**

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**DOI:** 10.35429/H.2022.8.107.125

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## Abstract

Based on a study carried out, through the application of 115 surveys to heads of families in the rural area of the municipalities of Peñamiller and Jalpan de Serra, in the state of Querétaro, the main market parameters for the use of solar cookers for the area of influence. The people who answered the surveys were chosen according to a series of homogeneous characteristics such as rural geographic area, social and economic vulnerability, uses and customs. The selected localities were: Valle Verde, San Antonio Tancoyol and Las Ánimas of the municipality of Jalpan de Serra, while, for the municipality of Peñamiller, the surveys were applied to the inhabitants of the following localities of Peña Blanca, Alto Bonito and Mentiras. It should be noted that the instrument underwent a pilot test which made it possible to validate that the wording of the questions was adequate, that there was a clear understanding in the wording, the use of simple language and that, of course, the application time will be found in the recommended parameters. For the pilot test, a small sample was chosen that represented 2% of the representative sample under study. In addition, other results of the survey have made it possible to obtain information regarding the main energy sources used for cooking food, the number of inhabitants per household, knowledge about the existence of solar cookers, the availability of trying this type of cooker, as well as such as the type of food that would be cooked in the appliance and the prices willing to pay. However, it must be considered that the cost the user is willing to pay is less than one thousand pesos in order to be attractive, the product must also be weather resistant. In this research stage, no product presentation variables such as weight, volume or appearance were considered. The scope of this study is exploratory and market tests on physical prototypes are required, which are planned in the near future.

## Renewable Energy, Market research, Solar stoves, Solar cooking

### Resumen

Con base en un estudio realizado, a través de la aplicación de 115 encuestas a jefas o jefes de familia en la zona rural de los municipios de Peñamiller y Jalpan de Serra, del estado de Querétaro, se determinaron los principales parámetros de mercado para el uso de cocinas solares para la zona de influencia. Las personas que contestaron las encuestas fueron elegidos de acuerdo a una serie de características homogéneas tales como, zona geográfica rural, vulnerabilidad social y económica, usos y costumbres. Las localidades seleccionadas fueron: Valle Verde, San Antonio Tancoyol y las Ánimas del municipio de Jalpan de Serra, mientras que, para el municipio de Peñamiller, las encuestas fueron aplicadas a los habitantes de las siguientes localidades de Peña Blanca, Alto Bonito y Mentiras. Cabe señalar que el instrumento pasó por una prueba piloto la cual permitió validar que la redacción de las preguntas fuese adecuada, que se tuviera una comprensión clara en la redacción, uso de un lenguaje sencillo y que por supuesto el tiempo de aplicación se encontrará en los parámetros recomendados. Para la prueba piloto se eligió una muestra pequeña que representó el 2% de la muestra representativa objeto de estudio. Además, otros resultados de la encuesta han permitido obtener información respecto a los principales energéticos utilizados para la cocción de alimentos, el número de habitantes por hogar, el conocimiento sobre la existencia de las cocinas solares, la disponibilidad de probar este tipo de cocinas, así como el tipo de alimentos que se cocinaría en el artefacto y los precios dispuestos a pagar. Sin embargo, se debe considerar que el costo dispuesto a pagar por el usuario es menor a mil pesos para poder ser atractivo, el producto también debe ser resistente a la intemperie. En esta etapa de investigación no se consideraron variables de presentación del producto como peso, volumen o aspecto. El alcance de este estudio es exploratorio y se requieren pruebas de mercado sobre prototipos físicos, los cuales están previstos en el futuro cercano.

## Energía renovable, Estudio de mercado, Estufas solares, Cocción solar

### 1. Introduction

The Sun is a star that was formed approximately 4.65 billion years ago and it is estimated that it still has fuel for another 5.5 billion years. A person requires the consumption of food that serves as fuel to carry out vital processes, to perform the work necessary to survive; until approximately 200 years ago the power required by man was 3 kWh per day<sup>-1</sup> (González-Velasco, 2009). It is estimated that each year the earth's surface receives approximately 1017 Wh of solar energy. The consumption of current human energy worldwide is estimated at  $13 \times 10^{12}$  W/h per year (Scheller et al., 2010).

Considering the above and according to (Miller, 2002), 99% of the energy used to heat the earth and what is inside it comes directly from the sun, without this inexhaustible input of solar energy, the average temperature of the earth would be  $-240^{\circ}\text{C}$  and life as we know it would not exist, the remaining 1% corresponds to commercial energy. About 1.5 billion people worldwide still lack access to electricity, and approximately 2.6 billion rely on wood, straw, charcoal or dung to cook their daily meals, (RENN21, 2010) which shows that cheap energy that is generated by the environment is necessary.

Much of Mexico's territory receives sunlight about 300 days a year. Mexico enjoys, on average, 300 days of sunlight per year, an enormous energy potential of which only a portion is used. When it is used, it is usually through photovoltaic power generation or to heat water in single-family homes. However, when it comes to cooking or processes such as distillation, drying or pasteurization, the first choices of Mexican companies are still fossil fuels (gas and diesel) and sometimes wood, which contribute to global warming and are harmful to health.

In Mexico, the use of firewood represents 33.7% of total energy consumption in the residential sector, only below the use of LP gas (SENER, 2015). Approximately a quarter of households (27.2 million people) cook with firewood (Masera et al, 2005). It is estimated that about 28 million m<sup>3</sup> of fuelwood is extracted by rural communities (Caballero, 2010). Firewood is often collected by women and children who use up their energy and time; however, there are also families who need to buy it, which represents an expense of 15-20% of total household income (Masera, Díaz, & Berrueta, 2005).

Solar energy and its manifestations (wind, hydro, biomass, ocean waves and others) are renewable energy sources (RES) or clean energies, which for thousands of years man has used to perform many tasks. They have used biomass to cook their food and more than 6,500 years ago, wind energy was used to propel boats. Unfortunately, the systems for harnessing FRE fell into disuse with the discovery of large fossil fuel deposits that offered abundant and cheap energy for industrial development (Mejía, 1999).

For this reason, a project has been proposed to develop solar stoves that can be produced industrially. The first stage of the project consists of measuring through a survey the expectations of potential users about solar stoves in terms of their current knowledge of their existence, possible acceptance, potential use, as well as the price they are willing to pay for the stove.

**Figure 1** Traditional wood-burning stove in Santa María Yacochi, Mexico



*Photo: Sandra Weiss*

The added value of this work is to develop an instrument that allows to know information regarding the main energy sources used for cooking food, the number of inhabitants per household, the knowledge about the existence of solar stoves, the availability to try this type of stoves, as well as the type of food that would be cooked in the appliance and the prices willing to pay. There is an important market in the area of Peñamiller and Jalpan de Serra in the state of Querétaro, where the people surveyed would be willing to try and buy solar stoves.

Cooking with solar energy is a wonderful experience. It means not only a daily saving in gas, coal, firewood or electricity, but also a change in people's consciousness and a learning process that is oriented towards sustainable human development. It is a new way of taking care of our lives, which is being applied in more and more countries every day. When the sun's energy is used, it is proven that fire is not necessary for cooking. The ability of sunlight to be transformed into heat, thanks to small and simple devices allow finding alternative solutions to everyday problems around the world, such as:

- The lack of firewood and charcoal,
- The effort involved in their transportation, mainly by peasant and indigenous women;
- The deforestation of forests;
- Pollution from smoke from firewood or charcoal during cooking, which is harmful to the lungs and the environment;
- The high cost of gas for daily food preparation.

Solar stoves and ovens, of which there are a large number of designs and models, are examples of a new technology that is inexpensive, easy to reproduce and most importantly: it is environmentally appropriate! They are easy to operate, easily transportable and do not require costly maintenance. The cooking time, however, is generally longer than with conventional stoves, since it depends on the intensity of solar radiation and, to a lesser extent, on the ambient temperature, i.e. it is possible to cook in summer and in winter.

### **1.1 To cook with firewood and charcoal is to die a little every day.**

The habit of collecting and using firewood prevents us from realizing what this means for humanity and for the environment. However, it is important to think about why we use wood and charcoal:

- Money is not always enough to buy gas;
- You live so far away from urban centers that it is the only fuel available;
- You want to make the gas cylinder last as long as possible.
- Besides, it has always been thought that firewood is free... but it is not!

### **1.2 Firewood is not free, it has a cost in terms of environment, health and time.**

Families have to walk farther in search of firewood, which means a very significant expenditure of time. If they were to work during that time, how much would the economic income amount to? It has been calculated that a family of 5 people can spend half a ton of firewood per month on cooking. This explains the decrease or disappearance of trees and shrubs that beautify the mountains and hills some time ago. It means that many forests are disappearing or have already disappeared and what was once green is now desert. This decrease in vegetation is changing the climate. Today it is drier and hotter and when it is cold, it is much colder. Collecting firewood from the banks of the streams is taking away their natural containment, allowing sand, soil and leaves to be washed down the river. This can dry up the stream and destroy plants and animals, in short, it damages the environment in which we live.

Look for other economic and easy to obtain fuels, which allow us to consume less firewood or charcoal. At the same time, reforest the soils and recover nature for future generations. But... What to do then, if you need to cook and keep your house warm in the most economical way possible?

The solution lies in the sun, it is a good alternative: natural, inexhaustible, clean, free and if you take advantage of it, it can replace, partially or totally, the wood that is burned or save on the purchase of other fuels.

### **1.3 Cooking with the sun**

It is possible to cook with the luminous energy produced by the sun, but it is not enough to simply put a pot in the sun. It requires a specially designed device that transforms solar radiation into sufficient heat through accumulation or concentration. It is similar to playing with a mirror directing the rays towards an object, burning paper or wood with a magnifying glass or leaving a hose full of water in the sun for a certain period of time.

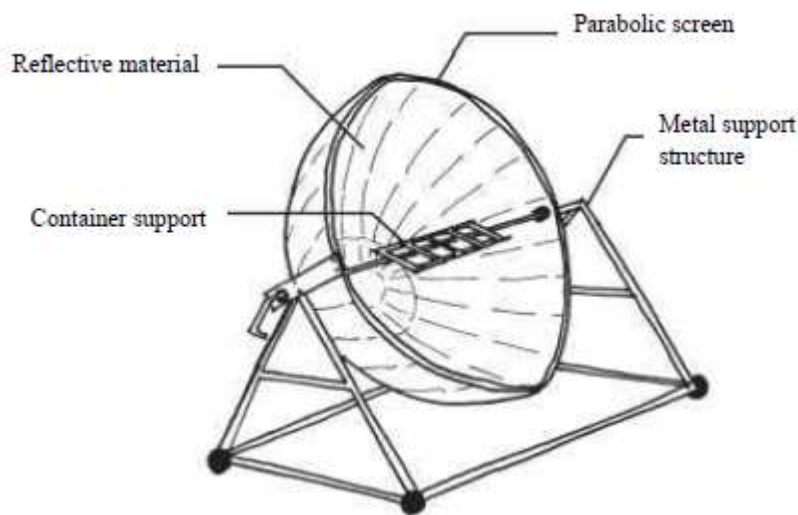
The phenomenon of heating the interior of a car parked in the sun with the windows closed is also similar. One of the alternatives are solar stoves, devices that have been used for years to cook food with the help of the sun's energy; they are thermo-converters, i.e., devices that transform the sun's radiation into sufficient calorific power to cook food. There are multiple designs of solar stoves in the world, but there is still a lot of research to be done (González-Avilés et al., 2017).

#### 1.4 What types of solar stoves are there?

Basically two types are distinguished:

- The parabolic solar stove, which is similar to an antenna with the same name, but covered with a reflective surface. It heats by concentrating the sun's rays on a single point, called a focus, where the cooking container is located.
- The solar oven, which is a hermetically sealed box with a transparent lid, which allows the sun's rays to be captured. It heats by the so-called greenhouse effect or heat trap.

**Figure 2** Parabolic solar stove



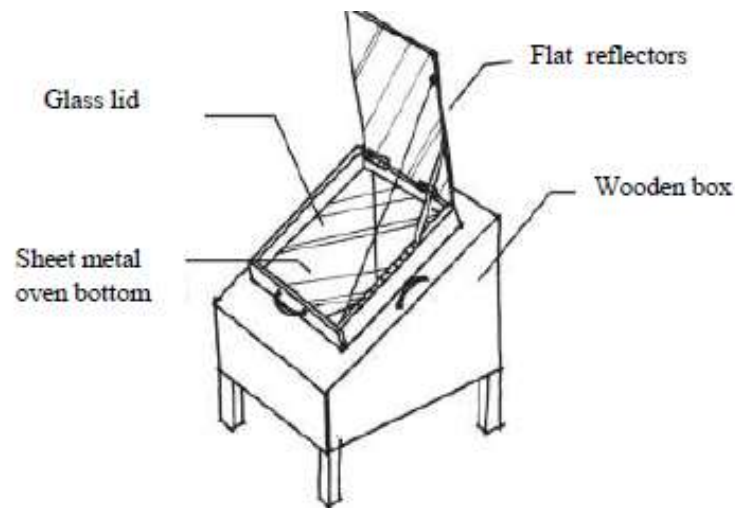
*Source: Guide for the use of solar stoves and ovens. Recetario Solar Fundación Celestina Pérez de Almada, 2005*

Parabolic solar stoves have a structure generally made of metal, basically composed of a support and a parabolic screen supported by the support. Normally the support is equipped with wheels so that the stove can be moved easily without the need to lift it. The parabolic screen is fixed in such a way by the support, so that it is easy to change its inclination according to the angle of incidence of the sun. The inner surface of the screen is covered with a reflective material, which can be made of strips of a special aluminum sheet or composed of a large number of small pieces of mirror glass. In the center of the screen, slightly separated from it is the holder for the cooking vessels, the defined size and shape of which may vary from one model to another. The size of the stove can vary according to requirements. For family use, the parabolic screen has a diameter of approximately 1 m. to 1.50 m. The larger the size, the greater the heat output and consequently the cooking capacity.

#### 1.5 What does a solar oven look like?

The solar oven box can be made of a wide variety of materials and of different sizes depending on the need. The simplest and cheapest ovens are made of cardboard boxes and the more expensive ones of wood, plastic or metal. The transparent lid is usually made of glass, but acrylic or polyester plates or sheets can also be used, which have the advantage of being less fragile, with the disadvantage that they do not retain heat as well as glass (greenhouse effect).

**Figure 3** Solar oven. Source: Guide to the use of solar stoves and ovens. Recetario Solar Fundación Celestina Pérez de Almada, 2005



Source: Guide for the use of solar stoves and ovens. Recetario Solar Fundación Celestina Pérez de Almada, 2005

By using a double glass lid, the oven retains more heat. To minimize heat loss through the walls and bottom of the box, a thermal insulator several centimeters thick is used. To capture more of the sun's rays, the sides of the glass lid can be equipped with flat reflectors. The inside of the oven generally consists of a sheet metal box with an opaque black painted bottom, which absorbs the sunlight to transform it into heat. Here's the golden fact: A good solar oven can reach temperatures of up to 150°C. It's a marvel! To make its use more comfortable, the oven can be mounted on a raised support with wheels. This will make it easy to move and orient it towards the sun.

### 1.6 When can the solar stove and oven be used?

Solar stoves and ovens work only when the sun is shining. When it is dark, cloudy or raining, the solar stove and oven will not work. However, when it is cold and sunny, you can cook, regardless of the outside temperature. The proper functioning of the solar stove and solar oven depends on the good collection of the sun's rays. It is therefore necessary to ensure that the solar stove and solar oven are always oriented towards the sun and that the collection surfaces (reflectors and glass) are always clean.

### 1.7 What are the advantages of solar stoves?

Saving money while there is sun you can cook with it - the sun is free! People who use solar stoves and ovens save between 50 to 80% of gas, coal or firewood. This means that a large part of the energy used for cooking food can be saved.

#### *Time savings*

You don't have to fetch firewood or buy gas or other fuel as often. Cooking, especially in the solar oven, does not require constant attention. As the food does not burn, you do not have to stir it constantly as when cooking with fire. You can then have more time for other activities that you do not have time to do now.

#### *Better health*

Not having to walk for long hours looking for firewood and carrying it on your back is beneficial to your health. The smaller amount of smoke that one has to breathe during the cooking with firewood also contributes to better health.

#### *It allows to take care of the environment.*

Using less wood and charcoal means cutting less trees and maintaining our forest. Burning less wood reduces smoke pollution in the air, which is beneficial for our health and for animals and plants.

## 1.8 What are the disadvantages of solar stoves and ovens?

*They do not work without the sun*

Solar stoves and ovens ONLY work when there is SUN. At night or when it is cloudy they cannot be used. Therefore, it is good to have an auxiliary stove.

*Cooking is done outside the house*

This means, you have to walk from the house to the patio and expose yourself more to the sun and wear a nice straw hat.

*You have to move it from time to time*

It is necessary to keep it focused towards the sun.

*It is uncommon*

It takes time to get used to its use and this is only achieved by practicing with it. The more you use it, the better you get to know it!

## 2. Market research

Market research for (Malhotra, 2008) is the "identification, collection, analysis and dissemination of information in a systematic and objective way, with the purpose of improving decision making related to the identification and solution of marketing problems and opportunities" Market research is a technique used to collect data on any aspect that you want to know and then interpret them and finally make use of them for proper decision making (QuestionPro, 2019). (QuestionPro, 2019).

There are two types of market research, the first with a qualitative approach that is based on feelings and thoughts, the second with a quantitative approach that allows making use of statistical and mathematical techniques. The main tool of quantitative research are surveys, which can be face-to-face, telephone, mail, online.

In particular, the face-to-face survey, also known as "Face-to-face", is the survey that allows collecting information without a large amount of bias since the researcher is present and can verify at all times that the participant answers from start to finish and that they provide adequate answers to each question.

Market research has 3 different types of objectives.

**Administrative:** To help the development of the company or business through proper planning, organization and control of both material and human resources, in order to meet specific needs within the market at the right time.

**Social:** To satisfy the specific needs of the client by means of a required good or service, that is to say, that the product or service fulfills the requirements and desires of the client when it is used.

**Economic:** Determine the economic degree of success or failure that a company may have when it is new in the market, or failing that, introduce a new product or service in order to know for sure the actions to be implemented. (QuestionPro, 2019).

### 2.1 Market research process

To carry out market research it is vital to plan the activities and execution actions, therefore, the process allows to know what to do when faced with various situations that arise and thus make time efficient. The following structure indicates the sequence of the six research steps to follow according to (Malhotra, 2008):

**Figure 4** Market research process

Source: (Malhotra, 2008)

## 2.2 Geographic location of the municipalities

Figure 5 shows the location of the municipalities of Peñamiller and Jalpan de Serra, in the state of Querétaro.

**Figure 5** Map of the state of Querétaro

Source: INEGI. Geostatistical Framework, December 2018

The municipality of Peñamiller is geographically located in the north of the state of Queretaro, in the middle of the Queretaro semi-desert and has been defined as the gateway to the Sierra Gorda. It is located between the geographical coordinates  $20^{\circ} 57'$  and  $21^{\circ} 14'$  North latitude and  $99^{\circ} 42'$  and  $100^{\circ} 02'$  West longitude of the Greenwich meridian; with altitudes ranging from 1,280 to 3,000 meters above sea level. To the north it borders the municipalities of Xichú and Atarjea in the state of Guanajuato; to the south with the municipalities of Tolimán and Cadereyta de Montes; to the east with the municipalities of Pinal de Amoles and Cadereyta de Montes; and to the west with the municipality of Santa Catarina in the state of Guanajuato. The municipal seat is located at  $21^{\circ} 03'$  North latitude and  $99^{\circ} 49'$  West longitude of the Greenwich meridian, 127 km from the State Capital. It has an altitude of 1,330 meters above sea level. The municipality of Jalpan de Serra is located in the northern part of the state of Queretaro, between the geographic coordinates:  $21^{\circ} 06'$  and  $21^{\circ} 41'$  North latitude and  $99^{\circ} 05'$  and  $99^{\circ} 33'$  West longitude and has altitudes ranging from 420 m to 2900 m. It has a territorial extension of 1,121km<sup>2</sup>. It is part of the Pánuco and Santa María river basins.



The climate is warm and humid and it is part of the Sierra Gorda Biosphere Reserve (1997), it has two of the five Franciscan Missions declared Cultural Heritage of Humanity by UNESCO (2003) and as of 2010 it is part of the Magical Towns Program of the Federal Tourism Secretariat. In 2005 it had a population of 22,025 inhabitants (INEGI, 2020).

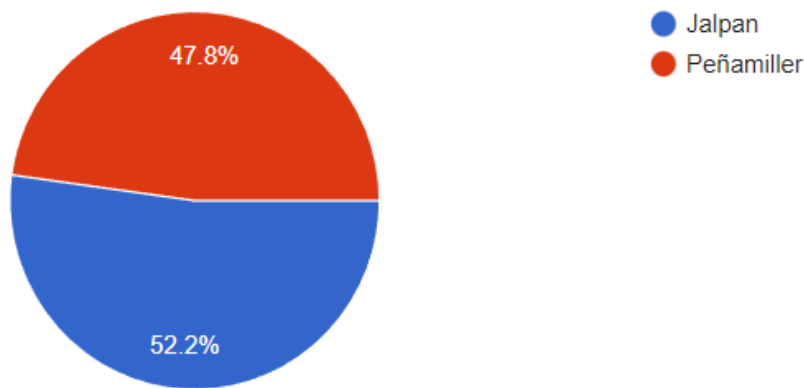
**2.3 Results**

Fieldwork was conducted in the municipalities of Jalpan de Serra and Peñamiller in the state of Querétaro, during a period of two weeks from March 21 to April 1, 2022, the surveys were answered by 115 participants, the confidence level is 95% with a margin of error of 5%, the tool was a face-to-face survey, the surveys were conducted by students of the Business Development career area Marketing, of the academic unit Jalpan de Serra, of the Technological University of San Juan del Río, coordinated by Dr. Guadalupe Morado Huerta, and the students of the academic unit Jalpan de Serra, of the Technological University of San Juan del Río, coordinated by Dr. Guadalupe Morado Huerta. Guadalupe Morado Huerta, on the other hand, in the municipality of Peñamiller, the surveys were applied by the students of the Business Development Marketing area of the Peñamiller campus of the Technological University of San Juan del Río, coordinated by Professor Francisco Javier Fabian Balderas. The pilot test lasted three days, in the execution of the pilot test, participated the students of the 2nd semester of the Marketing Research I course, of the Business Development career in the Marketing area of the Technological University of San Juan del Río. The results are shown below:

**Section I "Identification Data".**

**Question 1. Municipality to which you belong.**

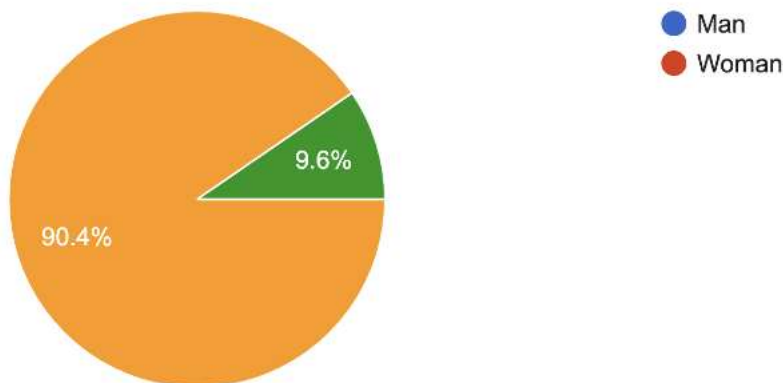
**Graph 1** 52.8% of respondents belong to the municipality of Peñamiller while 47.8% belong to the municipality of Jalpan de Serra



*Source: Own elaboration, using google forms*

**Question 2 Sex of participants**

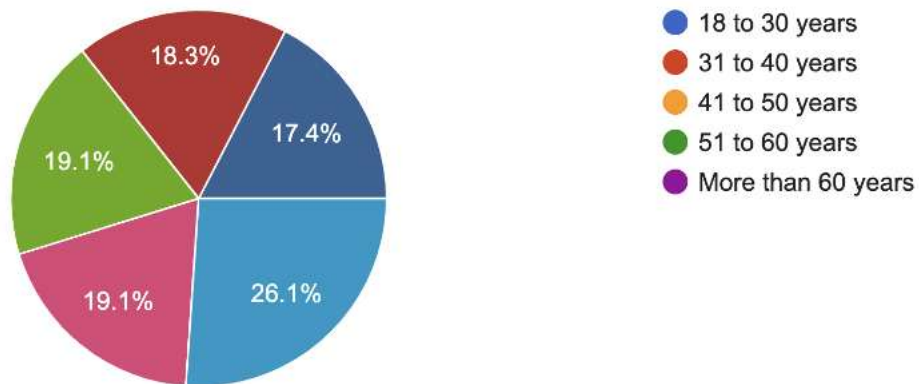
**Graph 2** 90.4% of respondents are female and 9.6% are male



*Source: Own elaboration, using google forms*

### Question 3. Age range of participants

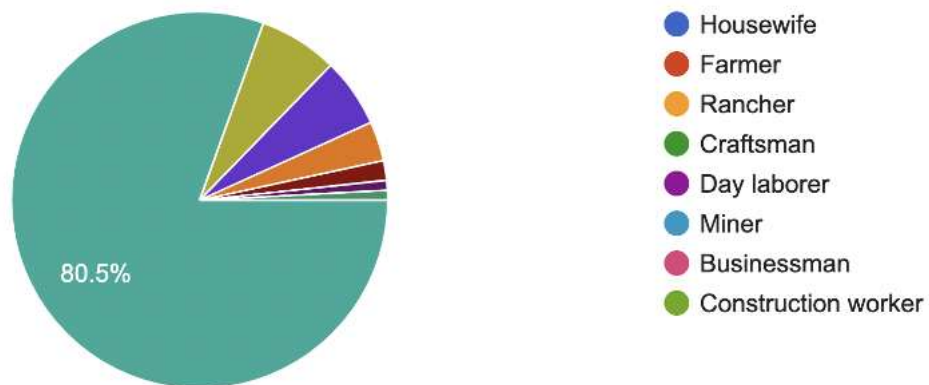
**Graph 3** 26.1% of the participants are between 31 and 40 years old, while 17.4% are over 60 years old



Source: Own Elaboration, using google forms

### Question 4. Occupation of the participants

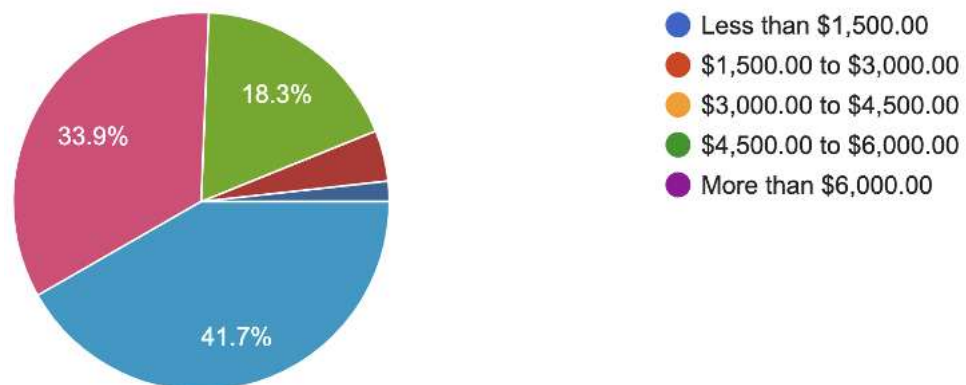
**Graph 4** 80.5% of the participants are householders, the remaining 19.5% of the respondents are farmers, cattle ranchers, artisans, day laborers, miners, merchants and bricklayers



Source: Own Elaboration, using google forms

### Question 5. Range of family income

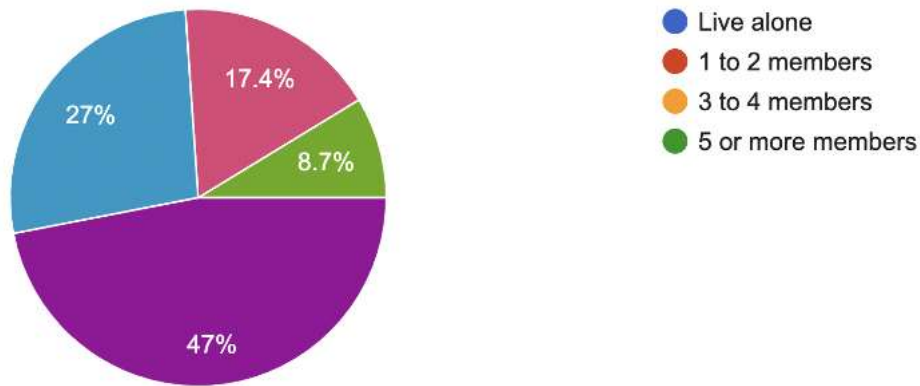
**Graph 5** 41.7% of the people surveyed have incomes of less than \$1500.00 per month, 18.3% have incomes between \$3000.00 and \$4500.00



Source: Own Elaboration, using google forms

**Question 6. Number of family members**

**Graph 6** 47% of the respondents are part of a family composed of 3 to 4 people; it is important to note that 27% of the respondents stated that their family is composed of 5 or more members, while 8.7% of the respondents live alone

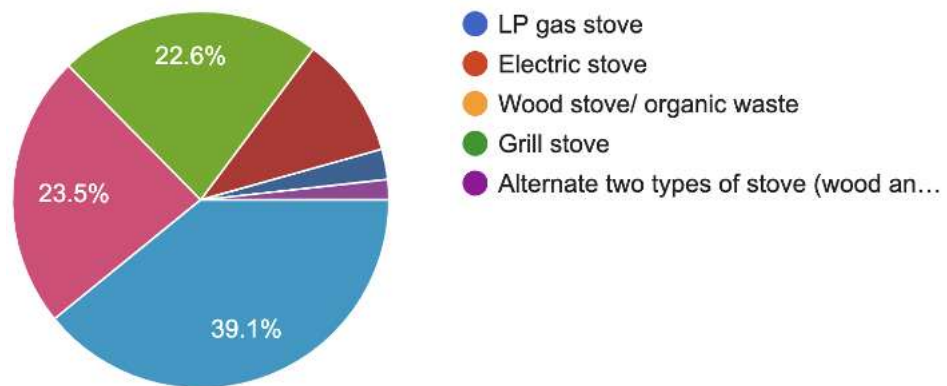


Source: Own Elaboration, Using Google Forms

**Section II "Use of Stoves**

**Question 7. What type of stove do you use in your home?**

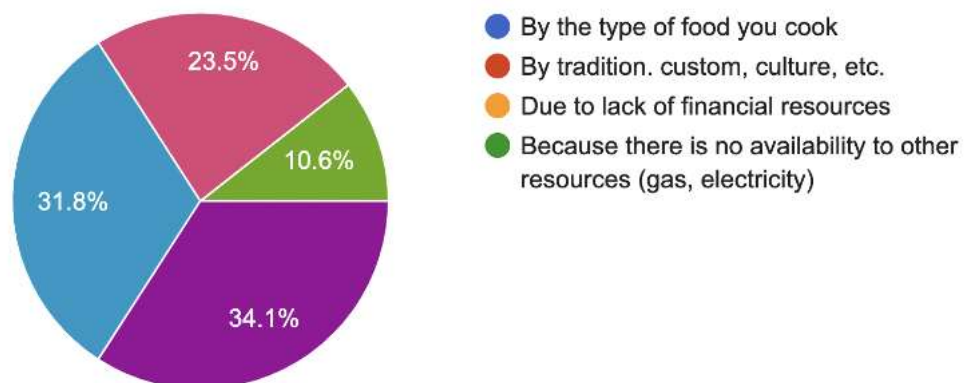
**Graph 7** 39.1% of the respondents answered that they use LP gas stove, while 10.4% alternate the use of L.P gas stove with wood stove, the use of grill stoves is below 10.4%



Source: Own elaboration, using google forms

**Question 8. If you use firewood or any other organic waste for cooking, what is the reason you continue to use firewood for cooking?**

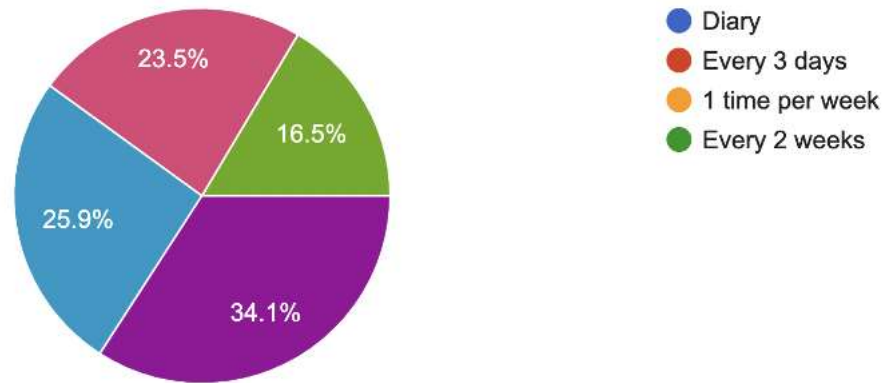
**Graph 8** 34.1% of the respondents commented that they mainly use firewood and organic waste because of the type of food they cook while 10.6% use these resources because other resources such as gas and electricity are not available.



Source: Own elaboration, using google forms

**Question 9. If you use firewood for cooking, how often do you cut down or purchase organic waste?**

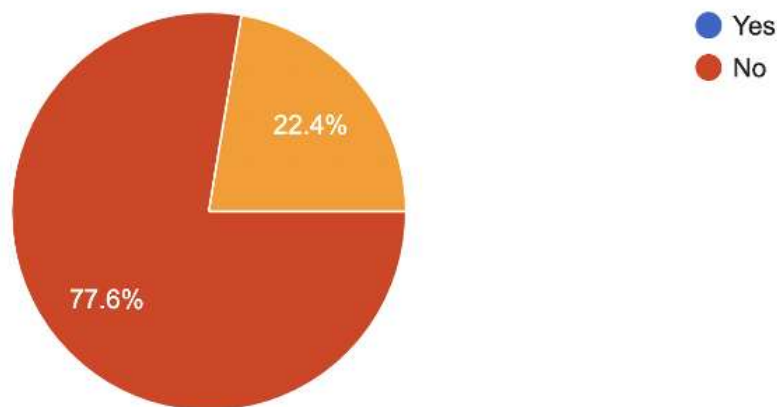
**Graph 9** The frequency with which families cut trees or acquire organic waste is every 2 weeks represented by 34.12 % while with 16.5% daily they have the need to use such resources



*Source: Own elaboration, using google forms*

**Question 10. In case of cooking with firewood, have you had any health problems?**

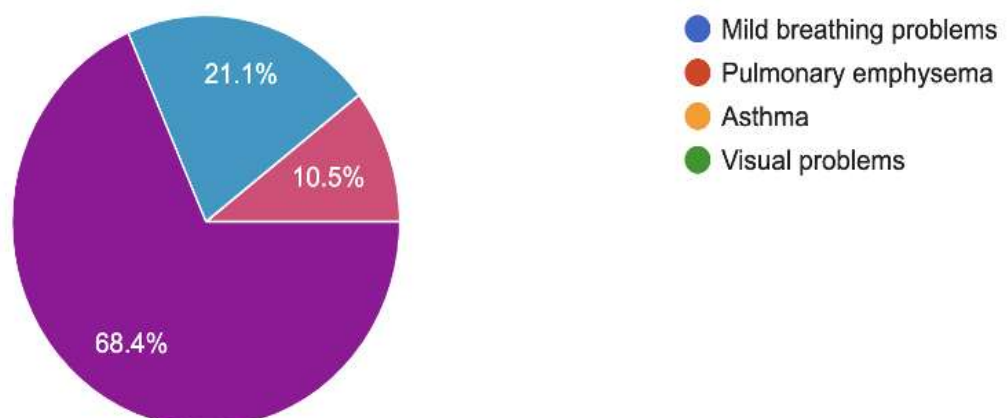
**Graph 10** 77.6% of the people who cook with firewood have presented health problems, while 22.4% have not fallen ill due to this cause



*Source: Own elaboration, using google forms*

**Question 11. In the case of cooking with firewood and having presented health problems, which illness was manifested?**

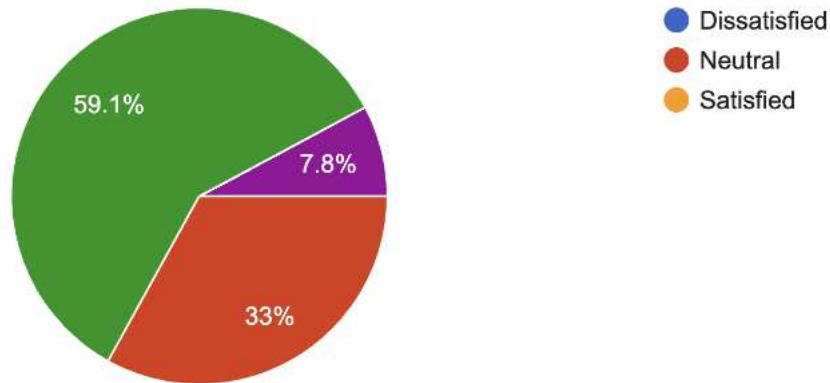
**Graph 11** With 68.4%, mild respiratory problems are the main ailment reported by people who cook with firewood, while asthma was the least common cause with 10.5%



*Source: Own elaboration, using google forms*

**Question 12. Regarding the level of satisfaction, how satisfied do you feel with your current stove?**

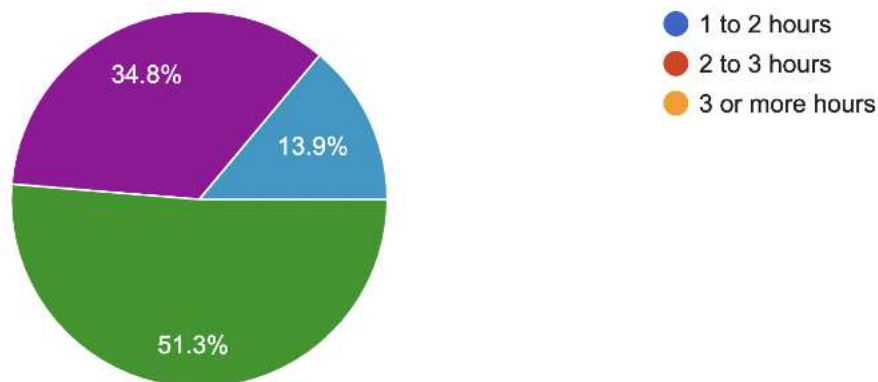
**Graph 12** 59.1% of people are currently satisfied with the type of stove they have in their homes and only 7.8% are dissatisfied



. Source: Own Elaboration, using google forms

**Question 13. On average, how much time do you spend cooking per day?**

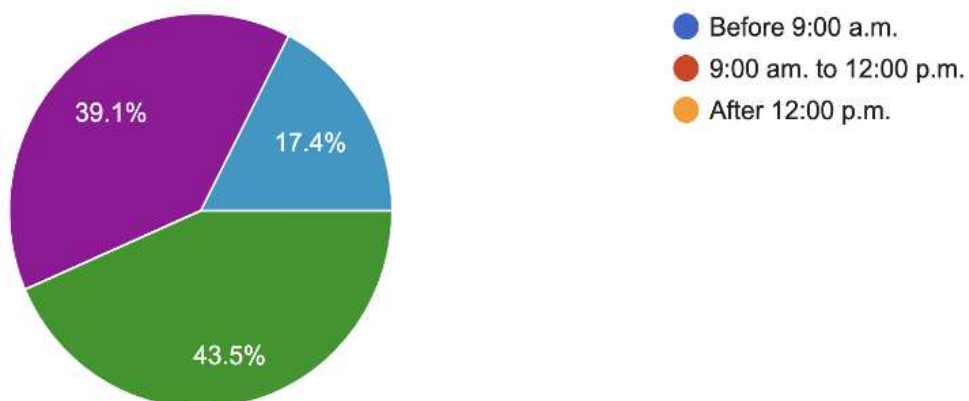
**Graph 13** 51.3% of the people invest 1 to 2 hours a day to cook their food and only 13.9% spend 3 or more hours to cook



Source: Own Elaboration, using google forms.

**Question 14. At what times of the day do you usually cook?**

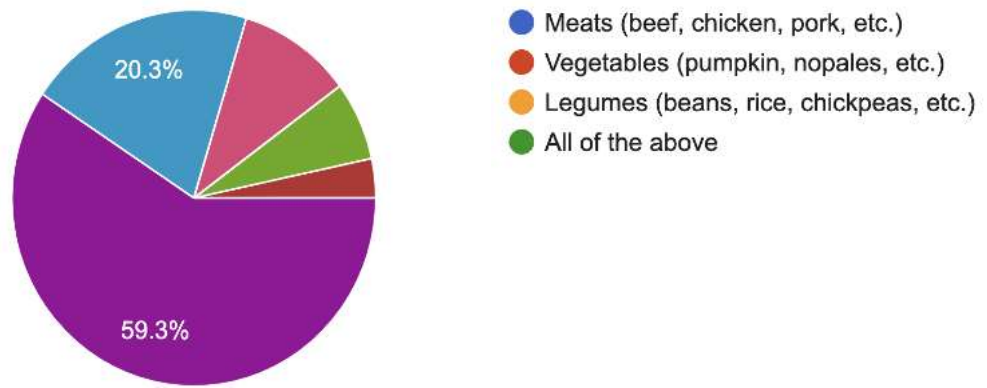
**Graph 14** 43.5% of the people affirm that they prefer to cook from 9:00 a.m. to 12:00 p.m. and only 17.4% do it after 12:00 p.m



Source: Own elaboration, using google forms

**Question 15. What type of food do you usually prepare most frequently?**

**Graph 15** 59.3% of people answered that the foods they prepare most frequently are meats, vegetables and legumes.

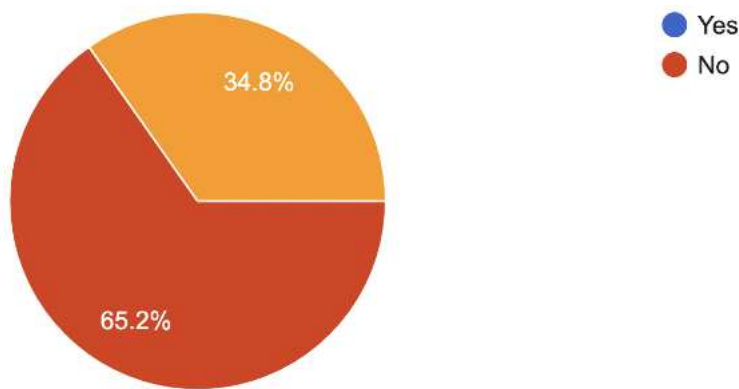


Source: Own elaboration, using google forms

**Section III "Solar Cookers".**

**Question 16. Have you heard about renewable energies?**

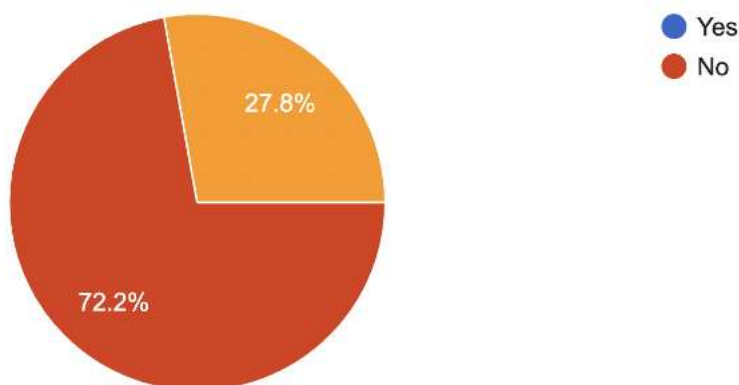
**Graph 16** 65.2% of the people affirmed that they have heard of renewable energies while 34.8% have not heard of renewable energies.



Source: Own elaboration, using google forms

**Question 17. Do you know or have you heard about solar stoves and their benefits?**

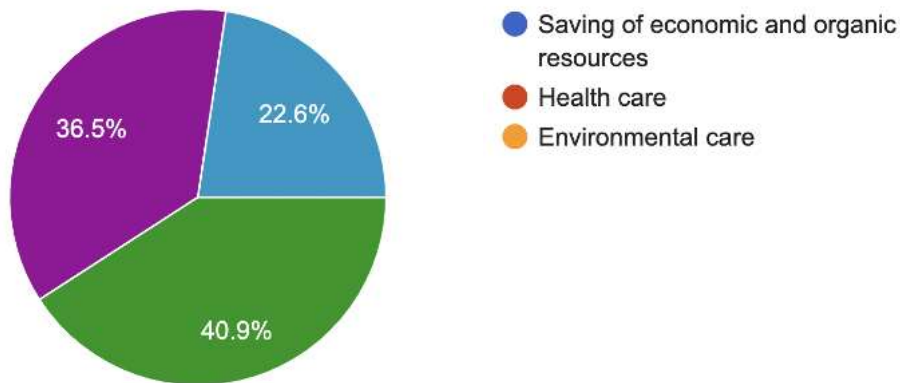
**Graph 17** 72.2% of the people have heard of solar cookstoves and their benefits, while 27.8% do not know about solar cookstoves or their benefits



Source: Own elaboration, using google forms

**Question 18. Of the following benefits provided by the use of solar cookstoves, which do you find most interesting?**

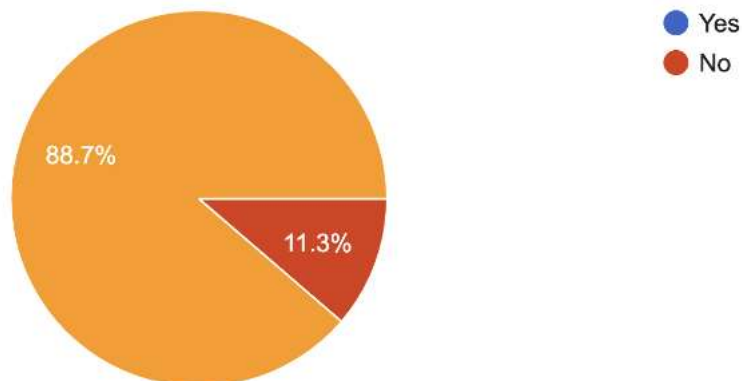
**Graph 18** 40.9% answered that the main benefit of solar stoves is health care, while 22.6% answered that they are beneficial for the environment



*Source: Own elaboration, using google forms*

**Question 19 Would you like to cook on a solar stove?**

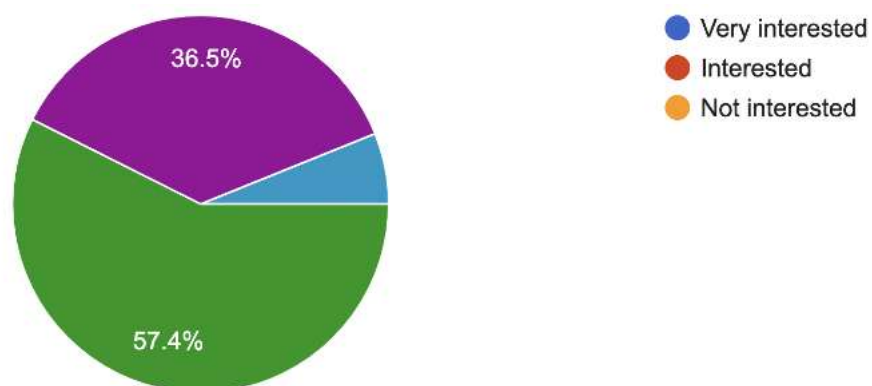
**Graph 19** 88.7% of the people stated that they would like to cook on a solar cookstove and only 11.3% stated that they would not like to cook on solar cookstoves



*Source: Own elaboration, using google forms*

**Question 20. How interested are you in learning how to use a solar cookstove?**

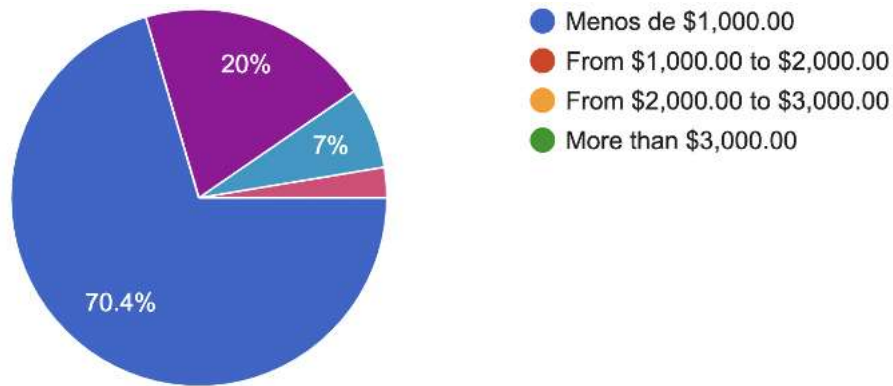
**Question 20** People's interest in learning how to use solar cookstoves represents 57.4% and 6.1% answered that they are not interested at all in learning how to use a solar cookstove.



*Source: Own elaboration, using google forms*

**Question 21. If you had the opportunity to buy a solar cookstove, how much would you be willing to pay?**

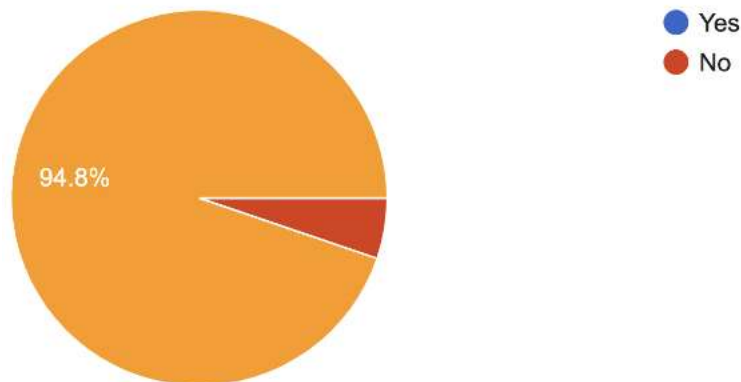
**Graph 21** With a majority of 70.4% of people are willing to pay less than \$1000 for a solar cookstove and only 2.6% of people would be willing to pay more than \$3000 for a solar cookstove.



*Source: Own elaboration, using google forms*

**Question 22. If a government institution gave you a solar cookstove, would you use it?**

**Graph 22** 94.8% of the people are willing to use a solar stove if it were a gift from a government institution and 5.2% would not use the solar stove



*Source: Own elaboration, using google forms*

## 2.4 Results and discussion

**For section 1 of the instrument, identification data, the following is a summary of the highlights.**

A sample of 115 surveys were conducted among the inhabitants of the municipalities of Jalpan de Serra and Peñamiller in the Sierra Gorda of the State of Querétaro; 47.8% of the total number of surveys carried out corresponded to the inhabitants of Peñamiller and 52.2% of the total number of surveys carried out to the inhabitants of Jalpan de Serra. Of those surveyed, 90.4% were women and 9.6% were men. 26.1% of the participants are between 31 and 40 years of age, while 17.4% are over 60 years old. 80.5% of the participants are householders, the remaining 19.5% of the respondents are farmers, cattle ranchers, artisans, day laborers, miners, merchants and bricklayers. 41.7% of the people surveyed are women and 9.6% are men. Of those surveyed, 41.7% have incomes of less than \$1,500.00 pesos per month, 18.3% have incomes between \$3,000.00 pesos and \$4,500.00 pesos per month. Forty-seven percent of those surveyed are part of a family made up of 3 to 4 people; it is important to note that 27% said that their family has 5 or more members, while 8.7% of those surveyed live alone.



**For section 2 of the instrument, use of cookstoves, the following is a summary of the highlights**

39.1% of the respondents answered that they use LP gas stove, while 10.4% alternate the use of L.P gas stove with wood stove, the use of grill stoves is below 10.4%. 34.1% of the respondents comment that they mainly use firewood and organic waste because of the type of food they cook while 10.6% use these resources because other resources such as gas and electricity are not available. The frequency with which families cut down or acquire organic waste is every 2 weeks represented by 34.12% while 16.5% use these resources daily. With 77.6% of the people who cook with firewood have presented health problems while 22.4% have not gotten sick because of this cause.

With 68.4%, mild respiratory problems are the main ailment reported by people who cook with firewood, while asthma was the least common cause with 10.5%. 59.1% of the people are currently satisfied with the type of stoves they have in their homes and only 7.8% are dissatisfied. 51.3% of the people spend 1 to 2 hours a day cooking their food and only 13.9% spend 3 or more hours cooking. 43.5% of people affirm that they prefer to cook from 9:00 a.m. to 12:00 p.m. and only 17.4% do so after 12:00 p.m. 59.3% of the people responded that the foods they prepare most frequently are meats, vegetables and legumes.

**For section 3 of the instrument, solar cookstoves, the following is a summary of the highlights**

65.2% of the people affirmed that they have heard of renewable energies while 34.8% have not heard of renewable energies. 72.2% of the people have heard of solar cookstoves and their benefits, while 27.8% have not heard of solar cookstoves or their benefits. 40.9% answered that the main benefit of solar cookstoves is health care, while 22.6% answered that they are beneficial for the environment. 88.7% of the people stated that they would like to cook on a solar cookstove and only 11.3% stated that they would not like to cook on solar cookstoves. People's interest in learning how to use solar cookstoves represents 57.4% and 6.1% answered that they are not interested in learning how to use a solar cookstove at all. With a majority of 70.4% of the people are willing to pay less than \$1000.00 for a solar cookstove and only 2.6% of the people would be willing to pay more than \$3000.00 for a solar cookstove. 94.8% of the people are willing to use a solar cookstove if it were a gift from a government institution and 5.2% would not use the solar cookstove.

## **2.5 Conclusions**

There is an important market niche in the area of Peñamiller and Jalpan de Serra in the state of Querétaro, where the people surveyed would be willing to try and buy solar stoves, an important niche are households with less than 4 inhabitants for a specific product that can cook meats (beef, chicken, pork, etc.), vegetables (pumpkins, nopales, etc.), legumes (beans, rice, chickpeas, etc.), representing the possibility of satisfying 47.8% of the total 17.8% of the total. ), vegetables (pumpkins, nopales, etc.), legumes (beans, rice, chickpeas, etc.) representing the possibility of satisfying approximately 47.8% of the total 17,040 inhabitants, which represent more than 4,260 households in Peñamiller, and could satisfy 52.2% of approximately 22,050 inhabitants, which represent more than 5,512.5 households in Jalpan de Serra. A market research allows to know the purchase intentions of consumers, or provides feedback about the growth of the market to which it belongs.

Through research, valuable information can be discovered, which can be used to estimate the prices of a product or service and find a point of equilibrium that benefits the creators and consumers. The use of solar stoves is feasible in these rural areas because families can see the stoves as an alternative that benefits their health, their economy, the environment in general, and most importantly, solar stoves can be alternated with the use of their traditional stoves.

The people surveyed are willing to pay less than \$1,000.00 pesos for a solar cookstove and only 2.6% of the people surveyed would be willing to pay more than \$3,000.00 pesos for a solar cookstove. Therefore, the challenge is to develop a very low-cost product that can be easy to use. Product presentation variables such as weight, volume or appearance were not considered at this stage of the research. The scope of this study is exploratory and market tests on physical prototypes are required, which are planned in the near future.

## 2.6 Acknowledgements

The authors wish to express their gratitude to the directors of the Universidad Tecnológica de San Juan del Río, for the facilities granted for the realization of this work, as well as to the students of the business development career in the marketing area of the Peñamiller campus, We would also like to thank the students of the ER01SM-21 group of the renewable energy career in the area of quality and energy saving, for their support in the preparation of the food in the solar kitchen.

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