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Electrical and Computer Engineering

**THE EFFECT OF PV SOLAR CELL
ELECTRIFICATION ON RUSTIC LIVELIHOOD
TRANSFORMATION**

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Master`s Thesis

Supervisor

Asst. Prof. Dr. Ayça Kurnaz TÜRKBEN

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I hereby declare that all information presented in this graduation project has been obtained in full accordance with academic rules and ethical conduct. I also declare all unoriginal materials and conclusions have been cited in the text and all references mentioned in the Reference List have been cited in the text, and vice versa as required by the abovementioned rules and conduct.

Omar Basil Abdulameer AL-HEBASHI

Signature

DEDICATION

I give and vow this examination work to my manager who is remarkable for directing me through the entire exploration fill in as well as my family for continuously helping me in my difficult time.



PREFACE

At the beginning, I thank Allah Almighty first, then I thank my supervisor Asst. Prof. Dr. Ayça Kurnaz TURKBEN For advised me, guided me, contributed, or directed me with me in preparing this research and connecting me to the required references and sources at any of the stages it went through.



ABSTRACT

THE EFFECT OF PV SOLAR CELL ELECTRIFICATION ON RUSTIC LIVELIHOOD TRANSFORMATION

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Photovoltaic solar energy has the potential to serve as a catalyst for a variety of activities and to provide a space in which education and health may be enhanced, so assisting in the elimination of poverty. Solar power, according to studies, is critical in bringing about development in disadvantaged communities, especially in rural areas. It contributes more significantly to the utilization of electric light for night studies, the use of electrical equipment such as televisions, radios, and charging device telephone, and, most importantly, the support of income-generating activities than any other source of energy. And also thinking about to consider other elective wellsprings of energy, such as renewable energy, and particularly solar energy, if the livelihood of rural communities is to be transformed, rather than focusing solely on sources that appear to be beset by a slew of difficulties.

Keywords: Solar Cell, Renewable Energy, Livelihood Transformation

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ABBREVIATIONS

- PV : photovoltaic system
- SPSS : Statistical Package for Social Sciences
- DC : Direct current
- AC : Alternative Current
- PVA : photovoltaic array
- GNESD : Global Network for Energy Security and Development
- UNDP : United Nations Development Programme
- WHO : World Health Organization
- MDGs : Millennium Development Goals
- USAID : The United States Agency for International Development

LIST OF SYMBOLS

μ : Electron mobility

λ : Wavelength

ω : Angular frequency



1 INTRODUCTION

Photographic solar energy has the potential to be employed as a catalyst for a wide range of activities, including as education and health care, which might aid in the alleviation of poverty. As a result of scientific investigation, solar energy has been identified as being critical for the development of disadvantaged communities, particularly in rural areas. Night studies, usage of electrical equipment such as televisions, radios, and mobile phone chargers, as well as the support of income-generating activities [1] are all made possible by this source of energy to a greater extent than by any other source of energy. As a result, it is critical to consider other sources of energy, such as renewable energy and particularly solar energy, rather than relying entirely on sources that appear to be troubled by multiple issues, in order to enhance the lives of rural populations.

While other sources of energy are restricted in their availability and affordability, photovoltaic solar energy stands out because it is copious and affordable. Solar energy, according to Mahmood et al [2], is a low-cost, infinitely renewable energy source that can be utilized in a wide range of locations across the world. Renewable energy, like photovoltaic solar energy, is significant for rustic live change because of its dependability, cost effectiveness, and practicability in terms of deployment. Individuals who are unable to connect to the national grid because distance or the high expense of doing so can generate their own electricity using a photovoltaic solar system as an alternative energy source. According to the Global Network for Sustainable Development, access to inexpensive energy is essential for the advancement of health, education, and poverty alleviation initiatives (GNSD, 2007). According to Mkunda, solar energy (photovoltaic solar energy, often known as solar power) has revolutionized socio-economic life in villages, towns, and nations across Africa, and he highlights the relevance of this [3]. The project that broke the cycle of poverty by providing disadvantaged people with access to modern energy services had a huge influence on the lives of the individuals who participated in it.

1.1 BACKGROUND

Energy is certainly a significant role in the process of plant development. In order to accomplish sustainable development, there must be an appropriate supply of energy accessible. If the Millennium Development Goals are to be achieved by 2015, according to the Global Network for

Energy Security and Development (GNESD), "significant improvements in the kind of energy services that impoverished people have access to are required" (2007). The World Health Organization (WHO) and the United Nations Development Programme (UNDP) believe that meeting the Millennium Development Goals (MDGs) is attainable if the energy issue is appropriately handled in terms of both quantity and quality. In addition, "the worldwide goal date for accomplishing the Millennium Development Goals" is six years away, according to the language of the document. There is no Millennium Development Goal for energy since it is not possible to meet the global goals outlined in the objectives without significant improvements in the availability and quality of energy services " (WHO and UNDP, 2009).

Indisputable evidence exists that energy is a critical component of socio-economic growth, has an impact on practically every element of human existence, and is required for human progress in general [4]. Providing improved home energy solutions to the poorest of the poor, which would minimize indoor air pollution caused by solid fuel combustion, might potentially prevent as many as 2 million fatalities each year in the developing world. The World Health Organization (WHO) and the United Nations Development Programme (UNDP) (2009). Because of this, the FAO (Food and Agriculture Organization of the United Nations) (2000) believes that energy is essential for human development and livelihood transformation because it improves a variety of socioeconomic activities at the household level, including agriculture, health care, and education, which can spur people's livelihood transformation. Economic growth is directly related to a rise in the availability and use of energy services, demonstrating the vital role that energy plays in the advancement of human civilization and development. According to Baston et al [5], the current level of prosperity, education, and health cannot be sustained without sufficient energy. According to Tarujyot [1], modern energy is not only important, but it is also

a basic human need that must be treated on an equal footing with water and food if civilization is to continue to develop and progress. A case in point is the rural electrification program in the United States, which he uses to demonstrate his thesis. The need for rural electricity, in contrast to water and food, has only recently been recognized as a fundamental human necessity. It is undeniable that rural electrification has a positive influence on social welfare in a variety of ways, as demonstrated by a number of studies. " The researchers wrote down their findings in a piece of paper. The third instalment in the series. According to the ESMAP research, modern energy services are on par with other social services such as education, health, and water in terms of importance. Tanzania's Energy Policy (TEP) recognizes and values energy as a critical component of development, and it recognizes and appreciates it as a factor that may decide the success or failure of a civilisation.

1.2 OBJECTIVE

As a result of the difficulties that rural areas face in terms of power generation and transmission, scientists have been working on developing alternative energy sources to assist with rural electrification. There has been more than one research that has demonstrated that photovoltaic solar energy has had an impact on the transformation of rural community livelihoods in terms of material gain, health improvement, and social well-being enhancement, but only a small number of studies have proven this. Aside from a few studies, we are unaware of any that have examined how people perceive their sense of ownership and/or acceptability, along with their desire and readiness for technology transfer, and their understanding of the benefits of such technology in the context of the change of their livelihood. Aims of this research include bridging this gap and developing a framework that will allow for the long-term viability of knowledge transfer and solar energy project installation operations in the years to come.

Most of the study is focused on understanding how solar energy electrification impacts rural communities' economic well-being and how people's perceptions regarding solar photovoltaic technology are formed.

- a. Most of the study is focused on understanding how solar energy electrification impacts rural communities' economic well-being and how people's perceptions regarding solar photovoltaic technology are formed.
- b. To identify the new social and economic opportunities that have opened for the community as a result of the effective functioning of the PV solar energy plant.
- c. In order to determine how much solar energy is consumed by a village's people.
- d. To find out what the general public thinks about the PV Solar project and what they have in mind for its long-term stability and care.
- e. According to the people of the hamlet, the purpose of the study is to determine the environmental effect of the solar energy plant.

1.3 SIGNIFICANCE

It is likely that the conclusions of this study will have broad ramifications. In the first section, the article describes how a village's Photovoltaic Solar Energy Project has benefited both its people and the larger community. In addition, the findings of this study demonstrate the readiness, acceptance, and ownership of the project in the village, also, more significantly, the acknowledgment of individuals over PV solar powered innovation in their social orders, which helps to lay the groundwork for and ensure the long-term viability of photovoltaic solar energy projects in developing countries like Kenya. This would help not just the individuals who would profit from the projects, but also scholars and other stakeholders in the energy industry as a whole. But it would serve as a catalyst for a shift in perspective and open the door for legislators to consider renewable energy as a viable source of electricity for rural populations.

1.4 OUTLINE

This thesis will be organized as follow:

- a. Introduction: This chapter represented an overview of the main objectives of the research, statement of problems, aims and objectives of the study.
- b. Literature review: This chapter presented a background about.
- c. Methodology: This chapter 3 investigates the interviews, and the survey will be organized for different group of people.
- d. Results and analysis: Results will be shown and analyse in this chapter.
- e. This chapter summarized the problems

2 LITERATURE REVIEW

2.1 INTRODUCTION

This chapter presents a survey of key literature in the field of education. This section contains information on the status of solar energy in Iraq, the benefits of solar energy on rural livelihood transformation, the status and constraints of solar adoption in Iraq, as well as maintenance methods. This section also contains information on the theoretical framework that guided this study. In this part, we'll define and explain the most important terms that emerged from our investigation.

2.2 KEY TERMS

2.2.1 Livelihood

A number of scholars and organizations have defined "livelihood" in a variety of ways, each with their own definition. According to the World Bank, having enough food and money to meet one's basic needs is considered to be a source of livelihood (WCED 1987a). The emphasis appears to be primarily on materials in this definition, with no mention of any other equally important parts of the process. According to Conway and Chambers [6], life is defined by the presence or absence of a source of money. In their eyes, capabilities are both a means to an end and a source of wealth, and they value both equally. Being able to maintain one's financial well-being is critical for developing one's abilities. One's abilities, on the other hand, enable one to make a life. The capacity to make a livelihood, as well as a person's assets (history, resources, claims, or access), and activities [6] [7] [8] [9] are all considered to be part of his or her life span. It is vital when defining a person's means of subsistence that the links between their assets and their practical alternatives for seeking other sources of income be taken into consideration [10].

2.2.2 Solar Energy

Solar energy is the phrase used to refer to the heat and radiation emitted by the sun, which account for the great bulk of the sun's output. What I'm talking about is illustrated in Figure 2.1. When it comes to renewable energy sources, the sun's rays and heat may be used in a number of ways, including solar thermal energy, molten salt power plants, and artificial photosynthesis, among other applications [11]. As a result of its immense magnitude, solar energy is a particularly attractive form of renewable energy. Solar radiation is absorbed by the seas, clouds, and land masses to the tune of 30% of its total energy (about).

Photovoltaic (PV) cells are solar cells that generate electricity. Direct current electricity is produced by converting sunlight into electricity (DC). By using a charge controller, you can restrict the amount of power that is returned to the solar panel, so preventing damage to the solar panel itself. During times when the sun is not shining, a battery system can be used as an emergency power source (i.e., night). Direct current (DC) is converted to alternating current (AC) by use of an inverter, which is connected to the system in question (AC).

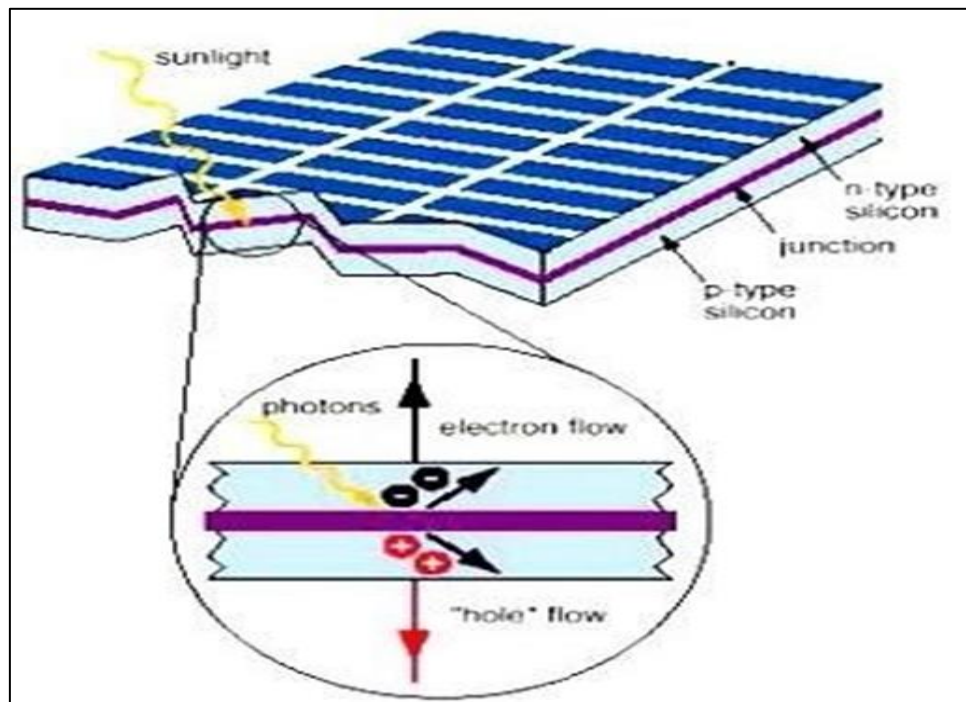


Figure 2.1: PV internal cell design [11]

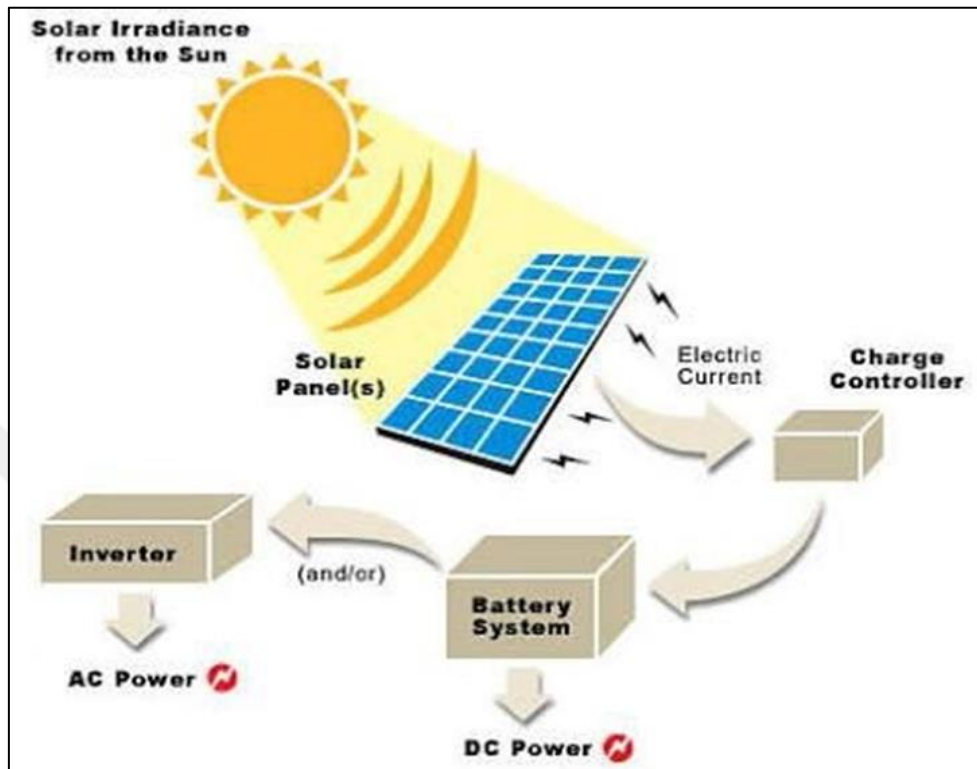


Figure 2.2: Solar System architecture of work [11]

2.2.3 Photovoltaic Solar Energy

A photovoltaic system is a system that makes advantage of a phenomenon in which solar energy is converted into electricity without the usage of any external stimuli or other procedures to do this. It is the most practical approach of making use of the available resources. As a consequence of their long-term dependability and performance, a broad range of systems (ranging from 0.5 watts to several megawatts) have already been created and are in operation across the world; their usage is rising on a daily basis as a result of their reliability and performance. In the case of Taraghdari and his associates [12]. Deb et al. [13] employ the photoelectric effect to convert sunlight into electrical current in photovoltaic cells, which they describe as follows: One of the most common materials used in photovoltaic solar cells today is silicon, which may be either mono-crystalline or polycrystalline in structure. Amorphous silicon and cadmium telluride are also common.

Photovoltaic (PV) technology generates electricity by taking use of the electrical properties of semiconductors. As a result of being exposed to sunlight, semiconductor materials create an electrical charge that is sent across a circuit to anything that requires electricity. Solar-powergeneration cells are used to create semiconductors, which are subsequently combined into a structural panel to form an integrated circuit. For greater output, panels can be grouped together in larger groups, known as arrays, and then linked together. Solar arrays are available in a variety of forms and sizes and may power anything from a tiny office to a large complex (EPA).

The cells were able to convert solar light into electricity very instantaneously. This gadget is made up of a variety of different types of semiconductor materials. It is possible to manufacture lowcost solar cells with excellent conversion efficiencies using this cell method. As depicted in figure 2.1, there are two sorts of charges: positive charge and negative charge. During the photosynthesis process, electrons are liberated from silicon atoms and dragged away by a grid of metal conductors, resulting in a flow of direct current in the form of an electric charge. A large number of chemicals are used in photovoltaic (PV) solar cells.

It comprises of a pre-wind, field-instable device made up of one or more PV modules that is connected to the grid. The PV cells of this panel are connected together via series connections. Solar panels are made up of PV cells (photovoltaic cells) that are connected together. A Photovoltaic Array is formed by connecting PV cells in series and parallel to produce a photovoltaic array (PVA). Increasing the voltage of the module is accomplished through series connection, while increasing the current through parallel connection improves the overall performance of the array. It has the potential to produce up to 180W when exposed to direct sunlight. As a general rule, the larger surface area a solar array has, the more solar energy it can create in general.

2.3 LIMITATIONS OF SOLAR ENERGY ADOPTION

The wealth of data in industrialized countries has led to a concentration of study on the factors that impact the adoption of renewable energy technology in these countries. Until yet, only a

few studies have investigated how factors such as the adoption of biogas [14] and the impact on livelihoods [15] influence household renewable energy technology adoption decisions. Other studies are now underway. The choices and views of Ethiopian families about Pico photovoltaic (PV) systems have been investigated in other Ethiopian studies using a qualitative methodology [16]. Using the national Living Standard Survey (LSS), researchers conducted cross-country study in Ethiopia, Kenya, and Uganda to determine the characteristics that influence residential solar PV adoption [16]. Studies on the technical characteristics of renewable energy technologies, such as their cost and accessibility, have also been carried out. Due to the fact that solar energy technology has only just become widely available and employed in rural Ethiopia, there was a scarcity of data from which to make conclusions. According to the researcher's knowledge, only a few quantitative studies have been conducted in rural Ethiopia on household solar energy technology adoption behaviour and deciding variables. The majority of empirical examinations of the country's energy crisis have focused on the energy mix in metropolitan areas and the type of cook stoves used in households. The use of biomass and fossil fuels as sources of energy in rural homes, on the other hand, has been the subject of only a small number of investigations [17].

When it comes to the growth and extension of solar energy, limitations have been identified as potential roadblocks. There have been several research conducted on the limitations of photovoltaic solar energy. As stated in the table below, this study has some of the shortcomings that have been identified in previous papers.

When it comes down to it, the policy that guides the process is what ultimately defines the success or failure of a development project. In a similar vein, the progress of solar energy technology is primarily dependent on existing government initiatives to achieve success. It is vital for government policies to be able to create an environment favourable to RET distribution and resource mobilization, as well as to promote private sector investment [18].

The development and implementation of diverse solar energy projects need the development and implementation of a clearly defined policy and regulatory framework. The invention and promotion of renewable energy technologies (RETs), according to Karekezi and colleagues

[19], are now being carried out in the absence of a defined national policy on renewable energy technology development and promotion. As a result, there was a disconnect between the renewable energy targets and the national power policy. In [19], there is a character named Karekezi.

In the same way that many other development projects face financial difficulties, the rise of solar energy does as well. This is the most significant impediment to the expansion of solar energy in Tanzania. The high initial costs of materials and installation devices make it hard for this technology to be implemented to its full potential in Tanzania's rural areas, resulting in a lack of sufficient energy supply in such areas. As Mwiha [21] points out, destitute rural households constitute the primary target for rural electrification, and they can only pay the prices of renewable energy technologies if they receive financial support because they are unable to cover the charges on their own income. According to the European Commission [22], the high cost of photovoltaic volume is a major impediment to the development of solar energy technology. In fact, according to Karekezi et al. [23] and Bauner D et al. [24], a lack of long-term finance resources is the most significant hurdle to the widespread adoption of renewable energy technologies and technologies. Because of the high cost of solar photovoltaics in Sub-Saharan Africa, it is believed to have helped primarily the wealthiest segments of the people there. Solar PV is out of reach for the great majority of people in Sub-Saharan Africa because of the high levels of poverty prevalent in the region. The characters' names are Karekezi and Kithyoma, and they are both females. [19].

Researchers conducted a solar energy research in Bangladesh [19]. This research appears to be primarily concerned with the deployment of new technology in Bangladesh, as well as the adaption of the technology. Because of the high cost of solar panels, as well as the nature of the technology, they realized that adaption was a difficult task. The capacity to adapt to new technologies, as well as other technological obstacles, were the top priorities.

Despite the fact that solar energy has expanded and improved, there is still a lack of institutional support for the development of this energy industry. As a result, it appears that the private sector is the only one actively pushing and developing solar energy technologies. In order to develop

solar energy production and utilization, it is advised that a robust institutional structure be established. Laing and Rosseli are two of the most talented musicians in the world [19]. Solar energy promotion may be achieved if the government, funders, and private enterprise work together to develop a variety of projects targeted at exploiting the country's renewable energy potentials.

2.4 THEORETICAL APPROACH

Theories are relied upon by researchers because they provide a framework for exploring the subject under consideration. Further research into the role or efficacy of solar energy in the process of livelihood transformation is expected to be conducted in the future, using the theoretical framework produced in this study as a foundation. Because the Capability Approach developed by Amartya Sen has typically served as a guiding concept in human development research, we are employing it as a guiding principle in our inquiry.

The Capability Approach developed by Sen in the 1980s, as depicted above, served as the basis for this research. "Capability" refers to a person's ability to realize their potentials as human beings, both in the sense of "being," which is defined as "being adequately nourished, free of illness," and in the sense of "doings," which is defined as "exercising choices, gaining skills and experience, participating in social activities, and so on" [25]. Developed in the 1980s, it raises concerns about the use of gross domestic product (GDP), personal wages, industrialization, and social modernism as indicators of human development [25] [26]. People's capacity to function, effective chances to take action, and the activities in which they are interested are all important factors in developing countries, according to Sen. Sen believes in his own writings that "progress" is defined as the process of improving the freedoms that individuals are able to enjoy. Human liberties are emphasized in opposition to narrow conceptions of development, such as equating progress with the growth of gross national product or an increase in individual wages, or with industrialization [26]. Sen, on the other hand, argues that they are essential because they serve as a vehicle for increasing individual liberty. According to him and in accordance with this point of view [26], freedoms are also impacted by social and economic issues such as access

to education and healthcare. It is vital to place a strong emphasis on the development of people's ability and freedom in order to assist them in living lives that are rewarding.

"Beings" and "doings" are viewed as a collection, collectively referred to as "Functioning's," and the quality of a person's life is judged on the basis of his or her ability to perform these functions. An important aspect of the logic of the capacity approach is that social change should be judged in terms of the improvement in the quality of human living that it brings about. In this light, the concept that the success of a development project must be measured in terms of how it impacts the lives of the people by increasing their freedoms and powers, which is being and doing, comes into play.

Known as the capacity approach, it is a study paradigm that includes sociological, economic, and political research and holds that a person's well-being should be measured in terms of their abilities [27]. When it comes to development, people require the ability to be flexible in order to improve their talents. This suggests that they must be able to do or be whatever it is that they find valuable to do or be. The capacity approach developed by Sen, according to Alkire and Deneulin, serves as the conceptual underpinning for human development, as seen by its use in the human development index. For example, human development reports, as opposed to those produced by the World Bank, place a greater emphasis on human well-being and poverty reduction. According to studies on human development, the purpose of development is to improve people's lives by expanding their independence, dignity, and access to opportunities for them.

The two most important normative arguments in this theoretical framework are those of freedom and competence. First and foremost, the "freedom" to pursue happiness is of the highest importance, according to the first claim. Second, if we accept the second claim, it follows that people's capabilities, that is, their true opportunities to accomplish and be what they have the rationale to value, must be taken into consideration when interpreting their freedom to reach wellbeing.

The influence of photovoltaic solar power on rural community livelihood development was investigated in this study through the use of a capacity approach. As a result of this strategy, it is now much simpler to comprehend the impact of photovoltaic solar power projects on people's everyday life, both at home and in their communities. Because of this strategy, people were able to make more informed decisions about how they want to live and who they want to be. According to Sen's capabilities approach to development, the eradication of primary sources of un-freedom, poverty, and tyranny, low economic prospects and systemic social deprivation, neglect of public facilities, and intolerance or over-activity of depression are all necessary for development [26].

2.5 SOLAR SYSTEM STABILITY

Renewable energy is one of the fastest expanding industries in the global economy, with a compound annual growth rate of about 20%. In the recent decade [29–30], the usage of renewable energy has expanded by around 49 percent throughout the world. According to Tenaga Nasional Berhad, the country's energy utility company, grid-connected solar farms in Malaysia are predicted to gain in popularity over the next 15 years (TNB). TNB expects to boost its generation capacity from 23.3 MW to 73.3 MW this year, after the purchase and building of a large-scale solar (LSS) facility with a capacity of 50MW, which will be the company's first of its kind. Because of this, it is vital to investigate grid voltage stability in connection to solar energy. Voltage is one of the most important features of a power plant, and it must be carefully monitored in order to avoid catastrophic problems. It is probable that a significant increase in solar production will present significant technological challenges and will have a significant impact on the stability and dependability of our electricity infrastructure. [31–32] Several studies have been conducted on the impact of solar energy on the stability of power systems. It is one of the aspects that might have an impact on the voltage stability of solar PV systems. By expanding the use of solar energy, it is possible to increase the stability of a power system. Increased real power as well as better reactive power may be obtained via the application of photovoltaics (PV). An electrical system that is connected to the grid uses photovoltaic panels

installed on a building to power the system, which is powered by electricity generated by the utility grid.

Stability is vital for ensuring the long-term reliability and functioning of photovoltaic solar energy systems. For this to happen, a well-thought-out system of maintenance must be in place. There are several aspects that might influence the project's success, including the quality of the project's gadgets, maintenance and capacity building, and long-term financing. Photovoltaic solar energy systems must be correctly planned, built, and maintained, and they must be able to receive continual funding for repairs and replacements of components, as well as for replacement parts and spare parts. In the opinion of Researchers, the techniques used to fund after-sale services for operation and maintenance are crucial to the success of a long-term project's development. As previously noted, this has been cited as a contributing factor to the failure of a number of solar energy and other renewable energy efforts in a variety of countries.

Furthermore, it is believed that the technical know-how and maintenance services of PV solar energy systems are important factors in their stability. In other countries, many of the solar projects that have been constructed have not been successful due to poor installation and a lack of ongoing maintenance. To achieve long-term success, Mwiwaha [21] highlights the need of continual maintenance as well as the development of local capacity in the project's implementation. In the PV solar industry, vandalism and theft of solar system equipment are typical concerns, thus guaranteeing the safety of the solar system equipment is essential.

2.6 PV SOLAR ENERGY APPLICATION

The use of photovoltaic solar energy has been researched in a number of methods by academics in both urban and rural environments. According to Jacobson [34], research on solar energy electrification in Kenya was conducted with a particular emphasis on how the technology is interrelated as well as its potential for social transformation.

When he looked into it more, he learned that as the rural house market for solar PV systems has grown, there has been a significant uptick in the use of renewable energy technology in Kenya.

According to him, a significant number of people in rural areas have embraced the technology, resulting in a significant increase in the size of the Kenyan solar market.

According to Tegemeo Institute survey data from the year 2000, 4.2 percent of rural Kenyan homes had their own solar-powered electricity generation system, which was a significant alternative to grid-based rural electrification in Kenya.

Researchers in Kenya, Kirumbi et al. [35], investigated the issue to see if community-based electric micro networks might promote rural development. It is possible that rural electrification will help to stimulate economic growth in rural regions, provided that the mechanism for doing so is well defined. When small and micro enterprises get access to electricity, the results of this study reveal that they can use electric equipment and tools to considerably increase their productivity.

2.7 KNOWLEDGE CHASM

With regard to the change and growth of societies, there is no question that solar energy has a vital role to play in both developed and developing countries. According to the findings of the above literature review, much has been said and studied about the evolution of solar energy consumption across the world, with Tanzania serving as one of many case studies. Many of the many stakeholders involved in the development of solar energy technology have been carefully investigated and analysed in the accessible literature, as well as the benefits and drawbacks connected with each of their positions.

Communities' acceptability and sense of ownership of PV solar energy systems are not revealed in literature, nor is the success of PV solar energy projects in various locations examined from the views of community members. This investigation intends to address that gap by concentrating on the acceptability and sense of ownership that community members have for the PV solar energy project and the underlying rationale for its implementation. Abstract: On the issue of photovoltaic solar energy projects, the viewpoints of community members on the project's success have also been taken into consideration.

3 RESEARCH METHODOLOGY

3.1 INTRODUCTION

The research methodologies that were utilized in this study are broken down and illustrated throughout this chapter. This section provides concrete examples that demonstrate how the original research objectives of the study were not only attained but also surpassed. In this chapter, in addition to discussing the research design and methodology, topics such as the methods for data generation, ethical issues, and the limitations of the study are discussed.

3.2 RESEARCH DESIGN

During the course of their study, researchers might use this as a guide to help them make decisions. It is a plan for carrying out scientific research that describes what subject areas will be researched, how participants will be selected, how data will be gathered and processed, and what kinds of conclusions can be drawn from the findings. According to [37], which focuses on the process of designing research for development, it is an important component of carrying out research. It acts as both a road map and a conceptual framework for the activities that will be conducted during the study. It makes it feasible for an investigation to produce the most information regarding research methods in the shortest amount of time and with the lowest amount of efforts imaginable [38]. People can figure out how to go where they need to go with the assistance of road maps, which also give them with the instructions or procedures they should follow in order to collect evidence for the questions they are investigating.

A descriptive approach was taken for this study's design. The emphasis of the research design, both in the proposal and in the writing of the thesis, is placed on people's attitudes, beliefs, and habits, as well as the numerous educational and societal concerns that are the subject of the study. It was utilized in order to maximize the possibility of acquiring sufficient data to meet the research issue that was posed by the study. According to the processes used in social science research, it provides the researcher with assistance in explaining people's viewpoints and insights into the problem that is being studied.

3.3 RESEARCH APPROACHES

Throughout the entirety of the investigation, a qualitative approach was utilized. As a consequence of this, this approach was utilized in order to investigate social reality due to the fact that it is the most suitable strategy. In order to get a deeper comprehension of the social environment, the methodologies of social research place an emphasis on the utilization of a wide range of qualitative data gathering techniques. The use of qualitative research methods is required for investigating the relevance of people's worlds. Instead of collecting data in a laboratory setting, we will be doing it in the field, and we will create our hypotheses using an inductive reasoning process based on what we see. As a result of the descriptive nature of the qualitative approach, it was decided that this approach would be the best one to choose while carrying out this study. Researchers that use a descriptive research design have another option for getting to the bottom of the causes behind the issues with their study.

3.4 SAMPLING METHODS

When selecting people to take part in our research, we used a method that is known as "purposive sampling" [39]. The procedure of purposefully sampling consisted of two different stages. To get things rolling, we needed to settle on a rural hamlet as the base of operations for our research. In order to be eligible, applicants needed to demonstrate that they either already had an active solar energy program and project or that they had only just begun one. Musal rarul hamlet was chosen as the location since it is the community where a solar energy project for a micro grid is now being developed. Another remote settlement that does not have dependable access to modern energy sources. The hamlet has a high rate of poverty and a low literacy rate, despite the fact that it has a plentiful supply of natural resources.

Second, the people that participated in this research project were chosen on purpose. In addition, several different conditions were present at this very time as well. The research for this study focused on solar power project recipients as well as homes that did not profit from the project. I went inside each of these homes in search of the most trustworthy and informed members of the household in order to collect the most pertinent information for our investigation. To be

clear, only a limited number of families were asked questions for the purpose of this research. The Village Executive Officer (V.E.O.) and the project committee secretary were two of the most important leaders in the process of locating research participants and families who satisfied the requirements of the study. This would have been the first stage in the process if houses had been connected for photovoltaic solar power in the past. The residents of those households who were chosen for pre-visits by the leaders of the village were the ones who were re-selected for interviews from the larger list of dwellings. As a direct consequence of this, the leaders of the village were only able to conduct house interviews with a small fraction of the total population. As a direct consequence of having their assistance, the process of locating and scheduling F.G.D. participants became much more doable. Finding the most qualified individuals for the open positions was of the utmost importance. The Village's Chief Executive Officer, the chairman of the project, and the project secretary were all present at one of the F.G.D. meetings.

Within the village, there were a total of three focus groups that were established. People from all walks of village life, including local social workers, women's organizations, and fishing associations, have been involved in these initiatives. The backers of the project believe that these and other groups are among the groups that have benefited from or will gain from it in the future.

Fifty people were questioned at a total of twenty residences around the city. On this piece of land, ten of the houses already have solar power systems, while the other ten lacked such systems. These interviews were carried out with the primary purpose of learning how local residents felt about the presence of the small grid solar project in the neighbourhood as well as what they experienced as a result of its presence there.

3.5 DATA GENERATION METHODS

In order to collect data that was reliable and valid for this inquiry, qualitative methodologies were utilized. In-depth interviews and focus groups were also employed for this purpose. The data was gathered using a combination of direct observation, in-depth interviews, and discussion groups. People's comprehension, sentiments, and perspectives regarding the mini grid solar electricity project; newly emerging possibilities and opportunities made possible as a result of

the project's presence in the village; people's sentiments regarding the administration and management of the project, as well as their perspectives regarding the project; and people's views regarding the project overall (solar energy).

Documentation of a wide variety of events and activities, as well as the method in which folks were utilizing solar electricity both inside and outside of their houses, was compiled by first-hand observation of these things. It was also helpful for recording the numerous evening activities that passers-by engaged in when they were illuminated by the lighting. The degree of socialization that existed in the hamlet may be seen in a number of different ways. People of varying ages and genders found a way to connect with one another via their shared interest in gaming. The children and teenagers of the community were seen participating in a wide array of activities, including card games. Another popular activity for young people in the region was participating in the draft. The children in the village were able to safely play outside thanks to the village street lights, while their moms gathered inside to watch films (movies). The building of the solar power plant was responsible for a number of changes that were seen in the hamlet, including the development of new services and the improvement of existing ones. People in the hamlet, for instance, are now able to watch European leagues from a variety of countries as a result of a DSTV link that was provided by a young person from the area. As a direct consequence of these discoveries, people who were engaged have been prompted to conduct more research and make a greater effort to obtain explanation.

In order to create an atmosphere in which people's genuine feelings and thoughts on the effort carried out in their community could be unearthed, interviews were employed. This allowed for the gathering of data. By conducting these interviews, we were able to acquire a clearer picture of the feelings and perspectives that individuals have towards the project. As a direct consequence of this, respondents were given the opportunity to discuss the project as a whole with a greater degree of candour and openness. As a direct result of this, a total of 54 in-depth interviews with members of households were conducted.

In order to collect the information required for this inquiry, focus group discussions were carried out. The participants in this FGD were selected one at a time, based not only on their general

competence but also on their familiarity with the history of the hamlet. There was a total of three Focus Group Discussions (FGDs) that were held. Those who belonged to the first group included the Village Executive Office (V.E.O.), the members of the Village Council, and the former Chairman of the Village Council. The second group included the Secretary of the Solar Project

Committee, an Education Officer (Teacher), and a Healthcare Official, in addition to the Current and Former Members of the Village Council. The second focus group discussion was on the topic of fishermen, and the third session was on the topic of women who worked in small companies. The focus group discussions were essential not only for verifying and evaluating the veracity of the information acquired during the in-depth interviews in the households, but also for gaining a deeper understanding of the ways in which the project has benefitted different segments of the community. In addition to that, they were expected to offer more insight into the feelings of the individuals who were working on the project.

3.6 DATA PROCESSING AND ANALYSIS

Qualitative methods were utilized throughout the processing and analysis of the data. The language that was used for the data collection was Kiswahili, and in-depth interviews and focus group discussions were recorded using a recorder. The recordings were then painstakingly transcribed, and the results were translated into English. The residents of the community had their views, understandings, experiences, attitudes, and sentiments regarding this effort analysed in order to obtain insight into how it influenced their lives and the lives of others in the neighbourhood. The most important contribution that the survey made was to assist in capturing the thoughts, feelings, and sense of project ownership that were held by the members of the community. Coding of the data was done in order to discover the themes connected with the execution of the solar power project, transformational changes, and their link to the feelings and perceptions of the people in the community. This had an effect on the feelings, attitudes, and opinions of the people in their community towards the effort that was being carried out. In order to reach a decision, it was necessary to provide a comprehensive account of the events that transpired.

3.7 ETHICAL ISSUES

One must have a conscience towards the rights of other people in order to act ethically. The pursuit of truth is considerably more challenging when one takes ethical issues into account. In accordance with the ethical standards, it is desirable to preserve human dignity rather than the truth, even if doing so causes one to be oblivious to the real nature of human beings. Throughout the course of the investigation, it was essential to keep this in mind as a relevant consideration. The participants' privacy and safety should be protected at every stage of the research process, and at the same time, the participants' dignity should be preserved. The ethical conduct of social research was guaranteed throughout the course of this investigation. In order to conduct out this inquiry, it is necessary to first receive both permissions from the research team and a letter of introduction from such team. In the village where the research was being done, the procedure of introducing oneself to the local authorities was finished. A second introduction was provided to the individuals that make up the Project committee by the Village Executive Officer. Information was given to the families and groups that were participating in the research before the visit actually took place. They were assured of their right to privacy, dignity, and protection both during and after the course of the research.

3.8 LIMITATIONS TO THE STUDY

This study did not come without its share of problems. Due to the fact that there was no power in the house where the data collection was taking place, it was difficult to continue working on the data for a significant amount of time. Another disadvantage was that there were not enough female family heads to participate in discussions at the home level. Even if their wives were present, they were unable to provide sufficient information since other individuals were either preoccupied with other matters or in a rush to complete other tasks. They did not have any freedom, which placed limitations on them.

When these constraints were placed in front of us, it was clear that immediate action was required. It was agreed that the first restriction would address data gathering and data processing in a manner that was distinct from one another. In light of the second limitation, it was essential

to include households in which a woman served as the head of the home and who was able to freely communicate and had sufficient time for doing so. It is necessary to provide a comprehensive overview of the study's goals in order to make the interviewing procedure as pleasurable as it can possibly be.



4 FINDINGS AND DISCUSSIONS

4.1 INTRODDUCTION

This chapter presents, interprets, and evaluates findings concerning the importance of PV solar power to improving the lives of people in Iraq. In this section, we detail the positive changes that have occurred in the village as a direct result of the PV solar power project or have been bolstered by the existence of its presence, as well as how these developments have affected the lives of the locals and the community as a whole. In addition, we discuss how these developments have affected the lives of the locals and the community as a whole. At both the individual and the societal level, there is the potential for the PV solar power project to provide advantages. – – There are a number of factors that contribute to a community's sense of ownership over a PV solar electrification project, including the attitudes and perceptions of the members of the community regarding the efficacy of the project. One of these factors is the sense of ownership that the community has over the project.

Members of the community think that the PV solar power plant is serving as a driving force behind the expansion of their town and believe that it has created new opportunities. Many people in the neighbourhood consider this as a turning point in terms of their community's downward spiral towards poverty and a lower level of living.

4.2 PHOTOVOLTAIC SOLAR ENERGY'S ABILITY TO ALTER PEOPLE'S LIVES

The availability of energy, namely in the form of electricity, has been critical to the growth of this community. The one and only thing that they were unaware of was the fact that solar power could be used to create modern energy. The number of residents in this community who have travelled to locations other than their hometown is rather low. However, prior to the beginning of the project, a significant number of people living in the neighbourhood were unaware of the efficiency of PV solar electricity. As a consequence of this, the purpose of this study was to investigate the various perspectives held by members of the community on the capacity of photovoltaic solar electricity to enhance their way of life. A photovoltaic solar energy project

has been constructed in the municipality. The people who live in this community are quite knowledgeable about the power that the national grid provides. As a consequence of this, it was essential for the purpose of this research to collect their ideas and perspectives about the potency and effectiveness of solar electricity. How does the general population perceive the concept of solar energy? The answers to these questions were essential to the accomplishment of the study's goals. What are the majority of people's thoughts on the viability of solar energy? Do inhabitants of the town believe that solar energy may serve as a driver of economic development?

Due to the fact that solar energy is a relatively recent innovation, the majority of people have never ever heard of it. Even while some people had seen solar power systems, they were unaware of the amount of electricity that could be generated by a single mini-grid and delivered to several residences at the same time, as is the case with the current project. The following are some remarks made by a respondent regarding their comprehension of solar energy and its usefulness:

Residents of this hamlet had the opportunity to observe and experience the benefits of photovoltaic (PV) solar power for the very first time as a result of their own personal experiences as well as their exposure to a number of various power sources as a result of other initiatives in the region.

The ideas and perspectives of individuals on the usefulness of solar electricity have been made abundantly evident by the remarks that have been made above. They were all in agreement that this was the very first time they had ever witnessed a solar power system being utilized in a building project of this magnitude. When they first started working on the PV solar project, some of them had no idea how the system actually functioned. In spite of the fact that they admired the effectiveness and power of solar electricity, they were able to point out the challenge that they were unable to use some electric appliances, such as refrigerators, subwoofers, and freezers, that could have provided them with more possibilities. Even while some people in the community had their doubts about solar energy's capacity to supply such a large amount of electricity, the vast majority of people thought it could if solar panels and batteries were installed.

The solar power plant that is located at the village has significantly altered the lives of the people who live there. It was amusing to learn that the majority of people interpreted this in terms of the length of time it took to charge a phone as opposed to the length of time it took to charge a generator. When asked how she evaluates the efficacy of solar energy, for instance, one resident of the village responded that she takes into consideration not only the amount of time that is spent now charging the phones, but also the peace of mind that one has when taking phones in order to be charged. Her reaction may be seen down below.

4.3 TECHNOLOGY ACCEPTANCE AND SENSE OF OWNERSHIP

After analysing their sense of pride in the work and their willingness to adopt new technology, it was essential to discover the reasons for their devotion to the project so that they might find a solution. That was the impetus behind not just their sense of ownership over the project but also their willingness to experiment with new forms of technology.

A significant number of respondents, both in the houses and in the focus groups, brought up the prior information and preparation that was supplied to them by the village officials. It would appear that the fact that their hamlet was one of three finalists for the grant and that the winner would be picked from among those three made them feel unique. As a result, they are reluctant to accept defeat because of this feeling of specialness.

The information that individuals were given regarding the project has a significant role in determining how they think about it. They have the impression that it belongs to them, and they are under the impression that it is their responsibility to make the most of the chance that has been presented to them.

This is an essential component to the overall success of the project. As was said earlier, the people living in the three communities that are being taken into consideration for the project have been informed of the possible advantages that the installation of a solar power system may offer to their area. Nevertheless, it was not certain which community would emerge victorious in the competition. The members of the community were had to wait in order to find out whether or not the project that had been described to them had been awarded to their hamlet.

When the local government first started planning where and how the project would be carried out, the people were apparently informed, and they were urged to participate in village meetings. These parties had a say in matters such as the placement of power generators and transmission lines, among other choices (beneficiaries). The community was given a large amount of input into a number of crucial decisions, including the location of the power plant, which was one of the most essential considerations. The first concept was for it to be situated in the centre of the village, close to the boundary between the Pwani and Maputo subvillages, so that people of both of those areas would have equal access to its benefits. It would appear that the fact that a member of the community already owned private property had a role in the decision to compel the community to buy the land. For the purpose of preventing such needless expenditures, the villagers suggested constructing the PV solar power plant at a location close to the village office, which they claimed was an area that was being underused. The people living in the village and the governing body of the village came to a consensus on the key reasons for the decision, which were to save unnecessary costs and to ensure the safety and security of the project devices. These concepts were conceived by citizens of both sub villages simultaneously. This is an essential component to the overall success of the project. There were three communities that were under consideration for the solar power project, and the residents of each town were provided with information on the possible benefits of the project; however, it was unclear which neighbourhood would end up being selected. The members of the community were had to wait in order to find out whether or not the project that had been described to them had been awarded to their hamlet.

According to the reports, when the administrators of the village began planning the site of the project and its execution, all of the people were alerted and encouraged to participate in the planning process through the community meetings. They did so. These parties had a say in matters such as the placement of power generators and transmission lines, among other choices (beneficiaries). The community was given a large amount of input into a number of crucial decisions, including the location of the power plant, which was one of the most essential considerations. The initial site of the project was scheduled to be in the heart of the village, which meant that residents of both the Pwani and Maputo sub villages, namely Pwani and

Maputo, were expected to profit equally from its existence. It would appear that the fact that a member of the community already owned private property had a role in the decision to compel the community to buy the land. For the purpose of preventing such needless expenditures, the villagers suggested constructing the PV solar power plant at a location close to the village office, which they claimed was an area that was being underused. The people living in the village and the governing body of the village came to a consensus on the key reasons for the decision, which were to save unnecessary costs and to ensure the safety and security of the project devices. These concepts were conceived by residents of both of the sub villages. People were also included in the process of making recommendations for adjustments to the monthly payment of bills.

Every single person who participated in the interviews, surveys, and observations voiced their appreciation for the fact that politicians were unable to utilize the initiative to further their own agendas and interests. Even those people who were criticizing the politicization of the project claimed that the leaders had violated the prior information that had been supplied to them. The information in question had been disclosed to them before.

The community members' expectations regarding the project were raised favourably as a direct result of the promises that were made to them. It was supposedly promised to the people of the village that the project would be passed to them at the conclusion of its lifespan and that they would have entire ownership of one hundred percent of it when it was initiated. The citizens of the village expressed their extreme happiness at hearing the vow. They are more worried about the initiative's long-term survival and success as a consequence of the fact that they will own it for the rest of their lives, which explains why they will own it for the rest of their life. When asked why they felt like they owned the initiative, the majority of participants mentioned the promise of ownership as one of the factors, just as the one lady claimed.

The vast majority of individuals who were questioned said that it was very important to explain to the general public why they were doing what they were doing. As a result of the fact that it is seen as a community-wide endeavour, every person in the community, regardless of their standing, feels bound to adore and protect the endeavour. There was an uncanny similarity between the stories that were shared in people's homes and in discussion groups, as well as the

ones that were heard on the streets. It was intriguing to hear from ladies who were selling their products such as food and tea in the evening; they divulged comparable features and went on to link the effort with their own commercial operations. According to her, this is what was mentioned by one of the women.

4.4 SOCIO-ECONOMIC OPPORTUNITIES FROM PV SOLAR ELECTRICITY PROJECT

The effort has resulted in a positive change in people's lives by bringing about several social and economic opportunities that were either made available for the first time or expanded as a result of the development of the project in the hamlet. The project served as a driving force behind the realization of some of these possibilities, which had already existed in the community prior to its implementation. Since the introduction of photovoltaic (PV) solar electricity, there have been additional opportunities for expansion.

The answer of villager was entered into database in SPSS software.

The main question was as following:

- a. What is your age?
- b. Do you have electricity in your home?
- c. Do the whole village have electricity?
- d. Is it the main source of energy in your home solar powered or not?
- e. Is it the main source of energy in your village solar powered or not?
- f. Is it the PV system implemented or not?

The answers are exposed in the following tables and Charts.

Table 4.1: Distribution of ages.

AGE					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20.00	1	1.9	1.9	1.9
	22.00	11	20.4	20.4	22.2
	25.00	10	18.5	18.5	40.7
	31.00	10	18.5	18.5	59.3
	34.00	1	1.9	1.9	61.1
	35.00	10	18.5	18.5	79.6
	37.00	10	18.5	18.5	98.1
	39.00	1	1.9	1.9	100.0
	Total	54	100.0	100.0	

Table 4.2: Question 2 Response.

have electricity					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	49	90.7	90.7	90.7
	No	5	9.3	9.3	100.0
	Total	54	100.0	100.0	

Table 4.3: Question 3 Response.

all village have electricity					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	50	92.6	92.6	92.6
	No	4	7.4	7.4	100.0
	Total	54	100.0	100.0	

Table 4.4: Question 4 Response.

Source of energy					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	solar	37	68.5	68.5	68.5
	other	17	31.5	31.5	100.0
	Total	54	100.0	100.0	

Table 4.5: Question 5 Response.

main village source of energy					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	solar	48	88.9	88.9	88.9
	other	6	11.1	11.1	100.0
	Total	54	100.0	100.0	

Table 4.6: Question 6 Response.

PV system implementation					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	8.00	2	3.7	3.7	3.7
	9.00	48	88.9	88.9	92.6
	SA	4	7.4	7.4	100.0
	Total	54	100.0	100.0	

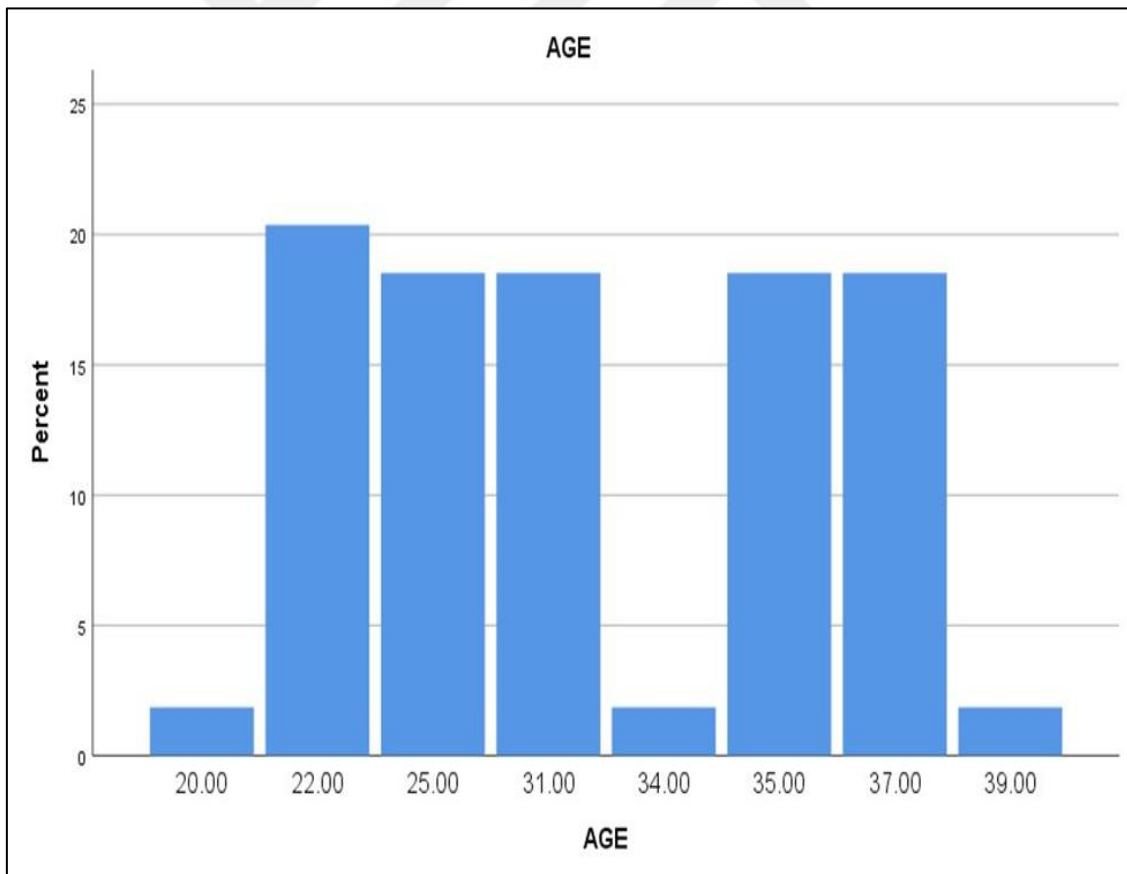


Figure 4.1: Age distribution graph.

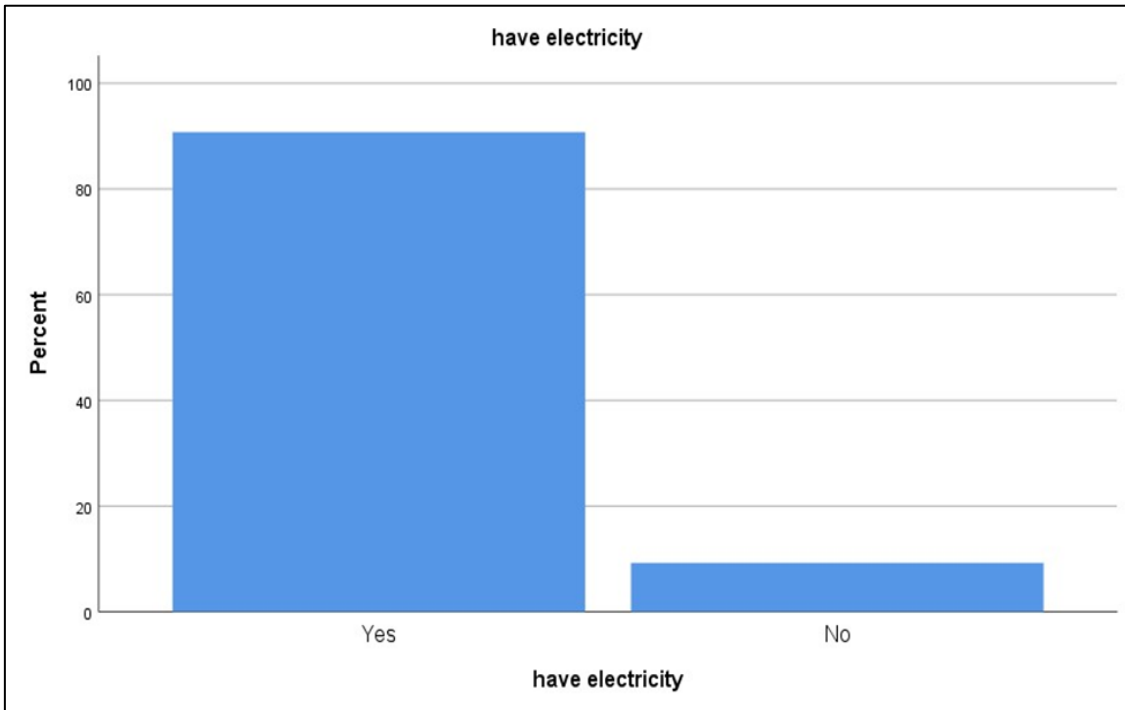


Figure 4.2: Do they have electricity.

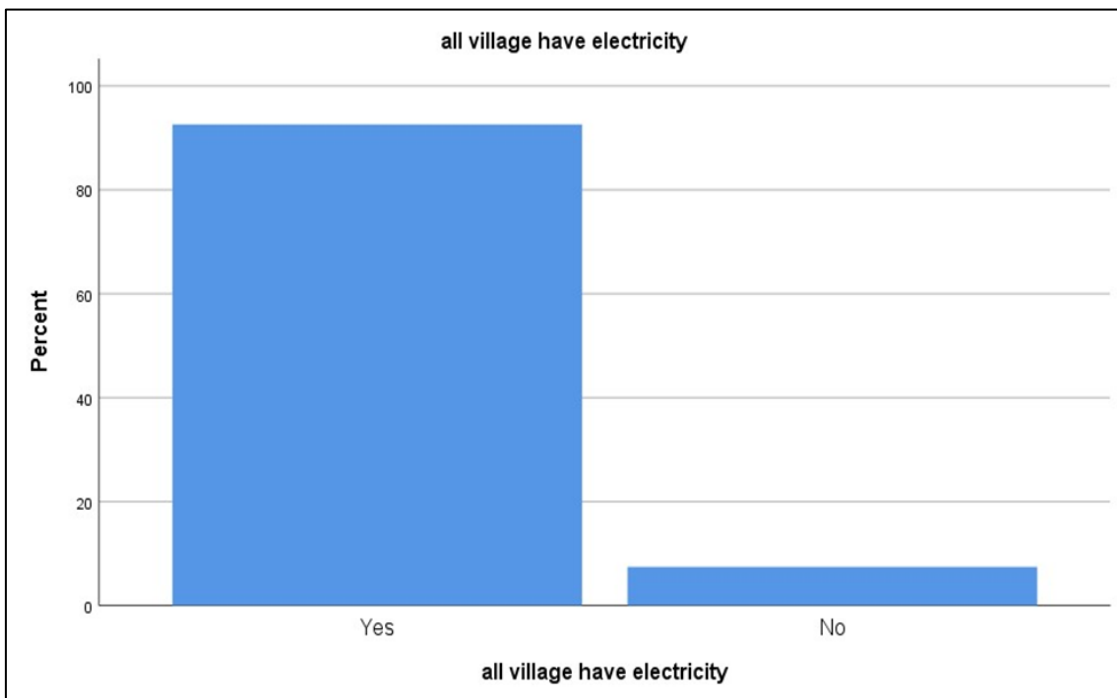


Figure 4.3: Do the whole village have electricity.

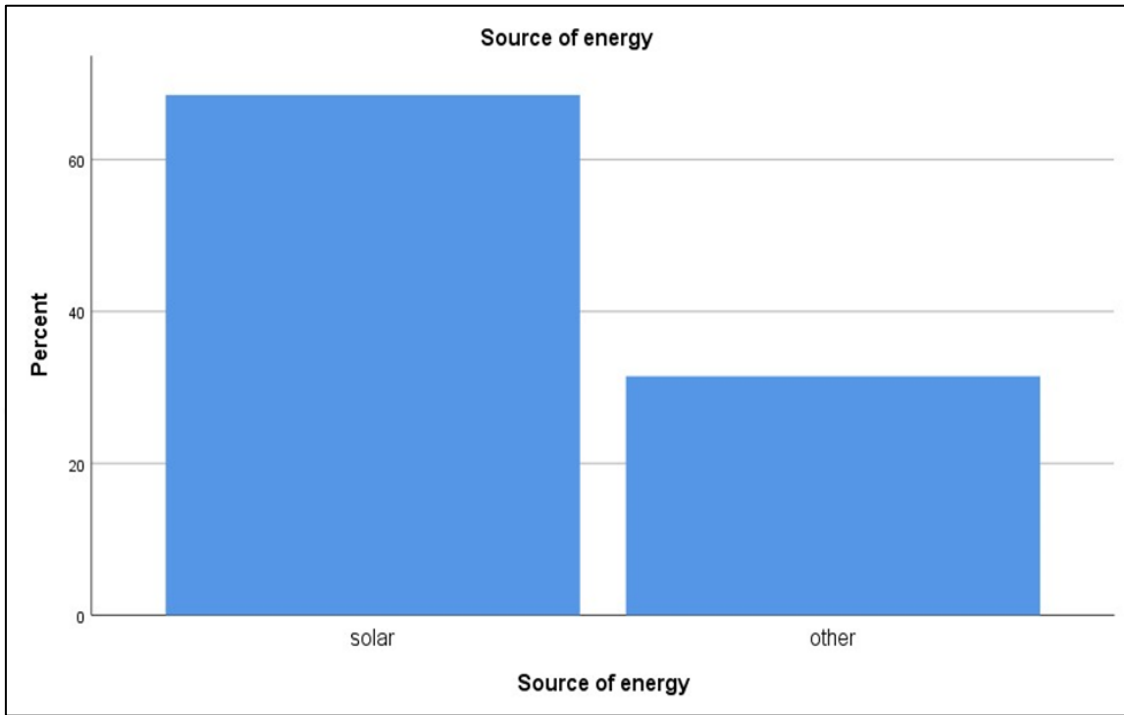


Figure 4.4: Solar energy is the source of energy or not.

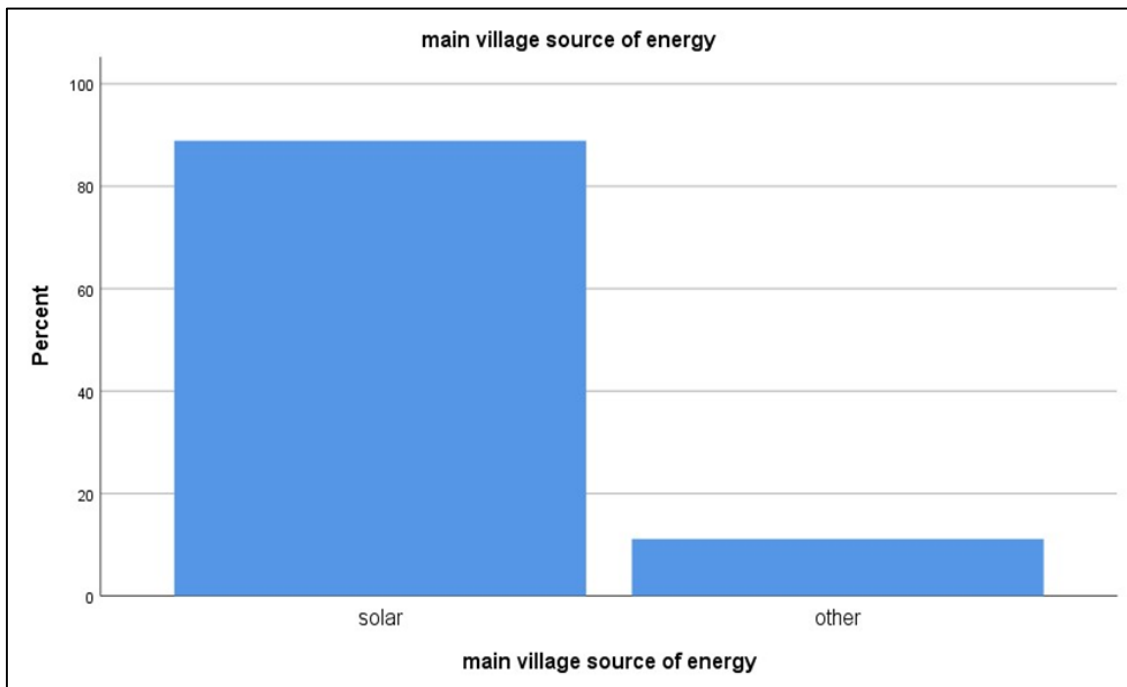


Figure 4.5: The solar energy is the main source of energy for the whole village or not

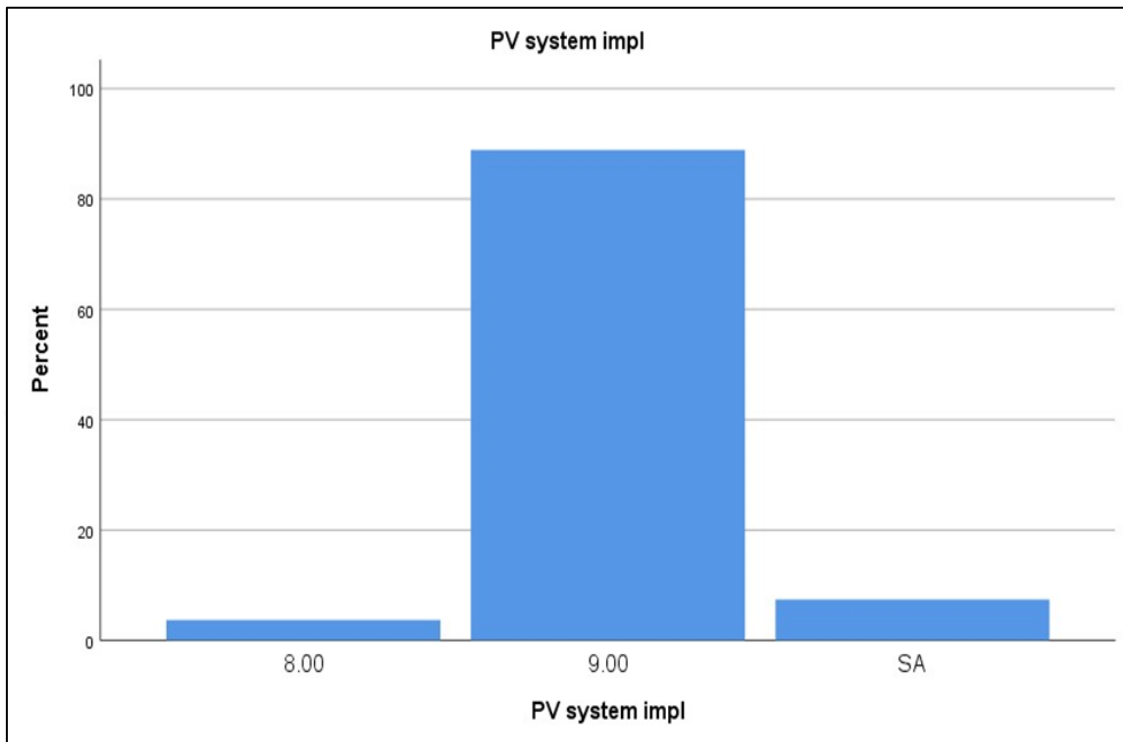


Figure 4.6: PV system implementation level

4.4.1 Overall Life After PV System

The opinion of villager about the life enhancement after the PV system implementation was mostly positive, more than 79% of the whole population state the life is better with PV system with scale of 9.

Table 4.7: Life after solar energy.

life after solar energy					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7.00	1	1.9	1.9	1.9
	9.00	43	79.6	79.6	81.5
	SA	10	18.5	18.5	100.0
	Total	54	100.0	100.0	

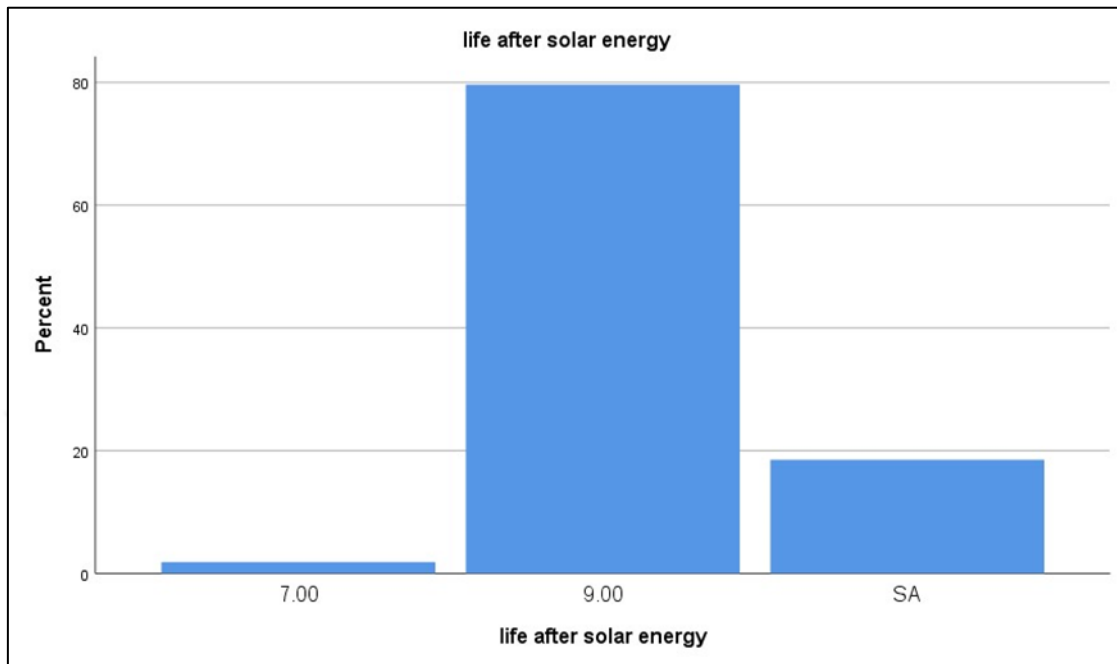


Figure 4.7: Life after solar energy.

4.4.2 Effectiveness of PV System

Electrons are expelled from the semiconductor material of a PV cell when it is exposed to light, which results in the flow of electrical current. It is typical for photovoltaic (PV) cells to have a rectangular form and generate a few kilowatts of direct current (DC) electricity. Through the use of electrical connections, electrons are able to go from the PV cell to the load. Glare can also be reduced thanks to the surface coatings that are applied to PV cells. The majority of individuals who use solar systems and benefit from them do so because of the diverse range of places that may be powered by these systems. They investigated how the installation of the PV system will influence the overall quality of their lives. Eighty-five percent of respondents rated the PV system at a 9 out of 10, with 10 being the highest.

Table 4.8: PV system effectiveness.

PV system effectiveness					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7.00	1	1.9	1.9	1.9
	8.00	2	3.7	3.7	5.6
	9.00	46	85.2	85.2	90.7
	SA	5	9.3	9.3	100.0
	Total	54	100.0	100.0	

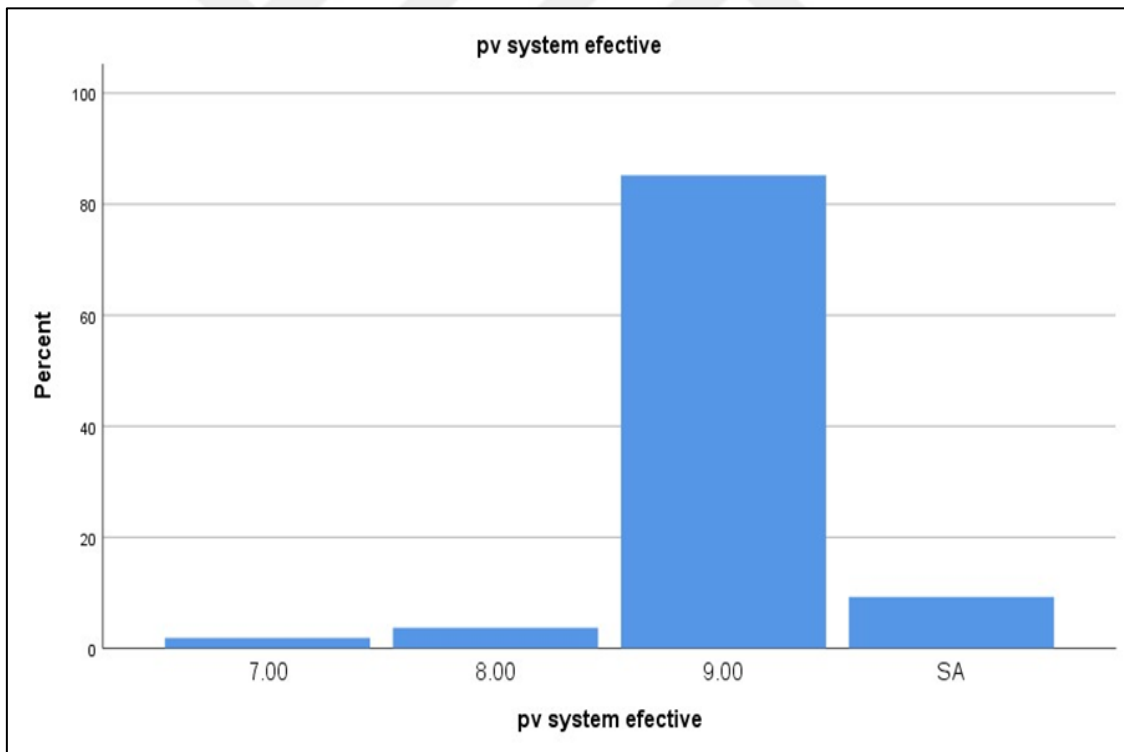


Figure 4.8: PV system effectiveness.

4.4.3 Effect on Education

Education in rural areas is a high issue not just for the United States of America but also for the rest of the globe. However, in many countries, access to electricity, which may support educational activities in remote areas, is not always possible. In recent years, remote areas have been able to provide their homes and businesses with electricity and thermal energy thanks to the development of renewable energy systems that are reliable and cost-effective.

Many non-profit organizations, charitable organizations, and for-profit enterprises from all over the world, in addition to national and local governments, are lending a hand in the process of installing renewable energy systems in rural regions where education in rural areas is a national priority.

Because there is such a broad range of renewable energy systems on the market, the choice of which system is the most suitable for a particular place will depend on a number of criteria, such as the area's topography and climate. Photovoltaic (PV) lighting systems are being utilized in a great number of remote communities all over the world; nonetheless, research into other modest renewable energy sources ought to also be conducted. The readers of this handbook will get knowledge about alternative forms of renewable energy besides photovoltaics, such as wind and hydropower, thanks to the book.

In the not-too-distant future, microbiomes gasification and direct combustion, in addition to concentrated solar thermal-electric technology, are anticipated to become viable commercial options in rural areas.

The quantity and timeliness of the electrical needs, together with the cost of the various components, including alternative fuels for fossil fuels, are the three most important factors to take into account when selecting the appropriate technology.

The local natural resource, the magnitude and timing of the electrical demands, as well as the cost of the different components, including alternate forms of fossil fuel, are significant elements that play a role in the selection of the right technology.

In this questionnaire, the opinion of villagers was taken into consideration. 63% evaluated the impact of PV system on education by 8 out of 10. Mainly, different opinions were proposed in this field. Some state that the presence of a sustainable source of power helps in education activities. Others feel that the abundance of electricity opens the door for more entertainment materials which is a distraction for students.

Table 4.9: PV system effectiveness.

		effect on education			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7.00	1	1.9	1.9	1.9
	8.00	34	63.0	63.0	64.8
	9.00	15	27.8	27.8	92.6
	SA	4	7.4	7.4	100.0
	Total	54	100.0	100.0	

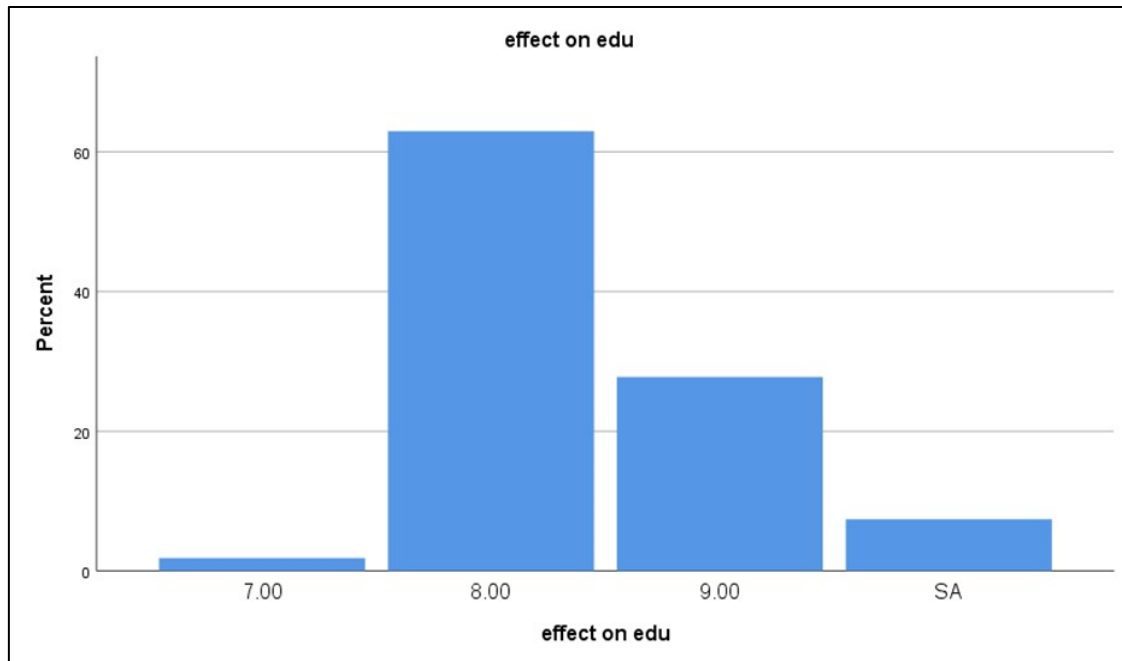


Figure 4.9: PV system effectiveness.

4.4.4 Effect on Health

In view of the rapid increase in the price of fossil fuels and the inconsistent availability of these fuels, photovoltaic (PV) systems provide an alternative source of energy. The most prevalent applications of photovoltaic systems in medical facilities are for illumination and refrigeration of vaccines. This is due to a combination of factors, some of which include inadequate system design, improper usage of the batteries, and an underestimate of the average daily load.

The United States Agency for International Development (USAID) Energy Team also has its own online information site called "Powering Health" for rural health institutions in developing countries. This site contains a wide variety of experience and case studies on photovoltaic systems and other forms of energy delivery. There are several different papers that can be found on the portal. One of these is titled "Powering Health: Electrification Options for Rural Health Centres." The pamphlet contains up-to-date information as well as cost estimates for a variety of different power sources. Another publication that addresses the topic of load balancing and energy management in rural health care facilities is titled "Powering Health: Energy Management in Your Health Facility."

About eighty percent of the village residents who took part in the study believed that the PV system had a positive influence on their overall health.

Table 4.10: Effect on health.

effect on health					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7.00	1	1.9	1.9	1.9
	8.00	1	1.9	1.9	3.7
	9.00	43	79.6	79.6	83.3
	SA	9	16.7	16.7	100.0
	Total	54	100.0	100.0	

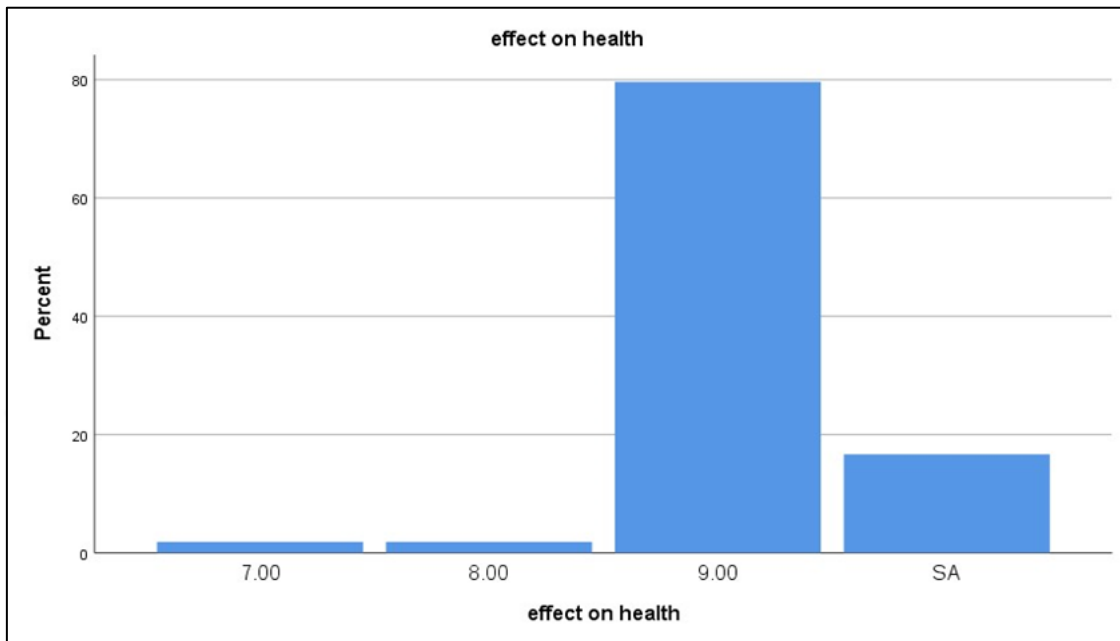


Figure 4.10: Effect on health.

4.4.5 Effect on Business

A nation's agricultural, livestock, and fisheries production, in addition to its educational and commercial facilities, as well as its conditions of law and order, are all indicators of the level of rural development that exists in that nation.

In the modern world, doing business is an essential component of typical living. On the other hand, opinions on the influence of solar panels and other forms of renewable energy were very diverse. It is only possible for half of the individuals to acknowledge that the installation of the PV system had a beneficial effect on the firm. During the assessment, it became clear that businesses had already been plugged in; as a result, these companies did not see a significant amount of change.

Table 4.11: Effect on business.

effect on business					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	8.00	4	7.4	7.4	7.4
	9.00	20	37.0	37.0	44.4
	SA	30	55.6	55.6	100.0
	Total	54	100.0	100.0	

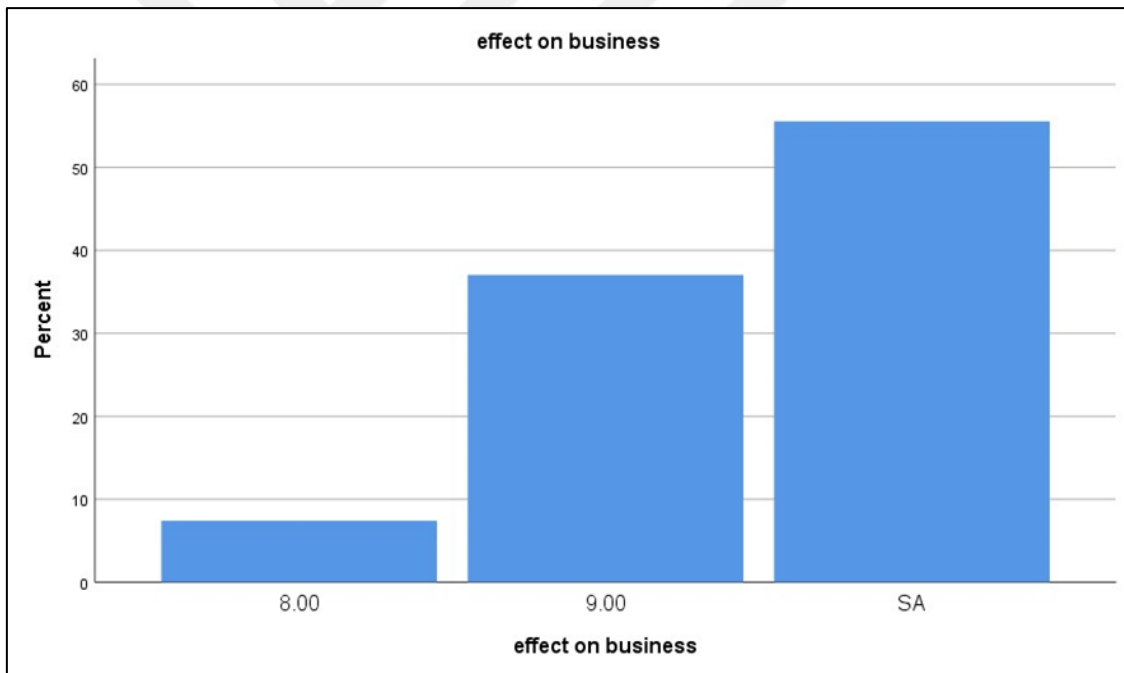


Figure 4.11: Effect on business.

4.4.6 Effect on Environment

Energy use and production are likely to blame for a significant number of environmental problems. Environmental repercussions such as climate change, acid emissions, particle emissions, hazardous waste, and the unsustainable use of biomass are growing in significance

as concerns emerge regarding how to manage the world's rising demand for energy, which is anticipated to increase dramatically over the course of the next few decades.

There is no controversy about the idea that PV systems have an unquestionably positive impact on the surrounding ecosystem.

Table 4.12: Effect on environment.

effect on env					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SA	54	100.0	100.0	100.0

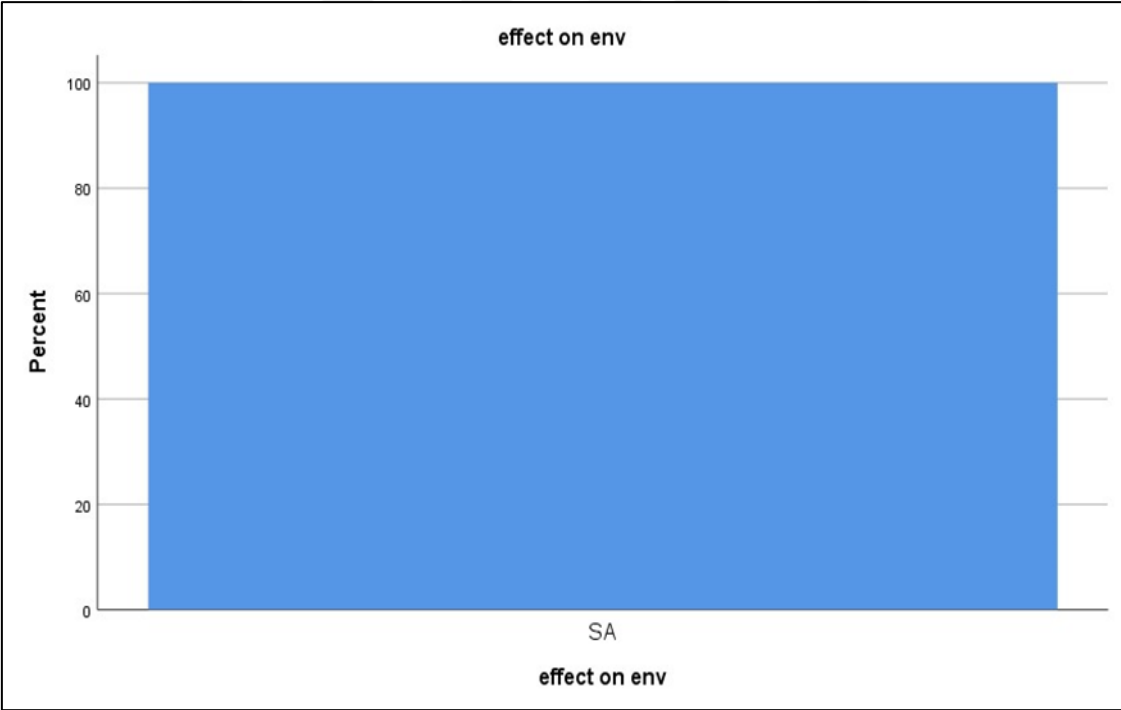


Figure 4.12: Effect on environment.

4.4.7 Effect on Woman

More basic and direct empowerment was accomplished via the creation of systems that rely on the leadership and engagement of women, and this empowerment was not only for the women who were participating in the activity. Because new cultural norms and community discourses are shared by nature in their whole, everyone was impacted, albeit to varying degrees. A sociotechnological transition and a rise in women's position both occurred at the same time, and as a consequence, a "double revolution" occurred as a result of these two simultaneous revolutions. At the other locations and systems, on the other hand, the responsibilities that women played in the supply chain were more restricted, and it was more probable that men would be the ones to provide them with access to electricity.

Additional than sixty percent of the people in the hamlet held the belief that the photovoltaic system that had been constructed had provided the ladies there with more power and had helped them.

Table 4.13: Effect on women life.

effect on women					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	8.00	1	1.9	1.9	1.9
	9.00	20	37.0	37.0	38.9
	SA	33	61.1	61.1	100.0
	Total	54	100.0	100.0	

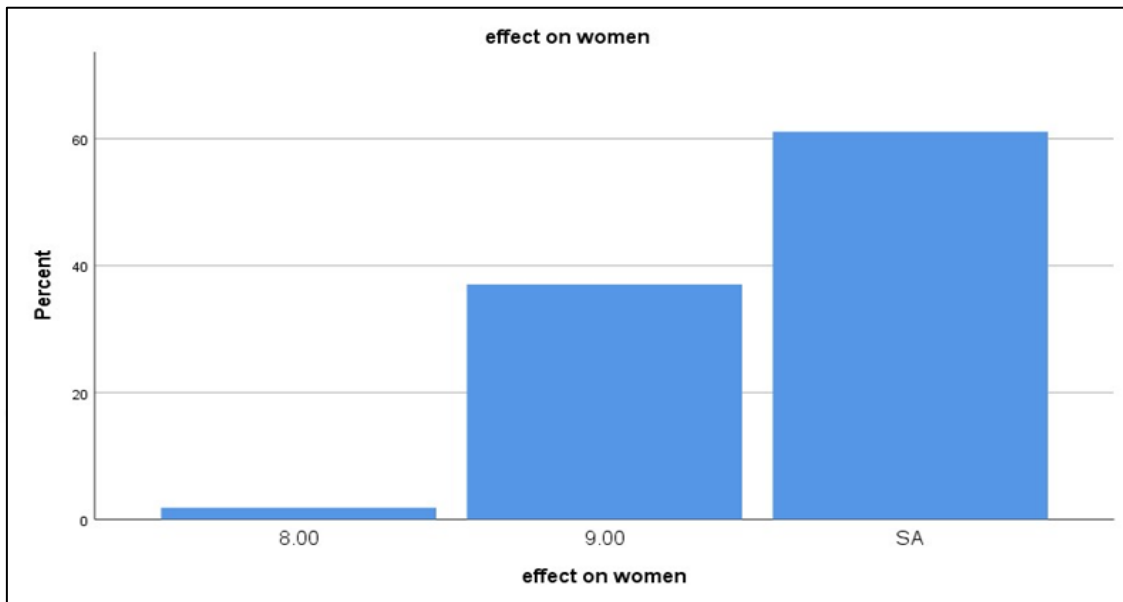


Figure 4.13: Effect on women life.

4.5 FUTURE IMPACT PREDICTION

In order to testify the idea that PV system make life in rural villages in Iraq easier and help people in different aspect, a prediction using regression study was done. By taking the implementation of the PV system into consideration, all linear regression curves are plotted using SPSS tools.

The overall life enhancement expected by the implementation of PV system is fairly fitted. The impact of PV system increase of implementation will be beneficial for health services and women life. The impact of more implementation for the PV system will have some drawbacks for education and business in villager opinion.

Table 4.14: Regression model.

Model Description		
Model Name		MOD_9
Dependent Variable	1	pv system effective
	2	life after solar energy
	3	effect on Edu
	4	effect on health
	5	effect on business
	6	effect on env
	7	effect on women
Equation	1	Linear
Independent Variable		pv system implementation
Constant		Included
Variable Whose Values Label Observations in Plots		Unspecified

Table 4.15: Case Processing Summary.

Case Processing Summary	
	N
Total Cases	54
Excluded Cases	0
Forecasted Cases	0
Newly Created Cases	0
a. Cases with a missing value in any variable are excluded from the analysis.	

Table 4.16: Variable Processing Summary.

Variable Processing Summary									
		Variables							
		Dependent							Independent
		pv system effective	life after solar energy	effect on Edu	effect on health	effect on busines s	effect on env	effect on women	PV system impleme ntation
Number of Positive Values		54	54	54	54	54	54	54	54
Number of Zeros		0	0	0	0	0	0	0	0
Number of Negative Values		0	0	0	0	0	0	0	0
Number of Missing Values	User-Missing	0	0	0	0	0	0	0	0
	System-Missing	0	0	0	0	0	0	0	0

Table 4.17: Model Summary.

Model Summary and Parameter Estimates							
Dependent Variable: PV system effective							
Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.000	.001	1	52	.974	9.075	-.006

The independent variable is PV system implementation

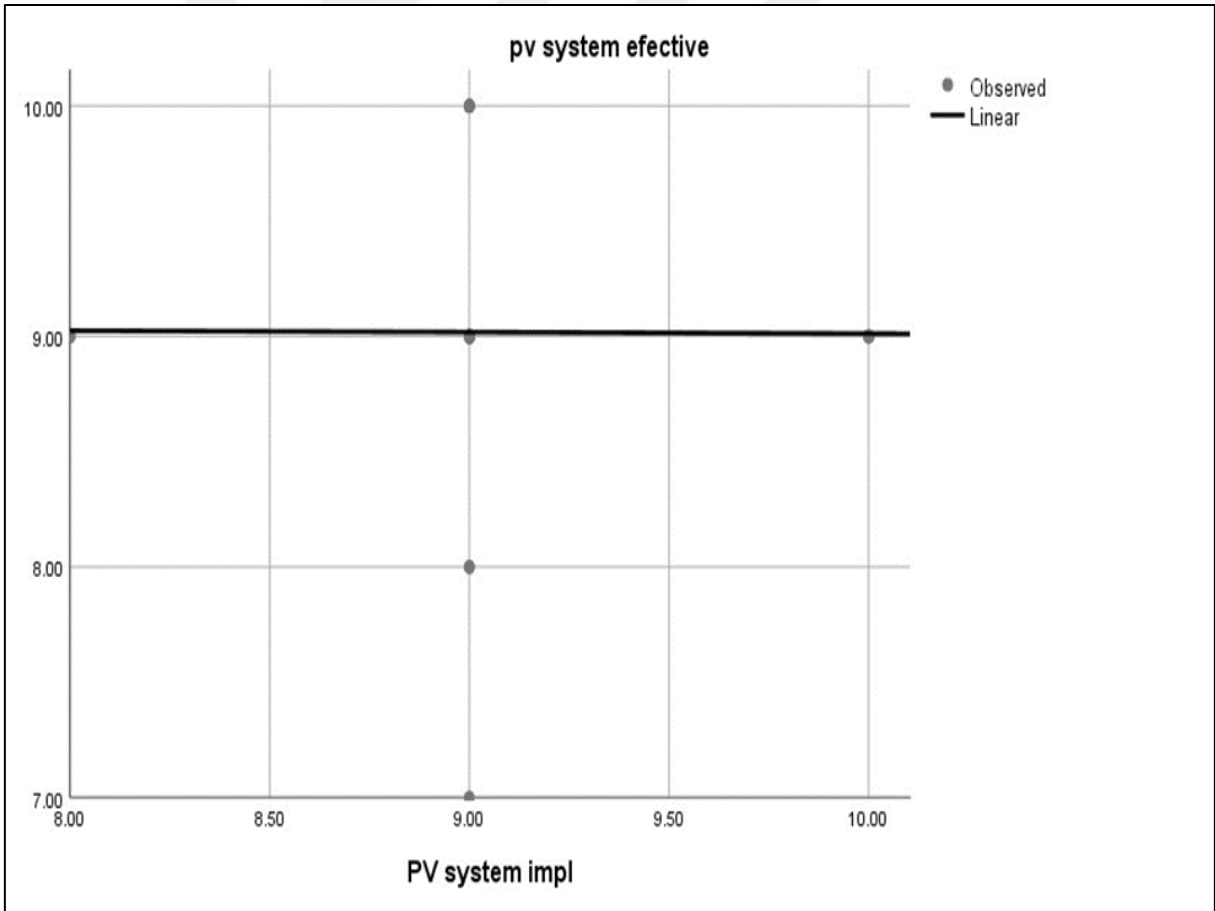


Figure 4.14: PV system effectiveness in term of implementation.

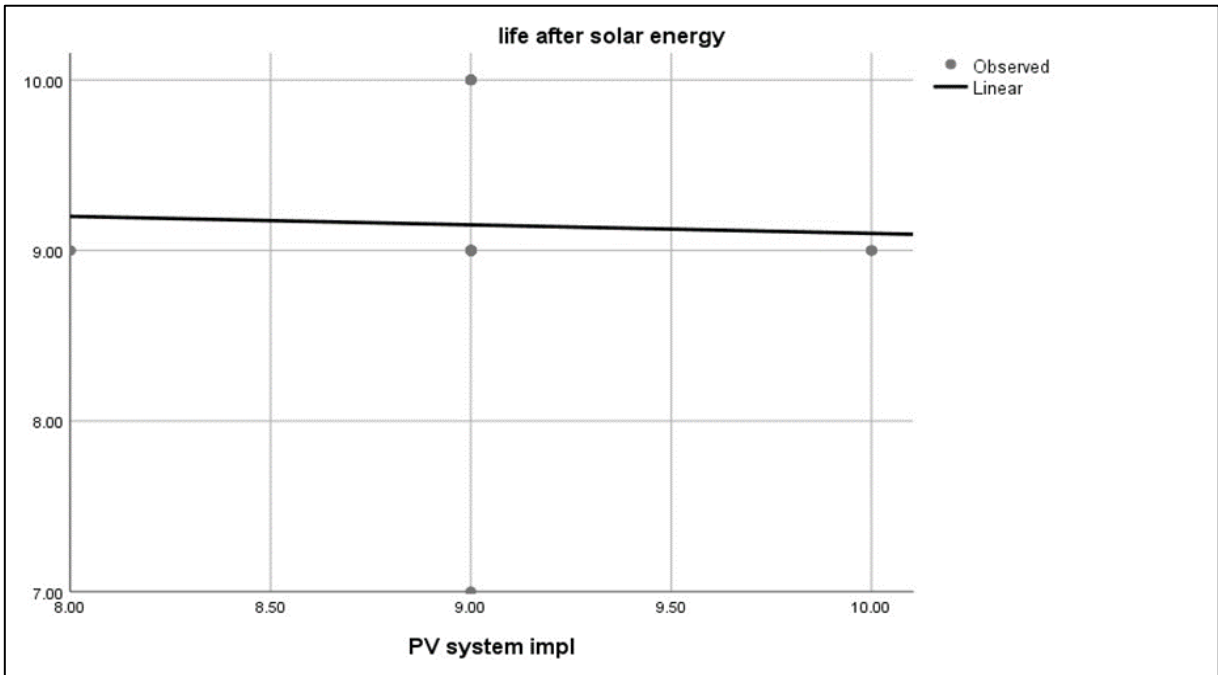


Figure 4.15: The regression prediction of the life after solar system enhancement vs the implementation of the system.

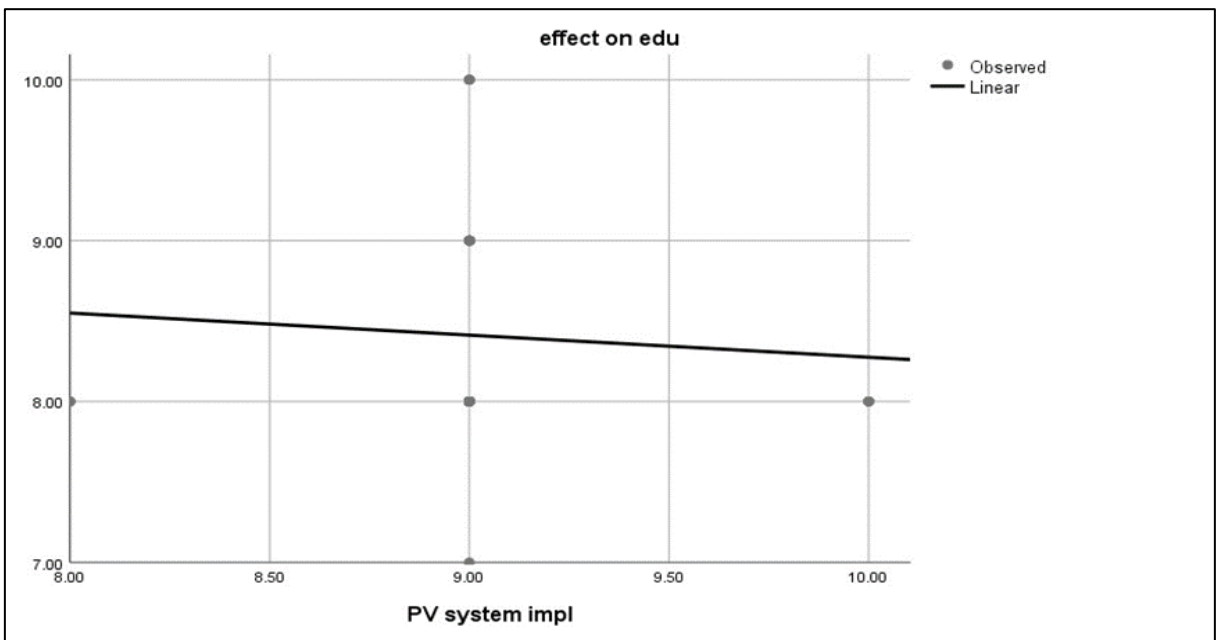


Figure 4.16: The regression prediction of the education after solar system enhancement vs the implementation of the system.

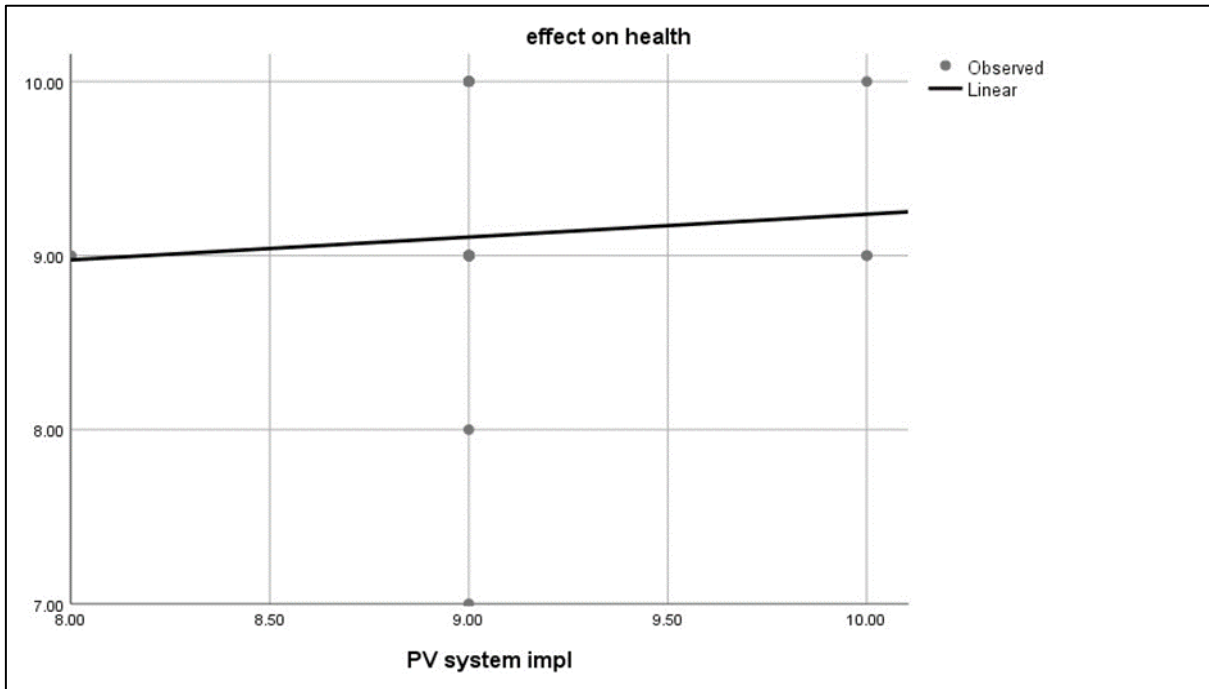


Figure 4.17: The regression prediction of health after solar system enhancement vs the implementation of the system.

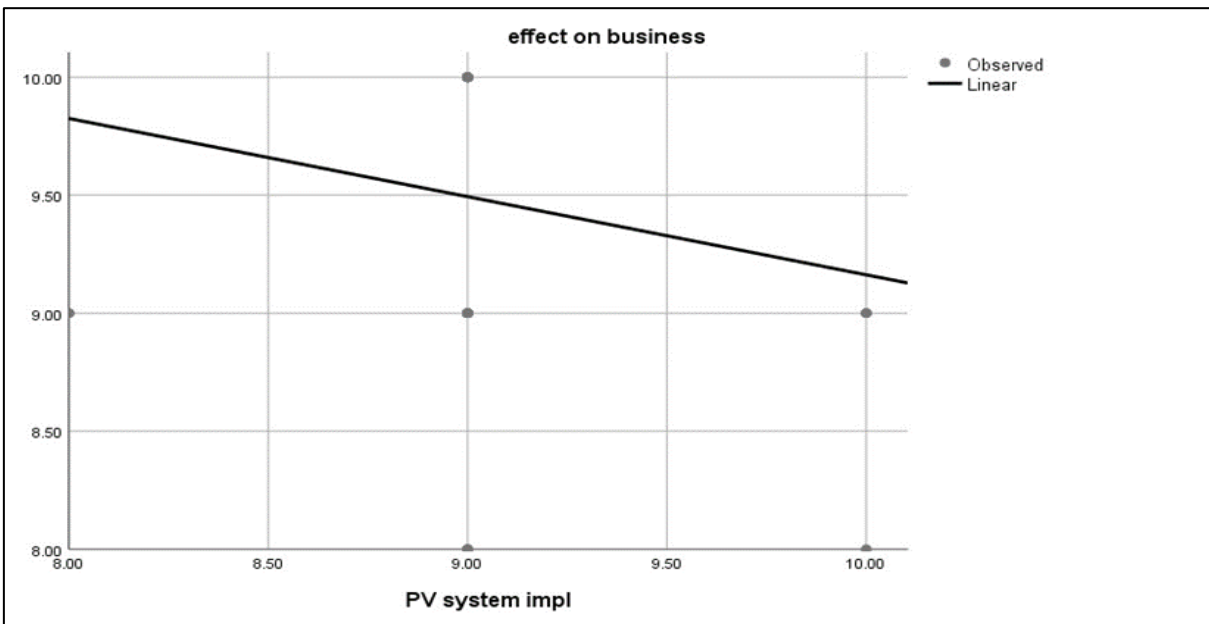


Figure 4.18: The regression prediction of business after solar system enhancement vs the implementation of the system.

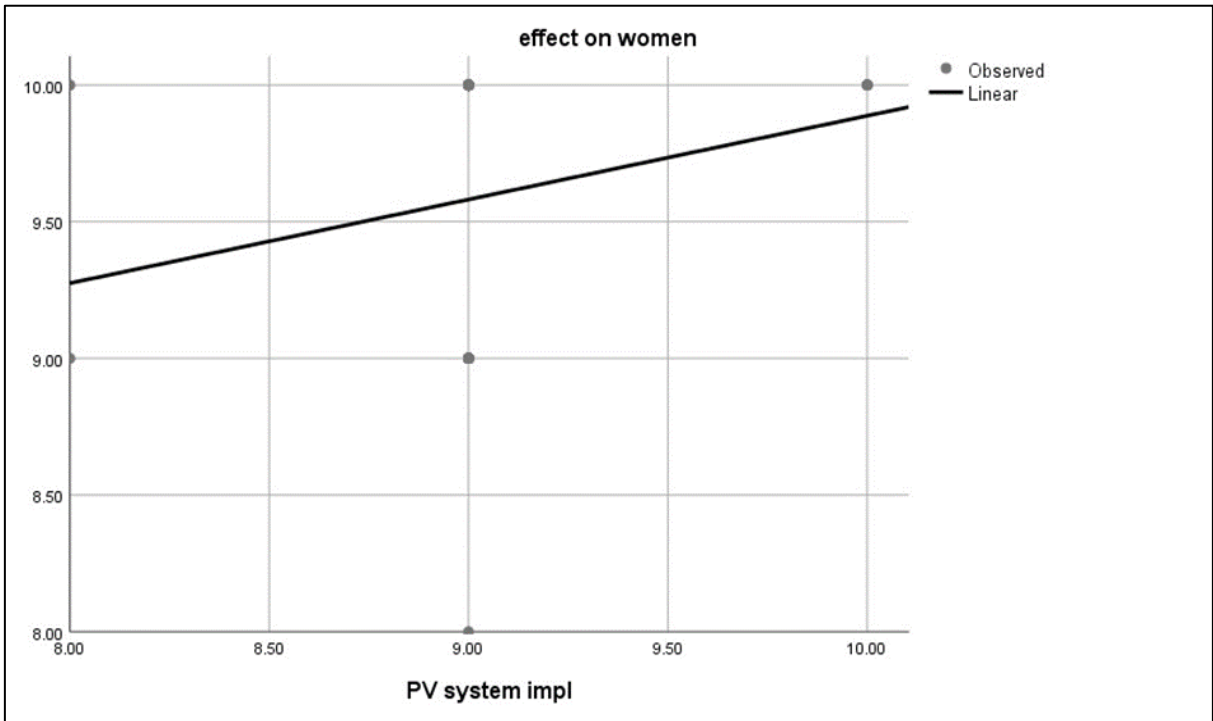


Figure 4.19: The regression prediction of women life after solar system enhancement vs the implementation of the system.

5 CONCLUSIONS

5.1 SUMMARY OF MAJOR FINDINGS

The purpose of this study was to gather information that might be utilized to gain a better understanding of the influence that PV solar power has on the capacity of rural inhabitants to maintain themselves. The data collected indicated that installing photovoltaic solar panels is an effective method for improving the lives of individuals living in rural areas. According to the findings of a recent research, people's levels of freedom, alternatives, and capacities have increased in rural areas. The population that did not have access to power was the primary focus of the study, as opposed to the group that did have access to electricity. In addition to that, it included the knowledge gained from both the electrified and the non-electrified sub villages. The information that was gathered from all of these areas, which included residences and sub-villages, revealed that there is a substantial gap between locations that have access to power and those that do not.

According to Amartya Sen's capability viewpoint, development is a process of enhancing the liberties that are available to individuals. This expansion of individual freedoms is essential to development. According to Sen, a human existence may be broken down into a sequence of "doings and beings" or "functioning," both of which can be referred to. A person's capability can be evaluated based on the number of different ways of living they are open to exploring as options. The driving force behind freedom is encapsulated in Marx's observation that we must "replace the tyranny of circumstances and chance over people by the rule of persons over chances and circumstances." Marx's observation encapsulates the fundamental motivation for freedom.

When evaluating the efficacy of the project, it is essential to take into account the ways in which it has impacted the rural population and the ways in which it has contributed to the development of new opportunities and the extension of existing ones for the rural population. It has been

proved in this way that the dominance of circumstances and chances over humans has been supplanted by the dominance of individuals over circumstances and chances.

According to the findings of this study, it is abundantly clear that the PV solar power project has had a positive influence on the rural population of Iraq. This influence has manifested itself in the form of increased opportunities for sociability, expanded control options, and an overall increase in the level of satisfaction among Iraqi citizens. The ingenuity with which the villages of the PV solar power project came up with new ways to make a living is now on show as a consequence of the project.

In this study, researchers looked at people's attitudes and views regarding the potential of the PV solar power project to enhance people's livelihoods, as well as the reasons or motives that lie behind people's positive attitudes and perceptions. As is the case with the PV solar power project, the engagement of the people in the decision-making process throughout the execution of projects should under no circumstances be disregarded during the process of planning and executing development projects. The pursuit of political objectives has no place in the planning of development initiatives. Using the information obtained from this study, these aspects are what construct the relationship between the project and its stakeholders, which in turn ensures the project's long-term survival. Consequently, as a result of this research, a gap in our understanding of the ways in which Iraqis see PV solar power as a new technology for rural electrification and their reasons for doing so has been filled.

5.2 CONCLUSION OF THE STUDY

The goal of this study was to investigate the influence of rural PV solar electricity on the rural community's feeling of ownership, attitude, and impression of the impact of rural PV solar electrification on the rural community's livelihood change. PV solar power has been demonstrated to be a workable alternative to obtaining energy from the grid in remote areas where it is impossible to do so. It is very important for the expansion of the country's rural areas to have access to electricity. According to the findings of this study, converting to PV solar electricity is the most effective way to overhaul an individual's way of life.

As was previously said, there was also an emphasis placed on how people felt about the project as a whole as well as how they felt about solar power in particular. According to the findings of the research, people have a favourable attitude and perception of projects because of the benefits they receive from them, the degree to which they are involved and participate in them, and the degree to which they benefit and accommodate people from all walks of life, regardless of the social or political differences between them. If the initiative is to remain free of political influence and not profit from political manipulation, this is an absolutely necessary component.

The investigation also discovered that after the village took over the project, people's faith in its leaders had diminished, which indicates that the community's leaders have lost the trust of the people they serve in the community. Everyone who was polled at the household level suggested that the project committee, which is the result of their participation, continue to exist even after the village takes over the project. They were all in agreement. When asked how they intended to manage the project, the leaders disclosed that they had no intention of managing it themselves and instead wanted to privatize it. The endeavour may evolve into a company in addition to being a service in its current form. The fact that people have these views and initiatives demonstrates that they do not trust the authority in the community.

It is imperative that the leaders of the village have a crystal-clear understanding that the initiative's primary purpose is to serve the people of the village, and not just as a means to an end; additionally, it is imperative that this fact be emphasized in terms of capacity building and further training.

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