Original Research Article

Constraints in adoption of solar photovoltaic water pump sets in Haryana

Abstract

The investigation aimed to find the constraints faced by adopters and non-adopters of solar photovoltaic water pump set. The study was conducted purposely in Jhajjar district of Haryana on the basis of highest number of solar photovoltaic water pump sets installed. 50 beneficiaries and 50 non-beneficiaries were taken for the study and interviewed through a well-defined questionaire. Garret ranking methodology was used to know the ranks of constraints given by farmers in adoption of solar water pump set. The major constraints faced by adopters were poor after sale service by the service providers, delay in installation of solar pump set, small land holdings and availability of less number of solar photovoltaic water pump set (SPWPS). Similarly, the constraints which the non-adopters highlighted in adoption of this technology for irrigation purpose were less availability of subsidized solar water pump set, high initial cost, small landholdings and lack of knowledge about the profitability of solar pump technology. Suggestions for proper implementation of this technology were also incorporated in the study.

Keywords: constraints, solar pump technology, garret ranking, suggestions

1. Introduction

India is on the road to prosperity, but in order to maintain a high rate of progress, continuous electricity supply is required. Manufacturing, education, agriculture, and healthcare are all heavily reliant on electricity and fuel. There are various roadblocks in the way of fully realising India's electricity sector's potential. Fuel availability is a crucial issue in every industry. Due to the increased reliance on outsourced coal, Coal India ltd restricted the supply of coal to coal-based thermal power plants. As a result, the cost of electricity generation rises. The agricultural sector in India consumes around 20 per cent of overall energy consumption, with 85 million tonnes of coal and nearly 4 billion litres of diesel being used as fuel for fuel-operated water pumps (Singh and Kumar & Hundal, 2019). Farmers' face a difficult scenario due to poor energy supply and expensive electricity costs, which results in coarse irrigation. If a sufficient amount of water for irrigation is available when it is needed, crop yields can boost by 10 per cent(Singh and Kumar & Hundal, 2019). The disparity between demand and supply for electricity is likely to widen in the future. The primary goal of a solar-powered pump is to increase agricultural production by providing farmers with safe access to groundwater resources. In India's rural areas, there is a huge untapped market for solar off-grid energy, which offers a lot of potential for power generation and the possibility to replace fossil fuel supplies (Alvar Closas & Edwin Rap, 2017).

Purohit and Michaelowa (2008) studied the potential of solar photovoltaic pumps in India. A renewed impetus for developing and disseminating renewable energy-pump sets was an erratic availability of traditional sources of energy and environmental and sustainable development but high initial investment in adoption of solar water pumps was found to be the main hindrance in the

adoption of this technology. Tayde *et al.* (2010) observed that the major constraint faced by the beneficiaries of the sprinkler irrigation scheme were less contact with extension workers, very poor availability of spare parts and repair service, and lack of technical knowledge about sprinkler irrigation scheme. Kumar *et al.* (2017) did research in Hisar and Rohtak districts of Haryana state. Less working hours in winter season and technology only works in shallow (less than 8 meters) water table, were considered as major technical constraints respectively. While in Rohtak district, less availability of spare parts and feasibility of technology in shallow water table were observed major constraints in adoption of PWPS. The high cost of PWPS was considered to be the most severe financial restriction encountered by the Hisar District respondents. Less subsidy on PWPS was the most serious financial constraint and it was ranked 1st by non-adopters of Rohtak District.

Solar energy has become increasingly important in minimising the usage of fossil fuels. Solar-powered irrigation water pumps have been promoted as an important part of every country's reliable energy portfolio. Solar technology is now being used in every country, and since 2010, the world has seen an increase in solar energy systems and capacity as compared to the previous four decades. Despite some shortcomings in use of this technology, it is going to be the ultimate solution in place of our non-renewable sources.

2. Materials and Methodology

The study was conducted in Jhajjar district of Haryana. The district was selected purposely on the basis of highest number of solar water pump sets installed. Two blocks and five villages from each block were selected randomly. 50 adopters and 50 non-adopters were choosen randomly. Hence a total of 100 farmers were interviewed through a well designed questionnaire.

A comprehensive list of constraints in using the solar water pump set was identified after studying the review of literature and in consultation with the major advisor and other experts. Relevant constraints were selected after proper addition and deletion. The **Garret ranking** methodology was used to determine the major constraints that affect the respondents. Respondents were asked to rank all constraints using this process, and the results were then translated into a score value using the formula below:

Percent position = $100*(Rij-0.5)/N_{ij}$

Where R_{ij} stands for rank given for i^{th} (i=1,2,3,……10) constraint given by j^{th}(j=1,2,3,……100) individual

Nij stands for number of i^{th} constraint given by j^{th} individual.

Following the discovery of the percent positions, the percent positions of each rank were translated to scores using the table provided by **Garret and Woodsworth (1969)**. The scores for each constraint were then averaged over the number of sample farmers who ranked them. Total scores for each constraint were calculated in this manner, and mean scores were calculated by

dividing the total score by the number of respondents who provided ranks. Finally, the constraints were ranked overall by assigning a rank in descending order of the mean scores.

3. Results and Discussion

A list of constraints faced by adopter farmers in the study area is presented in Table 1. Majority of the respondents were stated that poor after sale service by solar panel service providers is major constraints in adoption of SPWPS followed by delay in installation of solar water pump, small and scattered land holdings. Similarly, lack of credit facilities, less number of availability of SPWPS on subsidy and low farm income were also identified as major constraints in wider adoption of SPWPS in the study area.

Table 1: Constraints faced by adopters of SPWPS in Jhajjar district of Haryana (n = 50)

Sr. No.	Constraints	Percent position P.P= 100* (Rij-0.5)/N_{ij}	Garret Score	Mean Score	Rank
1.	Fear of theft	4.5	83	44.9	9
2.	High cost of PWPS	13.6	72	46.02	8
3.	Low farm income	22.7	65	51.58	6
4.	Lack of knowledge about solar system	31.8	60	47.68	7
5.	Lack of credit facilities	40.9	55	52.5	**5**
6.	Small landholding	50.0	50	61.86	**3**
7.	delay in installation of solar water pump set	59.1	46	61.94	**2**
8.	Maintenance and operational problems	68.2	41	35.42	10
9.	Poor after sale service by solar panel service providers	77.3	36	75.76	**1**
10.	Less number of PWPS are available on subsidy	86.4	29	53.16	**4**
11.	Others	95.5	18	21.5	11

Constraints faced by non-adopters in the study area

The constraints faced by non-adopters in the study area are shown in the Table 2. The results showed that less availability of solar photovoltaic water pump sets on subsidy ranked 1st by the majority respondents followed by high cost of SPWPs, maintenance and operational problems of diesel engine.

Similarly, small landholdings, lack of information regarding profitability of SPWPS and low farm income were identified major constraints in wider adoption of SPWPS in the study area. Despite above stated constraints, some of the problems viz; lack of credit facilities, poor quality of ground water, long waiting list in getting connections, and lack of extension services were also identified which were faced by non-adopters of SPWPS in the study area.

Table 2: Constraints faced by non-adopters of SPWPS in Jhajjar district of Haryana (n = 50)

Sr. No.	Constraints	Percent position P.P= 100* (Rij-0.5)/N_{ij}	Garret score	Mean score	Rank
1.	Lack of information regarding profitability of SPWPS	4.5	83	53.02	**5**
2.	Poor quality of ground water	13.6	72	38.7	8
3.	High water table depth	22.7	65	36.84	9
4.	Low farm income	31.8	60	51.32	**6**
5.	Lack of credit facilities	40.9	55	47.26	7
6.	Small landholding	50.0	50	55.18	**4**
7.	Maintenance and operational problems of diesel engine	59.1	46	68.22	**3**
8.	Long waiting list in getting connection	68.2	41	36.28	10
9.	Less number of PWPS are available on subsidy	77.3	36	75.78	**1**
10.	High cost of SPWPS	86.4	29	70.54	**2**
11.	Others	95.5	18	22.14	11

4. Suggestions and policy implications

In the study area, some suggestions were given by the majority of the farmers for improvement in the solar photovoltaic pump technology. These are given below:

1. In order to improve the after-sale service of solar photovoltaic pump set, necessary guidelines need to be given to the concerned companies so that after sale service can be improved.
2. There should be a timely installment of solar photovoltaic water pump set as many farmers reported that there is a huge gap between filing the application form and installment of solar pump set.

3. Availability of more number of subsidized solar photovoltaic water pump set should be ensured to enhance the uses of eco-friendly green energy.
4. High rate of solar pump cost remains a challenge especially for small-scale farmers hence more credit with lower interest rate should be promoted to encourage the purchase and wider adoption towards this technology especially among the marginal and small farmers.
5. Appropriate steps should be taken to connect solar tube wells to the grid with a provision for buy back of surplus power to discourage over-exploitation of groundwater and realization of extra income by the farmers. training and extension services on efficient water management have the potential to shape farmers' behavior and prevent over-extraction.
6. Solar pump fitted with inbuilt trolly system should be promoted so that along with reducing the dangers of theft as well as its potential can also be fully utilized.

5. Conclusion

In India, solar electricity is a great way to boost power production. This is also beneficial to our economic development and environmental conservation. Solar power is an infinite source of energy, and our country has a climate that is conducive to its use, but we need a better idea to improve efficiency and lower production costs. Proper implementation of policies and suggestions has the full potential to replace the non-renewable source of energy. Hence mitigating the above limitations and full utilization of renewable resources can lead to tremendous growth in the economy.

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