International Journal of Geography, Geology and Environment

P-ISSN: 2706-7483
E-ISSN: 2706-7491
IJGGE 2022; 4(2): 69-72
Received: 15-05-2022
Accepted: 20-07-2022

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Satisfaction regarding solar rooftop panels among household users in Gurugram, Haryana

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DOI: https://doi.org/10.22271/27067483.2022.v4.i2a.119

Abstract
For the expansion of a new technology on a massive scale like solar energy in general and solar rooftop panels in particular, satisfaction level of the current users needs to be known. So that the unsatisfactory variables can be worked upon before infusing more resources and time into it. Such timely checks ensure a fast paced and buoyant holistic development. With the satisfaction of the end users only the extraordinarily high targets set by the government can be achieved. This paper deals with the satisfaction level regarding solar rooftop panels in this regard for the city of Gurugram. The city is part of the NCR-Delhi and is hub of Multi-National Corporations in north India. With increasing employment opportunities comes the increasing demand of residence. This inevitably escalates the demand of power. This power supply can be supported by and relied upon by installing solar rooftop panels. The households where these are in place have been surveyed and the satisfaction level has been tried to found out on the basis of economic, technical and environmental factor. The performance of the solar panels have been found to be satisfactory in the concerned study area.

Keywords: Solar energy, multi-national corporations, Gurugram, Haryana

Introduction
Non-renewable sources of energy brought the industrial revolution in the world. With this, came a fast paced society with never ending demands. The most prominent of these demands was power or electricity. Coal based thermal power plants became a major source of electricity. Two centuries have passed and the world has invented various means of electricity generation but thermal and hydro power are still the dominant ones.

The pressure on non-renewable resources is increasing with increase in population and increase in energy demand. Everyone around the planet has not received power yet and the world is already running out of fuel. To fill this energy gap and make power more decentralised it became necessary to focus on the alternative options.

Multiple type of energy sources are now available like wave, tidal, wind and solar which are renewable form of energy. Out of all these, solar is the most widespread one and hence the most promising.

This demand of energy, in countries like India, is needed desperately as huge section of society is still deprived of this basic amenity. The deprivation is not just of complete absence of power but long power cuts, fluctuations etc. are also observed on a regular basis. Even in the most developed regions of the country these observations can be made. It means power ability does not resonate with power quality.

It thwarts regular activities of a household, impacting the study hours of children, forcing cooking in dark, irregular sleeping hours, charging various equipment and the like.

With the coming of solar energy, decentralisation of power can be envisaged. Here, the power can be produced at a household and self-sufficiency can be felt by the end user. With on grid, off grid and hybrid systems available, this can be turned into a reality. India, with its high commitments towards a greener future has already put a high confidence in solar energy. In the last climate summit, India announced a vision of meeting 50 percent of its energy requirements through non-fossil energy. To achieve it, India needs to install 42 GW of energy every year. But the main reason India is lagging behind is because it is finding tough to achieve solar rooftop installation targets.

It is because the adoption of a new technology, needs a lot of sincere efforts on the part of government, private players and people. A major change can be seen only if the adoption is hassle free.

According to IEA, 2020 coal accounted for 74 percent of electricity generation whereas the share of solar was that of 1.7 percent. This gap needs to be diminished and more enthusiasm needs to be built towards the adoption regarding solar energy.

Haryana Scenario

Haryana has set a target of 4.2 GW by 2022 of which rooftop target is 1.6 GW. The state is providing benefits like a loan up to 10 lacs to residential property owners for residential buildings larger than 500 square yards. Also, there is a mandatory clause to have 3 to 5% solar capacity's instalment. Government also provides waiver on electricity taxes, electricity duty etc. But the state has so far achieved 1 GW out of its total target of 4.2 GW. Although, the remaining cannot be achieved in one year only but the growth will continue to happen in the future. But not just Haryana, all the states have performed differently and the 100 GW seems unachievable by 2022 now.

Gurugram Scenario

The city is situated in the south-eastern part of the state. It has border with Delhi on its northeast. The climate of this area is hot semi-arid type. The average temperature of summers is 40 °C. the average annual rainfall is 28.1 inches. It is also one of the major satellite cities of the national capital. It is India's second largest hub of IT and third largest banking hub. It is home to thousands of start-up companies and is the 8th largest city in India in terms of total wealth.

This all means that immigration population is a major contributor to the growth of the city but it also means growing population because of favourable financial conditions. The demand for energy in general and electric energy in particular is high in such areas. Hence, the data from HAREDA suggests that the highest growth of solar rooftop panels has been observed in Gurugram for Haryana. Out of the total installations for the period 2016-2019, 18.5 were that in Gurugram alone and the second highest were in Rohtak which was 7.01 percent of the total installations.

It clearly suggests that, Gurugram district, with its proximity to national capital and energy demands has shown more zeal than the rest of the state in adoption of the technology.

With government reducing subsidies now, the way forward to spread this technology is if users share their experiences. More are the people satisfied with it, higher will be the positive attitude in community. Also, the areas can be segregated where more needs to be done on the part of authorities to increase satisfaction level of people.

Objective of the Study

To find out the contribution of satisfaction indicators separately among the household users in Gurugram, Haryana.

Methodology

A sample of 100 households was collected from the Gurugram district which have solar rooftop panels.

These households had been selected from a total of 816 households which had solar panels in their houses during the time period of 2016-2019.

The research paper is based on primary survey and questions had been asked in "yes" and "no" format.

The following variables were chosen to know about the satisfaction among household users:

- High Cost
- Investment Returns
- Consistency
- Equipment Quality
- Easy Maintenance
- Savings in Bill
- High Safety Concerns
- Self-sufficiency

These variables were then categorised into three factors, namely, economic, technical and environmental. Economic factor includes high cost, investment returns and savings in bill. Technical factor includes equipment quality, easy maintenance and high safety concern.

Environmental factor includes consistency and self-sufficiency.

Results and Discussion

The following figure represents users' responses regarding satisfaction of economic factor of solar rooftop panels.

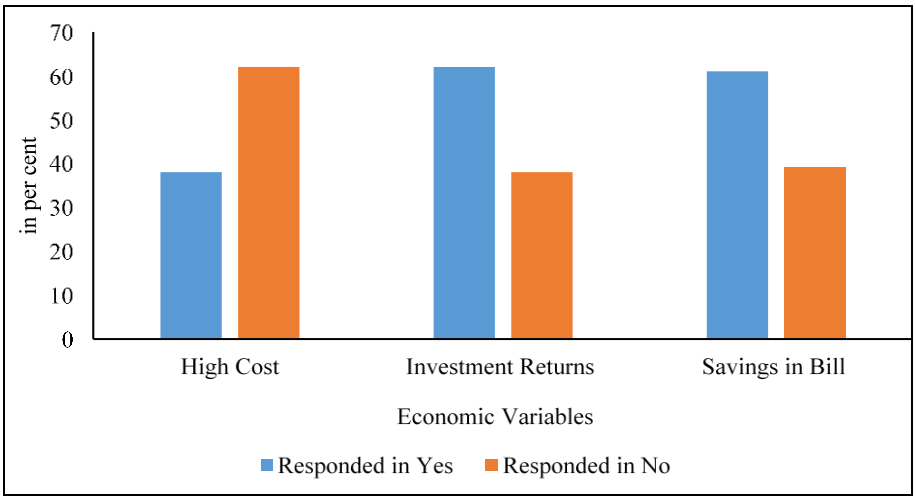

Fig 1: Economic Factor in percent

When asked about whether the cost was high or not, 62 percent users gave a negative response. It means that for a place like Gurugram where income level of people is higher than many other cities of the country, the cost was not a

major concern.

Again, 62 percent households were satisfied with returns they got on the money they invested in the solar rooftop panels. But these users were not necessarily the same who said that the costs were not high.

The main motivation of households to adopt this new technology is the savings in bill. If these users would not feel satisfied with the savings then the spread of technology would become troublesome. In the study, 61 percent households were found to be satisfied with the savings in bill.

The following figure shows the satisfaction considering the technical factor.

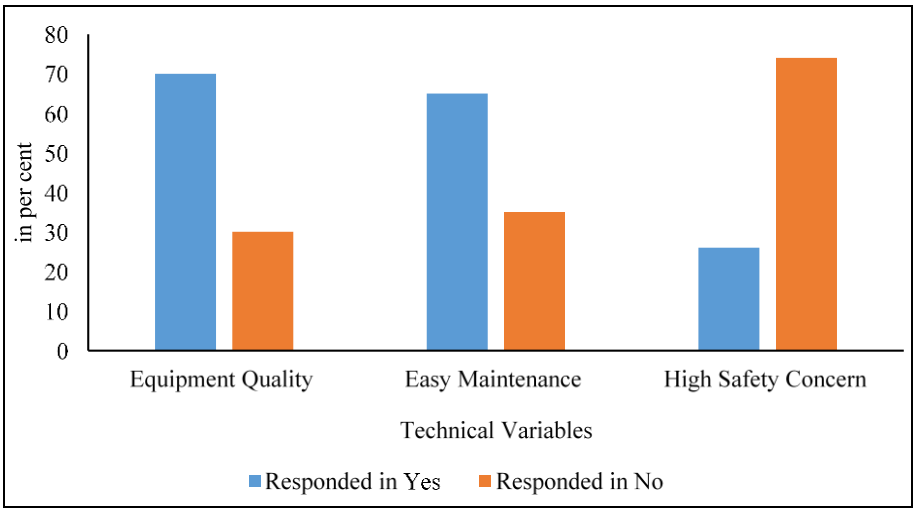

Fig 2: Technical Factor in percent

Figure 2 70 percent households were satisfied with equipment quality. It means that the quality of panels and the other related equipment were found to be satisfactory by the people on a large scale.

65 percent users agreed that the entire system did not need much maintenance. It means that the system was found to be manageable and without devoting much time to its maintenance it could provide satisfactory production. Rest 35 percent found maintenance process cumbersome and thus unsatisfactory.

Electricity production is said to be perilous. High voltage and Direct Current (DC) produced through solar panels comes with its safety concerns. But the panels have been made in such a manner that they are safe to use by everyone. With a little knowledge regarding precautions, these can be installed in the households without any danger for safety. A very high, 74 percent households, also believed in the same. Users did not have high safety concerns regarding them.

The following figure represents the users' satisfaction of environmental factor.

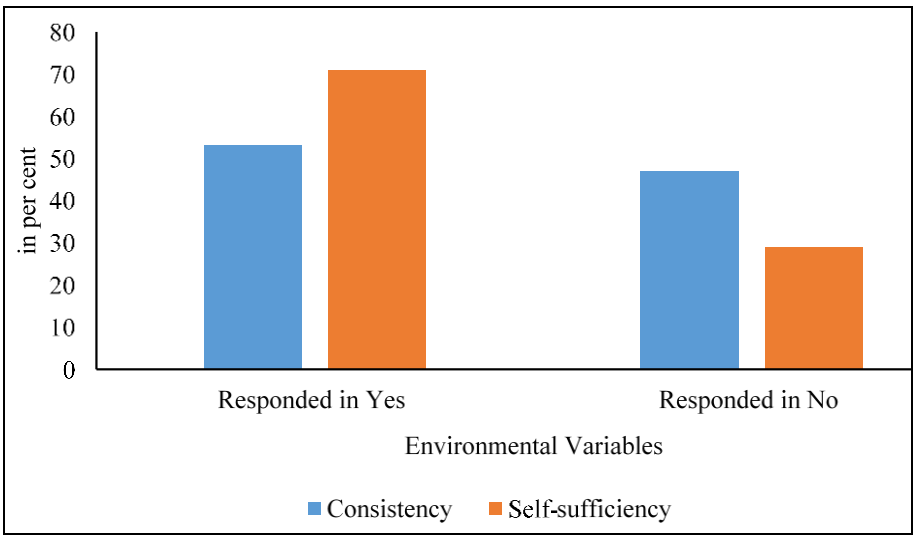

Fig 3: Environmental Factor in percent

Figure 3 53 percent households agreed that the system was consistent in production and the situation regarding power stability has improved after installation of solar rooftop panels. Whereas, 47 percent did not agree to that.

To promote solar panels to new users, it is necessary to have faith in the system. With depleting fossil fuels, renewable energy is the fuel of the future. To make users believe that and move in that direction, it becomes vital that they believe that self-sufficiency in terms of power production can be achieved through it. In that matter, 71 percent households had positive attitude towards it. This positive attitude would set the base for new users.

Conclusion

Most of the users were found to be satisfied with investment returns and the cost of installation was also not high for many of them.

Maintenance requirement and equipment quality go hand in hand as there is no remarkable difference in the satisfaction of both these variables. Users find it easy to maintain and relate it directly to the proficiency of the equipment. Also, people are not worried about the safety and this assurance also comes with the satisfaction of equipment quality.

As people are found to be satisfied with investment returns and consistency of production, they believe that this could be the fuel of future which can lead the country towards self-sufficiency.

But the income level of households of Gurugram along with lifestyle of the city life cannot be made implicit for the rest of the state. The district stands as an exceptional case in total installations of solar panels as well. Hence, the data collected from here can be used to shape the attitude regarding satisfaction level of the people throughout the state but similar response in other cities could not be guaranteed except in high GDP cities.

It can be concluded that once the installation is done then the majority of the people are satisfied with returns, savings in electricity bill, equipment and consistency. Overall performance of the solar panels can be said to be satisfactory by the users. So, the focus should be on engaging more and more people through the awareness programs as once the technology is used it is giving satisfactory output from the perspective of users.

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