CHAPTER 4: RESEARCH METHODOLOGY

4.1 Introduction

Research is the search for knowledge through objective and systematic methods of finding solution to a problem. According to Clifford Woody research comprises defining and redefining problems, formulating hypothesis or suggested solutions; collecting, organising and evaluating data; making deductions and reaching to conclusions and at last carefully testing the conclusions to determine whether they fit the formulating hypothesis. Research Methodology is the systematic way to carry out research and solve the research problem. It involves different steps taken by researcher to solve the research problem and the logic used in solving the problem. It is not only important to know research methods/techniques but also it is important to know the research methodology. Research methodology has many dimensions such as problem statement, research design, sampling plan, questionnaire design, field work plan and analysis plan. This chapter focuses on research methodology used in this study. This study mainly focuses on awareness and perception of people towards the promotional strategies for solar applications in Gujarat State. It includes the study of promotional policies for solar energy in Gujarat State and also focuses on whether people are aware about these policies. This study also covers the awareness of people for using solar energy applications and the perception of the people towards solar applications and promotional strategies of government towards solar energy applications. The study also includes the people’s view on difficulties in adoption of solar energy for electricity generation. The responses are taken from both users and non-users of solar applications in the State of Gujarat only.

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Kothari C.R., RESEARCH METHODOLOGY-Methods and Techniques, Second revised edition, New Age International Publishers, pp.1
4.2 Objectives of the Study

Objectives of the study are as under:


2. Study of awareness among citizens of Gujarat for applications of Solar Energy

3. Study of difficulties faced by citizens of Gujarat for installing the solar energy system for generation of electricity.

4. Study of perception of the general public regarding the schemes announced by Gujarat Government for applications of solar energy.

4.3 Research Design

The research design is the conceptual structure within which research is conducted. It is the blueprint for the collection, measurement and analysis of data. It is the “arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure”\textsuperscript{143}. For this study descriptive research is adopted. Descriptive studies include surveys and fact-finding enquiries of different kinds. Its main purpose is to describe the state of affairs as it exists at present. The data collected for this comprises of both primary and secondary data. Primary data was collected with the help of Questionnaire and is described in detail in following sections. Secondary data was collected from Government websites, books, magazines, journals, newspapers, internet. This study tries to understand the promotional policies for solar energy in Gujarat State. The study mainly comprises of people’s awareness towards use of solar energy and its applications. This study lists out the advantages of solar energy and tries to find out public opinion related to it. The study also finds the difficulties faced by the citizens of Gujarat in adopting solar energy for electricity generation. Perception of people towards different attributes of solar policies was also studied.

\textsuperscript{143} Kothari C.R., RESEARCH METHODOLOGY-Methods and Techniques, Second revised edition, New Age International Publishers, pp.31
4.4 Sampling Design

Sampling design is a plan that a researcher adopts for obtaining a sample out of given population. It is the method, technique or procedure used to select sample from the universe and decide about the sample size.

4.4.1 Sampling Technique

There are two types of sampling design: non-probability sampling and probability sampling. Probability sampling is based on random selection whereas non-probability sampling is based on non-random sampling. For this study non-probability convenience type of sampling is adopted. When population elements are selected in the sample based on the ease of access, it is called as convenience sampling.

4.4.2 The Universe

Universe is the set of objects that are under study. For this study the universe is people living in this world both users and non-users of solar energy applications.

4.4.3 The Population

It is very important for the researcher to select the target population. The target population is the specific group of people or objects for which data can be gathered or experiments can be performed to obtain certain information and data structures. For the study the people of India specifically of Gujarat State are considered as population.

4.4.4 Sampling Unit

Sampling unit is the object for which the data is gathered. In this study sampling unit are the individuals of Gujarat State both users and nonusers of solar energy applications.

4.4.5 Sample Size

Sample size refers to the number of items to be selected from the targeted population. Sample size of 754 individuals is considered from the state of Gujarat. Samples are drawn from five major cities of Gujarat such as Vadodara, Ahmedabad,
Surat, Rajkot and Jamnagar. Table no.4 shows the number of samples considered from different cities for the research.

Table 4.1: City wise sample size of Gujarat State

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of City</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vadodara</td>
<td>235</td>
</tr>
<tr>
<td>2</td>
<td>Ahmedabad</td>
<td>250</td>
</tr>
<tr>
<td>3</td>
<td>Surat</td>
<td>170</td>
</tr>
<tr>
<td>4</td>
<td>Rajkot</td>
<td>66</td>
</tr>
<tr>
<td>5</td>
<td>Jamnagar</td>
<td>33</td>
</tr>
</tbody>
</table>

The sample size is decided as per the population of the city. Ahmedabad, Vadodara and Surat are more populated than Rajkot and Jamnagar so the sample size is more as compared to other cities.

4.5 Data Collection

Both Primary and secondary data was collected for the study.

4.5.1 Primary Data

Primary data was collected with the help of structured questionnaire. The questionnaire was filled online as well as offline from the respondents from five cities of Gujarat such as Vadodara, Ahmedabad, Surat, Rajkot, and Jamnagar. Online questionnaire was filled up through E-mails and What’s app application. Questionnaire in physical form was also filled up at some places such as Rajkot, Surat and Ahmedabad.

4.5.2 Secondary Data

Secondary data was collected from different sources such as various government websites, journals, books, magazines, research thesis, internet, newspapers and unpublished work of certain authors. Work of several researchers in the same field was studied to understand the scope of research in a better way. Several questionnaires were studied to frame the questionnaire in a proper direction.
4.6 The Research Tool

As this is a survey type of research so the research tool selected was Questionnaire. The detail information of the questionnaire is given below:

4.6.1 Details of Questionnaire

Questionnaire is the heart of survey. It should be constructed with utmost care to get the data fulfilling our objectives or requirements. If the questionnaire is not properly sequenced or drafted it may result to failure of survey. Question sequence, formulation and wording are very important in designing the questionnaire. It should convey the correct meaning to the respondent so as to help him fill the questionnaire without any mistakes.

Primary data for this study is collected through a proper structured questionnaire in English language. The questionnaire was constructed with objective to study the awareness and perception of people of Gujarat State towards applications of solar energy. The preliminary questionnaire was prepared after discussing with experts and studying literature on the respective topic. It was redesigned 2 to 3 times after eliminating unnecessary questions. The structure of final questionnaire is stated below:

Initial Questions from 1 to 3 are asked to understand the awareness of people towards renewable energy, solar energy and its applications. Q1. is to know that whether people are aware about renewable energy. Q2. is regarding awareness of people towards different applications of solar energy. Q3. gives us the information regarding the number of people using solar applications and people planning to use it in future.

Question no. 4 is related to know the media through which people got information about solar energy and its application.

Question no. 5 & 6 are the core questions to study the perception of people of Gujarat State towards use of solar energy. In Question 5 people are asked to rate the importance for advantages of using solar energy from 1 to 5 on likert scale. 1 is no importance and 5 is very important. Total 20 advantages are stated in the question. In Question 6 reasons for not using solar energy for electricity generation are given. Respondents have to give their response as whether they strongly agree, agree,
neutral, disagree, strongly disagree ranging from 1 to 5 respectively for the reasons stated. Total 21 reasons are stated in the questionnaire.

Question 7 is to check the awareness of respondents towards few attributes of solar policy of Gujarat State.

Question 8 is to find out whether people are interested to adopt solar if more financial incentives are provided by the Government.

Question 9 is for collecting the views and suggestion of respondents towards using solar energy.

Questions 10 to 16 are related to personal information of respondent. It comprises of Name of respondent, name of city, gender, education, profession, family income and mobile number. The Questionnaire is given in appendix I.

### 4.7 Data Analysis Techniques

Data after collection is in raw form and has to be processed and analysed to draw meaningful inferences. Before analysis it has to undergo different processes such as editing, coding, classification and tabulation to make it amenable to analysis. Data analysis involves computation of certain measures to find out the relationships that exist between data groups. Several statistical techniques are applied in data analysis depending upon the 1) scale of data 2) characteristics of data 3) objectives of our study and 4) features of research design. The data of 754 respondents in this study were properly coded and transformed into required design format to make it suitable for analysis.

Data analysis techniques used for this study is briefed in the following paragraph. Detailing of these techniques is explained in chapter 5.

Data analysis techniques can be divided into following three categories depending upon the number of variables analysed:

- **Univariate analysis:** Involvement of single variable for measurement at a time.
- **Bivariate analysis:** Involvement of two variables for measurement at a time.
- **Multivariate analysis:** Involvement of three or more than three variables for measurement at a time.

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4.7.1 Univariate Techniques

It involves measurement of a single variable or each element at a time. Frequency distribution is the most widely used method which involves calculation of count of responses for that single variable. It can be displayed in number of forms such as frequency tables, bar charts, pie charts showing percentages, clustered bar charts. In this study the univariate analysis is carried out by presenting the frequencies in the form of tables as well as charts. The charts used display the data in percentage form for quick understanding of data. Type of charts that are used are pie chart, bar chart, column chart as per the data under measurement.

Another method used in this study is the calculation of mean score of several factors to know the influence of certain factors among the responses received.

4.7.2 Bivariate Techniques

Bivariate techniques involve studying two variables at a time. For this study statistical techniques such as cross tabulation, Chi-Square test are used to show the association between two variables.

4.7.3 Multivariate Techniques

Multivariate techniques involve analysis of three or more than three variables at a time. In this multiple relations between multiple variables are studied simultaneously. Multivariate techniques can be divided into dependence and interdependence techniques. In dependence technique both dependent and independent variables are present while in interdependence technique several variables are present having no dependency relationship.

For this study the interdependence technique used is Factor analysis, where no one variable is designated as being predicted by another variable. Factor analysis seeks to resolve a large set of measured variables into few categories called as factors. Thus it allows the researcher to group the variables into factors based on their correlation between variables. Before factor analysis is conducted, the data is checked for its reliability and adequacy. Several test such as Croanbach’s alpha, KMO and Bartlett’s test is used to check reliability, adequacy and sphericity of the data. A five point likert scale is used for question 5, which depicts the importance of benefits of
using solar energy and question 6, which states the reasons for not using solar energy for electricity generation.

Before conducting any statistical analysis it is important to check the Normality of the data through test of normality because several statistical techniques assume data to be normally distributed. In this study the data is not normally distributed so the dependence technique used for this study is Kruskal-Wallis test. It is used to test the null hypothesis that ‘k’ independent random samples come from identical universes against the alternative hypothesis that the means of these universes are not equal.

Cluster analysis is also conducted to group the people in different clusters according to their views. One-way ANOVA test is also conducted using several independent variables such as gender, age, family income, education and profession of respondents with respect to dependent variables of question 5, which depicts the importance of benefits of using solar energy.

4.8 List of Hypothesis

Following is the list of hypothesis framed for the present study.

- **Chi-Square Test**
  1. H0: There is no significant relationship between education of respondent and awareness for renewable energy.
     H1: There is significant relationship between education of respondent and awareness for renewable energy.
  2. H0: There is no significant relationship between gender and awareness for renewable energy.
     H1: There is significant relationship between gender and awareness for renewable energy.
  3. H0: There is no relationship between awareness for renewable energy by the respondent and use of solar energy applications by the respondent.
     H1: There is relationship between awareness for renewable energy by the respondent and use of solar energy applications by the respondent.
Kruskal–Wallis Test

1. H0: There is no difference in opinion or perception of people towards importance of benefits of solar energy with respect to gender.
H1: There is difference in opinion or perception of people towards importance of benefits of solar energy with respect to gender.

2. H0: There is no difference in opinion or perception of people towards importance of benefits of solar energy with respect to age group.
H1: There is difference in opinion or perception of people towards importance of benefits of solar energy with respect to age group.

3. H0: There is no difference in opinion or perception of people towards importance of benefits of solar energy with respect to education.
H1: There is difference in opinion or perception of people towards importance of benefits of solar energy with respect to education.

4. H0: There is no difference in opinion or perception of people towards importance of benefits of solar energy with respect to family income.
H1: There is difference in opinion or perception of people towards importance of benefits of solar energy with respect to family income.

5. H0: There is no difference in opinion or perception of people towards importance of benefits of solar energy with respect to profession.
H1: There is difference in opinion or perception of people towards importance of benefits of solar energy with respect to profession.

6. H0: There is no difference in opinion or perception of people according to gender about the several reasons for not using solar energy for electricity generation.
H1: There is difference in opinion or perception of people according to gender about the several reasons for not using solar energy for electricity generation.

7. H0: There is no difference in opinion or perception of people...
according to age group about the several reasons for not using solar energy for electricity generation.

H1: There is difference in opinion or perception of people according to age group about the several reasons for not using solar energy for electricity generation.

8. H0: There is no difference in opinion or perception of people according to education about the several reasons for not using solar energy for electricity generation.

H1: There is difference in opinion or perception of people according to education about the several reasons for not using solar energy for electricity generation.

9. H0: There is no difference in opinion or perception of people according to family income about the several reasons for not using solar energy for electricity generation.

H1: There is difference in opinion or perception of people according to family income about the several reasons for not using solar energy for electricity generation.

10. H0: There is no difference in opinion or perception of people according to profession about the several reasons for not using solar energy for electricity generation.

H1: There is difference in opinion or perception of people according to profession about the several reasons for not using solar energy for electricity generation.

➢ One-Way ANOVA Test

1. H0: There is no impact of age group of respondents on the importance given by the respondents to several benefits of solar energy.

H1: There is impact of age group of respondents on the importance given by the respondents to several benefits of solar energy.

2. H0: There is no impact of education of respondents on the importance given by the respondents to several benefits of solar energy.
H1: There is impact of education of respondents on the importance given by the respondents to several benefits of solar energy.

3. H0: There is no impact of family income of respondents on the importance given by the respondents to several benefits of solar energy.
   H1: There is impact of family income of respondents on the importance given by the respondents to several benefits of solar energy.

4. H0: There is no impact of gender of respondents on the importance given by the respondents to several benefits of solar energy.
   H1: There is impact of gender of respondents on the importance given by the respondents to several benefits of solar energy.

5. H0: There is no impact of profession of respondents on the importance given by the respondents to several benefits of solar energy.
   H1: There is impact of profession of respondents on the importance given by the respondents to several benefits of solar energy.