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Evaluation of the perception of PM-KUSUM scheme and its adoption in Odisha

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ABSTRACT

PM-KUSUM scheme is an ambitious program of government of India launched in 2019 across the nation. With the introduction of the scheme all the states have unanimously rolled it out replacing any other state specific schemes for solarization of the agriculture pumps. Among those, Odisha is a state with no proper electricity grid connection to irrigate the lands across the districts. Hence the PM-KUSUM scheme acts as a solution to help the unelectrified farms to get unlimited, no-cost clean fuel in the form of solar energy for irrigating the fields throughout the year. Thus, Odisha government along with OLIC (Odisha lift irrigation corporation) and OREDA (Odisha renewable energy agency) have been trying to connect the farmers with solar irrigation and make them energy independent.

In Odisha the districts of Sambalpur and Keonjhar were surveyed for the study, 100 solar adopter farmers and 30 non-solar adopter farmers were interviewed to know the status of implementation of the scheme. 2 blocks from each district were chosen and farmers were asked to opine on the pre tested questionnaire to know the status of solar irrigation and the awareness level about the solar scheme and its usage. Along with this the constraints faced by the farmers were also analyzed and ranked. The results showed that farming experience and family member size were the factors affecting the adoption of solar irrigation. While other factors were not found to be affecting significantly the adoption trend. It also showed that 64% of farmers said that OLIC was the source of information for them to go for solar irrigation. While 29% of the farmers said agriculture departments created the awareness about the scheme in the area. In Sambalpur 83% agreed that with solar irrigation their cropped area has increased and in Keonjhar where most farmers were totally rain dependent and with introduction of solar, more than 90% of the farmers reported increase in cropped area with assured irrigation due to solar, enabling the farmers to take more than one crop.

Keywords: PM-KUSUM, Solar, OLIC, OREDA, Irrigation

INTRODUCTION

The PM-KUSUM (Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan) scheme aims to promote renewable energy use in Indian agriculture by subsidizing the installation of solar water pumps. PM-KUSUM scheme with its Solar water pumps are transforming the irrigation needs of the farmers in no grid connected remote areas across Indian states since its launch in 2019. Odisha is one such state dominated by tribal regions with small and marginal famers who are left out from the main electricity grid connections even today for their day-to-day livelihoods. Hence, Farmers here are heavily dependent on diesel irrigation which is way too costly to carry out farming in all the seasons. Even the farmers who are connected to grid electricity face unassured supply issues during crop seasons. Thus, for these areas the PM-KUSUM

scheme providing highly subsidized solar pumps is real blessing, as it fills those small pockets that were left empty with fallow lands due to lack of assured irrigation source throughout the year.

The study examines the implementation of the PM-KUSUM scheme in Odisha, where the solar pumps are provided to farmers having minimum of 0.5 acre of land or on cluster basis in the areas where there is lack of electricity connections to the farmers. PM-KUSUSM scheme being a flagship program of government of India, is rolled out nationwide since 2019 for standalone and grid connected pumps. With this the state of Odisha previously having the Saur Jal Nidhi yojana for solar irrigation merged it under the central PM-KUSUM scheme as every state can get 30% Central Financial Assistance and 30% to be borne by the State Government subsidy in most regions, with farmers paying only 10% of the cost as direct payment and financing the remaining 30% via loans. In Odisha OLIC (Odisha lift irrigation corporation) is the agency for setting up the grid connections for the borewells for agricultural uses and OREDA (Odisha renewable energy agency) is the nodal agency for installation of the solar pumps after selection of the beneficiaries, which is scrutinized by OLIC. Interestingly in Odisha the OLIC is selecting only those farmers as beneficiaries who have never had electricity grid connection or failed grid connections at the fields and every single grid installed feeds 4 to 5 farmers' fields or minimum of 5 acres of land for electricity connections. Thus, it excludes all those farmers who may wish to have solar pumps as renewable source of energy for irrigation supplementing to existing electricity grid connections. Hence, in Odisha PM-KUSUM scheme is exclusive in selection of farmers with no prior electricity connections. Invariably, the scheme has to penetrate in tribal and unconnected areas where farmers lack assured source of power from OLIC or depend on diesel for irrigation throughout the year. It indeed has helped those farmers to get assured day time autonomous solar power who were once totally deprived of electricity for irrigation needs. Here, the study analyses the penetration of PM-KUSUSM scheme in the Odisha's unconnected regions of Keonjhar and Sambalpur and its adoption in the area.

STUDY DESIGN AND METHODOLOGY

The study adopted a primary survey–based analytical framework to evaluate adoption of PM-KUSUM scheme among the farmers in Eastern Indian state of Odisha. A total sample size of 130 farm households was surveyed across the state of Odisha selecting Sambalpur and Keonjhar as the study regions. To know the adoption of the scheme logit model was used to see the factors affecting the scheme adoption in the area, it shows the factors affecting the penetration of the scheme in the region.

Logit model

Binary Logistic regression will be estimated to identify the factors influencing adoption of solar irrigation. The dependent variable model will be used for capturing the influence of several factors on adoption of solar irrigation by the beneficiaries.

$P_i = e(y=1/X_i) = 1/(1+e^{-z}) = e^z/(1+e^z)$

Where, the explanatory variables include level of income, Age of the farmer, Education, Head of the family, land holding of the beneficiary, access to institutions, contact with extension agents access to market, farming experience etc.

$Z = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + \ldots + b_iX_i$

Odds ratio = $(p/1\text{-}p) = e^{b0+bixi+ui}$

Log odds = $Li = Ln\ (p/1\text{-}p) = b_0 + b_iX_i + u_i$

Perception analysis was made using Likert scale technique to quantify the adoption of the scheme based on the farmers perception, where a set of pre-constructed statements were asked to famers regarding adoption of the scheme. Likert scale is a psychometric response scale primarily used in questionnaires to obtain participant's preferences or degree of agreement with a statement or set of statements. Likert scales are a non†comparative scaling technique and are unidimensional (only measure a single trait) in nature. Respondents are asked to indicate their level of agreement with a given statement by way of an ordinal scale. A 5†point scale ranging from "Strongly Disagree" on one end to "Strongly Agree" on the other with "Neither Agree nor Disagree" in between. Perception of farmers can be seen through various aspects like access to Solar irrigation, timely availability, Source of information, ease of usage of solar pumps, input availability, trustworthiness of farmers on the agency implementing the scheme and effect on yield.

Followed by Garette ranking technique to know the constraints faced by the farmers in adoption of the solar irrigation or taking up the PM-KUSUSM scheme as such.

To see the constraints faced by stake holders in availing the solar irrigation and its implementation with PM-KUSUSM scheme, various statements will be asked to the stakeholders by means of primary survey where opinions of all the farmers involved will be considered. The constraints will be prioritized by using Garrett's ranking technique in the following manner:

$$\text{Percentage position} = \frac{100\ (R\ ij - 0.50)}{N\ j}$$

Where,

R_{ij} = Rank given for the i^{th} item by the j^{th} individual and

N_j = Number of items ranked by the j^{th} individual.

The percentage position of each rank will be converted into scores using Garrett table. For each constraint, scores of individual respondents will be added together and divided by total number of respondents for whom scores will be added. Thus, mean score for each constraint would be ranked by arranging them in the descending order. In the same manner, opinion about further prospects will be obtained from stakeholders and then Garrett's ranking technique will be used for prioritizing the statements.

RESULTS AND DISCUSSION

The government of Odisha already had the Soura Jalanidhi scheme for solar pumps operating not much inclusively to meet the energy needs and boost states production as well as irrigation potential. Here the scheme offered 90% subsidy to give around 5000 solar pumps to the farmers in the state. The state distributed 230 solar pumps of 0.5 HP to farmers with minimum of 0.5 acre of land in FY 2019-2020 (GIZ, 2023). Hence, along with the centrally launched PM-KUSUM scheme since 2019, the state runs its scheme in convergence mode with the center. Under PM-KUSUM component A, the total sanctioned solar capacity for Odisha is 500 MW but as of now no installation has taken place. With only component B being fully functional and suitable to Odisha so far, 10356 off-grid (standalone) solar pumps have been installed generating the total solar capacity of 37.98 MW. out of the targeted 5471 numbers (PM-KUSUM Odisha State Portal, n.d.).

Th states implementation agencies are OREDA and OLIC, and are also the source of information generation and selection of beneficiaries for the scheme. It operates through district level OLIC offices and the chain of extension agents associated with. The results of the study made in districts of Keonjhr and Sambalpur regarding scheme uptake are discussed below.

Factors Influencing Adoption of Solar Irrigation

The comparative analysis between adopters and non-adopters revealed statistically significant differences across key socio-economic and farm-level variables. Logistic regression results identified access to extension services and farming experience as significant predictors of solar irrigation adoption. The coefficient for access to extension services was positive and statistically significant (B = 0.2213; p = 0.0381), indicating that an increase in access to extension services enhances the likelihood of adoption. The corresponding odds ratio (1.2477) suggests that every additional access to extension services increases the probability of adopting solar irrigation by about 22 percent as given in Table 1. While education of the farmers positively influenced the adoption of solar irrigation with odds ratio

Table 1. Factors influencing the adoption of Solar irrigation

Predictor	Coefficient	Std. error	Sig.	Exp(B)
Age	–0.0226	0.0190	0.2349	0.9777
Caste	–0.2670	0.2654	0.3144	0.7657
Education	0.1051	0.1337	0.0397**	1.0102
Size of holding	–0.0060	0.0331	0.8558	0.9940
Access to extension services	0.2213	0.1067	0.0381**	1.2477
Farming experience (years)	–0.0632	0.0238	0.0080***	0.9388
Social contacts	–0.0639	0.1905	0.7371	0.9381
Family members	0.1932	0.4909	0.6939	1.2132
Annual income	–0.000001	0.000002	0.4924	1.0000
Constant	4.6213	1.5990	0.0039	101.624

Note: ** $p < 0.05$, *** $p < 0.01$

(1.0102) suggests that every one year of extra schooling increases the adoption rate by 10 percent. Similar results are found in a study by Narayanmoorthy *et al.*, (2025) where they found education of the farmer, farm size and cropping intensity as the factors influencing the adoption of solar irrigation significantly in Tamil Nadu.

In contrast, farming experience exhibited a negative and statistically significant relationship with adoption (B = –0.0632; p = 0.0080). The odds ratio (0.9388) implies that each additional year of farming experience reduces the likelihood of adoption by nearly 6 percent, indicating possible resistance to technological change among more experienced farmers.

In a study made by Satish *et al.*, (2024), the similar results were seen for Gujarat, where most farmers using solar irrigation out of the 150 sampled farmers were in the age group of 30-50. Having higher secondary education levels. While 32 farmers only were above the age of 50 years in adopting the solar irrigation. The study showed government policy and economic benefit as factors contributing to adoption, indirectly government policy can be attributed to the access to extension services component which is significantly affecting adoption of solar irrigation in Odisha (Satish *et al.*, 2024).

Perception study was made to see the farmers uptake of solar and what are the conceived beliefs about solar irrigation scheme in the study area. The farmers were asked various statements regarding the solar irrigation and PM-KUSUM scheme which is represented in the Table 2. Analyzed with Likert scale technique capturing the set of statements perceived among the sampled farmers in percentage terms.

It is evident from the table that, most of the farmers (61%) are aware about the scheme with the help of OLIC or OREDA who have actually installed the pumps in their fields. Showing less influence of local agents or media in spreading the news. While 90% farmers agreed upon increased cropped area after solar pump installation in the state. Similar results are found in a report (Kavitha, 2025) where the farmers I Odisha perceive solar irrigation as beneficial in reducing diesel costs yearly and also provide reliable irrigation to them and also easier with farm operations. Nearly 68% of majority farmers did not find any handling issues with solar pumps once installed reducing need of trainings. While there was poor monitoring status by the agencies after installation with 67% farmers opining the same and it is corroborated by a study in Odisha districts for 70 farmers (Ankhila *et al.*, 2025). More than 80% famers agreed upon reduced cost of fuel such as diesel. Though the center and state government provides direct subsidy of 60% still 47% of the farmers find it difficult to finance through self. In general studies point out to high upfront cost of solar irrigation, Credit challenges among the small and marginal Indian farmers (Srinivasa & Mithöfer, 2024). The studies also point to the lack of technical knowledge I handling the SIPS (solar irrigation pumps) along with institutional challenges and economic barriers among constraints.

The first and foremost constraint as seen by the farmers was the lack of awareness about the scheme and the benefits that they are going to accrue in the long run. Since no much awareness programs were conducted, farmers away from mainland lacked information about the scheme and its benefits until told or installed by the OLIC at their fields for connection hence it was ranked as 1. Performance of SIPs was severely affected during the cloudy days, since there was no battery backup. Hence Weather-related performance was a challenge faced by the farmers, ranked as 4th constraint due to lack of battery

Table 2. Perception of the PM-KUSUSM scheme of solar irrigation

Statements	Agree (%)	Neutral (%)	Disagree (%)
Awareness about the PM-KUSUS scheme through OREDA/OLIC	61	20	19
Functionality of the solar pumps post installation	68	15	17
Solar pump adoption led to Increase in cropped area in the study sites	90	10	0
There are handling difficulty with solar pumps after field installation	21	6	73
Solar pumps have led to reduction in diesel usage and cost of fuel significantly	81	9	10
Monitoring and evaluation done regularly by OLIC/OREDA	21	12	67
Formal trainings on Solar irrigation schemes are imparted to farmers	16	31	53
Farmers find that 40% of the installation amount of solar pump to be still high, to pay self	47	24	29

Table 3. Constraints faced by the farmers in adoption of solar irrigation through PM-KUSUSM scheme

Particulars	Average score	Garrett ranking
Lack of awareness of the scheme benefits	72.41	1
Complexity of registration for the scheme	72.03	2
Lack of battery backup with solar pumps	64.97	3
Weather related performance of SIPs	57.8	4
High initial investment and low subsidy	45.9	5
Technical information gap	45.54	6
Poor after installation services for maintenance	40.56	7
Theft and wildlife damages	39.41	8
Equity and inclusion challenges	33.74	9
Risk of groundwater over extraction	25.51	10

back-up in the installation system ranked at 3 (More *et al*., 2024, Srinivasa & Mithöfer, 2024). The registration process for PM-KUSUSM is made online and needs to fulfill certain criteria by the applicant, hence assistance for filling and internet services is mandatory for the farmers or have to go the local portal making the process little cumbersome for the not so tech-friendly farmers which is ranked as 2nd constraint ,other studies too point out on complexity of the filing process and lack of awareness of the scheme among farmers as major challenges (More *et al*., 2024; Sharma, 2025). High initial investment was ranked as the 5th constraint, with 60% subsidy the remaining 40 % still needs to be borne by the farmers while some individual farmers felt it to be more, while those on cluster basis did not find it more to pay as it was minimal of ₹ 20000 - ₹ 30000/ only, study by Srinivasa & Mithöfer, (2024). reflect on high initial upfront cost and accessing easy credit as constraint among the farmers in India. Poor after installation services of solar pumps leading to lack of maintenance is found to be one among the top 10 constraint ranked at 7th. Similarly studies point out the lack of service providers nearby and their accessibility to farmers are the hindrance in its adoption and also the technical issues related to operation of the SIPs, slow down its adoption (Agarwal *et al*., 2025; More *et al*., 2024). Along with this in Odisha, wildlife menace to solar panels and few cases theft of solar panels was seen among the top 10 constraints, which could be handled with proper fencing arrangements to the farm area. Exclusion of women farmers or those from weaker sections created bias, though it was not widely noticed as constraint. Risk of groundwater extraction as a constraint was not seen by the farmers as such in the surveyed areas. while many other studies point out that with solar there can always be overexploitation of groundwater thus, creating water table constraint (Shah, 2024; Pearce, 2024; Shah, 2023) citing the cases of Karnataka, Gujarat and Rajasthan along with other south Asian countries and Bangladesh in specific based on the groundwater sustainability studies (Aditi, 2022; Tanmoy, 2026).

CONCLUSION

The study revealed that with introduction of PM-KUSUM scheme, many of the farmers in the unelectrified regions of Odisha are able to get assured source of renewable power supply for their farms throughout the year with zero pricing. Penetration of the scheme in the interior regions depends on popularizing the scheme benefits among the rural community, thus extension services play a pivotal role along with local implementing agencies like OLIC. In adoption of the scheme among the farmers, education and access to extension services played a positive role while farming experience negatively affected the adoption showing resistance among the experienced old farmers in adoption of the new scheme. On the whole, the PM-KUSUM scheme with motto of popularizing solar irrigation has huge potential to transform the livelihoods of the farmers providing them with constant, reliable energy supply and assured flow of income throughout the year.

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