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Adoption analysis of vegetable production technology by beneficiaries and non-beneficiaries under solar pump set scheme in Jaipur district of Rajasthan

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Abstract
The present study was conducted in Jaipur district of Rajasthan to analyze adoption of vegetable production technology by beneficiaries and non-beneficiaries under solar pump set scheme in Jaipur district of Rajasthan. Total 120 farmers were selected as a part of sample study from two sub-divisions i.e. Govindgarh (area 269.8 acre) and Jalsu (area 210.8 acre) of Jaipur. Among the beneficiary respondents adoption about the improved practices of vegetable production namely, vegetables growing, selection of improved seed variety, time of sowing, seed treatment, organic and chemical manure, application of irrigation at the right time, intercultural operations, weed management, insect and disease management and harvesting were found to be popular. The results of the study revealed that the majority of 96.66 per cent beneficiaries fall into the category of partial to complete level of adoption against 80 per cent of the non-beneficiaries who were falling under low to partial adoption level. It can be summarized that the variables *viz.*, education, occupation, annual family income, size of landholding, farm mechanization, utilization of information, contact with extension agent, economic motivation and scientific orientation were found significant with their adoption of vegetable production technology. The result also depict that the characteristics *viz.*, age were found non-significant relationship with their adoption of vegetable production technology. It is also concluded that organized trainings as well as promotion of the ongoing schemes should be conducted on the foregoing aspects, coupled with method demonstration, in combination with other extension and good governance activities have to be undertaken, to promote the adoption about the scheme as well.

Keywords: Adoption, solar pump and adoption index

Introduction
Adoption of any improved technology involves a process in which awareness is created, attitudes are changed and favourable conditions for adoption are provided (Ghosh *et al*) [2]. A solar energy-powered water pump is operated on the electricity that is generated by solar photovoltaic modules. It is equivalent to the input and output energy of the solar-pump panels and in addition available voltage security. As per the scheme farmers who set up any of the micro irrigation systems (Drip irrigation, Mini sprinkler or Sprinkler) on their fields are only eligible under the solar-pump subsidy scheme.

India's irrigation is mostly groundwater well based. At 39 million hectares 67 per cent of its total irrigation, India has the world's largest groundwater well equipped irrigation system. Around 84 per cent of the total available water is consumed for irrigation in the country and it is crucial to provide timely and adequate water supply to ensure improved agricultural productivity (NITI Aayog, 2015; Dhawan, 2017) [12, 1]. In India, irrigation is majorly dependent on diesel and electric pumps with nearly 21 million agricultural electricity connected pumps 70 per cent and more than 8 million diesel irrigation pumps sets 30 per cent (IEEFA, 2018) [6]. At present, only 0.4 per cent (around 2 lakh) of solar water pumps has reportedly been installed in the country (MNRE, 2018; IEEFA, 2018) [10, 6].

Table 1: Irrigation Pumps in India (2018)

Pump Type	No. of pumps (in millions)	Percentage of pumps
Electric pumps	21.00	70.16
Diesel pumps	08.80	29.40
Solar pumps	00.13	00.43
Total	29.93	100.00

Source: (MNRE, 2018; Jain & Agrawal, 2018; IEEFA, 2018) [10, 7, 6]

For agriculture in India grid electricity is given at tremendously short tariffs. In most cases, flat rates are paid depending on the pump classification (Tanwar 2016) [14].

There is a small market for non-subsidized pumps that witnesses demand from Non- Government Organizations (NGOs) and Institutions. Rajasthan has the mostly outstanding solar radiation in India and along with the most excellent in the world. Solar pump beside with micro-irrigation systems scheme is ongoing in Rajasthan from the year 2010-11. Solar radiation potential in the state is up to 6-7 kWh/m^2 and there are more than 325 sunny days per year, where a solar-powered pump can be made available for never-ending irrigation supply for 6-8 hours in a day.

Encouraged by the reducing cost of solar power system and its environmental compensation, the Government of Rajasthan launched this scheme in the year 2011 with sum of Rs 515 crore to provide subsidized solar irrigation system to the state's 10,000 farmers within three years. Presently, this scheme in Rajasthan was initiated to provide financial support to horticulture farmers who utilized drip irrigation and farm ponds. Kamble *et al.* (1996) [8] revealed that 46 per cent of onion growers had taken care during onion storage and about 36.67 per cent growers graded their produce before marketing. Vasava (1997) found that majority of the tribal tomato growers had medium level of adoption.

The present study was undertaken with the specific objective to study 'Adoption analysis of vegetable production technology by beneficiaries and non beneficiaries under solar pump set scheme in Jaipur district of Rajasthan**'.**

Research Methodology

The present study was conducted purposely in the Jaipur district of Rajasthan, during the year 2020. Among the 33 districts of Rajasthan, Jaipur district, which is located on the North-Eastern part, was purposively selected, as this district stands first in number of beneficiaries under solar pump set as well as in the area under vegetable production. In total there are 13 Sub-divisions (blocks) in Jaipur district of Rajasthan, out of which, two sub-divisions i.e., Govindgarh with an area of 269.8 acre and Jalsu with an area 210.8 acre, were selected on the basis that these blocks cover the maximum number of beneficiaries under solar pump set and above mentioned areas are one among the highest vegetable growing regions of Jaipur district of Rajasthan. From each selected sub-divisions, 30 beneficiary farmers and 30 non- beneficiary farmers (60 farmers from both blocks) of solar pump set were chosen randomly with the help of data gathered from the office of Deputy Director of Horticulture, Govt. of Rajasthan, Jaipur. Thus, in all, 120 farmers were included in the sample for the further study. Thus, the sample size constituted of 120 respondents (60 beneficiary farmers, 60 non- beneficiary farmers). The information was collected by personal interview method with the help of structured schedule. The data were analyzed, tabulated and interpreted with the help of frequency and percentage.

It refers to the actual use of the improved vegetable production technology using solar pump set. The questions were regarding use of solar energy pumps in vegetables production. Solar energy pump set helpful in water supply for vegetables crops. The adoption is measured on three-point continuum as complete, partial and no adoption was given 3, 2 and 1 scores respectively. The total scores obtained by the respondents from adoption score of individual respondents. Finally the adoption score obtained by individual respondent were converted into adoption index as below:

$$\text{Adoption index} = \frac{\text{Obtained adoption Score}}{\text{Obtainable adoption score}} \times 100$$

Results and Discussion

a. Adoption of vegetable production technology by the beneficiaries and non-beneficiaries

The data presented in Table 1 indicates that various farm practices of vegetable cultivation were recommended to the farmers under solar pump set includes vegetables growing, selection of improved seed variety, time of sowing, seed treatment, organic & chemical manure, application of irrigation, intercultural operations, weed management, insect & disease management and harvesting.

Practices wise adoption of beneficiaries according to their vegetable production technology

In relation to vegetables growing majority of the respondents, (53.34%) had partial adoption whereas, (41.66%) had complete adoption and (5%) had low adoption about vegetables growing in vegetable production technology. As observed selection of improved seed variety maximum number of the respondents55 per cent had partial adoption, whereas (43.34%) had complete adoption and (1.66%) had low adoption about selection of improved seed variety. In case of time of sowing maximum number of the respondents, (58.34%) had partial adoption, whereas (40%) had complete adoption and (1.66%) had low adoption about time of sowing in vegetable production technology. In case of rate of seed treatment, 51.66 per cent of the respondents had partial adoption, whereas (45%) had complete adoption and (3.34%) had low adoption about seed treatment. In case of recommended dose of organic & chemical manure, majority of the respondents, (55%) had partial adoption, followed by complete (43.34%) and low (1.66%) respectively. Regarding application of irrigation, (53.34%) of the respondents had partial adoption, whereas (46.66%) had complete adoption and low adoption about application of irrigation. Regarding intercultural operations, (53.34%) of the respondents had partial adoption, whereas (45%) had complete adoption and (1.66%) had low adoption about intercultural operations. In case of weed management maximum number of the respondents (38.34%) had partial adoption, while (60%) had complete and 1.66 per cent had low adoption about weed management in vegetable production technology. In relation to insect & disease management maximum number of the respondents, (41.66%) had partial adoption, while (50%) had complete and (8.34%) had low adoption about insect & disease management in vegetable production technology. As regards harvesting, maximum number of the respondents, (40%) had partial adoption, while (51.66%) had complete adoption and (8.34%) had low adoption about harvesting.

Practices wise adoption of non-beneficiaries according to their vegetable production technology

In relation to vegetables growing maximum number of the respondents 35 per cent had partial adoption while, (43.34%) had low adoption and (21.66%) had complete adoption about vegetables growing in vegetable production technology. As sensible selection of improved seed variety maximum number of the respondents 38.33 per cent had partial adoption, while (43.33%) had low and (18.34%) had complete adoption about selection of improved seed variety. In relation to time of sowing more than half of the respondents 36.67 per cent had partial adoption whereas, (46.66%) had low adoption and (16.67%) had complete adoption about time of sowing in vegetable production technology. Regarding rate of seed treatment, (35%) of the respondents had partial adoption, whereas (46.66%) had low adoption and (18.34%) had complete adoption about seed treatment. Regarding recommended dose of organic & chemical manure, maximum number of the respondents, (28.33%) had partial adoption, followed by low (53.33%) and complete (18.34%) respectively. Regarding application of irrigation, (38.34%) of the respondents had partial adoption, whereas (41.66%) had low adoption and (20%) had complete adoption about application of irrigation. Regarding intercultural operations, (35%) of the respondents had partial adoption, whereas (46.66%) had low adoption and (18.34%) had complete adoption about intercultural operations. In subsequently of kin to weed management maximum number of the respondents, (36.66%) had partial adoption, while (38.34%) had low adoption and (25%) had complete adoption about weed management in vegetable production technology. In relation to insect & disease management maximum number of the respondents, (40%) had partial adoption, while (40%) had low and (20%) had complete adoption about insect & disease management in vegetable production technology. As regards harvesting, maximum number of the respondents, (26.66%) had partial adoption, while (50%) had low adoption and (23.34%) had complete adoption about harvesting.

Table 1: Adoption of Vegetable Production Technology by the Beneficiaries and Non-Beneficiaries

Practices	Beneficiaries			Non-beneficiaries		
	Complete	Partial	Low	Complete	Partial	Low
Vegetables growing	25 (41.66)	32 (53.34)	03 (05.00)	13 (21.66)	21 (35.00)	26 (43.34)
Selection of improved seed variety	26 (43.34)	33 (55.00)	01 (01.66)	11 (18.34)	23 (38.33)	26 (43.33)
Time of sowing	24 (40.00)	35 (58.34)	01 (01.66)	10 (16.67)	22 (36.67)	28 (46.66)
Seed treatment	27 (45.00)	31 (51.66)	02 (03.34)	11 (18.34)	21 (35.00)	28 (46.66)
Organic and chemical manure	26 (43.34)	33 (55.00)	01 (01.66)	11 (18.34)	17 (28.33)	32 (53.33)
Application of irrigation	28 (46.66)	32 (53.34)	00 (00.00)	12 (20.00)	23 (38.34)	25 (41.66)
Intercultural operations	27 (45.00)	32 (53.34)	01 (01.66)	11 (18.34)	21 (35.00)	28 (46.66)
Weed management	36 (60.00)	23 (38.34)	01 (01.66)	15 (25.00)	22 (36.66)	23 (38.34)
Insect and disease management	30 (50.00)	25 (41.66)	05 (08.34)	12 (20.00)	24 (40.00)	24 (40.00)
Harvesting	31 (51.66)	24 (40.00)	05 (08.34)	14 (23.34)	16 (26.66)	30 (50.00)

(Figures in parenthesis indicate percentage**)**

b. Level of adoption

The data in Table.2 showed that (42.10%) of the respondents belong to partial level of adoption, followed by (33.34%) had complete level of adoption and (24.66%) low level of adoption. In case of beneficiaries of solar pump set scheme, maximum number of the respondents, (50%) belong to partial level of adoption, followed by (46.66%) had complete level of adoption and (3.34%) had low level of adoption. Similarly in case of non-beneficiaries of solar pump set scheme, maximum number of the respondents, (45%) had low level of adoption, followed by (35%) had partial level of adoption and (20%) had complete level of adoption.

Table 2: Distribution of the farmers according to their level of adoption regarding vegetable production technology

Level of adoption	Beneficiaries (n=60)	Non-beneficiaries (n=60)	Total (n=120)
Low (Up to 16)	02 (03.34)	27 (45.00)	29 (24.66)
Partial (17 to 25)	30 (50.00)	21 (35.00)	51 (42.10)
Complete (Above 25)	28 (46.66)	12 (20.00)	40 (33.34)

(Figures in parenthesis indicate percentage)

c. Association between the beneficiaries and non beneficiaries vegetable growers of solar pump set scheme with their knowledge and adoption of vegetable production technology

Association of Beneficiaries and Non-Beneficiaries' vegetable growers of solar pump set scheme with their adoption of vegetable production technology were worked out and the presented in table 3 & 4. In case of Non-Beneficiaries the profile *viz*., education, annual family income, farm mechanization, utilization of information, economic motivation and scientific orientation were found significant at 0.01 level of probability while occupation, size of land holding and contact with extension agent were found significant at 0.05 level of probability with their adoption of vegetable production technology, whereas age were found not significant association.

In case of education (X_2), annual family income (X_4), farm mechanization (X_6), utilization of information (X_7), economic motivation (X_9) and scientific orientation (X_{10}), calculated values of chi-square were found to be 25.58, 16.82, 21.24, 17.86, 13.67 and 16.58 respectively while tabular chi-square values at 4 and 8 degrees of freedom were 13.28 and 20.09 respectively because in each case of education (X_2), annual family income (X_4), farm mechanization (X_6), utilization of information (X_7), economic motivation (X_9) and scientific orientation (X_{10}), the computed chi- square value was larger than the corresponding tabular value at the 1 per cent level of significance, hence the hypothesis of independence between the adoption of vegetable production technology and the education (X_2), annual family income (X_4), farm mechanization (X_6), utilization of information (X_7), economic motivation (X_9) and scientific orientation (X_{10}) of

beneficiaries vegetable growers of solar pump set scheme were rejected. Similarly in case of occupation (X_3), size of landholding (X_5) and contact with extension agent (X_8), the calculated chi square value were 15.46, 15.82, 12.26 which were more than correspondent tabulated chi-square value of values of 5 per cent level of significance at 6 and 4 degree of freedom respectively. Thus the hypothesis of independence between adoption of vegetable production technology and occupation (X_3), size of landholding (X_5) and contact with extension agent (X_8), of the profile of beneficiaries' vegetable growers of solar pump set scheme were rejected. Which mean that there was a significant agreement between adoption of vegetable production technology of beneficiaries' farmers with their occupation (X_3), size of landholding (X_5) and contact with extension agent (X_8).

In case of age (X_1) the calculated chi-square value was less than its corresponding tabulated value at 4 degree of freedom. Thus, the null hypothesis "there is no association between age and adoption of vegetable production technology" was accepted and hence, it was calculated that the adoption of vegetable production technology did not depend upon the age of the beneficiaries farmers.

Table 3: Association between the Beneficiaries vegetable growers of solar pump set scheme with their adoption of vegetable production technology

(n=60)

Variables	χ^2 value	d.f.	C value	P value
Age (X_1)	4.37^{NS}	4	0.19	0.3582
Education (X_2)	25.58**	8	0.42	0.0012
Occupation (X_3)	15.46*	6	0.34	0.0169
Annual family income (X_4)	16.82**	4	0.35	0.0020
Size of landholding (X_5)	15.82*	6	0.34	0.0147
Farm mechanization (X_6)	21.24**	4	0.39	0.0002
Utilization of information (X_7)	17.86**	4	0.36	0.0013
Contact with extension agent (X_8)	12.26*	4	0.30	0.0155
Economic motivation (X_9)	13.67**	4	0.32	0.0084
Scientific orientation (X_{10})	16.58**	4	0.35	0.0023

^{NS} Non significant **Significant at 0.01 level of probability *Significant at 0.05 level of probability

In case of education (X_2), annual family income (X_4), farm mechanization (X_6), utilization of information (X_7), economic motivation (X_9) and scientific orientation (X_{10}), calculated values of chi-square were found to be 26.46, 15.58, 22.66, 16.54, 12.85 and 15.26 respectively while tabular chi-square values at 4 and 8 degrees of freedom were 13.28 and 20.09 respectively because in each case of education (X_2), annual family income (X_4), farm mechanization (X_6), utilization of information (X_7), economic motivation (X_9) and scientific orientation (X_{10}), the computed chi- square value was larger than the corresponding tabular value at the 1 per cent level of significance, hence the hypothesis of independence between the adoption of vegetable production technology and the education (X_2), annual family income (X_4), farm mechanization (X_6), utilization of information (X_7), economic motivation (X_9) and scientific orientation (X_{10}), of non-beneficiaries vegetable growers of solar pump set scheme were rejected. Similarly in case of occupation (X_3), size of landholding (X_5) and contact with extension agent (X_8), the calculated chi square value were 13.76, 14.75, 11.24 which were more than correspondent tabulated chi-square value of values of 5 per cent level of significance at 6 and 4 degree of freedom respectively. Thus the hypothesis of independence between adoption of vegetable production technology and occupation (X_3), size of landholding (X_5) and contact with extension agent (X_8), of the profile of non- beneficiaries vegetable growers of solar pump set scheme were rejected. Which mean that there was a significant agreement between adoption of vegetable production technology of non-beneficiaries farmers with their occupation (X_3), size of landholding (X_5) and contact with extension agent (X_8).

In case of age (X_1) the calculated chi-square value was less than its corresponding tabulated value at 4 degree of freedom. Thus, the null hypothesis "there is no association between age and adoption of vegetable production technology" was accepted and hence, it was calculated that the adoption of vegetable production technology did not depend upon the age of the non-beneficiaries farmers.

Table 4: Association between the Non-Beneficiaries vegetable growers of solar pump set scheme with their adoption of vegetable production technology

(n=60)

Variables	χ^2 value	d.f.	C value	P value
Age (X_1)	5.68^{NS}	4	0.21	0.2243
Education (X_2)	26.46**	8	0.43	0.0008
Occupation (X_3)	13.76*	6	0.32	0.0324
Annual family income (X_4)	15.58**	4	0.34	0.0036
Size of landholding (X_5)	14.75*	6	0.33	0.0222
Farm mechanization (X_6)	22.64**	4	0.39	0.0001
Utilization of information (X_7)	16.54**	4	0.35	0.0023
Contact with extension agent (X_8)	11.24*	4	0.29	0.0239
Economic motivation (X_9)	12.85**	4	0.31	0.0120
Scientific orientation (X_{10})	15.26**	4	0.34	0.0041

^{NS} Non significant **Significant at 0.01 level of probability *Significant at 0.05 level of probability

Conclusion

Among the beneficiary respondents adoption about the improved practices of vegetable production namely, vegetables growing, selection of improved seed variety, time of sowing, seed treatment, organic and chemical manure, application of irrigation at the right time, intercultural operations, weed management, insect and disease management and harvesting were found to be popular. The results of the study revealed that the majority of 96.66 per cent beneficiaries fall into the category of partial to complete level of adoption against 80 per cent of the non-beneficiaries who were falling under low to partial adoption level. It can be summarized that the variables *viz*., education, occupation, annual family income, size of landholding, farm mechanization, utilization of information, contact with extension agent, economic motivation and scientific orientation were found significant with their adoption of vegetable production technology. The result also depict that the characteristics *viz*., age were found non-significant relationship with their adoption of vegetable production technology. It is also concluded that organized trainings as well as promotion of the ongoing schemes should be conducted on the foregoing aspects, coupled with method demonstration, in combination with other extension and good governance activities have to be undertaken, to promote the adoption about the scheme as well.

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