Extending Solar Water Pump Subsidies : Impact on Water use, Energy use and Cropping Patterns in Rajasthan: Difference in Differences Analysis

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Abstract

The key objective of the study is to estimate the causal effect of solar water pumping program on water consumption, energy consumption, cropping intensity and cropping patterns of farmers in Rajasthan. For this we have done survey of 430 farmers from 6 districts-Jaipur, Sikar, Jaisalmer, Sriganganagar, Bikaner and Chittorgarh. We have used difference in differences analysis to estimate the above mentioned impacts of solar pump adoption during the period 2011-12-2015-16. We found that the solar pump subsidy program has increased energy and water access for solar pump adopters in Rajasthan. This has led to increase in cropping intensity, gross cropped area under fruits and vegetables, and annual profits of solar pump adopters in Rajasthan. Overall, this seems to be a good policy for enhancing food security and incomes of farmers, and reducing fossil fuel consumption of diesel and electricity consumption, which are associated with high degree of carbon emissions. Interestingly, we find that in all diesel using districts (except Chittorgarh) farmers are primarily dependent on canal irrigation and using solar pumps for ditribution of water from diggi (water tank which stores canal and rain water). This implies promoting solar pumps in these areas provide win win solution as farmer profits expand and fossil fuel consumption falls with no impact on ground water extraction.
However, there is a evidence of increasing ground water extraction by small and medium farmers who have electric pumps (up to 11-13 HP) or no electric pumps in Jaipur and Sikar. Access to solar pumps enabled them to extract more groundwater and meet some amount of previously unmet irrigation water demand leading to expansion in area under cultivation and area under fruits and vegatables. In the current study, almost all solar pumps are of the size 3 HP, which is relatively small compared to the existing average electic capacity of 15 HP in Jaipur and 8 HP in Sikar. However, the extension of subsidy to larger solar pumps such as 5-10 HP could result in over exploitation of ground water in the long run in the ground water using districts as solar is free and farmers have no incentive to save water. We need innovative policies for governing ground water level in a sustainable way. There is a need for metering agriculture water use and total water extraction by farmers using solar, electric or diesel pump.

1 Introduction

A majority of the world's poorest population live in rural areas and work in agriculture. Irrigation, which typically relies on access to energy inputs such as electricity and diesel, plays a crucial role in breaking the vicious cycle of poverty by providing food and income security. There are around 26 million irrigation pumps in India. Of which, about 8 million pumps are diesel-run and 18 million are electric pumps. Agricultural demand accounts for more than 20% of total electricity demand in India, which is equivalent to the consumption of about 85 million tons of coal annually (that is equal to coal imports in India in 2012)(KPMG 2014).

Government often give high agricultural subsidies which includes subsidies on diesel and electricity consumption and irrigation technology with the objective of reducing the cost of irrigation to the farmers and improving agricultural productivity. In rural India, quality of grid supply is low as there is acute shortage of grid supply. The farmers face recurrent power outages, and the growing cost of diesel, that has a direct adverse effect on the we bvfweghtylfare of the farmers. In order to overcome these problems in rural regions, India is implementing an ambitious plan to expand the installation of solar water pumps for irrigation. Solar-pumps can provide farmer's control over water supply and this may allow them to extend their cultivated area by adopting new crops and by using drip irrigation. Thus, solar water pumps could potentially help the farmers overcome their major challenge of poor electricity supply and increasing diesel prices.

Recognizing the massive potential for solar water pumps in India, the Ministry of New and Renewable Energy (MNRE) and different state governments are promoting the solar water pumps in rural sector. The MNRE started Solar Pumping Programme in the year 1992. About 20000 solar pumps have been installed in the country during 1992-2014, which is miniscule compared to 2.6 crore electric and diesel agricultural pumps currently installed in the country [MNRE 2015]. The solar water pumps are part of the off-grid PV scheme of the JNNSM, and are provided up to 30% capital subsidy by MNRE, 50-60% by state governments with remaining 15-20% share of the cost to be paid by farmers.

Rajasthan has been pioneer in promoting solar water pumps. In India, about 35000 solar pumps have been installed till now with Rajasthan accounting for about 25000 pumps. Rajasthan receives about 6-7 kWh/m2/day of solar insolation, with 325 sunny days in a year, on an average, making it the most promising ground in the country for harnessing solar energy. In terms of area, Rajasthan accounts for 10.5% of India, with 15.7 million hectares of land, of which only 35 to 38% is irrigated. Electricity losses amount to about 45%, which only accounts for the accessible areas where grid supply may reach. In the larger percentage of remote areas, electricity supply itself is a challenge. In such a setting, solar powered pumps are a boon that can be accessed in even the remotest of areas, with no emissions or transmission losses, and uninterrupted power supply throughout the duration of daylight, providing a most suitable alternative to conventional energy in the agricultural sector.

The key objective of the study is to estimate the causal effect of solar water pumping program on water consumption, energy consumption, cropping intensity and cropping patterns of farmers in Rajasthan. The rest of the paper is organized as follows. Section 2 reviews existing studies and models that assess the impact of irrigation technology. Section 3 explains theory of change underlying Solar Pump Subsidy program. Section 4 discusses the data and Section 5 describes the estimation strategy. In Section 6, we discuss summary statistics and results of the empirical model and in Section 7 we discuss key policy implications.

2 Relevant Literature

To our best knowledge, there is no previous study for India or any other country that measure quantitative impacts of solar water pump adoption on water consumption, electricity consumption, diesel consumption, cropping intensity, gross cropped area under fruits and vegetables and annual profits of farmers using rigorous econometric methodology. [Kishore et al., 2014] has undertaken qualitative analysis of the impact of solar water pumps in Rajasthan by conducting primary field survey of 107 solar pump adopters.The study reported number of benefits for solar pump adopters- large reduction in diesel consumption but little reduction in electricity consumption; improvement in water use efficiency but no change in quantity of water use; savings in labor use (as solar pumps do not require an operator); improvement in timeliness of irrigation; increase in frequency of water application; increase in area under irrigation and crop productivity by about 5-10%. According to this survey most farmers find them convenient to use. The key limitation of this study is a small sample size and absence of a control group for the comparison.
[Burney et al., 2010] is one important study in the current context though it did not study the impact of solar powered drp irrigation on resource use but food security as measured by farmer household income and nutritional intake in the rural Sudano-Sahel region of West Africa. Using a matched-pair comparison of villages in northern Benin (two treatment villages, two comparison villages), they found that solar-powered drip irrigation significantly augments both household income and nutritional intake, particularly during the dry season, and is cost effective compared to alternative technologies. Similarly, [Dillon, 2011] estimates the impact of small-scale irrigation investments on household consumption from a panel of Northern Malian households (1998-2006) using propensity score matching and matched difference-in-differences estimators. The study found that access to irrigation increases household consumption by 27-30% relative to water-recession and rain-fed cultivators.

3 Solar Pump Subsidy Program: Theory of Change

3.1 Intervention

The solar pump scheme for irrigation began in Rajasthan in 2010 – a combination of the Jawaharlal Nehru National Solar Mission (JNNSM), Rashtriya Krishi Vikas Yojana (RKVY), the water harvesting structure (WHS) scheme under the National Horticulture Mission (NHM), and various other State resources. Under the scheme, farmers are provided with subsidies from RKVY and the Ministry of New and Renewable Energy (MNRE). In the inception year, a subsidy figure of 86% was arrived at (30% from MNRE and 56% from RKVY), through calculations of a base price for the manufacturing and installation of a solar water pump set. The remaining 14%, equivalent to the cost of just the pump set, was to be paid by the farmer, which would amount to about Rs. 56000-63000. In 2010-11, 50 farmers were targeted, which was scaled up to 500 in 2011-12, and 10,000 in 2012-13, eventually covering all 33 districts of the State. There are three, very transparent eligibility criteria for the subsidy –1) the farmer should own at least 0.5 Ha of land; 2) the land should have a diggi/farm pond or other water storage structure; 3) drip irrigation system should be installed in a portion of the farm.

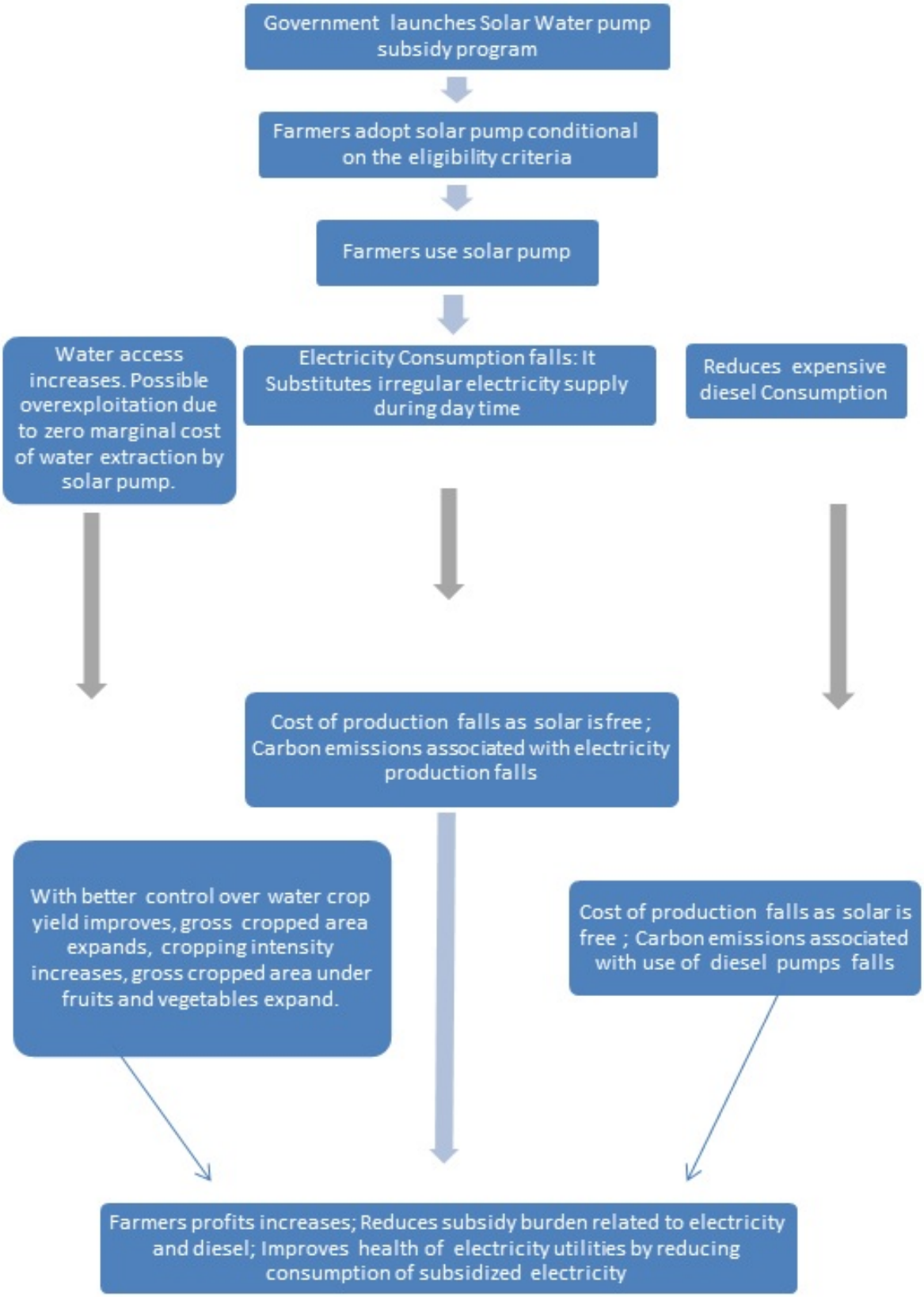
Progressively, the scheme was amended to include the usage of mini-sprinklers as criteria for areas where land holdings are relatively smaller and diggi construction is unfeasible or impractical. This inclusion widened the scope for the popularization of efficient irrigation methods, increasing the water use efficiency in many regions significantly. On the other hand,

the subsidy figure was reduced from 86% to 70% to an even lower 60% over the years, and this reduction in the subsidy amount is presently the major cause for farmers backing out from the scheme. Farmers who already have electric connections for irrigation shall be provided with a smaller figure of subsidy, amounting to about 30% of the total cost of the solar pump set. This calls for a study of the efficacy of the scheme and a detailed evaluation of the impact that these solar water pumps have actually had on farmers already using them, to enable us to ascertain why we should be moving towards this green, efficient, cheap, and emission-free energy source, and/or explaining how the scheme may be further improved for a much wider acceptance and preference among those that require such alternative solutions desperately.

3.2 Theory of Change

The main motivation of the policy makers for promoting Solar Water Pumping Program, in water constrained and solar abundant Rajasthan, is to increase water and energy access of farmers to improve agricultural output and income of farmers. Figure 1 explains underlying theory of change associated with the adoption of solar water pumps.

Figure 1: Theory of Change of Solar Water Pump Subsidy Program



3.3 Theoretical Framework

We have developed a simple profit maximization theoretical model for farmers using different combinations of pumps to meet their irrigation requirements. Our model is inspired by [Badiani et al., 2012]. To simplify the theoretical model of profit maximization we make the following assumptions:
1) Farmers grow two types of crops-Traditonal (Wheat, maize etc) and New (Fruits and Vegetables).
2) Farmers have cobb-Douglas production functions with respect to both types of crops
3) There are two inputs-Land (L) and Water $(W = W^s_{it} + W^{eu}_{it} + W^{ef}_{it} + W^d_{it} + W^C_{it})$; Ground water demand is sum of water demand met by solar, water demand met by unit metered electric pump, water demand met by flat metered electric pump and water demand met by diesel pump. Total water demand is sum of ground water demand and cannal water demand. We estimate the impact of solar pump adoption on groundwater consumption but not canal water consumption, which is supplied in fixed amount from the government.
4) Land owned is assumed to be fixed over the period of analysis and given by $\overline{L}$
. However, land cultivated can be greater than or less than land owned as farmer can rent in land from other farmers or rent out to other farmers. 5) Demand for electricity is derived demand and proportional to water demand. It can be presented as:

$$E^{gw}_{it} = g(x_{it}, \mu_c)(W^{eu}_{it} + W^{ef}_{it}) \quad (1)$$
$$E^{C}_{it} = h(\mu_{de})(W^{Ce}_{it}) \quad (2)$$
$$E_{it} = E^{gw}_{it} + E^{Ce}_{it} \quad (3)$$

Where $g(x_{it}, \mu_c)$ determines the amount of electricity required to get one unit of water. This is likely to be function of current ground water table/stock (x_{it}) and other cluster level characteristics as denoted by (μ_c). $h(\mu_{de})$ determines the amount of electricity required to distribute one unit of canal water.
6) Demand for diesel is derived demand and proportional to water demand. It can be presented as:

$$D^{gw}_{it} = l(x_{it}, \mu_c)(W^{d}_{it}) \quad (4)$$
$$D^{C}_{it} = m(\mu_{dd})(W^{Cd}_{it}) \quad (5)$$
$$D_{it} = D^{gw}_{it} + D^{C}_{it} \quad (6)$$

Where $l(x_{it}, \mu_c)$ determines the amount of diesel required to get one unit of water. $m(\mu_{dd})$ determines the amount of diesel required to distribute one unit of canal water.
7) Per unit cost of pumping is zero with flat meter or solar. $\kappa^{eu}(x_{it}, \mu_c)$ represents per unit cost of pumping by unit metered electricity pump. $\lambda^d((x_{it}, \mu_c)$ represents per unit cost of pumping by diesel pump.
8) let production function of old crops and new crops be given by F^o_{it} and F^1_{it} respectively.

$$F^o_{it} = L^{\alpha}_{oit}\left(\eta_{it}\left(W^s_{it} + W^{eu}_{it} + W^{ef}_{it} + W^d_{it} + W^C_{it}\right)\right)^{\beta} \quad (7)$$
$$F^1_{it} = \left(\overline{L} + L_{Rit} - L_{oit}\right)^{\gamma}\left((1-\eta_{it})\left(W^s_{it} + W^{eu}_{it} + W^{ef}_{it} + W^d_{it} + W^C_{it}\right)\right)^{\delta} \quad (8)$$

Profit of farmer i in period t can be written as:

$$\begin{aligned}\pi_{it} =& P_{ot}L_{oit}^{\alpha}\left(\eta_{it}\left(W_{it}^{s}+W_{it}^{eu}+W_{it}^{ef}+W_{it}^{d}+W_{it}^{C}\right)\right)^{\beta}\\ =&+P_{1t}\left(\overline{L}+L_{Rit}-L_{oit}\right)^{\gamma}\left((1-\eta_{it})\left(W_{it}^{s}+W_{it}^{eu}+W_{it}^{ef}+W_{it}^{d}+W_{it}^{C}\right)\right)^{\delta}\\ =&-\kappa^{eu}(x_{it},\mu_c)W_{it}^{eu}-F_{it}^{ef}-h(\mu_{de})(W_{it}^{Ce})-\lambda^{d}(x_{it},\mu_c)(W_{it}^{d})-m(\mu_{dd})(W_{it}^{Cd})-r_{it}L_{Rit}\end{aligned} \tag{9}$$

subject to:

- $W_{it}^{s}=0$ if non-adopter of solar pump
- $W_{it}^{eu}=0$ if not using unit electric meter
- $W_{it}^{ef}=0$ if not using flat meter
- $W_{it}^{d}=0$ if not using diesel pump
- $W_{it}^{C}=0$ if not using canal water
- $E_{it}\leq\overline{E}$ or $g(x_{it},\mu_c)(W_{it}^{eu}+W_{it}^{ef})\leq\overline{E}$ (Hrs of electricity supply, capacity of electric pump)
- $D_{it}\leq\overline{D}$ or $l(x_{it},\mu_c)(W_{it}^{d})\leq\overline{D}$ (capacity of diesel pump)
- $W_{it}^{s}\leq\overline{S}$ (No of sunny hours, Capacity of solar pump)
- $W_{it}^{Ce}+W_{it}^{Cd}\leq W_{it}^{C}$

Lagrangian for profit maximization for a farmer with all three types of pumps is given by:

$$\begin{aligned}L=&P_{ot}L_{oit}^{\alpha}\left(\eta_{it}\left(W_{it}^{s}+W_{it}^{eu}+W_{it}^{ef}+W_{it}^{d}+W_{it}^{C}\right)\right)^{\beta}\\ &+P_{1t}\left(\overline{L}+L_{Rit}-L_{oit}\right)^{\gamma}\left((1-\eta_{it})\left(W_{it}^{s}+W_{it}^{eu}+W_{it}^{ef}+W_{it}^{d}+W_{it}^{C}\right)\right)^{\delta}\\ &-\kappa^{eu}(x_{it},\mu_c)W_{it}^{eu}-F_{it}^{ef}-h(\mu_{de})(W_{it}^{Ce})-\lambda^{d}((x_{it},\mu_c)W_{it}^{d}\\ &-m(\mu_{dd})(W_{it}^{Cd})-\lambda_1\left(\frac{\overline{E}}{g(x_{it},\mu_c)}-W_{it}^{eu}-W_{it}^{ef}\right)\\ &-\lambda_2\left(\overline{S}\ -W_{it}^{s}\right)-\lambda_3\left(\frac{\overline{D}}{l(x_{it},\mu_c)}-W_{it}^{d}\right)\\ &-\lambda_4\left(W_{it}^{C}-W_{it}^{Ce}-W_{it}^{Cd}\right)-r_{it}L_{Rit}\end{aligned} \tag{10}$$

First order conditions are:

$$\frac{\partial \pi_{it}}{\partial W_{it}^{s}} = P_{ot}\frac{\partial F_{it}^{o}}{\partial W_{it}^{s}} + P_{1t}\frac{\partial F_{it}^{1}}{\partial W_{it}^{s}} = \lambda_2 \quad (11)$$

$$\frac{\partial \pi_{it}}{\partial W_{it}^{eu}} = P_{ot}\frac{\partial F_{it}^{o}}{\partial W_{it}^{eu}} + P_{1t}\frac{\partial F_{it}^{1}}{\partial W_{it}^{eu}} = \kappa^{eu}(x_{it}, \mu_c) + \lambda_1 \quad (12)$$

$$\frac{\partial \pi_{it}}{\partial W_{it}^{ef}} = P_{ot}\frac{\partial F_{it}^{o}}{\partial W_{it}^{ef}} + P_{1t}\frac{\partial F_{it}^{1}}{\partial W_{it}^{ef}} = \lambda_1 \quad (13)$$

$$\frac{\partial \pi_{it}}{\partial W_{it}^{d}} = P_{ot}\frac{\partial F_{it}^{o}}{\partial W_{it}^{d}} + P_{1t}\frac{\partial F_{it}^{1}}{\partial W_{it}^{d}} = \lambda^{d}(x_{it}, \mu_c) + \lambda_3 \quad (14)$$

$$\frac{\partial \pi_{it}}{\partial W_{it}^{Ce}} = P_{ot}\frac{\partial F_{it}^{o}}{\partial W_{it}^{Ce}} + P_{1t}\frac{\partial F_{it}^{1}}{\partial W_{it}^{Ce}} = h(\mu_{de}) + \lambda_4 \quad (15)$$

$$\frac{\partial \pi_{it}}{\partial W_{it}^{Cd}} = P_{ot}\frac{\partial F_{it}^{o}}{\partial W_{it}^{Cd}} + P_{1t}\frac{\partial F_{it}^{1}}{\partial W_{it}^{Cd}} = m(\mu_{dd}) + \lambda_4 \quad (16)$$

$$\frac{\partial \pi_{it}}{\partial L_{oit}} = P_{ot}\frac{\partial F_{it}^{o}}{\partial L_{oit}} = P_{1t}\frac{\partial F_{it}^{1}}{\partial L_{oit}} \quad (17)$$

$$\frac{\partial \pi_{it}}{\partial L_{Rit}} = P_{ot}\frac{\partial F_{it}^{o}}{\partial L_{Rit}} + P_{1t}\frac{\partial F_{it}^{1}}{\partial L_{Rit}} = r \quad (18)$$

$$\frac{\partial \pi_{it}}{\partial \eta_{it}} = P_{ot}\frac{\partial F_{it}^{o}}{\partial \eta_{it}} = P_{1t}\frac{\partial F_{it}^{1}}{\partial L\eta_{it}} \quad (19)$$

Equation 11 implies that solar pump adopter chooses to extract ground water using a solar pump to equalize the sum of value of marginal product of water from traditional and new crops to the marginal cost of water by a solar pump. This marginal cost is the shadow price of the solar pump capacity. As solar is free there are no per unit pumping cost in this case.
Equation 12 implies that a farmer using unit metered electric pump chooses to extract ground water using unit metered electric pump to equalize the sum of value of marginal product of water from traditional and new crops to the marginal cost of additional unit of water by unit metered electric pump. This marginal cost is sum of per unit cost of pumping and shadow price of the electric pump capacity.
Equation 13 implies that a farmer using flat metered electric pump chooses to extract ground water using flat metered electric pump to equalize the sum of value of marginal product of water from traditional and new crops to the marginal cost of additional unit of water by flat metered electric pump. This marginal cost is the shadow price of the electric pump capacity. As in the case of solar there are no per unit pumping costs.
Equation 14 implies that a farmer using diesel pump chooses to extract ground water using diesel pump to equalize the sum of value of marginal product of water from traditional and new crops to the marginal cost of additional unit of water by diesel pump. This marginal cost is sum of per unit cost of pumping by a diesel pump and shadow price of the diesel pump capacity.
Equations 15 and 16 are relevant for farmers using canal water and using electricity or diesel to distribute this water to the fields. As the total canal water that a farmer gets is fixed (as denoted by (W_{it}^{C})) from the government and the farmer can decide how much of the water to distribute by each type of a pump. Farmer selects optimal amount of water to be distributed by diesel or/and electric pump to equalize the sum of value of marginal product of water from traditional and new crops by each pump to the marginal cost of distributing additional unit of water by the respective pump. This marginal cost is sum of per unit cost of distributing by that pump and

shadow price (λ_4) of the canal water (which is in fixed supply). (λ_4) will be zero for farmers that get sufficient canal water and positive in case of water constrained farmer.
Equation 17 implies farmer allocates cultivated land area amongst traditional and new crops to equate value of its marginal product in these two crops.
Equation 18 shows that farmer selects optimal rented cultivated land area to equate sum of value of its marginal product in traditional and new crops to the value of per unit land rent.
Equation 19 shows that farmer allocates water to traditional and new crops such that value of marginal products is same for both.

The above model shows that whether solar pump is used as a complement or substitute to the existing pump will depend on the total water demand. If it is a small farmer with small size of land, his total water demand could be met by just solar pump in which case solar pump may be able to substitute electric pump. With both flat metered electric pump and solar pump, marginal cost of pumping is nearly zero. Thus, the farmer will be indifferent between using solar pump and flat metered electric pump. After exhausting the cheapest source farmer will move on to use more expensive source of unit metered electricity. Thus, farmer with unmet demand of water will be using solar pump as a complement to existing pumps.

3.4 Building Hypothesis For Evaluation

Hypothesis 1: Water consumption is positively related with the adoption of solar water pumps.

Apparently, this will hold true for rainfed adopters of solar pump using no ground water prior to the adoption of solar pumps. For rainfed farmers, a positive association suggests that solar water pumps provide reliable and easy access to ground water for irrigation. For electric or diesel pump using farmers, positive association suggests that an additional solar pump would complement existing pumps to meet previously unmet and newly created irrigation demand of the farmers. If hypothesis 1 is rejected, it is possible that farmers are extracting same amount of water as before adopting solar pump and thus substituting electric or diesel pumps by solar. As solar pumps extract ground water at a much slower rate and provide reliable supply of irrigation water for 7-8 hours during day time it may also decrease total water consumption of a farmer.

Hypothesis 2: Electricity consumption is negatively related with the adoption of solar water pumps.

When farmers have unit meters, it provides an incentive to substitute electric pumps by solar pumps and thus we expect negative association between electricity consumption and adoption of solar pumps. If hypothesis 2 is rejected, then farmers have large unmet irrigation demand that they expect to meet by a new solar pump. Also in case of flat meters where farmers have to pay fixed charges, we expect small or no effect on electricity consumption.

Hypothesis 3: Diesel consumption is negatively related with the adoption of solar water pumps. When farmers are using diesel pumps, it provides an incentive to substitute diesel pumps using expensive diesel by solar pumps and thus we expect negative association between diesel consumption and adoption of solar pumps. The negative relationship is expected to be stronger for poor and small farmers. If hypothesis 3 is rejected, then farmers may have large unmet irrigation demand that they expect to meet by a new solar pump. This is particularly expected in the case of large rich farmers.

Hypothesis 4: Cropping Intensity is positively related with the adoption of solar water pumps.

Access to more groundwater due to solar pump enables farmers to cultivate more intensively leading to increase in cropping intensity. The above hypothesis is likely to be true for areas

where farmers are dependent on groundwater for irrigation. In case of areas where farmers are getting fixed amount of water under canal irrigation system, the above hypothesis may be rejected. Also, the above relationship is expected to be relatively weaker for areas with abundant water and energy access prior to the access to solar pumps.

Hypothesis 5: Gross cropped area under fruits and vegetables and profits are positively related with the adoption of solar water pumps.

As the water access of the energy constraint farmers increases, they are able to change their cropping pattern towards higher remunerative crops, such as fruits and vegetables with specific water requirements. As electricity supply is erratic in rural villages of Rajasthan, access to solar pump will enable farmers to meet specific water requirements of these crops by providing reliable water supply during day time. Thus, the Gross cropped area under fruits and vegetables and profits are expected to increase with the adoption of a solar pump.

4 Empirical Strategy

Based on our theoretical framework, we derive and explain our empirical strategy. The first order conditions (eq 11- eq 19) from our theoretical model show that ground water demand will be function of energy access as measured by electric pump ownership and capacity, diesel pump ownership and capacity, solar pump ownership and capacity; ground water level; size of agricultural land holding; irrigation system (such as using drip, practising flood); water storage tank/diggi ownership and volume; farmer fixed effect to account for factors that remain fixed over period of analysis such as education, age, experience, management efficiency, level of awareness, agricultural assets and cluster level factors such as quality of soil and water; cluster specific trends to account for cluster level variables that change over time such as input and output prices.

To estimate impact of solar pump adoption on ground water demand and other outcome variables, we have done difference and differences analysis. In line with literature, we can estimate the ground water demand for farmer i in the year t in the following way:

$$W_{it} = \alpha_1 D^{Adopter} + \alpha_2 D^{After} + \alpha_3 D^{Adopter} D^{After} + \alpha_4 D_{it}^{Meter} + \alpha_5 D_{it}^{Irrigation} + \alpha_6 \overline{L}_i + \alpha_7 \overline{E}_i + \alpha_8 \overline{D}_i + \alpha_9 Year_{it} + \alpha_{10} x_{it} + \alpha_{11} \mu_{ct} + \alpha_{12} z_i \tag{20}$$

Similarly, we can express all other outcome variables as a function of the same variables as in the water demand equation.

$$E_{it} = \alpha_1 D^{Adopter} + \alpha_2 D^{After} + \alpha_3 D^{Adopter} D^{After} + \alpha_4 D_{it}^{Meter} + \alpha_5 D_{it}^{Irrigation} + \alpha_6 \overline{L}_i + \alpha_7 \overline{E}_i + \alpha_8 \overline{D}_i + \alpha_9 Year_{it} + \alpha_{10} x_{it} + \alpha_{11} \mu_{ct} + \alpha_{12} z_i \tag{21}$$

$$D_{it} = \alpha_1 D^{Adopter} + \alpha_2 D^{After} + \alpha_3 D^{Adopter} D^{After} + \alpha_4 D_{it}^{Meter} + \alpha_5 D_{it}^{Irrigation} + \alpha_6 \overline{L}_i + \alpha_7 \overline{E}_i + \alpha_8 \overline{D}_i + \alpha_9 Year_{it} + \alpha_{10} x_{it} + \alpha_{11} \mu_{ct} + \alpha_{12} z_i \tag{22}$$

$$CI_{it} = \alpha_1 D^{Adopter} + \alpha_2 D^{After} + \alpha_3 D^{Adopter} D^{After} + \alpha_4 D_{it}^{Meter} + \alpha_5 D_{it}^{Irrigation} + \alpha_6 \overline{L}_i + \alpha_7 \overline{E}_i + \alpha_8 \overline{D}_i + \alpha_9 Year_{it} + \alpha_{10} x_{it} + \alpha_{11} \mu_{ct} + \alpha_{12} z_i \tag{23}$$

$$GCAFV_{it} = \alpha_1 D^{Adopter} + \alpha_2 D^{After} + \alpha_3 D^{Adopter} D^{After} + \alpha_4 D_{it}^{Meter} + \alpha_5 D_{it}^{Irrigation} + \alpha_6 \overline{L}_i + \alpha_7 \overline{E}_i + \alpha_8 \overline{D}_i + \alpha_9 Year_{it} + \alpha_{10} x_{it} + \alpha_{11} \mu_{ct} + \alpha_{12} z_i \quad (24)$$

$$Profit_{it} = \alpha_1 D^{Adopter} + \alpha_2 D^{After} + \alpha_3 D^{Adopter} D^{After} + \alpha_4 D_{it}^{Meter} + \alpha_5 D_{it}^{Irrigation} + \alpha_6 \overline{L}_i + \alpha_7 \overline{E}_i + \alpha_8 \overline{D}_i + \alpha_9 Year_{it} + \alpha_{10} x_{it} + \alpha_{11} \mu_{ct} + \alpha_{12} z_i \quad (25)$$

We have estimated 3 other variants of the above model for each outcome variable which are discussed in the section on regression results.

5 Data

5.1 Study Design

The study applied a multistage, stratified, random sampling procedure. The first step was to draw a sample of 13 tehsils/blocks from six districts having large number of solar pump adopters -Jaipur, Sikar, Jaisalmer, Chittorgarh, Bikaner and Ganganagar. As the impact of solar pump is expected to be very different in different agro-climatic conditions, blocks are selected to capture this variation in agro-climatic conditions and related features such as differences in the irrigation system (tubewell/canal irrigated areas) and differences in farming contract (share-croppers/owners). Blocks are not all same.

The second step was to form homogeneous village clusters within blocks based on cropping pattern and water-table depth. The third step was to draw a sample of adopters and non-adopters of solar pumps from each homogeneous village cluster. The number of farmers selected in each cluster was determined by the population of adopters and non-adopters. The survey covered quite a range of different farmer types in terms of landholding size, farming equipment, features of farming contract and methods of irrigation.

The 430 sample size of farmers includes both adopters of solar water pumps and non-adopters. To the extent possible, we have selected non-adopters who have applied for the solar pump subsidy but are waiting for the pump. Due to unavailability of such non-adopters in many clusters, we have also selected some non-adopters who were interested in adopting a solar pump but yet not applied or who have backed out of the scheme altogether for whatever reasons (See Table 1). Adopters and non-adopters from each district are surveyed randomly, while attempting to maintain a sample size ratio of 1:2, the motive being that the control group, i.e. the non-adopters, should be as similar to the treatment group, i.e. the adopters, as possible, with the obvious exception of owning a solar water pump. District-level sampling plan is discussed in the appendix.

Table 1: Application Status of Non-Adopters (NA) in 2014-15

District	Application Status	Number of NA	Percentage of NA
Jaipur	Waiting (farmer's share with Dealer)	9	25%
Jaipur	Waiting (farmer's share with Department)	4	11%
Jaipur	Waiting (farmer's share not deposited)	8	22%
Jaipur	Backed out when selected in lottery	13	36%
Jaipur	Did not complete the file	2	5.5%
Sikar	Waiting (farmer's share with Dealer)	5	14%
Sikar	Waiting (farmer's share with Department)	1	3%
Sikar	Waiting (farmer's share not deposited)	5	14%
Sikar	Backed out when selected in lottery	4	11%
Sikar	Did not complete the file but interested	21	58%
Jaisalmer	Waiting (farmer's share not deposited)	4	20%
Jaisalmer	Backed out when selected in lottery	4	20%
Jaisalmer	Did not complete the file but interested	12	60%
Ganganagar	Waiting (farmer's share with Dealer)	1	4%
Ganganagar	Waiting (farmer's share with Department)	2	8%
Ganganagar	Waiting (farmer's share not deposited)	3	12.5%
Ganganagar	Backed out when selected in lottery	6	25%
Ganganagar	Did not complete the file but interested	12	50%
Bikaner	Waiting (farmer's share with Department)	1	3%
Bikaner	Waiting (farmer's share not deposited)	4	11%
Bikaner	Backed out when selected in lottery	4	11%
Bikaner	Did not complete the file but interested	28	76%
Chittorgarh	Waiting (farmer's share with Dealer)	1	12.5%
Chittorgarh	Backed out when selected in lottery	1	12.5%
Chittorgarh	Did not complete the file but interested	6	75%
Total	Waiting (farmer's share with Dealer)	16	%
Total	Waiting (farmer's share with Department)	8	%
Total	Waiting (farmer's share not deposited)	24	%
Total	Backed out when selected in lottery	32	%
Total	Did not complete the file but interested	81	%

6 Results

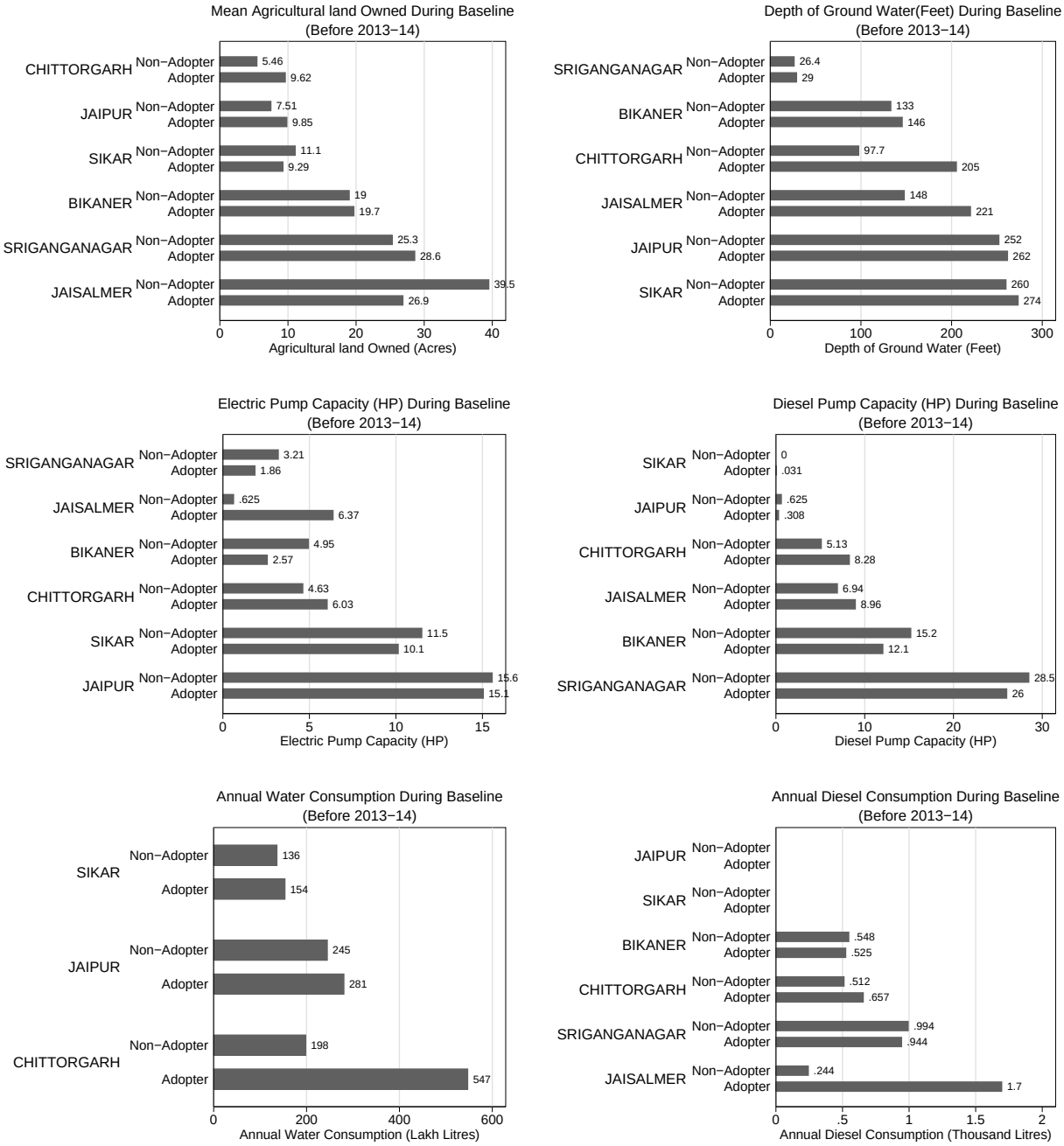
6.1 Summary Statistics

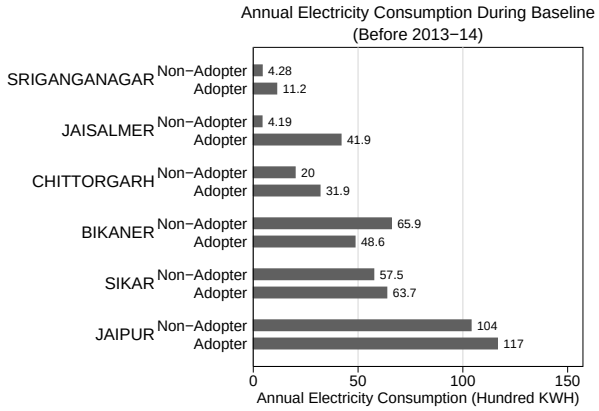
-

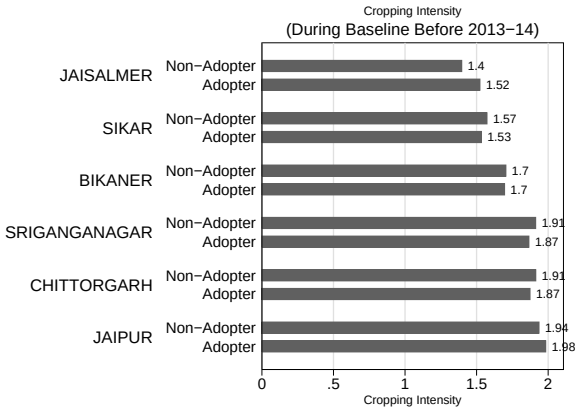
Figure 2 displays the sample mean of key variables for adopters and non-adopters of all the 6 districts during baseline. In the case of agricultural land holdings, we find that Chittorgarh, Sikar and Jaipur have relatively smaller landholdings with average size ranging between 5-11 acres as compared to the northern and western districts-Bikaner, Sriganganagar and Jaisalmer-with average size ranging between 19-40 acres. While these three districts with small landholdings are completely dependent on ground water irrigation, remaining three districts with

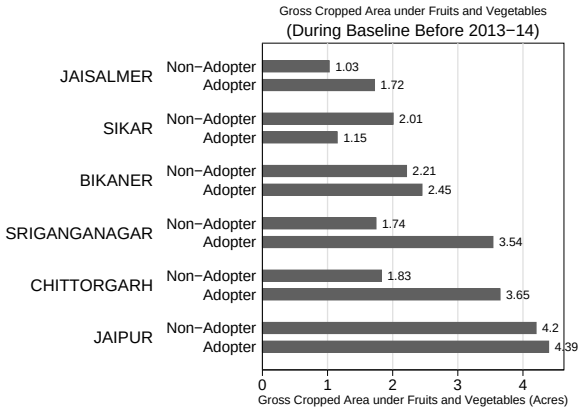
large landholdings are majorly dependent on canal irrigation. There are few areas within northern and western districts that use groundwater for irrigation such as Pokhran in Jaisalmer is completely dependent on groundwater irrigation. In three canal using districts, the quality of groundwater is not suitable for irrigation and thus very less number of farmers use it irrigation. In Bikaner and Jaisalmer, at many places the ground water depth is very high making it difficult to extract and use it for irrigation. In Jaipur and Sikar, farmers are only using electric pumps for irrigation with average electric capacity ranging from 10-16 HP. In canal irrigated areas, farmers are using very less electricity due to poor electricity access in these areas and are largely dependent on costly diesel use. We found average cropping intensity and gross cropped area under fruits and vegetables to be highest in Jaipur, Chittorgarh and Sriganganagar. These areas also have relatively better water access than other three districts. Sriganganagar is found to have highest average annual profits followed by Bikaner and Jaisalmer.

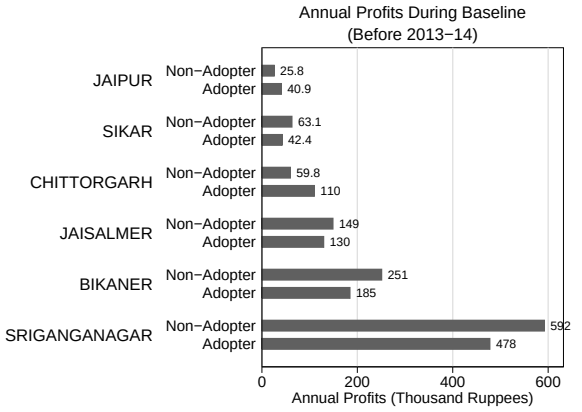
Figure 2:


Mean Agricultural land Owned During Baseline
(Before 2013−14)
CHITTORGARH Non−Adopter 5.46
Adopter 9.62
JAIPUR Non−Adopter 7.51
Adopter 9.85
SIKAR Non−Adopter 11.1
Adopter 9.29
BIKANER Non−Adopter 19
Adopter 19.7
SRIGANGANAGAR Non−Adopter 25.3
Adopter 28.6
JAISALMER Non−Adopter 39.5
Adopter 26.9
0 10 20 30 40
Agricultural land Owned (Acres)
Depth of Ground Water(Feet) During Baseline
(Before 2013−14)
SRIGANGANAGAR Non−Adopter 26.4
Adopter 29
BIKANER Non−Adopter 133
Adopter 146
CHITTORGARH Non−Adopter 97.7
Adopter 205
JAISALMER Non−Adopter 148
Adopter 221
JAIPUR Non−Adopter 252
Adopter 262
SIKAR Non−Adopter 260
Adopter 274
0 100 200 300
Depth of Ground Water (Feet)
Electric Pump Capacity (HP) During Baseline
(Before 2013−14)
SRIGANGANAGAR Non−Adopter 3.21
Adopter 1.86
JAISALMER Non−Adopter .625
Adopter 6.37
BIKANER Non−Adopter 4.95
Adopter 2.57
CHITTORGARH Non−Adopter 4.63
Adopter 6.03
SIKAR Non−Adopter 11.5
Adopter 10.1
JAIPUR Non−Adopter 15.6
Adopter 15.1
0 5 10 15
Electric Pump Capacity (HP)
Diesel Pump Capacity (HP) During Baseline
(Before 2013−14)
SIKAR Non−Adopter 0
Adopter .031
JAIPUR Non−Adopter .625
Adopter .308
CHITTORGARH Non−Adopter 5.13
Adopter 8.28
JAISALMER Non−Adopter 6.94
Adopter 8.96
BIKANER Non−Adopter 15.2
Adopter 12.1
SRIGANGANAGAR Non−Adopter 28.5
Adopter 26
0 10 20 30
Diesel Pump Capacity (HP)
Annual Water Consumption During Baseline
(Before 2013−14)
SIKAR Non−Adopter 136
Adopter 154
JAIPUR Non−Adopter 245
Adopter 281
CHITTORGARH Non−Adopter 198
Adopter 547
0 200 400 600
Annual Water Consumption (Lakh Litres)
Annual Diesel Consumption During Baseline
(Before 2013−14)
JAIPUR Non−Adopter
Adopter
SIKAR Non−Adopter
Adopter
BIKANER Non−Adopter .548
Adopter .525
CHITTORGARH Non−Adopter .512
Adopter .657
SRIGANGANAGAR Non−Adopter .994
Adopter .944
JAISALMER Non−Adopter .244
Adopter 1.7
0 .5 1 1.5 2
Annual Diesel Consumption (Thousand Litres)









6.2 Regression Results

For each pair of district and outcome variable, we have estimated four different models. M1 estimates a cluster fixed effect model and controls for lots of farmer level socio-economic variables that are fixed over time in addition to variables that change over time. Some variables that are fixed over time in our analysis include number of farming assets, level of education and age of farmers, main occupation of the farmer, number of electrical equipments. Some variables that change over time include ground water level, agricultural land holdings, number of animals possessed, electric capacity, diesel capacity, type of irrigation system and electricity connection type.

All other Models(M2-M4) estimate farmer fixed effect model. M2 is a basic specification with solar pump adoption dummy, solar pump before and after time dummy and interaction of these two dummies.The interaction dummy gives difference and differences estimate of the impact of solar pump adoption on the outcome variable. As in case of M1, M2 controls for all relevant variables that change over time. M3 extends M2 by interacting adoption dummy, time dummy and combination of adoption and time dummy by electric capacity in case of electricity using district. M3 extends M2 by interacting adoption dummy, time dummy and combination of adoption and time dummy by diesel capacity in addition to electric capacity in case of diesel using district. M4 extends M3 by interacting adoption dummy, time dummy and combination of adoption and time dummy by the size of agriculral land holdings.

All models (M1-M4) control for cluster specific time tends to a account for variables that may differ across clusters and may also change over time such as input prices, output prices and wages. In the appendix, we have included all the estimated models for the reference. In the main text, we only report results of the preffered model (for each pair of district and outcome

variable) for brevity. We have preferred a model which has the highest goodness of fit as measured by within adjusted R square among the set of robust models estimated. We used fixed effects to control for differences between the characteristics of farmers and clusters that were unobserved and did not change over time.

6.2.1 Impact on Water Consumption

The results from difference-in differences analysis show that annual total water consumption of farmers increase for solar pump adopters in all the three ground water using districts-Jaipur, Sikar and Chittorgarh. Table 2 displays results for impact on water consumption for all three districts. Figure 3 show marginal impact of solar pump adoption on water consumption. The results are consistent across Jaipur and Sikar: they suggest that annual water consumption increases for solar pump adopters having electric pumps with capacities less than or equal to 11 HP (from both district specific models) and 13 HP (as obtained from pooled model); and this positive marginal impact of solar pump adoption on annual water consumption varies positively with the size of the land holdings of the farmers. In our sample, 59 % of solar pump adopters in Jaipur and 49% of solar pump adopters in Sikar have electric pump capacity less than or equal to 13 HP. From the pooled model, we find that mean annual water consumption at average electric pump capacity (12 HP) and average land holding (9 acres) increases by 15 lakh litres. However, the increase in water consumption varies significantly from 38 lakh litres at 3 HP to 25 lakh litres at 8 HP to 12 lakh litres at 13 HP.

To put this in perspective, we express this increase as a percentage of the mean annual water consumption of farmers in this category. In Jaipur, which has a mean electric capacity of 15 HP and mean water consumption of 159 lakh litres for solar pump adopters with less than or equal to 13 HP electric capacity in the baseline, this turns out to be 9.4 % . On the other hand, Sikar, which has a mean capacity of 8 HP and lower mean annual consumption of 46 lakh litres in the baseline, the mean percentage increase turns out to be 54%. The above estimates are based at an average land holding size of 9 acres in our sample of Jaipur and Sikar. At higher levels of agricultural land holdings, we expect higher impact on water consumption. For example, mean annual water consumption at average electric pump capacity (12 HP) increases to 20 lakh litres at 11 acres and 25 lakh litres at 13 acres from 15 lakh litres at 9 acres.

In case of Chittorgarh, which has relatively good ground water levels and uses both electric and diesel pumps for irrigation, we find that increase in annual water consumption for solar pump adopters is positively related with both - electric capacity and diesel capacity (see Figure 4). In contrast with Jaipur and Sikar, increase in water consumption does not vary with the size of agricultural land holdings. We find that mean annual water consumption at average electric pump capacity (5 HP) and average diesel capacity (7 HP) increases by 103 lakh litres. At mean electric capacity of 5 hp, the increase in water consumption varies significantly from 103 lakh litres at 7 HP diesel capacity to 259 lakh at 15 HP diesel capacity. At mean diesel capacity of 7 hp, the increase in water consumption varies significantly from 103 lakh litres at 5 HP electric capacity to 382 lakh at 15 HP electric capacity. On average, there represents a 18% increase in the annual water consumption of solar water pump adopters over the mean annual water consumption of 574 lakh litres in the baseline.

Table 2:

Impact of Solar Water Pumps on Water Consumption in main ground water using districts

	(1)	(2)	(3)	(4)
VARIABLES	Jaipur M4	Sikar M4	Jaipur Sikar M4	Chittorgarh M4
Adopter = o,	-	-	-	-
After	11.00	-10.06	2.997	226.8***
	(26.85)	(14.95)	(17.25)	(70.62)
c.Adopter#c.After	54.46*	17.96	39.47*	-188.6**
	(29.82)	(17.48)	(20.27)	(87.70)
c.After#c.AgrLand	-3.287	-1.008	-2.518**	
	(2.132)	(0.853)	(1.107)	
c.After#c.AgrLand#c.Adopter	3.268	4.902***	4.528***	
	(2.747)	(1.237)	(1.723)	
c.After#c.ElecCap	0.855	-0.181	0.483	-15.62***
	(1.613)	(0.873)	(1.115)	(3.778)
c.After#c.ElecCap#c.Adopter	-4.824**	-3.284**	-4.500***	29.60
	(2.097)	(1.242)	(1.443)	(18.23)
ElecCap = o,	-			-
Agricultural Land Owned	93.85***		90.69***	128.8***
	(17.35)		(16.23)	(34.90)
Water Table	0.409	0.665	0.381	14.12***
	(0.310)	(0.574)	(0.291)	(3.630)
Flat Meter	10.86	-4.086	7.694	-43.52
	(17.02)	(14.74)	(11.44)	(34.19)
No Electric Pump = o,	-			
Rented Electric Pump	141.2***			
	(5.469)			
Animals_Possessed	-1.312***	-0.0458	-1.084**	1.286
	(0.417)	(0.659)	(0.427)	(3.852)
Drip_Area_Acre	1.264	27.01***	6.063**	32.27***
	(3.851)	(6.553)	(2.950)	(11.51)
Year Trend	-14.57	3.921	-15.40	21.05
	(12.93)	(6.426)	(13.17)	(26.84)
ElecCap		3.825	4.546	
		(2.420)	(3.038)	
Agricultural Land Owned = o,		-		
No Electric Pump		-46.54	-30.52	-532.3***
		(51.09)	(62.92)	(53.20)
Rented Electric Pump = o,		-	-	-

c.After#c.dcap				-16.46***
				(5.080)
c.After#c.dcap#c.Adopter				29.63***
				(6.742)
Diesel Capacity = o,				-
Constant	-677.9***	-65.66	-782.0***	-2,828***
	(200.8)	(156.8)	(196.2)	(844.7)
Observations	545	315	860	145
R-squared	0.251	0.456	0.257	0.460
Number of Sample	109	63	172	29
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	YES	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.2.2 Impact on Electricity Consumption

We found evidence of decline in electricity consumption after the solar water pump adoption in one major electricity using district-Jaipur. In Jaipur, the marginal impact of solar pump adoption on electricity consumption is negative and significant for farmers with electric capacity greater than 12 HP. At mean electric pump capacity (15 HP) and land holdings (9 acres), annual eletricity consumption in Jaipur declined by 8 hundred KWH for solar pump adopters. Farmers with greater electric pump capacity are found to experience greater reduction in electricity consumption. The decrease in annual electricity consumption varies from 6 hundred KWH at 13 HP to 18 hundred KWH at 25 HP. In our sample, 41 % of solar pump adopters in Jaipur have electric pump capacity greater than 12 HP.

In Sikar, which is another major electricity using district, we found negative but insignificant impact of solar pump adoption on electricity consumption (Table). One reason for insignificant results could be the high number of rainfed solar pump adopters (with no electric pump) in the sample of solar pump adopters in Sikar (42%). However, in the pooled model of Jaipur and Sikar, we do find a negative and significant impact on electricity consumption for farmers with electric capacity greater than or equal to 9 HP as against 11 HP from Jaipur specific model (Table 3; Figure 5).

Among the remaining four diesel using districts, we find significant and negative impact in only one district -Sriganganagar (Table 4, Figure 6). In Sriganganagar, about 24% of solar pump adopters use electric pump. The decrease in annual electricity consumption varies from 4 hundred KWH at 2 HP to 29 hundred KWH at 15 HP. In both Bikaner (with 12% adopters using electricity) and chittorgarh (with 76% adopters using electricity), we found negative but insignificant impact on electricity consumption.

Table 3:

Impact of Solar Water Pumps on Electricity Consumption in Jaipur and Sikar

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Jaipur M1	Jaipur M4	Sikar M1	Sikar M4	Jaipur Sikar M1	Jaipur Sikar M4
Adopter = o,	-	-	-	-	-	-
After	16.36**	6.154	2.509	2.367	10.98**	4.656
	(7.192)	(7.537)	(2.304)	(4.346)	(4.900)	(4.467)
c.Adopter#c.After	-16.48**	-0.219	-4.928	-10.20*	-11.75**	-3.969
	(7.206)	(8.220)	(3.668)	(5.959)	(4.992)	(5.128)
c.After#c.AgrLand		-1.522*		0.0776		-0.785*
		(0.889)		(0.332)		(0.428)
c.After#c.AgrLand#c.Adopter		1.271		0.489		0.930*
		(0.991)		(0.392)		(0.501)
c.After#c.ElecCap		1.390		-0.0736		0.911
		(0.883)		(0.247)		(0.584)
c.After#c.ElecCap#c.Adopter		-1.637*		0.0880		-1.134*
		(0.986)		(0.369)		(0.663)
ElecCap = o,	-	-				
Agricultural Land Owned	18.75***	19.47***			17.43***	18.26***
	(6.095)	(6.314)			(5.862)	(5.935)
Water Table	-0.121	-0.117	0.0545	0.131	-0.113	-0.100
	(0.101)	(0.0956)	(0.119)	(0.120)	(0.0927)	(0.0858)
Flat Meter	4.570	5.069	-5.685**	-5.861**	0.934	1.967
	(6.822)	(6.453)	(2.414)	(2.923)	(4.330)	(4.192)
No Electric Pump = o,	-	-				
Rented Electric Pump	56.75***	55.88***				
	(1.806)	(1.956)				
Animals_Possessed	-0.273	-0.266	-0.113	-0.184	-0.235	-0.230
	(0.243)	(0.226)	(0.257)	(0.188)	(0.219)	(0.206)
Drip_Area_Acre	0.439	0.591	5.014	4.865	1.421	1.432
	(0.848)	(0.997)	(3.157)	(3.028)	(1.057)	(1.066)
Year Trend	-3.206	-3.766	-3.022*	-2.820*	-3.119	-3.250
	(5.250)	(4.773)	(1.515)	(1.535)	(5.492)	(5.099)
Agricultural Land Owned = o,			-	-		
ElecCap			1.540	1.466	1.446	1.359
			(1.440)	(1.416)	(1.455)	(1.474)
No Electric Pump			-22.99	-22.43	-21.08	-21.58
			(29.34)	(29.12)	(28.48)	(29.26)
Rented Electric Pump = o,			-	-	-	-
Constant	-20.69	-28.75	42.84	22.19	-49.42	-60.30
	(68.55)	(68.99)	(45.50)	(45.51)	(70.91)	(69.96)

Observations	545	545	315	315	860	860
R-squared	0.138	0.170	0.350	0.370	0.152	0.172
Number of Sample	109	109	63	63	172	172
Cluster Fixed Effects	YES	YES	YES	YES	YES	YES
Farmer Fixed Effects	YES	YES	YES	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Table 4:

Impact of Solar Water Pumps on Electricity Consumption in four diesel using districts

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Bikaner M4	Sriganganagar M4	Jaisalmer M4	Chittorgarh M4	Group all 4 M4
Adopter = o,	-	-	-	-	-
After	8.322	2.648**	0.229	-0.0954	3.861
	(10.26)	(1.320)	(1.557)	(0.883)	(4.200)
c.Adopter#c.After	-19.10	1.785	2.544	-9.047	-15.22
	(12.94)	(3.194)	(3.241)	(6.556)	(9.589)
c.After#c.AgrLand	-0.854	-0.0460	-0.0462	0.00267	-0.350
	(0.829)	(0.0422)	(0.0539)	(0.00952)	(0.230)
c.After#c.AgrLand#c.Adopter	1.226	-0.0423	-0.0121	0.750	0.588
	(0.928)	(0.0903)	(0.0905)	(0.621)	(0.386)
c.After#c.ElecCap	-0.0838	0.0607	-2.827	-0.00107	-0.0391
	(0.657)	(0.185)	(2.667)	(0.00758)	(0.631)
c.After#c.ElecCap#c.Adopter	-1.455	-3.039***	2.980	-0.339	1.341
	(1.764)	(0.827)	(2.716)	(0.553)	(1.235)
c.After#c.dcap	0.136	-0.00524	0.0720	-0.00320	0.149
	(0.175)	(0.0166)	(0.0893)	(0.0185)	(0.110)
c.After#c.dcap#c.Adopter	-0.0682	-0.0417	-0.0770	0.216	-0.134
	(0.212)	(0.0478)	(0.101)	(0.238)	(0.135)
Diesel Capacity	-0.171	0.0554	-0.00199		-0.0725
	(0.108)	(0.0423)	(0.103)		(0.103)
ElecCap	5.694*	2.163	3.963		6.566***
	(2.902)	(1.727)	(2.778)		(2.433)
Agricultural Land Owned	0.740		0.0618	-0.815	3.390**
	(0.640)		(0.0466)	(0.813)	(1.512)
Water Table	-0.383	0.178	0.0874	0.0108	-0.421*
	(0.294)	(0.203)	(0.0740)	(0.192)	(0.233)
Flat Meter	6.896		-701.2***	0.00893	-51.52
	(48.71)		(101.9)	(1.238)	(41.70)

No Electric Pump	-11.56	-9.271	6.388*	-40.60***	-0.153
	(33.03)	(7.514)	(3.762)	(1.486)	(16.80)
Rented Electric Pump = o,	-	-	-	-	-
Animals_Possessed	0.140	-0.132	0.00279	0.0335	0.136**
	(0.160)	(0.104)	(0.00553)	(0.0971)	(0.0620)
No_Diesel_Pump	-9.569	-3.316	3.226		-9.903*
	(6.218)	(3.780)	(2.183)		(5.179)
Drip_Area_Acre	0.0780	0.190	-0.161	0.0118	0.0497
	(1.099)	(0.223)	(0.263)	(0.283)	(0.433)
Diggi_Volume	-0.00273	0.0129*	-0.00367		-0.00529
	(0.0132)	(0.00726)	(0.00320)		(0.0117)
Year Trend	-7.453	-1.303*	0.147	0.0467	0.638
	(6.604)	(0.776)	(0.322)	(0.369)	(2.311)
Agricultural Land Owned = o,		-			
Flat Meter = o,		-			
Diesel Capacity = o,				-	
ElecCap = o,				-	
No_Diesel_Pump = o,				-	
Diggi_Volume = o,				-	
Constant	86.80*	6.927	27.23	45.56	-10.85
	(46.93)	(12.23)	(31.08)	(32.82)	(42.39)
Observations	515	390	233	145	1,283
R-squared	0.135	0.534	0.993	0.389	0.485
Number of Sample	103	78	47	29	257
Cluster Fixed Effects	YES	YES	YES	YES	YES
Farmer Fixed Effects	YES	YES	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.2.3 Impact on Diesel Consumption

We found strong evidence of reduction in annual diesel consumption after solar pump adoption in all the four diesel using districts-Bikaner, Sriganganagar, Jaisalmer and Chittorgarh. As estimated from the pooled model (Table5) annual diesel consumption of solar pump adopters in these four districts fell by 421 litres on average after solar pump adoption. According to district specific models, we found that Sriganganagar has experienced the largest average decline of 620 litres in annual diesel consumption of solar pump adopters, followed by Bikaner (419 litres), Jaisalmer (402 litres) and Chittorgarh (229 litres). There is a decline in the annual diesel

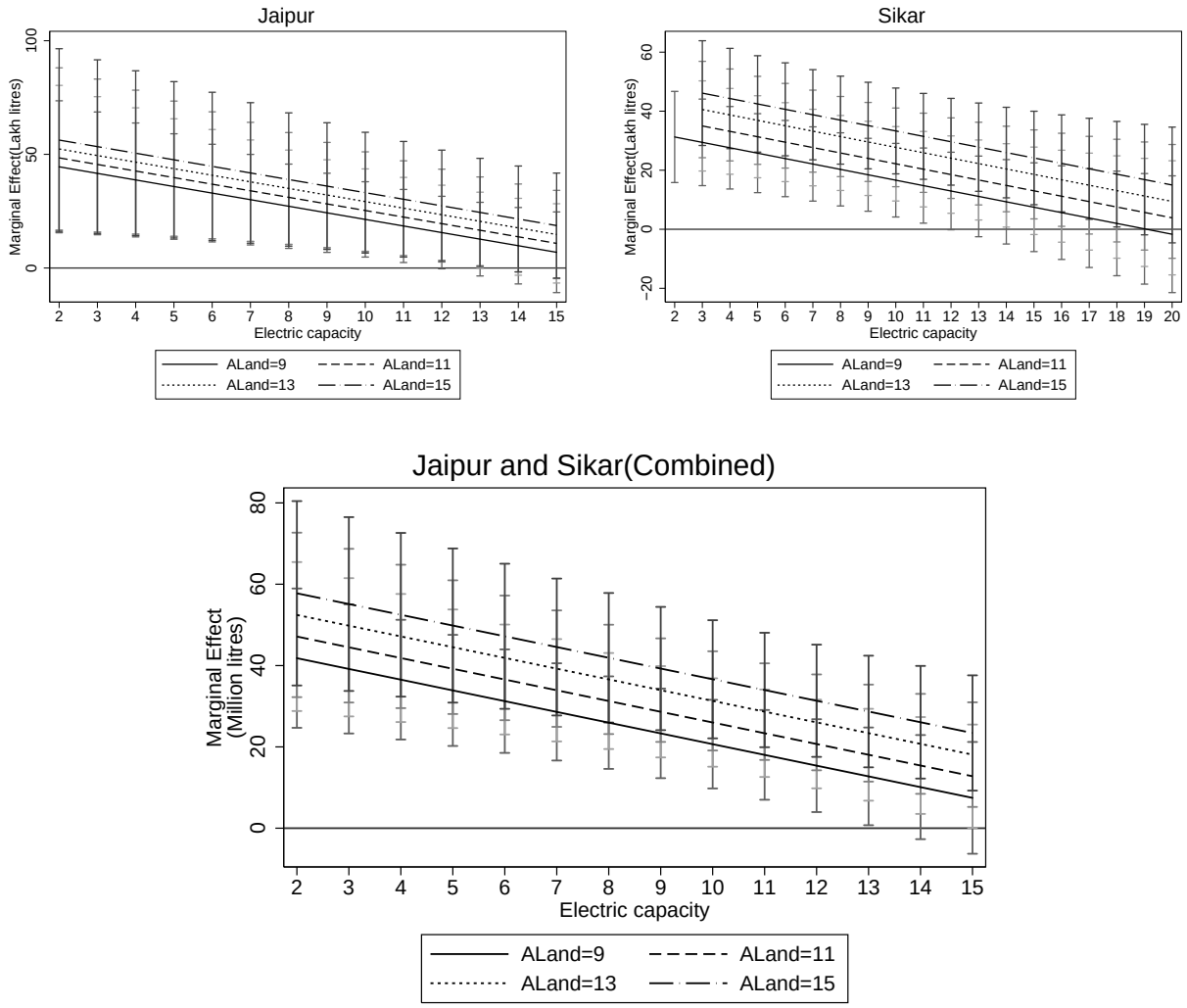

Figure 3: Marginal Effect of Solar Pump Adoption on Water Consumption in Jaipur and Sikar

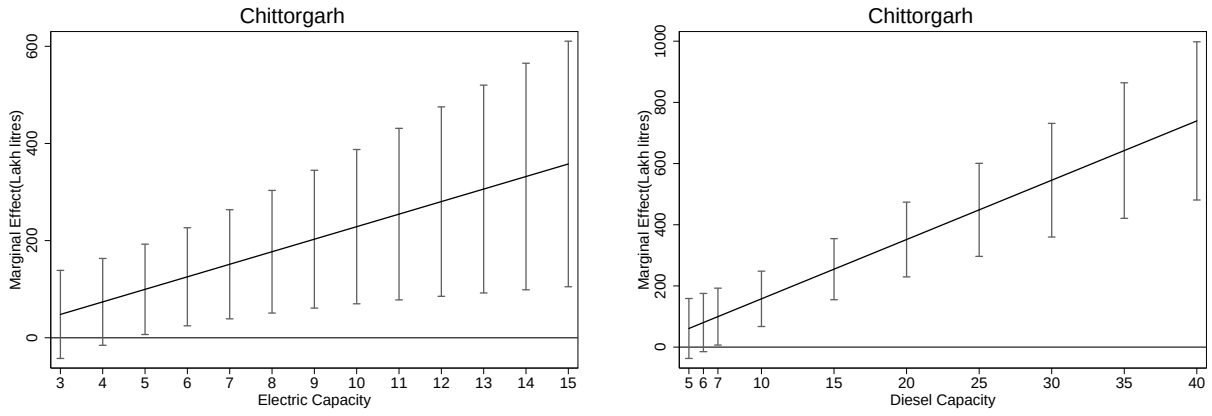

Figure 4: Marginal Effect of Solar Pump Adoption on Water Consumption in Chittorgarh

consumption of solar water pump adopters over the baseline consumption of 66% in Sriganganagar, 80% in Bikaner, 24% in Jaisalmer and 34% in Chittorgarh.

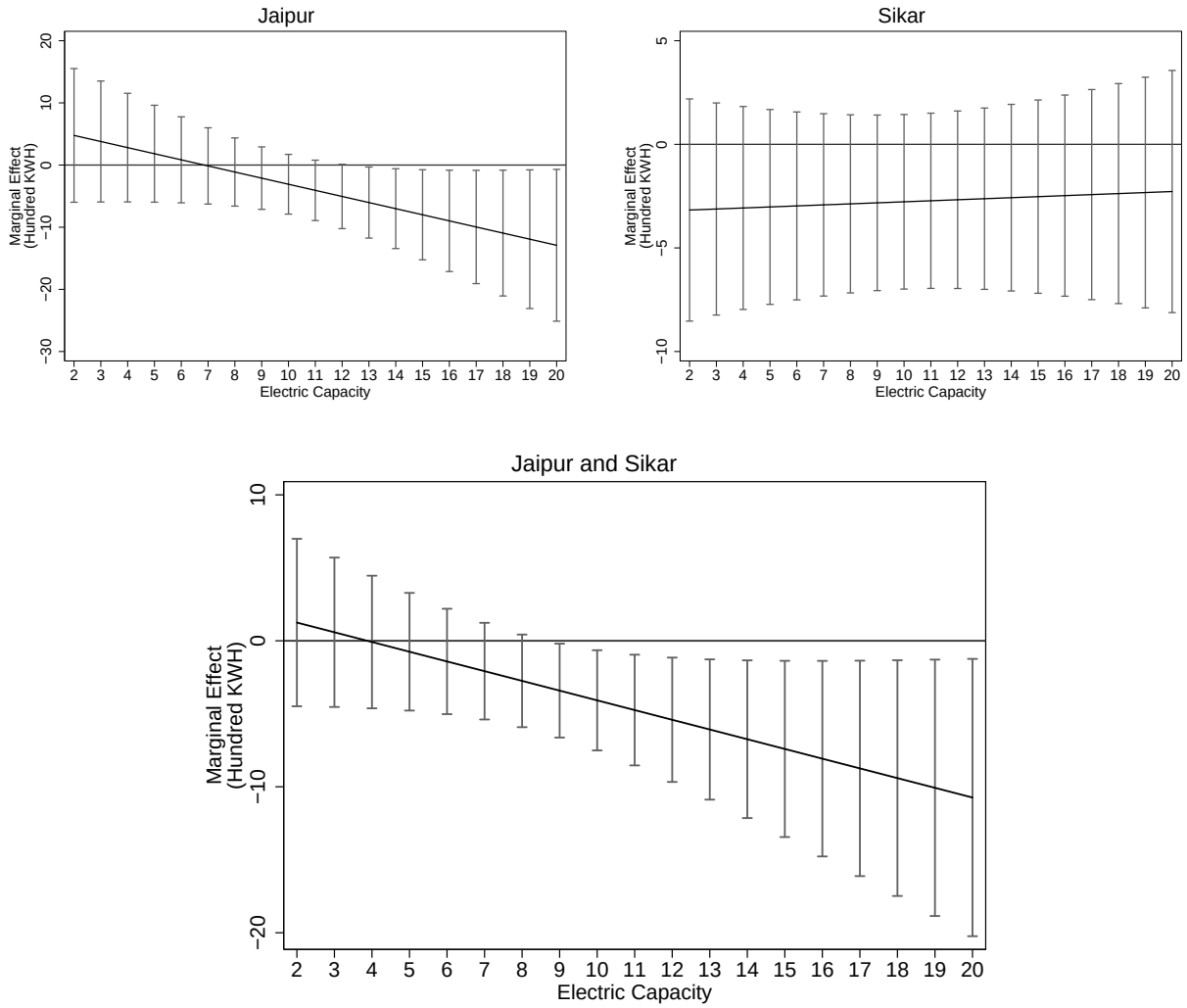

Figure 5: Marginal Effect of Solar Pump Adoption on Electricity Consumption in Jaipur and Sikar

Table 5:

Impact of Solar Water Pumps on Diesel Consumption in four diesel using districts

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Bikaner M1	Sriganganagar M1	Jaisalmer M1	Chittorgarh M1	Group all 4 M1
Adopter	-53.44	-163.9	2,607		
	(168.5)	(183.5)	(1,711)		
After	162.4	241.6	207.3	159.0*	195.0***
	(86.84)	(103.0)	(231.3)	(88.73)	(70.31)
c.Adopter#c.After	-443.6**	-597.3**	-584.6	-229.4**	-420.8***
	(48.81)	(34.54)	(339.6)	(87.05)	(91.57)
Agricultural Land Owned	3.058	7.650*	11.78	196.1***	17.50**
	(4.243)	(0.852)	(7.997)	(29.86)	(8.181)

ElecCap	-0.104	-24.01**	-4.140		-23.52***
	(2.300)	(1.818)	(4.139)		(8.724)
Diesel Capacity	5.782	13.28	12.42		7.083**
	(2.175)	(3.481)	(10.31)		(3.551)
Water Table	-0.417**	-4.871**	-4.384	53.85***	9.283
	(0.0803)	(0.334)	(1.364)	(8.595)	(10.48)
Flat Meter = o,		-			
No Electric Pump	136.6	-438.6	739.1	167.2*	107.7
	(242.0)	(73.03)	(568.9)	(83.03)	(219.6)
irrigation_new==flood	-353.0	-153.9	1,487	72.67	46.46
	(129.2)	(616.4)	(520.6)	(85.26)	(141.0)
Animals_Possessed	-2.919	5.723	1.566	-17.05***	0.212
	(1.118)	(8.072)	(2.286)	(4.785)	(1.273)
No_Diesel_Pump	-536.0**	-540.3*	389.9		-562.1***
	(68.41)	(61.12)	(761.8)		(144.2)
Drip		26.69			
		(451.2)			
Drip_Adopter		-137.7			
		(26.20)			
Drip_Area_Acre	-14.81	14.21	-128.8	-74.15**	-1.190
	(9.241)	(9.823)	(41.58)	(35.24)	(9.342)
Diggi_Volume	1.031	-1.012	1.499		0.808**
	(0.430)	(0.344)	(0.598)		(0.327)
Year Trend	-39.05	-82.01	-27.26	-60.72	-84.15**
	(21.59)	(28.41)	(144.4)	(36.07)	(35.14)
Flat Meter	-7.124		-333.8	382.4***	31.89
	(278.1)		(372.6)	(61.06)	(199.8)
Adopter = o,				-	-
ElecCap = o,				-	
Diesel Capacity = o,				-	
No_Diesel_Pump = o,				-	
Diggi_Volume = o,				-	
Constant	992.2*	1,453	-1,353	-9,602***	-568.5
	(250.9)	(704.6)	(2,290)	(1,597)	(1,429)
Observations	507	390	233	144	1,274
R-squared	0.189	0.289	0.150	0.691	0.173
Number of cluster	3	2	2		
Cluster Fixed Effects	YES	YES	YES		
Farmer Fixed Effects	NO	NO	NO	YES	YES
Cluster Specific YearTrends	YES	YES	YES		
Number of Sample				29	256

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.2.4 Impact on Cropping Intensity

We found that three out of six districts experienced improvement in the cropping intensity after adoption of solar water pumps. Sikar, with number of rainfed solar pump adopters, showed maximum increase of 17%. The positive impact on cropping intensity varies negatively with electric capacity and ranges from 18% at 2 HP to 7% at 12 HP. After 12 HP the marginal impact of solar pump adoption on cropping intensity becomes insignificant. In Jaipur, we did not find any significant impact on cropping intensity. In the pooled model for Jaipur and Sikar, we found positive significant impact of solar pump adoption on cropping intensity that varies negatively with electric capacity (Table 6, Figure 7).
In Bikaner, solar pump adoption resulted in 7% increase in cropping intensity on average. In Jaisalmer, the positive significant impact on cropping intensity varies positively with electric capacity (Figure 8). For instance, at mean diesel capacity of 10 HP and agricultural landholding of 33 acres, solar pump adopters with electric pump capacity experienced 13% increas at 2 HP and 27% increase at 15 HP. In Chittorgarh and Sriganganagar, we did not find any significant impact on cropping intensity. In the pooled model of all four diesel using districts, we found a average increase of 6% in the cropping intensity after adoption of solar water pump (Table 7).

Table 6:

Impact of Solar Water Pumps on Cropping Intensity in Jaipur and Sikar

	(1)	(2)	(3)
VARIABLES	Jaipur M4	Sikar M4	Jaipur Sikar M4
Adopter = o,	-	-	-
After	-0.0341	-0.0640	-0.0211
	(0.0450)	(0.0745)	(0.0437)
c.Adopter#c.After	0.0511	0.276***	0.147**
	(0.0585)	(0.103)	(0.0597)
c.After#c.AgrLand	0.00845	-0.00711	-0.00726*
	(0.00528)	(0.00566)	(0.00390)
c.After#c.AgrLand#c.Adopter	-0.0140**	0.00708	0.00447
	(0.00692)	(0.00737)	(0.00517)
c.After#c.ElecCap	-0.000604	0.00572	0.00423*
	(0.00226)	(0.00351)	(0.00237)
c.After#c.ElecCap#c.Adopter	0.00380	-0.0195***	-0.00865**
	(0.00365)	(0.00549)	(0.00371)
ElecCap = o,	-		
Agricultural Land Owned	-0.0317		-0.0367

	(0.0407)		(0.0363)
Water Table	0.000687	0.00218	0.000838
	(0.000554)	(0.00252)	(0.000614)
Flat Meter	0.0378	-0.0646	-0.00825
	(0.0812)	(0.0390)	(0.0552)
No Electric Pump = o,	-		
Rented Electric Pump	0.868***		
	(0.0226)		
Animals_Possessed	0.00252*	0.00229	0.00283**
	(0.00131)	(0.00310)	(0.00136)
Drip_Area_Acre	-0.0140	0.0769*	0.00840
	(0.00942)	(0.0459)	(0.0145)
Year Trend	-0.0522**	0.0562**	-0.0584**
	(0.0243)	(0.0266)	(0.0269)
ElecCap		0.0276*	0.0206
		(0.0139)	(0.0154)
Agricultural Land Owned = o,		-	
No Electric Pump		-0.0422	-0.0713
		(0.187)	(0.258)
Rented Electric Pump = o,		-	-
Constant	1.965***	0.607	1.600***
	(0.484)	(0.714)	(0.498)
Observations	545	315	860
R-squared	0.155	0.418	0.216
Number of Sample	109	63	172
Cluster Fixed Effects	YES	YES	YES
Farmer Fixed Effects	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7:

Impact of Solar Water Pumps on Cropping Intensity in four diesel using districts

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Bikaner M1	Sriganganagar M1	Jaisalmer M4	Chittorgarh M4	Group all 4 M4
Adopter = o,			-	-	-
After	-0.0341	-0.0114	-0.218**	-0.333***	-0.0647*
	(0.0132)	(0.00521)	(0.0999)	(0.109)	(0.0387)

c.Adopter#c.After	0.0605	-0.0483	0.238	0.499***	0.103**
	(0.0749)	(0.0800)	(0.186)	(0.148)	(0.0511)
c.After#c.AgrLand			0.00329***	0.00640	0.000119
			(0.00120)	(0.00565)	(0.000939)
c.After#c.AgrLand#c.Adopter			-0.00315	-0.0139	-0.000558
			(0.00402)	(0.00915)	(0.00121)
c.After#c.ElecCap			-0.0223***	0.0318***	-0.000397
			(0.00558)	(0.00746)	(0.00124)
c.After#c.ElecCap#c.Adopter			0.0198***	-0.0429**	-0.000445
			(0.00563)	(0.0186)	(0.00175)
c.After#c.dcap			-0.00426*	0.0170**	0.000721
			(0.00235)	(0.00737)	(0.000975)
c.After#c.dcap#c.Adopter			0.00595	-0.0162*	-0.000507
			(0.00464)	(0.00816)	(0.00114)
Diesel Capacity	0.00115*	0.00154	0.00782**		-0.00135
	(0.000303)	(0.00105)	(0.00361)		(0.00102)
ElecCap	0.00118	-0.0206**	0.00521		-0.00982**
	(0.00164)	(0.000950)	(0.00313)		(0.00462)
Agricultural Land Owned	-0.00373	-0.00279	0.000818	0.188***	0.000861
	(0.00314)	(0.000644)	(0.00497)	(0.0481)	(0.00405)
Water Table	-0.000405	0.000766	0.00256	0.0250***	0.000271
	(0.000395)	(0.000573)	(0.00443)	(0.00881)	(0.000796)
Flat Meter	0.198		-0.108	0.312***	-0.136
	(0.121)		(0.437)	(0.0681)	(0.102)
No Electric Pump	-0.0204	-0.474**	-0.272	0.415***	-0.154**
	(0.0957)	(0.0320)	(0.185)	(0.0861)	(0.0768)
Rented Electric Pump = o,			-	-	-
Animals_Possessed	-2.72e-05	-0.00164	-4.21e-05	-0.00506	-0.000268
	(0.000819)	(0.00176)	(0.000603)	(0.00406)	(0.000350)
No_Diesel_Pump	0.0533	0.136	-0.155		-0.0849*
	(0.0257)	(0.123)	(0.113)		(0.0450)
Drip_Area_Acre	-0.00607	0.00521*	-0.00914	0.0395	-0.00171
	(0.00564)	(0.000763)	(0.00924)	(0.0351)	(0.00286)
Diggi_Volume	0.000283	0.000150	-0.000114		-9.12e-05
	(0.000332)	(0.000172)	(0.000118)		(0.000105)
Year Trend	0.0141	0.0365*	0.0179	0.0262	0.0348**
	(0.00838)	(0.00374)	(0.0214)	(0.0254)	(0.0167)
Adopter	-0.00571	-0.107			
	(0.0537)	(0.0718)			
Flat Meter = o,		-			
irrigation_new==flood	-0.107**	-0.191			
	(0.0185)	(0.0599)			
Drip		-0.0241			
		(0.0424)			
Drip_Adopter		0.115			
		(0.117)			

Diesel Capacity = o,				-	
ElecCap = o,				-	
No_Diesel_Pump = o,				-	
Diggi_Volume = o,				-	
Constant	1.824***	2.403**	1.084	-3.981**	1.856***
	(0.103)	(0.0678)	(0.903)	(1.594)	(0.155)
Observations	507	390	233	145	1,283
R-squared	0.143	0.310	0.325	0.242	0.144
Number of cluster	3	2			
Cluster Fixed Effects	YES	YES	YES	YES	YES
Farmer Fixed Effects	NO	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES	YES
Number of Sample			47	29	257

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.2.5 Impact on Gross Cropped Area Under fruits and Vegetables

We found evidence of increasing GCA under fruits and vegetables in three districts-Jaipur, Bikaner and Chittorgarh. In Jaipur, GCA under fruits and vegetables increased by about .78 acres for solar pump adopters which amounts to about 18% increase over baseline mean GCA under fruits and vegetables for solar pump adopters. In Sikar, we did not find any significant impact on GCA under fruits and vegetables. In the pooled model, we do find positive and significant average impact of about .60 acres for adopters(Table 8).
In Bikaner, GCA under fruits and vegetables expanded by 1.2 acres on average for solar pump adopters, representing about 48% increase over the baseline GCA under fruits and vegetables for solar pump adopters. In Chittorgarh, we found positive significant impact which varies negatively with electric and diesel capacity (Table 8, Figure 9). At mean electric capacity (6 hP), we find positive significant impact till 7 HP diesel capacity. At mean diesel capacity (7 hP), we found positive siginificant impact till 6 HP electric capacity. In Jaisalmer and Sriganganagar, we did not find any significant impact on GCA under fruits and vegetables. In the pooled model of all four diesel using districts, we found a average increase of .5 acres in the GCA under fruits and vegetables after adoption of solar water pump (Table 9, Figure 10).

Table 8:

Impact of Solar Water Pumps on GCA in Fruits and Vegetables in Jaipur and Sikar

	(1)	(2)	(3)
	Jaipur	Sikar	Jaipur
VARIABLES	M1	M1	Sikar M1

Adopter = o,	-	-	-
After	-0.848***	-0.122	-0.636***
	(0.245)	(0.193)	(0.171)
c.Adopter#c.After	0.781***	0.135	0.631***
	(0.276)	(0.261)	(0.196)
Agricultural Land Owned	0.959***		1.092***
	(0.228)		(0.200)
ElecCap = o,	-		
Water Table	-0.00211	-0.00597	-0.00235
	(0.00580)	(0.0170)	(0.00557)
Flat Meter	-0.185	0.670	0.200
	(0.484)	(0.461)	(0.351)
No Electric Pump = o,	-		
Rented Electric Pump	-0.682***		
	(0.171)		
Animals_Possessed	0.00117	-0.00227	-0.000567
	(0.0108)	(0.0100)	(0.00903)
Drip_Area_Acre	0.0147	0.336	0.0783
	(0.0764)	(0.202)	(0.0693)
Year Trend	0.257	-0.0302	0.225
	(0.365)	(0.0964)	(0.355)
Agricultural Land Owned = o,		-	
ElecCap		0.0824	0.0888
		(0.0860)	(0.0915)
No Electric Pump		1.463	1.605
		(1.292)	(1.393)
Rented Electric Pump = o,		-	-
Constant	-4.137	1.335	-8.376**
	(3.462)	(4.865)	(3.386)
Observations	545	315	860
R-squared	0.156	0.288	0.173
Number of Sample	109	63	172
Cluster Fixed Effects	YES	YES	YES
Farmer Fixed Effects	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9:

Impact of Solar Water Pumps on GCA in Fruits and Vegetables in four diesel using districts

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Bikaner M1	Sriganganagar M1	Jaisalmer M1	Chittorgarh M4	Group all 4 M4
Adopter = o,	-	-	-	-	-
After	-0.655**	-0.569*	-0.728***	0.0202	-0.759**
	(0.303)	(0.302)	(0.157)	(0.431)	(0.334)
c.Adopter#c.After	1.246**	-0.409	0.617***	0.714**	0.586
	(0.596)	(0.501)	(0.204)	(0.319)	(0.502)
ElecCap	0.121*	-0.825***	0.0244		-0.0393
	(0.0711)	(0.0669)	(0.0675)		(0.0906)
Diesel Capacity	-0.00336	-0.0174	-0.00824		-0.00678
	(0.00772)	(0.0198)	(0.00775)		(0.00812)
Agricultural Land Owned = o,		-			
Water Table	0.00866	0.157	-0.00103	0.0130	0.0212
	(0.0114)	(0.109)	(0.00519)	(0.0129)	(0.0169)
Flat Meter = o,		-			
No Electric Pump		-4.012***	-0.442	0.569***	-1.759
		(0.602)	(1.029)	(0.135)	(1.306)
irrigation_new==flood	-0.338	-0.959	-1.190***	-1.475***	-1.418***
	(0.428)	(1.116)	(0.301)	(0.450)	(0.332)
Animals_Possessed	0.00625	-0.0674	0.00288	-0.00348	-0.000490
	(0.00580)	(0.0528)	(0.00216)	(0.0174)	(0.00215)
No_Diesel_Pump	-0.222	-2.475	-1.031*		-0.918*
	(0.430)	(1.703)	(0.533)		(0.482)
Drip		1.697			
		(1.061)			
Drip_Adopter		-0.587			
		(0.614)			
Drip_Area_Acre	-0.0823	0.176*	0.0696	-0.0634**	0.0987*
	(0.0509)	(0.0971)	(0.0521)	(0.0234)	(0.0587)
Diggi_Volume	0.00306**	-0.00361*	-0.00123		-0.000798
	(0.00138)	(0.00213)	(0.00118)		(0.00134)
Year Trend	0.464	0.178	0.217	0.114	0.0520
	(0.433)	(0.163)	(0.340)	(0.106)	(0.109)
Agricultural Land Owned	-0.0748**		0.0882*	0.739***	0.0159
	(0.0357)		(0.0522)	(0.0945)	(0.0388)
Flat Meter			-0.294	0.312**	0.250
			(0.394)	(0.138)	(1.223)
c.After#c.ElecCap				-0.0352	-0.0492***
				(0.0454)	(0.0178)
c.After#c.ElecCap#c.Adopter				-0.0568	0.133***

				(0.0500)	(0.0479)
c.After#c.dcap				-0.0161	0.00912
				(0.0251)	(0.00680)
c.After#c.dcap#c.Adopter				-0.00218	-0.0148*
				(0.0185)	(0.00825)
ElecCap = o,				-	
Diesel Capacity = o,				-	
No_Diesel_Pump = o,				-	
Diggi_Volume = o,				-	
c.After#c.AgrLand					-0.00122
					(0.00802)
c.After#c.AgrLand#c.Adopter					-0.0107
					(0.0195)
Constant	2.142	5.427	2.179	-4.600*	1.860
	(2.075)	(3.346)	(1.623)	(2.601)	(2.340)
Observations	507	390	2,214	144	1,274
R-squared	0.089	0.447	0.140	0.253	0.194
Number of Sample	102	78	444	29	256
Cluster Fixed Effects	YES	YES			YES
Farmer Fixed Effects	YES	YES	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES		YES
JAISALMER			YES		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.2.6 Impact on Annual profits

We found some evidence on improvement in annual profits in two electricity using districts-Jaipur and Sikar. In Jaipur, the positive impact is found at 10% level of significance for small solar pump adopters who have electric capacity less than or equal to 7 HP. In Sikar, we found positive but insignificant impact on annual profits of adopters. In the pooled model for Jaipur and SIkar, we obtain a significant and positive impact on profits particularly for small capacity farmers (Table 10, Figure 11). There is a stong evidence of improvement in annual profits of solar pump adopters in two diesel using districts-Bikaner and Sriganganagar. Sriganganagar experienced the highest average increase of 155 thousand rupees followed by Bikaner that showed an average annual increase of 106 thousand rupees. In Sriganganagar, marginal effect of solar pump adoption on annual profits increases with both electric and diesel capacity (Table 11, Figure 12). In Bikaner, on the other hand, marginal effect of solar pump adoption on annual profits increases with the size of the agricultural handholding (Table 11, Figure 12). In case of Jaisalmer and Chittorgarh, we did not find evidence on increase of profits.In the pooled model for four diesel using districts, we found positive and significant impact that varies positively with the size of land holdings and electric capacity (Table 11, Figure 12).

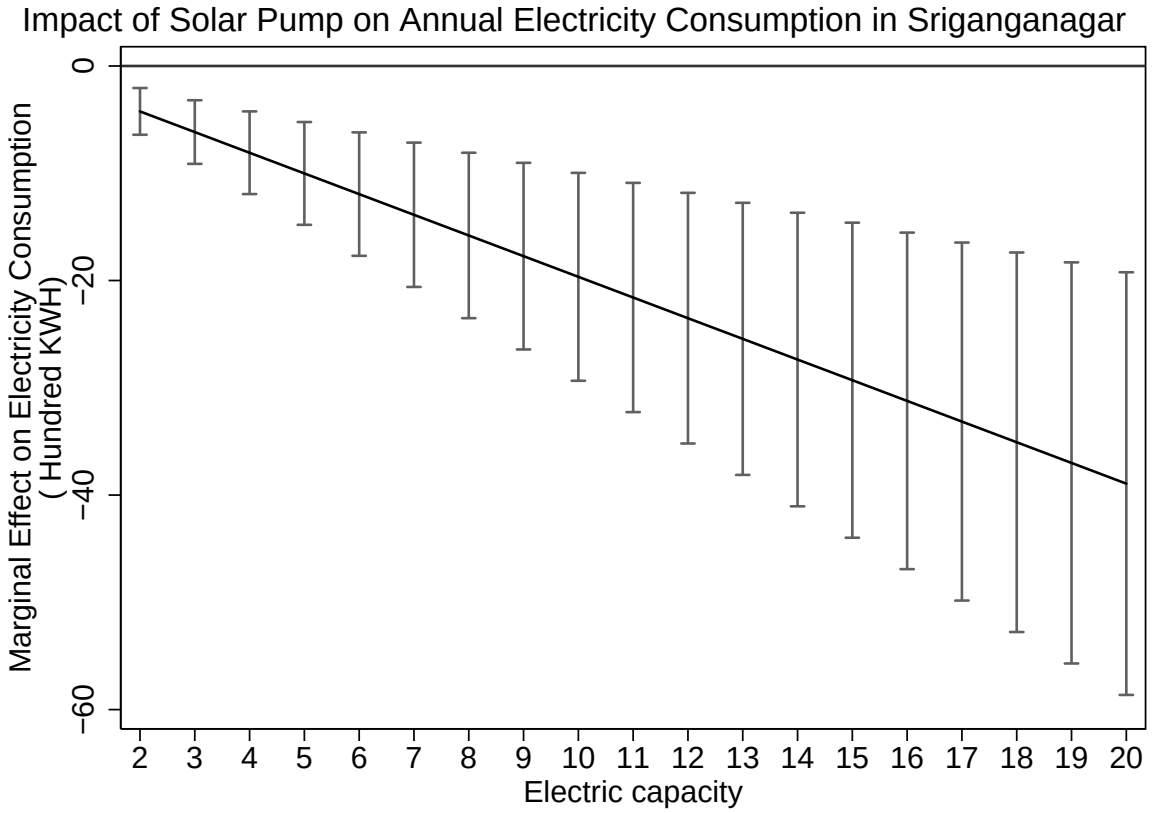

Figure 6: Marginal Effect of Solar Pump Adoption on Electricity Consumption in Sriganganagar

Table 10:

Impact of Solar Water Pumps on Profits of Farmers in Jaipur and Sikar

	(1)	(2)	(3)
VARIABLES	Jaipur M4	Sikar M4	Jaipur Sikar M4
Adopter = o,	-	-	-
After	-16.38	32.76***	0.143
	(9.909)	(9.469)	(8.039)
c.Adopter#c.After	14.71	-1.664	12.78
	(13.43)	(9.511)	(8.563)
c.After#c.AgrLand	0.0983	-0.898	-0.124
	(0.765)	(0.640)	(0.480)
c.After#c.AgrLand#c.Adopter	0.225	0.893	0.250
	(1.242)	(0.950)	(0.730)
c.After#c.ElecCap	0.402	-0.417	0.0570

	(0.284)	(0.495)	(0.234)
c.After#c.ElecCap#c.Adopter	-0.810*	-0.304	-0.697*
	(0.431)	(0.747)	(0.360)
ElecCap = o,	-		
Agricultural Land Owned	-0.0816		5.160
	(6.980)		(7.238)
Water Table	0.200	0.570**	0.273**
	(0.135)	(0.245)	(0.123)
Flat Meter	0.561	20.72	10.31
	(6.915)	(27.55)	(11.39)
No Electric Pump = o,	-	-	
Rented Electric Pump	-6.322	7.278	
	(4.342)	(11.03)	
Animals_Possessed	-0.0258	-0.00233	-0.0442
	(0.183)	(1.178)	(0.224)
Drip_Area_Acre	-0.112	3.577**	0.721
	(1.028)	(1.619)	(0.845)
Year Trend	7.016*	-7.983**	6.165*
	(4.009)	(3.180)	(3.566)
ElecCap		-2.466***	-1.924*
		(0.895)	(0.981)
Agricultural Land Owned = o,		-	
No Electric Pump			2.004
			(7.992)
Rented Electric Pump = o,			-
Constant	-29.65	-74.72	-66.40
	(82.14)	(60.36)	(86.83)
Observations	545	305	850
R-squared	0.068	0.126	0.068
Number of Sample	109	61	170
Cluster Fixed Effects	YES	YES	YES
Farmer Fixed Effects	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11:

Impact of Solar Water Pumps on Profits of Farmers in four diesel using districts

	(1)	(2)	(3)	(4)	(5)
	Bikaner	Sriganganagar	Jaisalmer	Chittorgarh	Group all 4

VARIABLES	M4	M4	M4	M4	M4
Adopter = o,	-	-	-	-	-
After	-20.83	-105.0	110.1	31.76	-19.36
	(47.38)	(80.89)	(276.5)	(20.15)	(54.11)
c.Adopter#c.After	16.51	43.91	-687.1	31.52	-172.5*
	(53.53)	(118.0)	(632.2)	(37.58)	(91.34)
c.After#c.AgrLand	-2.975	5.949**	-2.378	-1.601	-1.950
	(2.972)	(2.565)	(5.061)	(3.372)	(2.503)
c.After#c.AgrLand#c.Adopter	6.931**	-6.171*	2.138	-1.714	6.468**
	(3.158)	(3.463)	(14.41)	(4.964)	(3.135)
c.After#c.ElecCap	-1.136	-6.018	-47.84	-2.369	-2.522
	(2.301)	(6.091)	(55.26)	(3.112)	(2.844)
c.After#c.ElecCap#c.Adopter	-0.877	31.80**	102.5	2.059	22.01***
	(3.566)	(12.78)	(96.83)	(4.642)	(7.780)
c.After#c.dcap	0.942	-2.243	-4.968	-1.104	-0.366
	(1.190)	(1.975)	(7.512)	(1.717)	(1.461)
c.After#c.dcap#c.Adopter	-2.043	6.538**	20.75	-0.474	1.788
	(1.277)	(3.063)	(13.02)	(2.119)	(1.427)
ElecCap	10.94*	29.64	38.87		28.28
	(6.386)	(25.26)	(44.73)		(17.72)
Diesel Capacity	-1.348	0.325	13.39		0.501
	(1.093)	(1.250)	(17.33)		(1.958)
Agricultural Land Owned = o,		-			
Water Table	-1.123	28.11*	-44.52	-1.459	-7.021
	(0.948)	(14.88)	(64.80)	(1.173)	(10.10)
Flat Meter = o,		-			
No Electric Pump		242.1	14.71	-81.28***	201.1
		(152.5)	(233.6)	(15.00)	(137.9)
irrigation_new==flood	-46.35	29.78	-7.192	-110.6***	-55.75
	(30.02)	(80.59)	(322.8)	(32.99)	(45.89)
Animals_Possessed	0.780	4.688	5.922	-1.882	1.555
	(0.710)	(4.403)	(6.080)	(1.756)	(1.538)
No_Diesel_Pump	-67.91	-189.0**	561.1		-17.60
	(43.69)	(91.60)	(610.0)		(122.6)
Drip		-50.79			
		(95.68)			
Drip_Adopter		-208.5**			
		(90.72)			
Drip_Area_Acre	-6.711*	12.30	18.06	-5.645*	1.081
	(3.614)	(10.01)	(46.06)	(3.289)	(6.159)
Diggi_Volume	0.122	-0.655*	-0.979		-0.392
	(0.0816)	(0.356)	(0.690)		(0.244)
Year Trend	-29.48	-24.11	40.08	-5.639	7.970
	(28.15)	(22.07)	(60.62)	(6.563)	(19.89)

Agricultural Land Owned	1.858		10.25	-5.302	23.37**
	(4.293)		(16.22)	(9.471)	(9.613)
Flat Meter			4,875	-28.02**	-200.3
			(12,339)	(10.30)	(222.5)
ElecCap = o,				-	
Diesel Capacity = o,				-	
No_Diesel_Pump = o,				-	
Diggi_Volume = o,				-	
Constant	366.2**	-346.6	7,342	523.0**	360.5
	(154.8)	(446.4)	(11,570)	(198.1)	(1,109)
Observations	502	380	217	144	1,243
R-squared	0.132	0.269	0.236	0.138	0.158
Number of Sample	101	76	44	29	250
Cluster Fixed Effects	YES	YES	YES		YES
Farmer Fixed Effects	YES	YES	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES		YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

7 Discussion and Policy

The solar pump subsidy program has increased energy and water access for solar pump adopters in Rajasthan. This has led to increase in cropping intensity, gross cropped area under fruits and vegetables, and annual profits of solar pump adopters in Rajasthan. Overall, this seems to be a good policy for enhancing food security and incomes of farmers, and reducing fossil fuel consumption of diesel and electricity consumption, which are associated with high degree of carbon emissions.

There is a evidence of increasing ground water extraction by small farmers who have small electric pumps or no electric pumps. Access to solar pumps enabled them to extract more groundwater and meet some amount of previously unmet irrigation water demand leading to expansion in area under cultivation and area under fruits and vegatables. A number of rainfed farmers in Sikar who were previously only able to cultivate kharif crop during monsoon were able to also cultivate during rabi season due to access to solar water pump resulting in doubling of their cropping intensity.

Small farmers are using solar pump as a complement to the existing electric pump. As we find the impact of solar pump adoption on electricity consumption to be negative and significant for only large farmers with electric capacity greater than 9-12 hP. For large farmers (with electric capacity greater than 11-13 HP), the marginal impact of solar pump adoption on ground water consumption is not significant. This gives some evidence of substitution from electricity to solar by large farmers. We also found strong evidence of declining diesel consumption in diesel using districts. These are important positive impacts of this policy as solar pumps have many

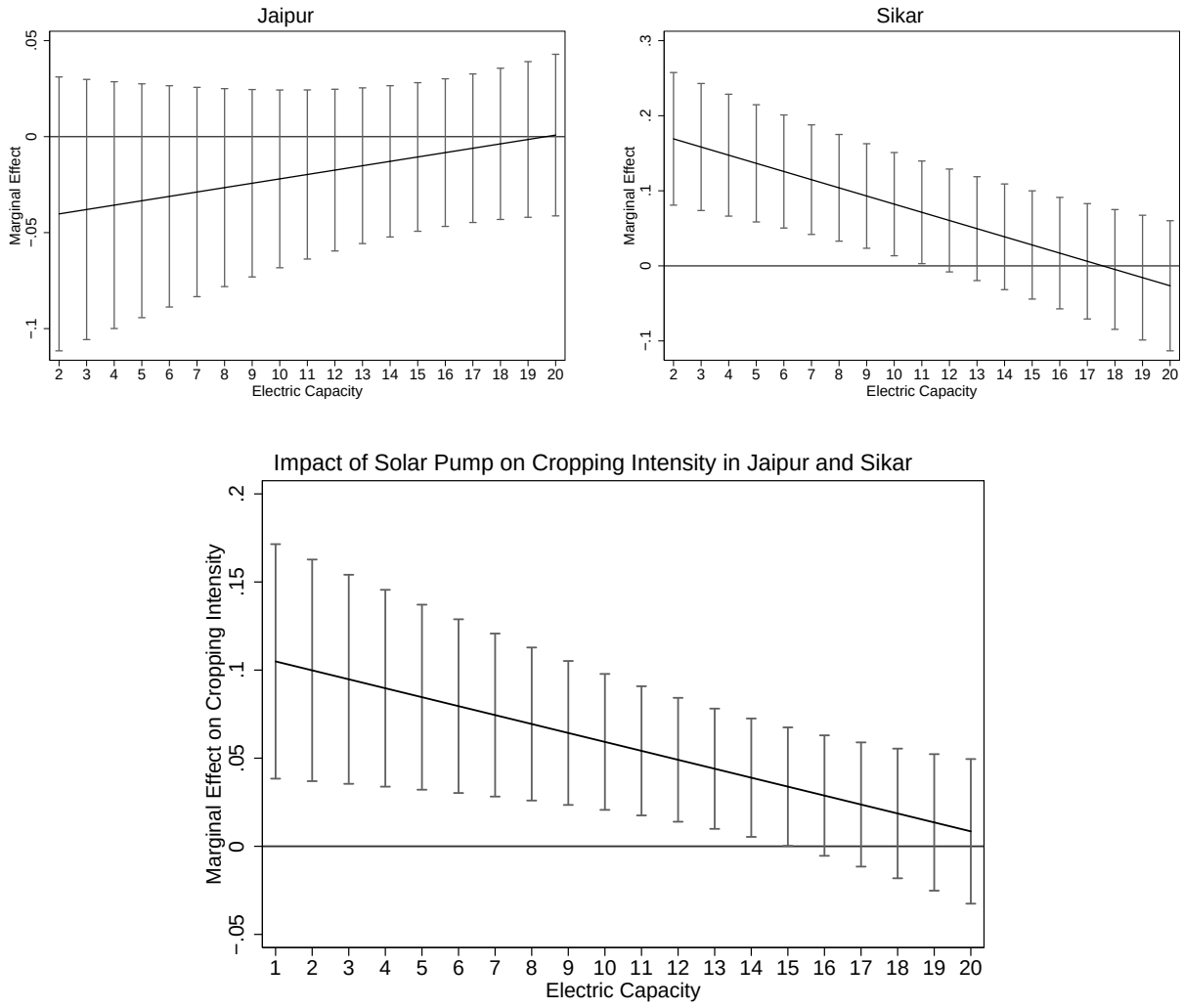

Figure 7: Marginal Effect of Solar Pump Adoption on Cropping Intensity in Jaipur and Sikar

advantages over electric and diesel pumps. One disadvantage is the possible overextraction of groundwater by solar adopters in the long run in ground water using districts as solar is free and farmers have no incentive to save water. In the current sample almost all solar pumps are of the size 3 HP which is relatively small compared to the existing average capacity of 15 HP in Jaipur and 8 HP in Sikar. However, the extension of subsidy to larger solar pumps such as 5-10 HP could result in over exploitation of ground water in the long run in these ground water using districts.

We need innovative policies for governing ground water level in a sustainable way. There is a need for metering agriculture water use. In this regard, Rajasthan government has started measuring ground water use by solar pumps by introducing remote sensing chips in the all newly installed solar water pumps. This is a great step ahead but we also need to monitor the total water use by farmers as what matters is not just extraction by solar pumps but by all pumps together. Probably, we need a policy that puts cap on the total water extraction by an individual farmer. Another possibility could be to connect the solar adopters to the grid which will enable the farmers to cultivate solar cash crop by producing and selling electricity and thus incentivizing efficient water use on farms as in the case of Surya Ratha policy in Karnataka ([Raitha, 2014]).

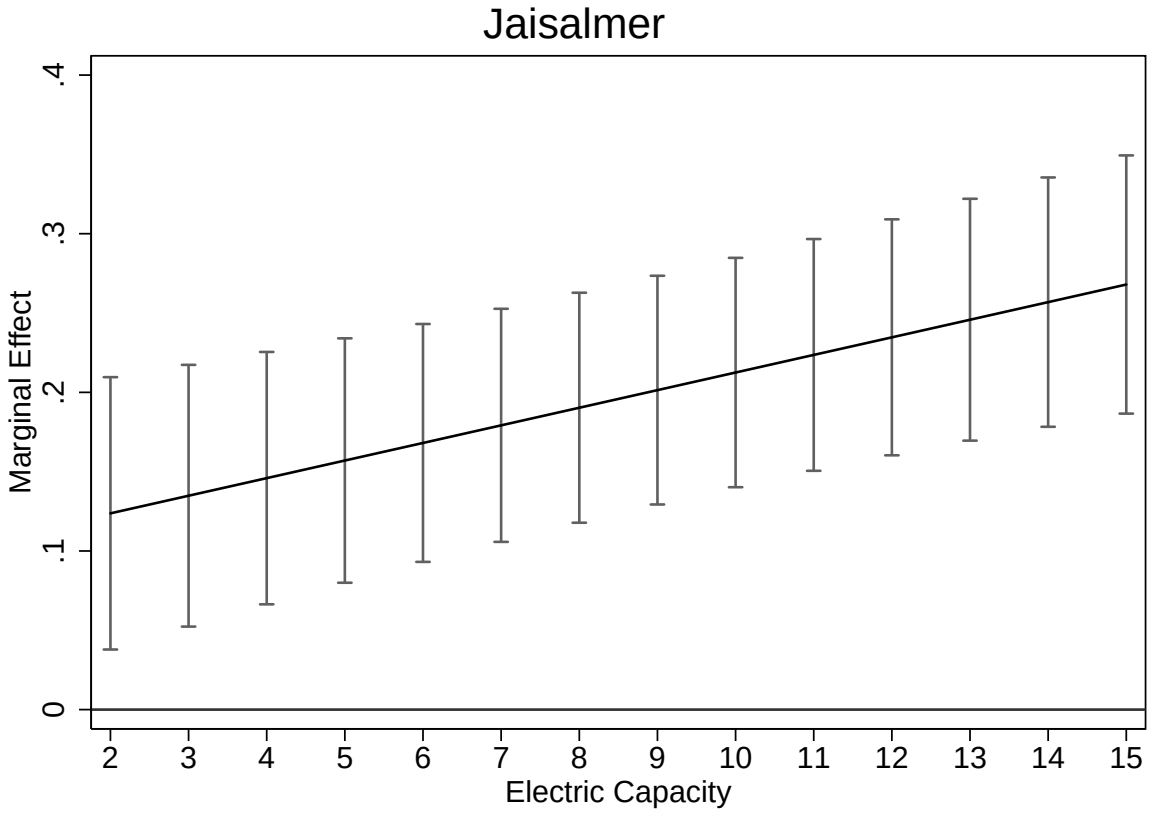

Figure 8: Marginal Effect of Solar Pump Adoption on Cropping Intensity in Jaisalmer

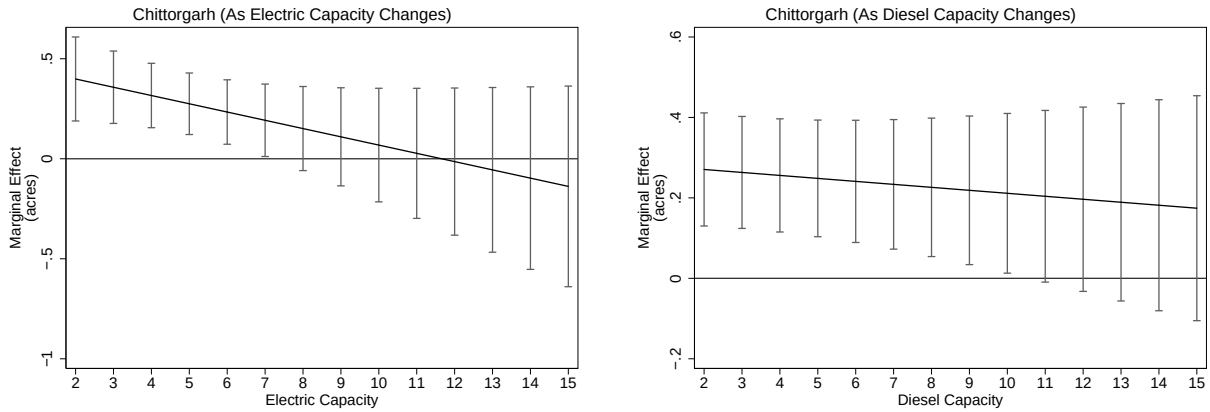

Figure 9: Marginal Effect of Solar Pump Adoption on GCA under Fruits and Vegatables in Chittorgarh

Interestingly, we find that in all diesel using districts (except Chittorgarh) farmers are primarily dependent on canal irrigation and using solar pumps for ditribution of water from diggi. This implies promoting solar pumps in these areas provide win win solution as farmer profits expand and fossil fuel consumption falls with no impact on ground water extraction. In Bikaner, many farmers reported improvement in the cropping intensity after adoption of solar pumps as it enabled them to grow zaid crop as they could save and store water in diggi from previous season and use solar pump for distributing water from diggi. Earlier it was not profitable for

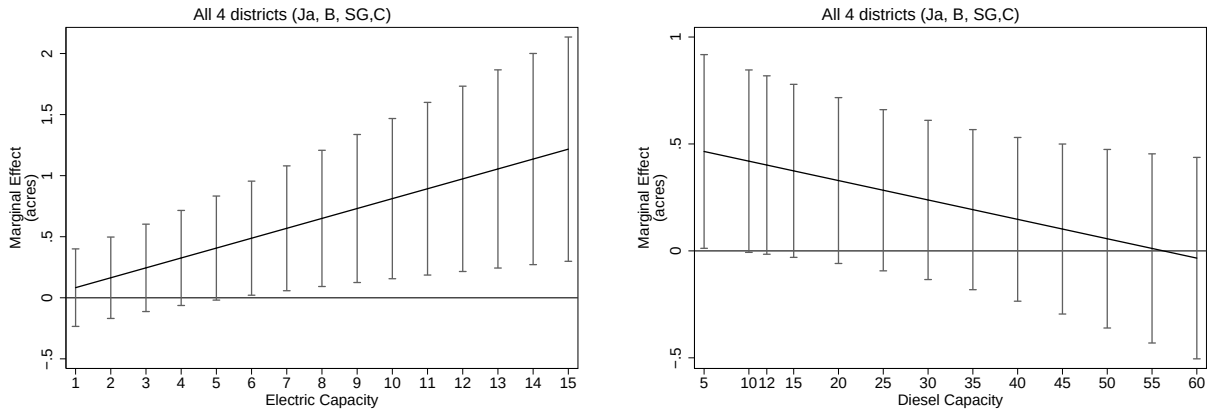

Figure 10: Marginal Effect of Solar Pump Adoption on GCA under Fruits and Vegatables in all four diesel using districts

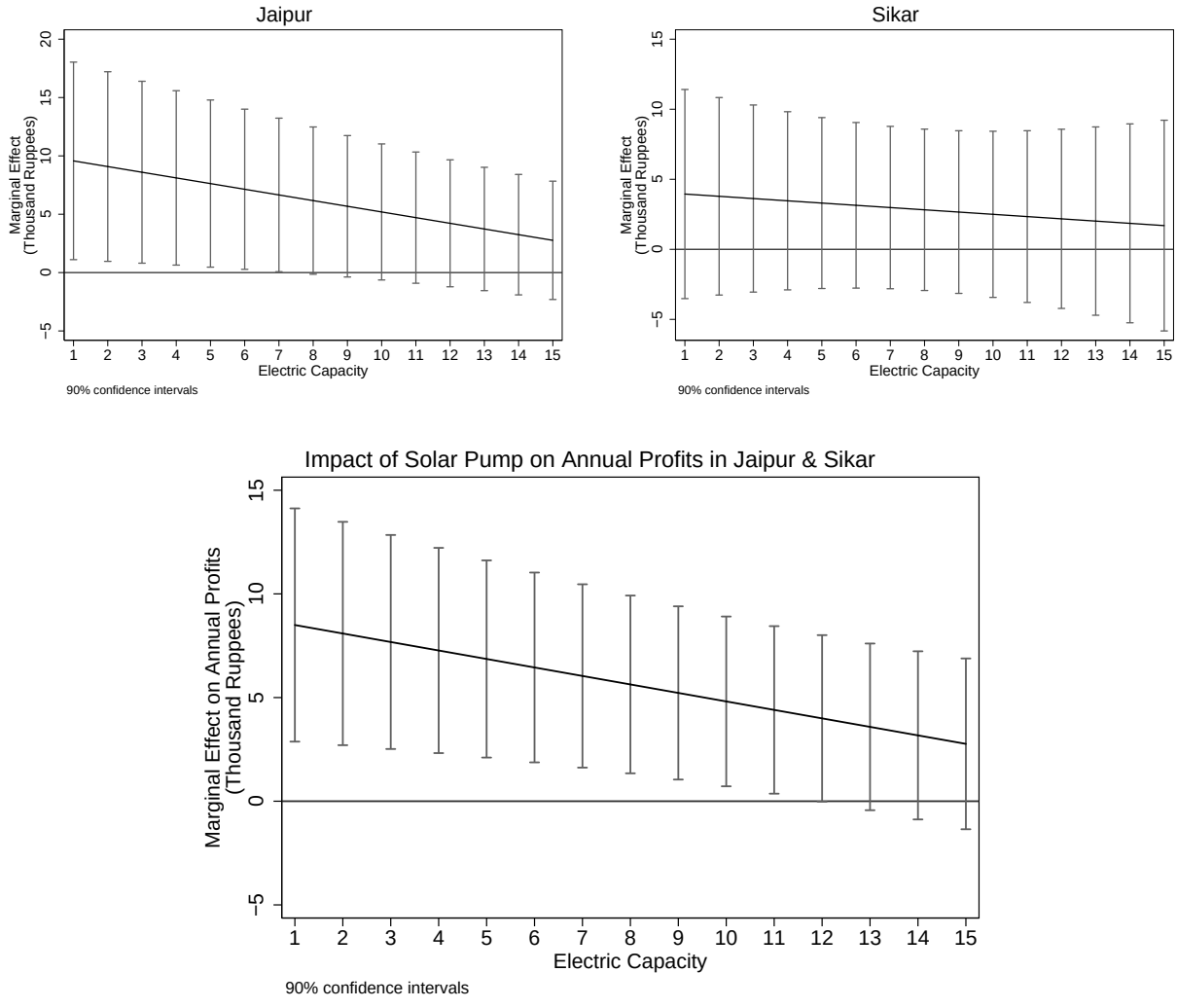

Figure 11: Marginal Effect of Solar Pump Adoption on Annual profits in Jaipur and Sikar

them to grow zaid crop with costly diesel and unreliable electricity supply during this season. Another key policy implication of the analysis is with regard to better targeting of the small

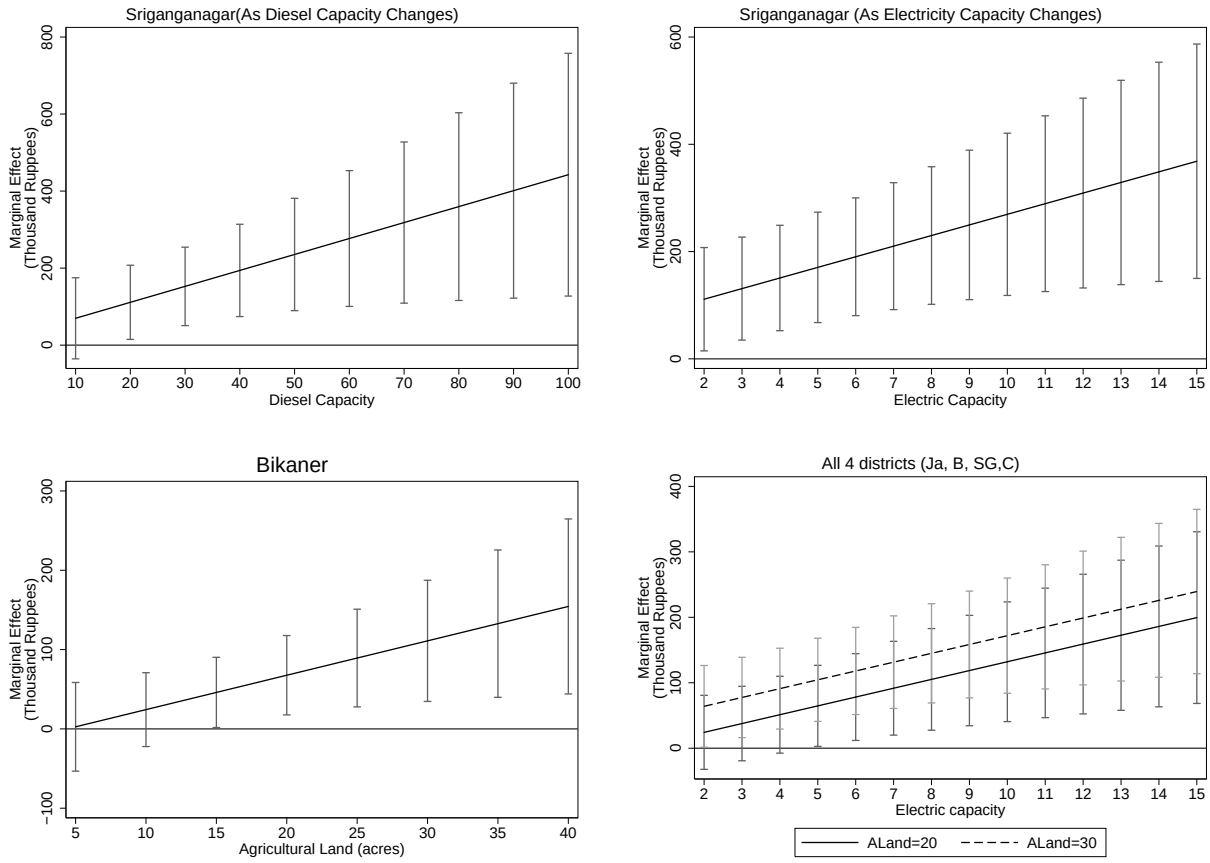

Figure 12: Marginal Effect of Solar Pump Adoption on Annual Profits in diesel using districts

farmers. We find that the marginal impact of solar pump adoption on water extraction in Jaipur and Sikar, and the marginal impact of solar pump adoption on profits in few diesel using districts is positively related with the size of landholdings. Therefore, while extending the solar subsidies, government should target well small farmers to meet one of the important objectives of poverty reduction.

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8 Appendix

8.1 Impact on Water Consumption

Table 12:

Impact of Solar water Pumps on Water Consumption in Jaipur

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	5.129			
	(20.49)			
After	-2.473	-1.085	-1.747	11.00
	(32.61)	(14.54)	(23.91)	(26.85)
c.Adopter#c.After	16.89	7.764	67.84**	54.46*
	(16.62)	(16.32)	(26.46)	(29.82)
Agricultural Land Owned	5.589	87.37***	94.29***	93.85***
	(4.642)	(15.36)	(17.13)	(17.35)
ElecCap	16.35***			
	(3.481)			
Water Table	-0.0317	0.348	0.407	0.409
	(0.196)	(0.298)	(0.310)	(0.310)
Flat Meter	-10.46	10.55	10.94	10.86
	(48.81)	(16.14)	(16.58)	(17.02)
No Electric Pump	-12.87			
	(112.1)			
Rented Electric Pump	-131.1*	150.3***	142.0***	141.2***
	(63.30)	(6.148)	(4.647)	(5.469)
Animals_Possessed	-2.167	-1.388***	-1.306***	-1.312***
	(1.485)	(0.462)	(0.419)	(0.417)
Drip_Area_Acre	-12.02	-2.322	1.234	1.264
	(6.135)	(4.273)	(3.770)	(3.851)
No of Farming Assets	11.43			
	(11.94)			
No of Earning Members	29.50**			
	(9.955)			
No_Electric_equip	-12.06			
	(21.03)			
Education Head	9.343			
	(8.032)			
Education Highest HH	-0.420			
	(7.146)			

Age Head	0.0504			
	(1.414)			
Non-Agr-Source	-53.00			
	(34.12)			
Year Trend	-19.86*	-16.45	-14.26	-14.57
	(8.209)	(13.60)	(12.99)	(12.93)
Adopter = o,		-	-	-
ElecCap = o,		-	-	-
No Electric Pump = o,		-	-	-
c.After#c.ElecCap			0.0872	0.855
			(1.566)	(1.613)
c.After#c.ElecCap#c.Adopter			-4.108**	-4.824**
			(1.905)	(2.097)
c.After#c.AgrLand				-3.287
				(2.132)
c.After#c.AgrLand#c.Adopter				3.268
				(2.747)
Constant	-141.9	-601.1***	-681.7***	-677.9***
	(130.4)	(190.1)	(200.3)	(200.8)
Observations	545	545	545	545
R-squared	0.550	0.191	0.248	0.251
Number of cluster	6			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	YES	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		109	109	109

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13:

Impact of Solar water Pumps on Water Consumption in Sikar

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	43.91			
	(30.84)			
After	-25.62	-23.21**	-17.46	-9.928
	(9.930)	(9.404)	(14.55)	(14.95)
c.Adopter#c.After	41.84	37.60***	50.29***	17.53
	(23.17)	(12.32)	(15.87)	(17.47)
Agricultural Land Owned	5.826*			

	(1.689)			
ElecCap	6.539	3.369	4.124	3.836
	(3.094)	(2.453)	(2.568)	(2.408)
Water Table	0.00310	0.345	0.207	0.661
	(0.241)	(0.664)	(0.647)	(0.573)
Flat Meter	51.49	-20.96	-10.98	-3.903
	(25.97)	(15.20)	(14.67)	(14.87)
No Electric Pump	-42.98		-50.35	-46.15
	(41.14)		(53.18)	(51.22)
Rented Electric Pump	-45.61	49.74		
	(108.2)	(49.64)		
Animals_Possessed	1.114	0.710	0.538	-0.0412
	(1.932)	(1.240)	(1.399)	(0.660)
Drip_Area_Acre	14.74	24.85***	26.70***	26.98***
	(8.723)	(6.222)	(6.385)	(6.541)
No of Farming Assets	8.549			
	(5.954)			
No of Earning Members	4.969			
	(6.786)			
No_Electric_equip	12.45			
	(10.78)			
Education Head	1.405			
	(4.388)			
Education Highest HH	-20.20*			
	(6.261)			
Age Head	0.239			
	(0.437)			
Non-Agr-Source	-8.755			
	(8.333)			
Year No	4.982	5.922	3.407	3.895
	(2.972)	(6.733)	(6.880)	(6.443)
Adopter = o,		-	-	-
Agricultural Land Owned = o,		-	-	-
No Electric Pump = o,		-		
c.After#c.ElecCap			-0.409	-0.199
			(0.855)	(0.877)
c.After#c.ElecCap#c.Adopter			-1.707	-3.241**
			(1.159)	(1.240)
Rented Electric Pump = o,			-	-
c.After#c.AgrLand				-1.001
				(0.856)
c.After#c.AgrLand#c.Adopter				4.921***
				(1.243)
Constant	24.29	8.485	60.69	-65.20

	(126.0)	(182.0)	(177.6)	(156.4)
Observations	315	315	315	315
R-squared	0.717	0.371	0.395	0.456
Number of cluster	3			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		63	63	63

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 14:

Impact of Solar water Pumps on Water Consumption in Jaipur and Sikar

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	17.46			
	(16.64)			
After	-16.95	-12.74	-12.05	2.997
	(22.02)	(10.18)	(15.13)	(17.25)
c.Adopter#c.After	26.36*	23.59**	67.96***	39.47*
	(13.68)	(11.71)	(16.84)	(20.27)
Agricultural Land Owned	5.212*	83.51***	90.78***	90.69***
	(2.358)	(14.63)	(16.18)	(16.23)
ElecCap	15.73***	3.493	4.795	4.546
	(3.350)	(3.008)	(3.091)	(3.038)
Water Table	0.110	0.291	0.318	0.381
	(0.139)	(0.287)	(0.293)	(0.291)
Flat Meter	8.543	0.109	6.016	7.694
	(35.57)	(11.45)	(11.17)	(11.44)
No Electric Pump	69.92	-28.47	-32.96	-30.52
	(64.05)	(59.60)	(63.57)	(62.92)
Rented Electric Pump	-71.39			
	(61.22)			
Animals_Possessed	-0.578	-1.054*	-1.045**	-1.084**
	(1.540)	(0.536)	(0.487)	(0.427)
Drip_Area_Acre	-5.017	3.271	6.442**	6.063**
	(7.528)	(3.145)	(2.780)	(2.950)
No of Farming Assets	5.219			
	(7.499)			
No of Earning Members	17.30**			
	(6.883)			
No_Electric_equip	2.459			
	(13.65)			

Education Head	1.491			
	(3.552)			
Education Highest HH	-4.493			
	(6.334)			
Age Head	-0.473			
	(0.552)			
Non-Agr-Source	-22.77			
	(40.23)			
Year Trend	-21.07**	-20.23	-16.86	-15.40
	(7.438)	(13.90)	(13.19)	(13.17)
Adopter = o,		-	-	-
Rented Electric Pump = o,		-	-	-
c.After#c.ElecCap			-0.00957	0.483
			(1.075)	(1.115)
c.After#c.ElecCap#c.Adopter			-3.540***	-4.500***
			(1.356)	(1.443)
c.After#c.AgrLand				-2.518**
				(1.107)
c.After#c.AgrLand#c.Adopter				4.528***
				(1.723)
Constant	-120.8	-671.2***	-767.2***	-782.0***
	(72.15)	(188.2)	(197.1)	(196.2)
Observations	860	860	860	860
R-squared	0.530	0.189	0.243	0.257
Number of cluster	9			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		172	172	172

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15:

Chittorgarh			
	(1)	(2)	(3)
VARIABLES	Model A	Model B	Model C
Adopter = o,	-	-	-
After	59.10	342.7***	349.2***
	(81.67)	(100.2)	(110.8)
c.Adopter#c.After	162.7	-289.8**	-171.2

	(119.6)	(116.6)	(184.1)
c.After#c.AgrLand			4.735
			(7.355)
c.After#c.AgrLand#c.Adopter			-22.69
			(17.63)
c.After#c.ElecCap		-31.11***	-35.21***
		(10.53)	(10.51)
c.After#c.ElecCap#c.Adopter		45.32**	58.57**
		(18.84)	(23.37)
c.After#c.dcap		-24.75***	-26.64***
		(7.142)	(7.492)
c.After#c.dcap#c.Adopter		34.04***	34.23***
		(7.166)	(8.235)
ElecCap = o,	-	-	-
Diesel Capacity = o,	-	-	-
Agricultural Land Owned	123.7***	113.7***	119.0***
	(32.01)	(33.81)	(32.67)
Water Table	15.78***	13.22***	8.941
	(3.056)	(3.668)	(5.569)
Flat Meter	27.20	-71.03*	-98.71*
	(54.09)	(41.69)	(54.36)
No Electric Pump	-443.9***	-558.7***	-561.3***
	(62.27)	(61.53)	(63.58)
irrigation_new==flood	-175.7	-180.5**	-196.4*
	(146.5)	(87.91)	(106.0)
Animals_Possessed	2.418	1.692	-0.359
	(3.913)	(4.042)	(2.779)
No_Diesel_Pump = o,	-	-	-
Drip_Area_Acre	29.91**	30.64**	29.50**
	(14.15)	(11.37)	(12.37)
Diggi_Volume = o,	-	-	-
Year No	20.81	19.55	17.43
	(27.98)	(26.79)	(26.65)
Constant	-3,032***	-2,441***	-1,747
	(756.6)	(870.7)	(1,041)
Observations	144	144	144
R-squared	0.393	0.464	0.483
Number of Sample	29	29	29
Farmer Fixed Effects	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

8.2 Impact on Electricity Consumption

Table 16:

Impact of Solar water Pumps on Electricity Consumption in Jaipur

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	6.361			
	(6.914)			
After	17.73	16.36**	0.289	6.154
	(14.19)	(7.192)	(7.419)	(7.537)
c.Adopter#c.After	-10.93	-16.48**	4.578	-0.219
	(6.919)	(7.206)	(8.350)	(8.220)
Agricultural Land Owned	1.369	18.75***	19.54***	19.47***
	(1.602)	(6.095)	(6.196)	(6.314)
ElecCap	7.341***			
	(0.739)			
Water Table	0.0340	-0.121	-0.114	-0.117
	(0.0712)	(0.101)	(0.0971)	(0.0956)
Flat Meter	1.935	4.570	5.041	5.069
	(9.173)	(6.822)	(6.716)	(6.453)
No Electric Pump	-12.43			
	(35.74)			
Rented Electric Pump	-19.91	56.75***	55.59***	55.88***
	(13.15)	(1.806)	(1.541)	(1.956)
Animals_Possessed	-0.593	-0.273	-0.263	-0.266
	(0.640)	(0.243)	(0.227)	(0.226)
Drip_Area_Acre	-4.306	0.439	0.544	0.591
	(2.934)	(0.848)	(1.000)	(0.997)
No of Farming Assets	3.598			
	(3.362)			
No of Earning Members	2.131			
	(1.508)			
No_Electric_equip	-2.244			
	(2.126)			
Education Head	-1.254			
	(2.711)			
Education Highest HH	0.403			
	(2.077)			
Age Head	-0.779			
	(0.432)			
Non-Agr-Source	-15.02			
	(17.18)			
Year Trend	-0.145	-3.206	-3.503	-3.766
	(2.539)	(5.250)	(4.796)	(4.773)

Adopter = o,		-	-	-
ElecCap = o,		-		-
No Electric Pump = o,		-	-	-
c.After#c.ElecCap			1.034	1.390
			(0.768)	(0.883)
c.After#c.ElecCap#c.Adopter			-1.370	-1.637*
			(0.845)	(0.986)
c.After#c.AgrLand				-1.522*
				(0.889)
c.After#c.AgrLand#c.Adopter				1.271
				(0.991)
Constant	12.22	-20.69	-30.19	-28.75
	(43.74)	(68.55)	(68.09)	(68.99)
Observations	545	545	545	545
R-squared	0.661	0.138	0.163	0.170
Number of cluster	6			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		109	109	109

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 17:

Impact of Solar water Pumps on Electricity Consumption in Sikar

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	18.71			
	(13.99)			
After	0.950	2.504	1.831	2.371
	(3.621)	(2.299)	(3.810)	(4.364)
c.Adopter#c.After	-2.327	-4.908	-7.556	-10.18*
	(6.749)	(3.660)	(5.988)	(5.985)
Agricultural Land Owned	1.674*			
	(0.522)			
ElecCap	3.972**	1.546		1.475
	(0.595)	(1.434)		(1.412)
Water Table	-0.0143	0.0540	0.121	0.130
	(0.0480)	(0.119)	(0.150)	(0.120)
Flat Meter	9.402	-5.675**	-7.428**	-5.839*

	(11.57)	(2.408)	(3.293)	(2.926)
No Electric Pump	-23.38		-37.16**	-22.23
	(22.73)		(16.72)	(29.23)
Rented Electric Pump	-35.21	22.81		
	(28.32)	(29.44)		
Animals_Possessed	-0.190	-0.114	-0.0669	-0.185
	(0.939)	(0.257)	(0.236)	(0.188)
Drip_Area_Acre	0.473	5.011	5.461	4.863
	(0.681)	(3.155)	(3.722)	(3.028)
No of Farming Assets	2.691			
	(2.910)			
No of Earning Members	2.198			
	(2.906)			
No_Electric_equip	7.747			
	(3.362)			
Education Head	1.869			
	(2.026)			
Education Highest HH	-8.928			
	(3.993)			
Age Head	0.0872			
	(0.255)			
Non-Agr-Source	-2.195			
	(6.031)			
Year No	-3.043**	-3.030**	-2.295	-2.832*
	(0.402)	(1.515)	(1.408)	(1.539)
Adopter = o,		-	-	-
Agricultural Land Owned = o,		-	-	-
No Electric Pump = o,		-		
c.After#c.ElecCap			0.0622	-0.0754
			(0.271)	(0.249)
c.After#c.ElecCap#c.Adopter			0.245	0.0878
			(0.367)	(0.370)
Rented Electric Pump = o,			-	-
c.After#c.AgrLand				0.0793
				(0.332)
c.After#c.AgrLand#c.Adopter				0.488
				(0.392)
Constant	9.826	32.29	45.69	22.15
	(38.13)	(37.29)	(44.79)	(45.48)
Observations	315	315	315	315
R-squared	0.777	0.350	0.324	0.371
Number of cluster	3			
Cluster Fixed Effects	YES	YES	YES	YES

Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		63	63	63

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 18:

Impact of Solar water Pumps on Electricity Consumption in Jaipur and Sikar

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	9.641			
	(6.242)			
After	9.924	10.98**	-0.169	4.656
	(8.923)	(4.900)	(4.525)	(4.467)
c.Adopter#c.After	-7.502	-11.75**	1.376	-3.969
	(4.146)	(4.992)	(5.562)	(5.128)
Agricultural Land Owned	1.400	17.43***	18.24***	18.26***
	(0.803)	(5.862)	(5.881)	(5.935)
ElecCap	6.972***	1.446		1.359
	(0.625)	(1.455)		(1.474)
Water Table	0.0278	-0.113	-0.101	-0.100
	(0.0419)	(0.0927)	(0.0860)	(0.0858)
Flat Meter	5.150	0.934	1.588	1.967
	(8.011)	(4.330)	(4.314)	(4.192)
No Electric Pump	17.57	-21.08	-33.84*	-21.58
	(16.65)	(28.48)	(18.72)	(29.26)
Rented Electric Pump	-24.40			
	(15.00)			
Animals_Possessed	-0.402	-0.235	-0.218	-0.230
	(0.564)	(0.219)	(0.211)	(0.206)
Drip_Area_Acre	-2.760	1.421	1.544	1.432
	(2.682)	(1.057)	(1.175)	(1.066)
No of Farming Assets	2.736			
	(1.960)			
No of Earning Members	1.777			
	(0.962)			
No_Electric_equip	2.290			
	(2.744)			
Education Head	-0.334			
	(1.663)			
Education Highest HH	-2.363			
	(2.404)			
Age Head	-0.482*			
	(0.251)			

Non-Agr-Source	-10.74			
	(16.44)			
Year Trend	0.285	-3.119	-3.227	-3.250
	(2.184)	(5.492)	(5.109)	(5.099)
Adopter = o,		-	-	-
Rented Electric Pump = o,		-	-	-
c.After#c.ElecCap			0.774	0.911
			(0.531)	(0.584)
c.After#c.ElecCap#c.Adopter			-0.949	-1.134*
			(0.608)	(0.663)
c.After#c.AgrLand				-0.785*
				(0.428)
c.After#c.AgrLand#c.Adopter				0.930*
				(0.501)
Constant	-2.453	-49.42	-39.77	-60.30
	(29.33)	(70.91)	(64.67)	(69.96)
Observations	860	860	860	860
R-squared	0.660	0.152	0.161	0.172
Number of cluster	9			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		172	172	172

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 19:

Impact of Solar water Pumps on Electricity Consumption in Jaisalmer

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-5.502			
	(17.50)			
After	-16.15	-4.042	-4.631	0.473
	(17.57)	(3.294)	(3.026)	(1.664)
c.Adopter#c.After	31.21	5.391	4.853*	2.286
	(44.64)	(3.496)	(2.475)	(2.999)
Agricultural Land Owned	0.157	0.0537	0.0563	0.0575
	(0.338)	(0.0448)	(0.0458)	(0.0429)
ElecCap	8.788***	1.409		3.837
	(0.0902)	(0.848)		(2.696)
Diesel Capacity	-0.112	0.152		0.0688

	(0.0637)	(0.115)		(0.0572)
Water Table	-0.0271	0.0822	0.115	0.0841
	(0.0452)	(0.0679)	(0.104)	(0.0760)
Flat Meter	-41.27**	-799.7***	-807.2***	-705.9***
	(2.248)	(28.38)	(69.57)	(99.34)
No Electric Pump	-16.17	6.584	8.195	6.043
	(5.049)	(4.454)	(5.886)	(3.733)
irrigation_new==flood	8.390	0.659	-0.213	0.134
	(10.07)	(0.942)	(1.138)	(0.860)
Animals_Possessed	0.0292	0.00529	0.00557	0.00236
	(0.00559)	(0.00355)	(0.00607)	(0.00290)
No_Diesel_Pump	-8.381	2.584	2.574	3.446
	(8.161)	(1.979)	(2.496)	(2.104)
Diggi_Volume	-0.00392	-0.00784	-0.00509	-0.00344
	(0.0141)	(0.00723)	(0.00381)	(0.00331)
No of Farming Assets	-1.288			
	(1.444)			
No of Earning Members	-4.408			
	(6.278)			
No_Electric_equip	-4.795			
	(7.629)			
Education Head	0.970			
	(0.810)			
Education Highest HH	2.587			
	(3.761)			
Age Head	0.297			
	(0.310)			
Non-Agr-Source	6.281*			
	(0.738)			
Year No	-0.598	0.397	0.477	0.138
	(2.439)	(0.534)	(0.511)	(0.328)
Adopter = o,		-	-	-
c.After#c.ElecCap			0.478	-2.722
			(0.521)	(2.570)
c.After#c.ElecCap#c.Adopter			-0.232	2.879
			(0.748)	(2.621)
c.After#c.dcap			0.0962*	
			(0.0551)	
c.After#c.dcap#c.Adopter			-0.0793	
			(0.0804)	
c.After#c.AgrLand				-0.0354
				(0.0512)
c.After#c.AgrLand#c.Adopter				-0.0325
				(0.0828)
Constant	12.27	43.91*	43.00	28.28
	(28.30)	(23.66)	(30.61)	(31.27)

Observations	228	233	233	233
R-squared	0.931	0.990	0.989	0.993
Number of cluster	2			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		47	47	47

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 20:

Impact of Solar water Pumps on Electricity Consumption in Bikaner

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	0.484			
	(7.678)			
After	-14.86	-5.790	-10.93	10.90
	(19.63)	(6.086)	(8.669)	(13.42)
c.Adopter#c.After	5.004	-4.148	4.012	-23.50
	(13.91)	(11.43)	(12.82)	(14.96)
Agricultural Land Owned	-0.929	0.0824	-0.303	0.625
	(0.838)	(0.171)	(0.284)	(0.775)
ElecCap	9.488**	4.900*		5.760*
	(1.624)	(2.722)		(2.927)
Diesel Capacity	0.283	-0.0433		-0.0643
	(0.282)	(0.0638)		(0.0633)
Water Table	-0.0223	-0.255	-0.233	-0.403
	(0.0189)	(0.205)	(0.223)	(0.300)
Flat Meter	235.2	5.074	-0.686	6.367
	(99.32)	(27.71)	(35.54)	(48.29)
No Electric Pump	32.81*	-16.90	-65.97**	-13.01
	(10.09)	(31.28)	(25.16)	(33.16)
irrigation_new==flood	-20.08	-9.348*	-7.875**	-6.875*
	(20.06)	(4.763)	(3.467)	(3.676)
Animals_Possessed	0.0821	0.0813	0.0913	0.130
	(0.104)	(0.121)	(0.124)	(0.155)
No_Diesel_Pump	18.03	-9.922	-4.697	-7.379
	(18.26)	(6.787)	(3.987)	(6.211)
Drip_Area_Acre	4.953*	0.866	1.180	0.101
	(1.661)	(1.570)	(1.654)	(1.075)
Diggi_Volume	-0.125	-0.00101	-0.00499	-0.00779
	(0.155)	(0.0116)	(0.0117)	(0.0133)
No of Farming Assets	0.631			
	(1.040)			

No of Earning Members	-0.995			
	(2.342)			
No_Electric_equip	-1.206			
	(1.880)			
Education Head	-1.165			
	(1.935)			
Education Highest HH	0.409			
	(3.218)			
Age Head	-0.272			
	(0.464)			
Non-Agr-Source	-20.91			
	(13.04)			
Year No	-13.69**	-9.459	-5.461	-8.044
	(2.913)	(6.895)	(5.994)	(6.846)
Adopter = o,		-	-	-
c.After#c.ElecCap			0.275	-0.111
			(0.622)	(0.688)
c.After#c.ElecCap#c.Adopter			-1.393	-1.399
			(1.623)	(1.777)
c.After#c.dcap			0.159	
			(0.183)	
c.After#c.dcap#c.Adopter			-0.120	
			(0.251)	
c.After#c.AgrLand				-0.829
				(0.829)
c.After#c.AgrLand#c.Adopter				1.254
				(0.928)
Constant	33.50	95.30**	153.1***	96.34*
	(62.23)	(43.27)	(45.86)	(50.61)
Observations	507	507	507	507
R-squared	0.861	0.094	0.084	0.137
Number of cluster	3			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		102	102	102

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 21:

Impact of Solar water Pumps on Electricity Consumption in Sriganganagar

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D

Adopter	9.432**			
	(0.504)			
After	3.331	2.153*	1.742	2.753**
	(3.129)	(1.097)	(1.244)	(1.312)
c.Adopter#c.After	-9.195	-6.833**	-0.416	2.167
	(2.997)	(2.779)	(1.758)	(3.273)
Agricultural Land Owned	0.319			
	(0.128)			
ElecCap	1.363	-2.595***		2.472
	(0.583)	(0.576)		(1.725)
Diesel Capacity	0.0390	0.107*		0.0595
	(0.0656)	(0.0542)		(0.0430)
Water Table	0.0238	0.190	0.130	0.231
	(0.0403)	(0.198)	(0.173)	(0.211)
Flat Meter = o,	-	-	-	-
No Electric Pump	-14.60	-32.07***	-22.91***	-7.114
	(2.969)	(3.526)	(2.823)	(7.977)
irrigation_new==flood	-1.967	6.327*	1.808	2.610
	(2.236)	(3.752)	(1.267)	(1.706)
Animals_Possessed	0.186	-0.148	-0.186	-0.0973
	(0.162)	(0.186)	(0.151)	(0.0830)
No_Diesel_Pump	4.954	3.478	-4.782	-2.989
	(1.534)	(3.470)	(3.254)	(4.097)
Drip	0.254	5.899	2.696**	4.354**
	(1.492)	(4.277)	(1.120)	(2.133)
Drip_Adopter	1.286	0.149	-0.923	-1.154
	(1.513)	(4.011)	(2.714)	(2.573)
Drip_Area_Acre	-0.0765	-0.0623	0.206	0.214
	(0.141)	(0.160)	(0.208)	(0.243)
Diggi_Volume	-0.0100***	0.0170**	0.0117	0.0139*
	(4.26e-05)	(0.00702)	(0.00722)	(0.00771)
No of Farming Assets	-0.250			
	(0.212)			
No of Earning Members	-1.460			
	(1.132)			
No_Electric_equip	-1.424**			
	(0.0938)			
Education Head	-0.361			
	(0.416)			
Education Highest HH	-0.983***			
	(0.000944)			
Age Head	-0.00285			
	(0.0189)			
Non-Agr-Source	-1.380			
	(0.492)			

Year No	-1.150	-1.730**	-1.161*	-1.334*
	(1.436)	(0.854)	(0.685)	(0.730)
Adopter = o,		-	-	-
Agricultural Land Owned = o,		-	-	-
c.After#c.ElecCap			0.0499	0.0695
			(0.151)	(0.182)
c.After#c.ElecCap#c.Adopter			-2.890***	-3.031***
			(0.633)	(0.808)
c.After#c.dcap			-0.0134	-0.00484
			(0.0136)	(0.0159)
c.After#c.dcap#c.Adopter			-0.0123	-0.0434
			(0.0420)	(0.0494)
c.After#c.AgrLand				-0.0509
				(0.0413)
c.After#c.AgrLand#c.Adopter				-0.0479
				(0.0840)
Constant	27.22	28.40***	24.98***	-0.0597
	(5.093)	(7.821)	(5.623)	(13.75)
Observations	390	390	390	390
R-squared	0.549	0.171	0.524	0.547
Number of cluster	2			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		78	78	78

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 22:

Impact of Solar water Pumps on Electricity Consumption in Chittorgarh

	(1)	(2)	(3)
VARIABLES	Model A	Model B	Model C
Adopter = o,	-	-	-
After	-0.222	-1.393	0.493
	(1.169)	(1.903)	(1.827)
c.Adopter#c.After	-2.063	-2.213	-8.357
	(3.096)	(2.493)	(6.440)
c.After#c.ElecCap		0.150	-0.0790
		(0.283)	(0.117)
c.After#c.ElecCap#c.Adopter		-0.161	-0.135

		(0.655)	(0.346)
c.After#c.dcap		0.0869	
		(0.151)	
c.After#c.dcap#c.Adopter		0.109	
		(0.186)	
Agricultural Land Owned	-0.637	-0.113	-1.364
	(0.980)	(0.850)	(1.065)
Water Table	-0.132	-0.133	0.0203
	(0.110)	(0.126)	(0.171)
Flat Meter	-0.814	-0.646	0.0699
	(0.875)	(1.152)	(1.249)
No Electric Pump	-39.84***	-39.94***	-39.88***
	(1.188)	(1.206)	(1.112)
irrigation_new==flood	-1.016	1.636	-1.507
	(1.247)	(3.111)	(2.174)
Animals_Possessed	-0.0282	-0.0408	0.0562
	(0.0940)	(0.103)	(0.0971)
No_Diesel_Pump = o,	-	-	-
Drip_Area_Acre	-0.000652	-0.0363	0.103
	(0.402)	(0.260)	(0.352)
Diggi_Volume = o,	-	-	-
Year No	0.0555	0.0983	0.0886
	(0.496)	(0.377)	(0.423)
ElecCap = o,	-		-
Diesel Capacity = o,	-		-
c.After#c.AgrLand			-0.0697
			(0.105)
c.After#c.AgrLand#c.Adopter			0.795
			(0.647)
Constant	68.54***	62.90**	48.88*
	(22.01)	(23.94)	(24.90)
Observations	144	144	144
R-squared	0.318	0.331	0.383
Number of Sample	29	29	29
Farmer Fixed Effects	YES	YES	YES

)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 23:

Impact of Solar water Pumps on Electricity Consumption in 4 districts (Ja

	B SG C)			
	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	3.162			
	(7.443)			
After	-11.78	-1.310	-4.100	6.352
	(7.903)	(3.739)	(4.008)	(4.540)
c.Adopter#c.After	-1.026	-0.739	-6.852	-18.43**
	(8.234)	(5.381)	(6.440)	(9.064)
Agricultural Land Owned	-0.411	4.674**	4.043**	3.364**
	(0.299)	(2.137)	(1.888)	(1.514)
ElecCap	10.04***	8.038***		6.529***
	(0.860)	(2.932)		(2.420)
Diesel Capacity	0.125	-0.00544		-0.00663
	(0.169)	(0.0689)		(0.0671)
Water Table	-0.0492	-0.620*	-0.331	-0.430*
	(0.0305)	(0.342)	(0.225)	(0.235)
Flat Meter	85.58	-79.54	-68.74	-51.99
	(67.71)	(56.19)	(46.76)	(41.35)
No Electric Pump	41.77	1.038	-37.17**	-0.470
	(22.29)	(20.85)	(14.83)	(17.00)
irrigation_new==flood	-7.693	-2.218	-2.931	-3.603
	(6.218)	(2.511)	(2.634)	(2.626)
Animals_Possessed	0.0783	0.160**	0.135*	0.130**
	(0.0807)	(0.0778)	(0.0708)	(0.0604)
No_Diesel_Pump	6.583	-10.58*	-8.078*	-8.570*
	(9.641)	(5.667)	(4.525)	(4.583)
Drip_Area_Acre	1.890	-0.0635	0.263	0.0368
	(1.166)	(0.548)	(0.642)	(0.440)
Diggi_Volume	-0.0253	-0.0232	-0.0125	-0.00470
	(0.0314)	(0.0182)	(0.00928)	(0.0124)
No of Farming Assets	-0.660			
	(0.855)			
No of Earning Members	-1.413			
	(1.607)			
No_Electric_equip	1.233			
	(1.895)			
Education Head	-0.458			
	(0.548)			
Education Highest HH	-1.372			
	(0.917)			
Age Head	-0.0534			
	(0.215)			

Non-Agr-Source	2.965			
	(6.749)			
Year No	1.289	1.641	0.0882	0.607
	(2.106)	(1.371)	(1.975)	(2.263)
Adopter = o,		-	-	-
c.After#c.ElecCap			0.615	-0.0669
			(0.508)	(0.636)
c.After#c.ElecCap#c.Adopter			1.617	1.385
			(1.335)	(1.238)
c.After#c.dcap			0.0604	
			(0.0872)	
c.After#c.dcap#c.Adopter			-0.0106	
			(0.143)	
c.After#c.AgrLand				-0.321
				(0.220)
c.After#c.AgrLand#c.Adopter				0.561
				(0.382)
Constant	-18.50	-19.65	14.85	-8.683
	(31.23)	(60.31)	(47.74)	(43.17)
Observations	1,260	1,274	1,274	1,274
R-squared	0.813	0.453	0.426	0.485
Number of cluster	8			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		256	256	256

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

8.3 Impact on Diesel Consumption

Table 24:

Impact of Solar water Pumps on Diesel Consumption in Jaisalmer

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	393.0			
	(348.0)			
After	446.6*	15.48	-75.34	-279.3
	(68.26)	(205.9)	(215.3)	(298.3)
c.Adopter#c.After	-360.7	-175.5	-455.9*	-231.1
	(120.0)	(216.2)	(240.1)	(420.1)
Agricultural Land Owned	6.684	2.682	4.184	5.741

	(1.692)	(11.99)	(11.57)	(12.47)
ElecCap	-7.177	-9.903	-15.18	-17.84
	(1.459)	(12.51)	(28.24)	(28.43)
Diesel Capacity	12.22	41.28*	26.03	33.93
	(3.895)	(21.32)	(18.58)	(21.30)
Water Table	-1.204	55.82**	56.26**	56.99**
	(0.695)	(26.89)	(25.58)	(25.35)
Flat Meter	-8.245	-2,898*	1,954	1,858
	(145.1)	(1,513)	(1,594)	(1,571)
No Electric Pump	305.2	99.54	-162.3	-139.2
	(55.22)	(221.9)	(236.4)	(238.4)
irrigation_new==flood	-1,195**	247.5	99.55	121.8
	(62.63)	(703.7)	(693.2)	(707.0)
Animals_Possessed	-0.611	-1.618	0.963	0.914
	(1.288)	(1.441)	(2.265)	(2.426)
No_Diesel_Pump	304.9	-693.7**	-907.7***	-883.6**
	(605.6)	(303.6)	(330.8)	(333.3)
Diggi_Volume	0.380	-0.508	-0.490	-0.863
	(0.147)	(0.711)	(0.629)	(0.885)
No of Farming Assets	83.58**			
	(1.699)			
No of Earning Members	-65.93			
	(62.95)			
No_Electric_equip	-166.9			
	(46.60)			
Education Head	-71.57**			
	(4.786)			
Education Highest HH	14.82			
	(32.21)			
Age Head	-11.40			
	(9.880)			
Non-Agr-Source	439.9			
	(165.3)			
Year No	-165.9	-100.3	-113.6	-108.8
	(48.57)	(87.33)	(85.92)	(86.50)
Adopter = o,		-	-	-
c.After#c.ElecCap			6.581	3.033
			(31.35)	(30.67)
c.After#c.ElecCap#c.Adopter			28.75	32.16
			(32.12)	(32.81)
c.After#c.dcap			10.44*	7.546*
			(5.493)	(3.920)
c.After#c.dcap#c.Adopter			19.94	22.39
			(18.93)	(19.06)
c.After#c.AgrLand				5.387
				(4.031)
c.After#c.AgrLand#c.Adopter				-6.075

				(11.00)
Constant	1,027*	-9,607*	-9,580*	-9,844*
	(115.1)	(5,375)	(5,157)	(5,164)
Observations	228	233	233	233
R-squared	0.414	0.356	0.405	0.409
Number of cluster	2			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		47	47	47

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 25:

Impact of Solar water Pumps on Diesel Consumption in Bikaner

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-173.1			
	(235.6)			
After	158.0	124.4	146.2	-38.14
	(78.11)	(115.9)	(128.3)	(176.5)
c.Adopter#c.After	-445.1**	-419.8***	-390.8**	-187.5
	(66.26)	(152.4)	(174.5)	(232.5)
Agricultural Land Owned	2.081	-2.406	-0.434	-8.440
	(1.500)	(15.32)	(13.85)	(14.61)
ElecCap	0.713	-26.85	-30.91	-29.38
	(1.899)	(19.15)	(19.31)	(19.17)
Diesel Capacity	6.358*	7.724	10.08*	10.03*
	(2.039)	(4.953)	(5.299)	(5.219)
Water Table	-0.328	-1.873	-1.773	-1.640
	(0.123)	(2.038)	(1.885)	(1.900)
Flat Meter	-15.22	228.8	184.0	69.84
	(308.7)	(343.5)	(366.1)	(427.8)
No Electric Pump	341.4	158.3	119.8	110.6
	(277.3)	(462.1)	(453.0)	(453.0)
irrigation_new==flood	-378.6**	-53.32	-59.27	-64.09
	(85.42)	(161.6)	(167.8)	(162.4)
Animals_Possessed	-2.005	4.346***	4.308***	3.796***
	(1.381)	(0.661)	(0.665)	(0.638)
No_Diesel_Pump	-482.5***	-424.2*	-398.9*	-399.6*
	(5.653)	(217.0)	(208.9)	(215.4)
Drip_Area_Acre	-25.60*	-19.29*	-20.84*	-20.63*
	(6.912)	(10.93)	(10.86)	(11.97)

Diggi_Volume	1.212*	2.183***	2.192***	2.193***
	(0.404)	(0.518)	(0.520)	(0.519)
No of Farming Assets	-29.51			
	(45.14)			
No of Earning Members	-20.76			
	(10.34)			
No_Electric_equip	75.01*			
	(17.45)			
Education Head	-16.03			
	(23.58)			
Education Highest HH	30.28			
	(24.29)			
Age Head	8.266			
	(2.993)			
Non-Agr-Source	-214.0			
	(299.9)			
Year No	-28.00	-7.409	-18.82	-14.08
	(12.46)	(64.41)	(67.79)	(68.70)
Adopter = o,		-	-	-
c.After#c.ElecCap			2.241	3.240
			(1.814)	(1.992)
c.After#c.ElecCap#c.Adopter			0.582	-0.612
			(3.771)	(4.332)
c.After#c.dcap			-1.851	-1.845
			(3.391)	(3.333)
c.After#c.dcap#c.Adopter			-1.641	-1.497
			(5.226)	(5.016)
c.After#c.AgrLand				9.615*
				(5.138)
c.After#c.AgrLand#c.Adopter				-10.71
				(8.209)
Constant	411.9	883.6	840.4	999.6
	(677.3)	(683.7)	(690.5)	(680.6)
Observations	507	507	507	507
R-squared	0.225	0.197	0.200	0.204
Number of cluster	3			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		102	102	102

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 26:

Impact of Solar water Pumps on Diesel Consumption in Sriganganagar

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-149.4			
	(132.5)			
After	266.2	355.4***	41.68	37.11
	(83.37)	(129.9)	(176.4)	(171.1)
c.Adopter#c.After	-636.5*	-620.9***	-426.3	-318.2
	(69.95)	(172.1)	(291.9)	(366.1)
Agricultural Land Owned	11.56			
	(3.234)			
ElecCap	-37.71*	-32.28	21.30	24.46
	(3.042)	(42.60)	(63.43)	(64.38)
Diesel Capacity	14.16*	6.477	0.0117	0.195
	(2.238)	(4.440)	(4.578)	(4.662)
Water Table	-4.506	-9.731	-11.87	-7.933
	(1.671)	(27.18)	(29.48)	(29.59)
Flat Meter = o,	-	-	-	-
No Electric Pump	-587.5	8.264	118.7	166.0
	(113.4)	(473.6)	(510.4)	(522.7)
irrigation_new==flood	-147.2	-126.8	-145.2	-135.7
	(602.6)	(436.1)	(420.4)	(429.7)
Animals_Possessed	11.63	0.723	2.710	3.794
	(5.978)	(14.81)	(14.16)	(13.62)
No_Diesel_Pump	-470.8	-369.3	-693.7**	-689.6**
	(104.9)	(249.4)	(319.2)	(326.9)
Drip	12.40	-381.1	-418.2	-399.4
	(508.7)	(412.3)	(401.8)	(419.1)
Drip_Adopter	38.98	147.6	34.70	11.16
	(116.8)	(224.6)	(267.8)	(255.0)
Drip_Area_Acre	10.01	16.37	25.64*	25.28
	(3.701)	(10.99)	(15.00)	(15.39)
Diggi_Volume	-0.704	-0.813	-0.925	-0.879
	(0.113)	(0.739)	(0.913)	(0.918)
No of Farming Assets	-61.54			
	(34.81)			
No of Earning Members	68.26			
	(76.85)			
No_Electric_equip	2.048			
	(62.89)			
Education Head	6.273			
	(8.691)			
Education Highest HH	-84.24**			
	(2.458)			
Age Head	-3.012			

	(2.836)			
Non-Agr-Source	-421.0			
	(161.1)			
Year No	-100.4*	-104.7	-112.0	-116.3*
	(15.19)	(66.58)	(68.23)	(69.72)
Adopter = o,		-	-	-
Agricultural Land Owned = o,		-	-	-
Drip_Adopter = o,		-		
c.After#c.ElecCap			-10.72	-12.96
			(14.85)	(16.27)
c.After#c.ElecCap#c.Adopter			-27.94	-22.25
			(33.37)	(34.79)
c.After#c.dcap			10.48*	10.09
			(6.224)	(6.831)
c.After#c.dcap#c.Adopter			-3.219	-2.634
			(8.903)	(9.237)
c.After#c.AgrLand				0.991
				(4.743)
c.After#c.AgrLand#c.Adopter				-4.829
				(7.660)
Constant	2,680*	1,531*	1,641*	1,476
	(310.5)	(777.6)	(848.2)	(909.8)
Observations	390	390	390	390
R-squared	0.338	0.195	0.237	0.240
Number of cluster	2			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		78	78	78

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 27:

Impact of Solar water Pumps on Diesel Consumption in Chittorgarh

	(1)	(2)	(3)
VARIABLES	Model A	Model B	Model C
Adopter = o,	-	-	-
After	159.0*	280.7**	293.8**
	(88.73)	(124.1)	(128.9)

c.Adopter#c.After	-229.4**	-289.7	-265.4
	(87.05)	(170.5)	(198.4)
c.After#c.AgrLand			-4.688
			(4.392)
c.After#c.AgrLand#c.Adopter			-0.589
			(13.06)
c.After#c.ElecCap		-14.70	-13.08
		(9.996)	(8.576)
c.After#c.ElecCap#c.Adopter		21.38	22.51
		(23.66)	(20.75)
c.After#c.dcap		-9.244	-8.163
		(5.619)	(4.932)
c.After#c.dcap#c.Adopter		-5.480	-7.226
		(5.889)	(5.221)
ElecCap = o,	-	-	-
Diesel Capacity = o,	-	-	-
Agricultural Land Owned	196.1***	144.2**	145.0**
	(29.86)	(55.54)	(56.71)
Water Table	53.85***	53.14***	51.82***
	(8.595)	(9.011)	(8.966)
Flat Meter	382.4***	357.2***	352.3***
	(61.06)	(71.55)	(70.62)
No Electric Pump	167.2*	162.0*	164.3*
	(83.03)	(91.06)	(90.36)
irrigation_new==flood	72.67	-135.2	-147.0
	(85.26)	(97.41)	(101.0)
Animals_Possessed	-17.05***	-16.22***	-16.89***
	(4.785)	(4.394)	(4.847)
No_Diesel_Pump = o,	-	-	-
Drip_Area_Acre	-74.15**	-69.72*	-70.10*
	(35.24)	(35.88)	(36.33)
Diggi_Volume = o,	-	-	-
Year No	-60.72	-65.31*	-66.12*
	(36.07)	(37.20)	(37.42)
Constant	-9,602***	-8,930***	-8,706***
	(1,597)	(1,821)	(1,787)
Observations	144	144	144
R-squared	0.691	0.707	0.708
Number of Sample	29	29	29
Farmer Fixed Effects	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 28:

Impact of Solar water Pumps on Diesel Consumption in 4 districts (Ja
B
SG
C
)

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	96.69			
	(162.9)			
After	203.4***	195.1***	114.7	123.7
	(50.78)	(70.28)	(86.26)	(97.35)
c.Adopter#c.After	-448.6***	-421.0***	-442.9***	-341.0**
	(31.50)	(91.56)	(120.8)	(137.6)
Agricultural Land Owned	5.676**	17.48**	12.40*	15.46*
	(1.826)	(8.182)	(6.996)	(8.557)
ElecCap	-0.917	-23.49***	-28.84***	-27.30**
	(1.652)	(8.696)	(10.91)	(10.82)
Diesel Capacity	11.16***	7.080**	3.482	3.465
	(3.113)	(3.551)	(4.048)	(4.041)
Water Table	-0.589*	9.285	10.30	10.48
	(0.266)	(10.48)	(11.30)	(11.21)
Flat Meter	-45.14	30.73	181.9	184.6
	(106.0)	(199.1)	(174.5)	(173.2)
No Electric Pump	-16.14	104.5	99.26	102.2
	(122.3)	(218.3)	(222.7)	(224.4)
irrigation_new==flood	-313.1**	46.51	52.79	62.65
	(107.9)	(141.0)	(143.7)	(145.1)
Animals_Possessed	-1.079*	0.212	0.317	0.200
	(0.457)	(1.272)	(1.289)	(1.319)
No_Diesel_Pump	-382.4*	-562.1***	-618.6***	-626.1***
	(174.1)	(144.2)	(146.2)	(147.7)
Drip_Area_Acre	-9.604	-1.148	1.328	2.662
	(10.00)	(9.342)	(10.08)	(9.757)
Diggi_Volume	0.583**	0.807**	0.790**	0.846**
	(0.193)	(0.327)	(0.358)	(0.385)
No of Farming Assets	-0.595			
	(28.72)			
No of Earning Members	-37.93			
	(21.44)			
No_Electric_equip	-30.68			
	(42.47)			
Education Head	-7.363			
	(17.60)			

Education Highest HH	8.623			
	(24.62)			
Age Head	0.632			
	(3.333)			
Non-Agr-Source	-75.51			
	(162.8)			
Year No	-91.76***	-84.15**	-76.54**	-91.66**
	(11.25)	(35.14)	(36.35)	(37.14)
Adopter = o,		-	-	-
c.After#c.ElecCap			-2.292	-2.552
			(3.283)	(3.306)
c.After#c.ElecCap#c.Adopter			8.587	10.59
			(6.509)	(6.840)
c.After#c.dcap			4.535	4.395
			(3.810)	(3.831)
c.After#c.dcap#c.Adopter			0.00980	0.583
			(4.644)	(4.687)
c.After#c.AgrLand				-0.330
				(2.189)
c.After#c.AgrLand#c.Adopter				-5.272
				(4.397)
Constant	1,136***	-565.1	-485.4	-588.1
	(284.3)	(1,428)	(1,415)	(1,420)
Observations	1,260	1,274	1,274	1,274
R-squared	0.194	0.173	0.180	0.184
Number of cluster	8			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		256	256	256

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

8.3.1 Impact on Cropping intensity

Table 29:

Impact of Solar water Pumps on Cropping Intensity in Jaipur

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	0.0938*			
	(0.0426)			
After	0.0179	0.0207	-0.000477	-0.0341

	(0.0216)	(0.0271)	(0.0423)	(0.0450)
c.Adopter#c.After	-0.0122	-0.00997	-0.0156	0.0511
	(0.0327)	(0.0303)	(0.0558)	(0.0585)
Agricultural Land Owned	-0.00428**	-0.0332	-0.0360	-0.0317
	(0.00150)	(0.0407)	(0.0416)	(0.0407)
ElecCap	0.00469**			
	(0.00122)			
Water Table	-0.000248	0.000798	0.000773	0.000687
	(0.000342)	(0.000538)	(0.000552)	(0.000554)
Flat Meter	-0.0357	0.0357	0.0361	0.0378
	(0.0253)	(0.0833)	(0.0833)	(0.0812)
No Electric Pump	-0.674***			
	(0.162)			
Rented Electric Pump	-0.162*	0.848***	0.851***	0.868***
	(0.0629)	(0.0173)	(0.0189)	(0.0226)
Animals_Possessed	0.00281**	0.00254*	0.00251*	0.00252*
	(0.000863)	(0.00135)	(0.00135)	(0.00131)
Drip_Area_Acre	-0.0278*	-0.0129	-0.0147	-0.0140
	(0.0136)	(0.00869)	(0.00918)	(0.00942)
No of Farming Assets	-0.00131			
	(0.00483)			
No of Earning Members	0.000337			
	(0.00847)			
No_Electric_equip	0.00487			
	(0.0179)			
Education Head	-0.00667			
	(0.0112)			
Education Highest HH	0.000454			
	(0.0108)			
Age Head	0.00126			
	(0.00183)			
Non-Agr-Source	0.0374			
	(0.0471)			
Year Trend	-0.0625***	-0.0486**	-0.0502**	-0.0522**
	(0.00423)	(0.0244)	(0.0247)	(0.0243)
Adopter = o,		-	-	-
ElecCap = o,		-	-	-
No Electric Pump = o,		-	-	-
c.After#c.ElecCap			0.00134	-0.000604
			(0.00213)	(0.00226)
c.After#c.ElecCap#c.Adopter			0.000479	0.00380
			(0.00302)	(0.00365)
c.After#c.AgrLand				0.00845
				(0.00528)
c.After#c.AgrLand#c.Adopter				-0.0140**

				(0.00692)
Constant	1.917***	1.949***	1.982***	1.965***
	(0.140)	(0.478)	(0.490)	(0.484)
Observations	545	545	545	545
R-squared	0.301	0.142	0.145	0.155
Number of cluster	6			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		109	109	109

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 30:

Impact of Solar water Pumps on Cropping Intensity in Sikar

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	0.00940			
	(0.0265)			
After	-0.126	-0.0754	-0.122**	-0.0628
	(0.0611)	(0.0480)	(0.0578)	(0.0748)
c.Adopter#c.After	0.184	0.168**	0.336***	0.274**
	(0.0985)	(0.0651)	(0.0844)	(0.103)
Agricultural Land Owned	-0.00494			
	(0.00407)			
ElecCap	0.0220*	0.0246*	0.0283**	0.0274**
	(0.00518)	(0.0130)	(0.0139)	(0.0136)
Water Table	-0.000102	0.00282	0.00219	0.00218
	(0.000378)	(0.00265)	(0.00241)	(0.00253)
Flat Meter	-0.0228	-0.138***	-0.0694**	-0.0645
	(0.0519)	(0.0482)	(0.0336)	(0.0391)
No Electric Pump	-0.201		-0.0470	-0.0422
	(0.0916)		(0.187)	(0.187)
Rented Electric Pump	0.0303	0.0389		
	(0.0630)	(0.169)		
Animals_Possessed	0.0113*	0.00318	0.00230	0.00230
	(0.00367)	(0.00391)	(0.00321)	(0.00310)
Drip_Area_Acre	0.0389	0.0639	0.0771*	0.0768*
	(0.0692)	(0.0443)	(0.0458)	(0.0459)
No of Farming Assets	0.00542			
	(0.0104)			
No of Earning Members	-0.00786			
	(0.00511)			

No_Electric_equip	-0.00216			
	(0.0106)			
Education Head	0.00661			
	(0.00542)			
Education Highest HH	0.00104			
	(0.00865)			
Age Head	0.00230			
	(0.00120)			
Non-Agr-Source	-0.305***			
	(0.0275)			
Year No	0.0744*	0.0672**	0.0536**	0.0562**
	(0.0241)	(0.0280)	(0.0264)	(0.0267)
Adopter = o,		-	-	-
Agricultural Land Owned = o,		-	-	-
No Electric Pump = o,		-		
c.After#c.ElecCap			0.00397	0.00556
			(0.00298)	(0.00349)
c.After#c.ElecCap#c.Adopter			-0.0179***	-0.0192***
			(0.00498)	(0.00548)
Rented Electric Pump = o,			-	-
c.After#c.AgrLand				-0.00708
				(0.00568)
c.After#c.AgrLand#c.Adopter				0.00715
				(0.00738)
Constant	1.490***	0.452	0.600	0.610
	(0.0609)	(0.740)	(0.683)	(0.717)
Observations	315	315	315	315
R-squared	0.617	0.364	0.414	0.417
Number of cluster	3			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		63	63	63

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 31:

Impact of Solar water Pumps on Cropping Intensity in Jaisalmer

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D

Adopter	-0.0345			
	(0.0407)			
After	-0.0979	-0.136**	-0.0898	-0.215**
	(0.0163)	(0.0522)	(0.0698)	(0.101)
c.Adopter#c.After	0.177**	0.159*	0.0987	0.234
	(0.00589)	(0.0820)	(0.101)	(0.189)
Agricultural Land Owned	-0.00218	0.000750	0.000322	0.00123
	(0.000522)	(0.00436)	(0.00460)	(0.00498)
ElecCap	0.000803	-0.00936**	0.00642*	0.00480
	(0.000943)	(0.00425)	(0.00329)	(0.00334)
Diesel Capacity	0.000338	0.000887	0.00239	0.00723*
	(0.00206)	(0.00357)	(0.00541)	(0.00390)
Water Table	-0.000150	0.00266	0.00208	0.00253
	(0.000299)	(0.00415)	(0.00434)	(0.00450)
Flat Meter	0.344	-0.238	-0.112	-0.171
	(0.102)	(0.331)	(0.429)	(0.444)
No Electric Pump	-0.267*	-0.291	-0.300	-0.285
	(0.0213)	(0.192)	(0.196)	(0.189)
irrigation_new==flood	-0.0429	-0.0247	-0.0413	-0.0280
	(0.120)	(0.0938)	(0.0959)	(0.0919)
Animals_Possessed	0.000403	-0.000211	-1.92e-05	-4.50e-05
	(0.000349)	(0.000466)	(0.000561)	(0.000608)
No_Diesel_Pump	-0.00743	-0.190*	-0.174	-0.160
	(0.0717)	(0.108)	(0.112)	(0.113)
Diggi_Volume	0.000353	4.19e-05	0.000116	-0.000113
	(7.56e-05)	(0.000164)	(0.000177)	(0.000128)
No of Farming Assets	-0.0128			
	(0.0254)			
No of Earning Members	-0.0166			
	(0.00923)			
No_Electric_equip	0.0210			
	(0.0295)			
Education Head	-0.00561			
	(0.00742)			
Education Highest HH	0.0143			
	(0.0213)			
Age Head	0.00374			
	(0.00390)			
Non-Agr-Source	-0.0928			
	(0.103)			
Year No	0.00277	0.0181	0.0125	0.0154
	(0.00280)	(0.0220)	(0.0217)	(0.0210)
Adopter = o,		-	-	-
c.After#c.ElecCap			-0.0196***	-0.0217***
			(0.00570)	(0.00566)

c.After#c.ElecCap#c.Adopter			0.0171***	0.0192***
			(0.00573)	(0.00572)
c.After#c.dcap			-0.00246	-0.00423*
			(0.00423)	(0.00232)
c.After#c.dcap#c.Adopter			0.00459	0.00610
			(0.00584)	(0.00473)
c.After#c.AgrLand				0.00330***
				(0.00118)
c.After#c.AgrLand#c.Adopter				-0.00362
				(0.00385)
Constant	1.575	1.233	1.271	1.109
	(0.335)	(0.848)	(0.886)	(0.915)
Observations	228	233	233	233
R-squared	0.411	0.295	0.308	0.324
Number of cluster	2			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		47	47	47

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 32:

Impact of Solar water Pumps on Cropping Intensity in Bikaner

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-0.0166			
	(0.0558)			
After	-0.0470	-0.0392	-0.0671*	-0.0823*
	(0.0193)	(0.0295)	(0.0343)	(0.0484)
c.Adopter#c.After	0.0457	0.0665*	0.114**	0.0961
	(0.0693)	(0.0340)	(0.0546)	(0.0678)
Agricultural Land Owned	-0.00441	-0.0228***	-0.0240***	-0.0252***
	(0.00290)	(0.00482)	(0.00521)	(0.00521)
ElecCap	0.00376***	-0.00551	-0.00449	-0.00495
	(0.000347)	(0.00780)	(0.00806)	(0.00827)
Diesel Capacity	0.00103	-0.000123	-0.000350	-0.000365
	(0.00105)	(0.00140)	(0.00146)	(0.00148)
Water Table	-0.000464		-0.000236	-0.000303
	(0.000353)		(0.000447)	(0.000447)
irrigation_new==flood	-0.101*	-0.168***	-0.171***	-0.178***
	(0.0297)	(0.0518)	(0.0530)	(0.0515)
Animals_Possessed	0.000686	5.49e-05	9.52e-05	6.38e-05

	(0.000729)	(0.000254)	(0.000249)	(0.000270)
No_Diesel_Pump	0.0543***	-0.000482	0.00557	0.0104
	(0.00299)	(0.0571)	(0.0579)	(0.0594)
Drip_Area_Acre	-0.0123*	-0.000134	-0.000596	-0.00150
	(0.00329)	(0.00251)	(0.00229)	(0.00238)
Diggi_Volume	0.000270	-0.000165	-0.000165	-0.000203
	(0.000325)	(0.000151)	(0.000147)	(0.000167)
No of Farming Assets	0.00700			
	(0.00774)			
No of Earning Members	0.00656			
	(0.0134)			
No_Electric_equip	0.0336			
	(0.0186)			
Education Head	0.0118*			
	(0.00374)			
Education Highest HH	-0.00249			
	(0.0152)			
Age Head	0.00196			
	(0.00101)			
Non-Agr-Source	-0.0474			
	(0.0198)			
Year No	0.0271	0.0181	0.0212	0.0218
	(0.00971)	(0.0178)	(0.0197)	(0.0200)
Adopter = o,		-	-	-
c.After#c.ElecCap			-0.000230	-3.33e-05
			(0.000858)	(0.000927)
c.After#c.ElecCap#c.Adopter			-0.00178	-0.00218
			(0.00167)	(0.00173)
c.After#c.dcap			0.00134	0.00139
			(0.000951)	(0.000956)
c.After#c.dcap#c.Adopter			-0.00185	-0.00200
			(0.00159)	(0.00164)
c.After#c.AgrLand				0.000736
				(0.00138)
c.After#c.AgrLand#c.Adopter				0.00114
				(0.00224)
Constant	1.506***	2.239***	2.296***	2.334***
	(0.0770)	(0.0981)	(0.118)	(0.111)
Observations	507	507	507	507
R-squared	0.189	0.158	0.164	0.167
Number of cluster	3			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		102	102	102

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 33:

Impact of Solar water Pumps on Cropping Intensity in Sriganganagar

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-0.127			
	(0.0672)			
After	-0.00868	-0.00689	-0.0327	-0.0244
	(0.00353)	(0.0585)	(0.0680)	(0.0837)
c.Adopter#c.After	-0.0334	-0.00687	0.00840	-0.0125
	(0.0673)	(0.0560)	(0.0746)	(0.0949)
Agricultural Land Owned	-0.00261			
	(0.00169)			
ElecCap	-0.0226	-0.0188**	-0.0176*	-0.0179*
	(0.00428)	(0.00741)	(0.00976)	(0.0100)
Diesel Capacity	0.00229	-0.000901	-0.00135	-0.00139
	(0.00118)	(0.000945)	(0.00113)	(0.00116)
Water Table	0.000621	-0.0124**	-0.0132**	-0.0137**
	(0.00105)	(0.00576)	(0.00619)	(0.00635)
Flat Meter = o,	-	-	-	-
No Electric Pump	-0.478**	-0.164	-0.158	-0.160
	(0.0371)	(0.100)	(0.0992)	(0.0991)
irrigation_new==flood	-0.244	-0.0603	-0.0628	-0.0648
	(0.0735)	(0.0785)	(0.0781)	(0.0797)
Animals_Possessed	-0.00336	-0.0120	-0.0123	-0.0123
	(0.000954)	(0.00993)	(0.00999)	(0.01000)
No_Diesel_Pump	0.188	-0.0434	-0.0636	-0.0615
	(0.134)	(0.0601)	(0.0639)	(0.0657)
Drip	-0.0885	-0.0382	-0.0406	-0.0427
	(0.0202)	(0.0680)	(0.0671)	(0.0697)
Drip_Adopter	0.101	0.0635	0.0551	0.0585
	(0.108)	(0.0500)	(0.0503)	(0.0516)
Drip_Area_Acre	0.00501**	-0.00288	-0.00208	-0.00203
	(0.000104)	(0.00274)	(0.00267)	(0.00269)
Diggi_Volume	0.000177	-0.000626***	-0.000736***	-0.000730***
	(7.25e-05)	(0.000229)	(0.000223)	(0.000236)
No of Farming Assets	-0.00594**			
	(0.000447)			
No of Earning Members	-0.0326			
	(0.0493)			
No_Electric_equip	0.00136			
	(0.00590)			

Education Head	0.0188			
	(0.0237)			
Education Highest HH	0.0160			
	(0.0257)			
Age Head	-0.00326			
	(0.000778)			
Non-Agr-Source	0.107			
	(0.153)			
Year No	0.0357***	0.0612***	0.0622***	0.0630***
	(0.000420)	(0.0173)	(0.0176)	(0.0175)
Adopter = o,		-	-	-
Agricultural Land Owned = o,		-	-	-
c.After#c.ElecCap			0.00366	0.00470
			(0.00589)	(0.00765)
c.After#c.ElecCap#c.Adopter			-0.00497	-0.00642
			(0.00749)	(0.00888)
c.After#c.dcap			0.000527	0.000769
			(0.00145)	(0.00217)
c.After#c.dcap#c.Adopter			5.29e-06	-0.000267
			(0.00163)	(0.00230)
c.After#c.AgrLand				-0.000805
				(0.00458)
c.After#c.AgrLand#c.Adopter				0.00127
				(0.00483)
Constant	2.420**	2.529***	2.572***	2.587***
	(0.120)	(0.257)	(0.267)	(0.274)
Observations	390	390	390	390
R-squared	0.367	0.207	0.210	0.211
Number of cluster	2			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		78	78	78

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 34:

Impact of Solar water Pumps on Cropping Intensity in Chittorgarh

	(1)	(2)	(3)
VARIABLES	Model A	Model B	Model C
Adopter = o,	-	-	-

After	-0.0608	-0.201	-0.195
	(0.0795)	(0.123)	(0.121)
c.Adopter#c.After	0.0769	0.327*	0.380**
	(0.0775)	(0.170)	(0.182)
c.After#c.AgrLand			0.000811
			(0.00682)
c.After#c.AgrLand#c.Adopter			-0.00917
			(0.0100)
c.After#c.ElecCap		0.0172	0.0159
		(0.0140)	(0.0109)
c.After#c.ElecCap#c.Adopter		-0.0303	-0.0248
		(0.0228)	(0.0226)
c.After#c.dcap		0.00985	0.00935
		(0.00788)	(0.00671)
c.After#c.dcap#c.Adopter		-0.0129*	-0.0132*
		(0.00642)	(0.00660)
ElecCap = o,	-	-	-
Diesel Capacity = o,	-	-	-
Agricultural Land Owned	0.146***	0.168***	0.170***
	(0.0230)	(0.0548)	(0.0556)
Water Table	0.0237**	0.0258**	0.0238**
	(0.00979)	(0.00951)	(0.00972)
Flat Meter	0.257***	0.300***	0.287***
	(0.0648)	(0.0733)	(0.0728)
No Electric Pump	0.344***	0.393***	0.392***
	(0.0848)	(0.0906)	(0.0894)
irrigation_new==flood	-0.201	-0.183	-0.192
	(0.122)	(0.172)	(0.167)
Animals_Possessed	-0.00417	-0.00371	-0.00468
	(0.00380)	(0.00371)	(0.00386)
No_Diesel_Pump = o,	-	-	-
Drip_Area_Acre	0.0413	0.0386	0.0380
	(0.0373)	(0.0365)	(0.0368)
Diggi_Volume = o,	-	-	-
Year No	0.0229	0.0255	0.0245
	(0.0231)	(0.0247)	(0.0247)
Constant	-3.281*	-3.847**	-3.519*
	(1.742)	(1.848)	(1.884)
Observations	144	144	144
R-squared	0.219	0.247	0.253
Number of Sample	29	29	29
Farmer Fixed Effects	YES	YES	YES

)
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 35:

Impact of Solar water Pumps on Cropping Intensity in 4 districts (Ja
B
SG
C
)

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-0.0301			
	(0.0343)			
After	-0.0491***	-0.0472*	-0.0613**	-0.0642*
	(0.0132)	(0.0251)	(0.0286)	(0.0378)
c.Adopter#c.After	0.0568	0.0609**	0.0819**	0.0903*
	(0.0379)	(0.0274)	(0.0382)	(0.0494)
Agricultural Land Owned	-0.00335***	-0.000601	6.73e-05	0.000231
	(0.000658)	(0.00356)	(0.00413)	(0.00419)
ElecCap	0.000801	-0.0109**	-0.00956**	-0.00958**
	(0.000884)	(0.00431)	(0.00440)	(0.00462)
Diesel Capacity	0.000344	-0.000772	-0.000943	-0.000929
	(0.000456)	(0.000901)	(0.000996)	(0.00101)
Water Table	-0.000220	0.000198	0.000132	0.000144
	(0.000175)	(0.000769)	(0.000751)	(0.000755)
Flat Meter	0.0426	-0.130	-0.135	-0.136
	(0.0853)	(0.0915)	(0.102)	(0.103)
No Electric Pump	-0.150**	-0.179**	-0.171**	-0.172**
	(0.0613)	(0.0731)	(0.0735)	(0.0749)
irrigation_new==flood	-0.112***	-0.107***	-0.107***	-0.107***
	(0.0293)	(0.0330)	(0.0335)	(0.0333)
Animals_Possessed	0.000110	-0.000352	-0.000324	-0.000333
	(0.000310)	(0.000337)	(0.000346)	(0.000349)
No_Diesel_Pump	0.0464	-0.0559	-0.0568	-0.0576
	(0.0297)	(0.0445)	(0.0459)	(0.0458)
Drip_Area_Acre	0.00413	-0.00174	-0.00171	-0.00163
	(0.00382)	(0.00283)	(0.00281)	(0.00282)
Diggi_Volume	0.000263**	-0.000111	-0.000129	-0.000133
	(8.24e-05)	(0.000103)	(0.000105)	(0.000103)
No of Farming Assets	0.00413			
	(0.00664)			
No of Earning Members	0.000858			

	(0.00927)			
No_Electric_equip	0.00821			
	(0.0102)			
Education Head	0.00448			
	(0.00544)			
Education Highest HH	-0.000197			
	(0.00619)			
Age Head	0.000405			
	(0.000865)			
Non-Agr-Source	0.00785			
	(0.0457)			
Year No	0.0325***	0.0337**	0.0346**	0.0341**
	(0.00554)	(0.0168)	(0.0170)	(0.0169)
Adopter = o,		-	-	-
c.After#c.ElecCap			-0.000314	-0.000321
			(0.00121)	(0.00124)
c.After#c.ElecCap#c.Adopter			-0.000525	-0.000422
			(0.00170)	(0.00174)
c.After#c.dcap			0.000736	0.000704
			(0.000933)	(0.000964)
c.After#c.dcap#c.Adopter			-0.000852	-0.000805
			(0.00114)	(0.00114)
c.After#c.AgrLand				0.000147
				(0.000960)
c.After#c.AgrLand#c.Adopter				-0.000420
				(0.00122)
Constant	1.816***	1.962***	1.948***	1.943***
	(0.0926)	(0.148)	(0.149)	(0.152)
Observations	1,260	1,274	1,274	1,274
R-squared	0.178	0.160	0.162	0.162
Number of cluster	8			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		256	256	256

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

8.3.2 Impact on Cropping Pattern

Table 36:

Impact of Solar water Pumps on GCA in Fruits and Vegetables in Jaipur

	(1)	(2)	(3)	(4)

VARIABLES	Model A	Model B	Model C	Model D
Adopter	-0.420			
	(0.757)			
After	-0.810***	-0.848***	-0.239	0.423
	(0.129)	(0.245)	(0.358)	(0.489)
c.Adopter#c.After	0.569	0.781***	0.146	-0.249
	(0.389)	(0.276)	(0.464)	(0.532)
Agricultural Land Owned	0.620***	0.959***	0.947***	0.954***
	(0.120)	(0.228)	(0.233)	(0.244)
ElecCap	0.0479			
	(0.0481)			
Water Table	-0.0110	-0.00211	-0.00219	-0.00291
	(0.00902)	(0.00580)	(0.00575)	(0.00549)
Flat Meter	-1.181*	-0.185	-0.202	-0.192
	(0.575)	(0.484)	(0.489)	(0.492)
No Electric Pump	-4.641**			
	(1.371)			
Rented Electric Pump	-3.141**	-0.682***	-0.661***	-0.560***
	(1.068)	(0.171)	(0.176)	(0.200)
Animals_Possessed	0.0686	0.00117	0.00103	0.000702
	(0.0383)	(0.0108)	(0.0110)	(0.0108)
Drip_Area_Acre	0.210	0.0147	0.0204	0.0293
	(0.183)	(0.0764)	(0.0727)	(0.0668)
No of Farming Assets	-0.00198			
	(0.189)			
No of Earning Members	-0.323*			
	(0.134)			
No_Electric_equip	-0.0931			
	(0.424)			
Education Head	0.239			
	(0.294)			
Education Highest HH	0.00974			
	(0.367)			
Age Head	-0.00160			
	(0.0381)			
Non-Agr-Source	1.558			
	(1.748)			
Year Trend	-0.102	0.257	0.274	0.231
	(0.182)	(0.365)	(0.370)	(0.370)
Adopter = o,		-	-	-
ElecCap = o,		-	-	-
No Electric Pump = o,		-	-	-
c.After#c.ElecCap			-0.0390*	0.00161
			(0.0234)	(0.0216)

c.After#c.ElecCap#c.Adopter			0.0408	0.0174
			(0.0342)	(0.0334)
c.After#c.AgrLand				-0.173**
				(0.0732)
c.After#c.AgrLand#c.Adopter				0.119
				(0.0781)
Constant	0.213	-4.137	-3.997	-3.869
	(3.572)	(3.462)	(3.425)	(3.450)
Observations	545	545	545	545
R-squared	0.572	0.156	0.163	0.190
Number of cluster	6			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		109	109	109

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 37:

Impact of Solar water Pumps on GCA in Fruits and Vegetables in Sikar

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-0.728			
	(0.499)			
After	-0.182	-0.122	0.0517	0.281
	(0.0834)	(0.193)	(0.234)	(0.371)
c.Adopter#c.After	0.203	0.135	-0.0518	-0.213
	(0.202)	(0.261)	(0.343)	(0.479)
Agricultural Land Owned	0.0846			
	(0.0452)			
ElecCap	0.110	0.0816	0.0837	0.0807
	(0.0687)	(0.0854)	(0.0852)	(0.0844)
Water Table	0.00439	-0.00596	-0.00646	-0.00804
	(0.00291)	(0.0170)	(0.0169)	(0.0171)
Flat Meter	0.0290	0.670	0.659	0.657
	(0.554)	(0.461)	(0.476)	(0.454)
No Electric Pump	0.609		1.470	1.477
	(1.765)		(1.295)	(1.303)
Rented Electric Pump	-0.984	-1.461		
	(0.474)	(1.295)		
Animals_Possessed	0.0331	-0.00230	-0.00271	-0.000777
	(0.0296)	(0.0100)	(0.0106)	(0.0114)
Drip_Area_Acre	0.361	0.337	0.333	0.331

	(0.234)	(0.202)	(0.200)	(0.201)
No of Farming Assets	0.149			
	(0.0709)			
No of Earning Members	0.0758			
	(0.0507)			
No_Electric_equip	0.0878			
	(0.175)			
Education Head	0.0787			
	(0.174)			
Education Highest HH	-0.133			
	(0.264)			
Age Head	-0.00575			
	(0.00988)			
Non-Agr-Source	-0.188			
	(0.779)			
Year No	0.000964	-0.0303	-0.0350	-0.0253
	(0.100)	(0.0965)	(0.0974)	(0.0985)
Adopter = o,		-	-	-
Agricultural Land Owned = o,		-	-	-
No Electric Pump = o,		-		
c.After#c.ElecCap			-0.0139	-0.00763
			(0.0158)	(0.0178)
c.After#c.ElecCap#c.Adopter			0.0151	0.0143
			(0.0311)	(0.0299)
Rented Electric Pump = o,			-	-
c.After#c.AgrLand				-0.0274
				(0.0280)
c.After#c.AgrLand#c.Adopter				0.0146
				(0.0419)
Constant	-1.849	2.010	1.453	1.919
	(1.099)	(4.725)	(4.862)	(4.921)
Observations	315	315	315	315
R-squared	0.550	0.288	0.289	0.293
Number of cluster	3			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		63	63	63

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 38:

Impact of Solar water Pumps on GCA in Fruits and Vegetables in Jaisalmer

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-0.0568			
	(1.230)			
After	-1.528*	-1.753*	-2.193**	-2.338
	(0.208)	(0.886)	(1.030)	(1.433)
c.Adopter#c.After	1.547	0.490	0.928	1.054
	(0.770)	(0.695)	(0.820)	(1.363)
Agricultural Land Owned	-0.00874	-0.00882	0.00143	0.00192
	(0.00151)	(0.0143)	(0.0144)	(0.0160)
ElecCap	0.161**	-0.105	-0.117	-0.118
	(0.00351)	(0.0913)	(0.0957)	(0.0966)
Diesel Capacity	-0.0319	-0.00527	-0.0407	-0.0351
	(0.0218)	(0.0326)	(0.0371)	(0.0406)
Water Table	-0.00634	0.0171	0.0147	0.0153
	(0.00207)	(0.0232)	(0.0259)	(0.0265)
Flat Meter	2.042	-16.18***	-19.82***	-19.88***
	(0.578)	(3.141)	(4.343)	(4.319)
No Electric Pump	0.898	-4.439	-4.337	-4.310
	(0.906)	(3.092)	(3.087)	(3.102)
irrigation_new==flood	-0.190	-1.475**	-1.425**	-1.413**
	(0.471)	(0.659)	(0.667)	(0.676)
Animals_Possessed	0.00646	-0.00278	-0.00152	-0.00149
	(0.00908)	(0.00194)	(0.00291)	(0.00311)
No_Diesel_Pump	-1.121	-0.783	-0.949	-0.936
	(0.329)	(0.759)	(0.775)	(0.781)
Diggi_Volume	-0.00133	-0.00218	-0.00302**	-0.00329*
	(0.000259)	(0.00135)	(0.00140)	(0.00168)
No of Farming Assets	0.214			
	(0.0672)			
No of Earning Members	0.00974			
	(0.0603)			
No_Electric_equip	0.176			
	(0.183)			
Education Head	0.165			
	(0.0965)			
Education Highest HH	-0.153			
	(0.111)			
Age Head	0.00296			
	(0.0168)			
Non-Agr-Source	0.292			
	(1.352)			
Year No	0.756*	0.989***	0.966***	0.969***
	(0.0643)	(0.340)	(0.346)	(0.353)

Adopter = o,		-	-	-
c.After#c.ElecCap			0.0256	0.0231
			(0.0599)	(0.0545)
c.After#c.ElecCap#c.Adopter			-0.0523	-0.0503
			(0.0449)	(0.0401)
c.After#c.dcap			0.0450**	0.0429**
			(0.0173)	(0.0170)
c.After#c.dcap#c.Adopter			-0.0361	-0.0342
			(0.0301)	(0.0301)
c.After#c.AgrLand				0.00386
				(0.0139)
c.After#c.AgrLand#c.Adopter				-0.00301
				(0.0215)
Constant	-0.702	3.570	4.296	4.107
	(3.489)	(5.271)	(5.620)	(5.786)
Observations	228	233	233	233
R-squared	0.598	0.323	0.331	0.331
Number of cluster	2			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		47	47	47

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 39:

Impact of Solar water Pumps on GCA in Fruits and Vegetables in Bikaner

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	1.237			
	(1.201)			
After	-0.816	-0.655**	-0.597*	-0.429
	(1.177)	(0.303)	(0.356)	(0.486)
c.Adopter#c.After	0.560	1.248**	0.982*	1.504
	(0.735)	(0.596)	(0.544)	(0.946)
Agricultural Land Owned	-0.0122	-0.0750**	-0.0760**	-0.0574
	(0.0287)	(0.0357)	(0.0350)	(0.0410)
ElecCap	0.268**	0.119*	0.113	0.123
	(0.0353)	(0.0703)	(0.113)	(0.100)
Diesel Capacity	0.0278	-0.00332	-0.00413	-0.00392
	(0.0371)	(0.00772)	(0.00861)	(0.00866)
Water Table	-0.00846	0.00869	0.0184	0.0199

	(0.00485)	(0.0114)	(0.0187)	(0.0186)
irrigation_new==flood	-1.713	-0.337	-0.550*	-0.411
	(1.833)	(0.427)	(0.316)	(0.370)
Animals_Possessed	0.0109	0.00625	0.00584	0.00609
	(0.0136)	(0.00580)	(0.00561)	(0.00656)
No_Diesel_Pump	1.539	-0.220	-0.191	-0.292
	(2.422)	(0.429)	(0.364)	(0.338)
Drip_Area_Acre	0.368**	-0.0826	-0.00358	0.0153
	(0.0476)	(0.0510)	(0.0456)	(0.0458)
Diggi_Volume	-0.00577	0.00306**	0.00282**	0.00357**
	(0.00755)	(0.00138)	(0.00122)	(0.00164)
No of Farming Assets	0.0815			
	(0.115)			
No of Earning Members	-0.613			
	(0.617)			
No_Electric_equip	-0.250			
	(0.328)			
Education Head	-0.0357			
	(0.0765)			
Education Highest HH	0.499			
	(0.550)			
Age Head	-0.0363			
	(0.0412)			
Non-Agr-Source	-0.890			
	(0.950)			
Year No	0.297	0.465	0.451	0.441
	(0.311)	(0.433)	(0.341)	(0.342)
Adopter = o,		-	-	-
c.After#c.ElecCap			-0.0561***	-0.0595***
			(0.0159)	(0.0173)
c.After#c.ElecCap#c.Adopter			0.131	0.138
			(0.0933)	(0.0921)
c.After#c.dcap			0.0108	0.00975
			(0.00944)	(0.00933)
c.After#c.dcap#c.Adopter			-0.0142	-0.0111
			(0.0123)	(0.0118)
c.After#c.AgrLand				-0.00769
				(0.0252)
c.After#c.AgrLand#c.Adopter				-0.0312
				(0.0411)
Constant	3.014	2.144	0.936	0.268
	(1.414)	(2.077)	(2.859)	(2.956)
Observations	507	507	507	507
R-squared	0.403	0.089	0.142	0.150
Number of cluster	3			
Cluster Fixed Effects	YES	YES	YES	YES

Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		102	102	102

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 40:

Impact of Solar water Pumps on GCA in Fruits and Vegetables in Sriganganagar

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-0.399			
	(0.577)			
After	-0.835	-0.571*	-0.606*	-1.106***
	(0.474)	(0.303)	(0.336)	(0.407)
c.Adopter#c.After	-0.897	-0.406	-0.512	0.194
	(0.280)	(0.502)	(0.639)	(0.723)
Agricultural Land Owned	0.0997			
	(0.0658)			
ElecCap	-0.210	-0.810***	-0.894***	-0.890***
	(0.180)	(0.0645)	(0.224)	(0.231)
Diesel Capacity	-0.0254	-0.0174	-0.0178	-0.0161
	(0.00482)	(0.0199)	(0.0167)	(0.0163)
Water Table	0.00141	0.156	0.147	0.154
	(0.0147)	(0.109)	(0.113)	(0.112)
Flat Meter = o,	-	-	-	-
No Electric Pump	-2.345	-4.041***	-4.272***	-4.393***
	(2.256)	(0.644)	(1.122)	(1.220)
irrigation_new==flood	0.587	-0.949	-0.942	-0.873
	(0.428)	(1.116)	(1.060)	(1.050)
Animals_Possessed	-0.0573	-0.0670	-0.0745	-0.0795
	(0.0549)	(0.0527)	(0.0533)	(0.0523)
No_Diesel_Pump	-1.749	-2.479	-2.420*	-2.576*
	(2.162)	(1.704)	(1.439)	(1.424)
Drip	3.062	1.705	1.721	1.751
	(1.533)	(1.061)	(1.065)	(1.090)
Drip_Adopter	0.612	-0.587	-0.613	-0.693
	(1.266)	(0.615)	(0.612)	(0.617)
Drip_Area_Acre	0.376	0.176*	0.177*	0.176*
	(0.0620)	(0.0971)	(0.0917)	(0.0902)
Diggi_Volume	0.0123***	-0.00361*	-0.00524*	-0.00591**
	(0.000193)	(0.00213)	(0.00270)	(0.00276)
No of Farming Assets	-0.0414			
	(0.0911)			

No of Earning Members	0.0197			
	(0.176)			
No_Electric_equip	-0.200			
	(0.241)			
Education Head	0.0395			
	(0.0411)			
Education Highest HH	0.0946			
	(0.260)			
Age Head	0.0197			
	(0.0751)			
Non-Agr-Source	0.0750			
	(0.108)			
Year No	0.192	0.177	0.196	0.173
	(0.167)	(0.163)	(0.162)	(0.161)
Adopter = o,		-	-	-
Agricultural Land Owned = o,		-	-	-
c.After#c.ElecCap			0.0744	0.0217
			(0.0576)	(0.0595)
c.After#c.ElecCap#c.Adopter			-0.0269	0.0318
			(0.134)	(0.125)
c.After#c.dcap			-0.00426	-0.0173**
			(0.00570)	(0.00713)
c.After#c.dcap#c.Adopter			0.00676	0.0206
			(0.0134)	(0.0146)
c.After#c.AgrLand				0.0450**
				(0.0214)
c.After#c.AgrLand#c.Adopter				-0.0524*
				(0.0263)
Constant	0.0798	5.446	6.252*	6.214
	(7.375)	(3.335)	(3.586)	(3.855)
Observations	390	390	390	390
R-squared	0.638	0.446	0.452	0.462
Number of cluster	2			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		78	78	78

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 41:

Impact of Solar water Pumps on GCA in Fruits and Vegetables in Chittorgarh

	(1)	(2)	(3)

VARIABLES	Model A	Model B	Model C
Adopter = o,	-	-	-
After	-0.174	0.0257	0.0844
	(0.249)	(0.423)	(0.425)
c.Adopter#c.After	0.214	0.715**	0.626*
	(0.141)	(0.313)	(0.338)
c.After#c.AgrLand			-0.0341
			(0.0264)
c.After#c.AgrLand#c.Adopter			0.0389
			(0.0303)
c.After#c.ElecCap		-0.0352	-0.0188
		(0.0431)	(0.0357)
c.After#c.ElecCap#c.Adopter		-0.0541	-0.0725
		(0.0476)	(0.0428)
c.After#c.dcap		-0.0164	-0.00705
		(0.0244)	(0.0217)
c.After#c.dcap#c.Adopter		-0.00325	-0.0130
		(0.0178)	(0.0181)
ElecCap = o,	-	-	-
Diesel Capacity = o,	-	-	-
Agricultural Land Owned	0.601***	0.735***	0.729***
	(0.0563)	(0.0938)	(0.0957)
Water Table	0.00183	0.0129	0.0137
	(0.0130)	(0.0128)	(0.0133)
Flat Meter	0.298**	0.308**	0.333**
	(0.134)	(0.138)	(0.138)
No Electric Pump	0.528***	0.560***	0.577***
	(0.151)	(0.135)	(0.138)
irrigation_new==flood	-1.078**	-1.485***	-1.520***
	(0.505)	(0.448)	(0.450)
Animals_Possessed	-0.00650	-0.00313	-0.00297
	(0.0182)	(0.0176)	(0.0181)
No_Diesel_Pump = o,	-	-	-
Drip_Area_Acre	-0.0347	-0.0634**	-0.0634**
	(0.0314)	(0.0234)	(0.0238)
Diggi_Volume = o,	-	-	-
Year No	0.0966	0.114	0.113
	(0.102)	(0.106)	(0.107)
Constant	-1.831	-4.547*	-4.626*
	(2.353)	(2.593)	(2.704)

Observations	144	144	144
R-squared	0.173	0.253	0.255
Number of Sample	29	29	29
Farmer Fixed Effects	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 42:

Impact of Solar water Pumps on GCA in Fruits and Vegetables in 4 districts (Ja
B
SG
C
)

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	0.461			
	(0.451)			
After	-0.910	-0.754***	-0.788***	-0.757**
	(0.495)	(0.251)	(0.301)	(0.335)
c.Adopter#c.After	-0.182	0.473	0.377	0.581
	(0.617)	(0.330)	(0.337)	(0.502)
Agricultural Land Owned	0.0206	0.0786*	0.00987	0.0163
	(0.0314)	(0.0466)	(0.0395)	(0.0388)
ElecCap	0.166***	0.0116	-0.0435	-0.0399
	(0.0167)	(0.0768)	(0.0904)	(0.0902)
Diesel Capacity	-0.000563	-0.00818	-0.00671	-0.00680
	(0.0139)	(0.00785)	(0.00802)	(0.00811)
Water Table	-0.00427	0.00670	0.0207	0.0211
	(0.00255)	(0.0102)	(0.0169)	(0.0169)
Flat Meter	2.989	-1.961	0.227	0.235
	(2.668)	(1.429)	(1.211)	(1.223)
No Electric Pump	0.253	-1.926	-1.773	-1.763
	(0.588)	(1.297)	(1.282)	(1.312)
irrigation_new==flood	-1.467**	-1.366***	-1.439***	-1.418***
	(0.453)	(0.332)	(0.319)	(0.332)
Animals_Possessed	0.00298	0.00245	-0.000243	-0.000478
	(0.00712)	(0.00206)	(0.00194)	(0.00215)
No_Diesel_Pump	-0.143	-1.046*	-0.904*	-0.919*
	(1.023)	(0.544)	(0.490)	(0.482)
Drip_Area_Acre	0.465***	0.0718	0.0960	0.0987*
	(0.0502)	(0.0566)	(0.0582)	(0.0587)
Diggi_Volume	-0.00229**	-0.00119	-0.000942	-0.000802
	(0.000859)	(0.00120)	(0.00119)	(0.00134)
No of Farming Assets	0.0282			

	(0.0620)			
No of Earning Members	-0.0632			
	(0.147)			
No_Electric_equip	0.0359			
	(0.122)			
Education Head	0.122			
	(0.0903)			
Education Highest HH	0.0190			
	(0.0656)			
Age Head	-0.00595			
	(0.0240)			
Non-Agr-Source	-0.265			
	(0.535)			
Year No	0.105	0.170**	0.0835	0.0509
	(0.114)	(0.0762)	(0.0985)	(0.110)
Adopter = o,		-	-	-
c.After#c.ElecCap			-0.0481***	-0.0487***
			(0.0175)	(0.0176)
c.After#c.ElecCap#c.Adopter			0.128***	0.132***
			(0.0455)	(0.0476)
c.After#c.dcap			0.00934	0.00913
			(0.00665)	(0.00679)
c.After#c.dcap#c.Adopter			-0.0159*	-0.0148*
			(0.00849)	(0.00825)
c.After#c.AgrLand				-0.00125
				(0.00802)
c.After#c.AgrLand#c.Adopter				-0.0106
				(0.0195)
Constant	0.619	2.322	2.088	1.869
	(1.693)	(1.995)	(2.253)	(2.338)
Observations	1,260	1,274	1,274	1,274
R-squared	0.400	0.149	0.193	0.194
Number of cluster	8			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		256	256	256

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

8.3.3 Impact on Farmer profits

Table 43:

Impact of Solar water Pumps on Profits of Farmers in Jaipur

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-1.511			
	(10.38)			
After	-12.57	-9.452	-16.05*	-16.38
	(8.492)	(6.394)	(9.081)	(9.909)
c.Adopter#c.After	1.252	4.851	16.18*	14.71
	(4.531)	(5.305)	(9.195)	(13.43)
Agricultural Land Owned	0.941	-0.550	0.0876	-0.0816
	(0.876)	(6.617)	(6.776)	(6.980)
ElecCap	-0.412			
	(0.324)			
Water Table	-0.00925	0.190	0.196	0.200
	(0.0866)	(0.128)	(0.124)	(0.135)
Flat Meter	5.386	0.436	0.647	0.561
	(9.776)	(6.780)	(6.920)	(6.915)
No Electric Pump	5.316			
	(22.63)			
Rented Electric Pump	2.002	-4.643	-5.497	-6.322
	(12.47)	(3.653)	(3.724)	(4.342)
Animals_Possessed	0.393	-0.0338	-0.0262	-0.0258
	(0.356)	(0.184)	(0.183)	(0.183)
Drip_Area_Acre	-0.588	-0.271	-0.0668	-0.112
	(1.951)	(0.813)	(0.921)	(1.028)
No of Farming Assets	2.828*			
	(1.211)			
No of Earning Members	0.864			
	(1.014)			
No_Electric_equip	0.671			
	(1.372)			
Education Head	-0.263			
	(1.787)			
Education Highest HH	-1.146			
	(1.458)			
Age Head	-0.598			
	(0.305)			
Non-Agr-Source	-29.42			
	(15.36)			
Year Trend	4.433	6.868*	6.846*	7.016*
	(2.509)	(3.815)	(3.687)	(4.009)
Adopter = o,		-	-	-
ElecCap = o,		-	-	-
No Electric Pump = o,		-	-	-

c.After#c.ElecCap			0.427*	0.402
			(0.233)	(0.284)
c.After#c.ElecCap#c.Adopter			-0.746	-0.810*
			(0.583)	(0.431)
c.After#c.AgrLand				0.0983
				(0.765)
c.After#c.AgrLand#c.Adopter				0.225
				(1.242)
Constant	50.52	-22.46	-29.98	-29.65
	(40.37)	(83.11)	(81.55)	(82.14)
Observations	545	545	545	545
R-squared	0.143	0.065	0.068	0.068
Number of cluster	6			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		109	109	109

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 44:

Impact of Solar water Pumps on Profits of Farmers in Sikar

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-15.05			
	(15.05)			
After	17.04	16.99***	25.52***	32.98***
	(10.02)	(5.388)	(7.983)	(9.515)
c.Adopter#c.After	-0.346	7.831	5.911	-1.949
	(2.191)	(6.299)	(7.446)	(9.523)
Agricultural Land Owned	1.249			
	(0.710)			
ElecCap	0.394	-2.832***	-2.323**	-2.482***
	(1.264)	(0.925)	(0.935)	(0.895)
Water Table	0.0674*	0.643***	0.568***	0.569**
	(0.0160)	(0.214)	(0.212)	(0.244)
Flat Meter	-1.610	16.92	20.26	20.82
	(23.15)	(27.78)	(28.23)	(27.56)
No Electric Pump	-19.46			
	(27.42)			
Rented Electric Pump	-35.85	10.13	7.949	7.470
	(18.38)	(11.75)	(11.50)	(11.08)

Animals_Possessed	2.072	0.0722	-0.00221	-0.000652
	(1.635)	(1.128)	(1.133)	(1.178)
Drip_Area_Acre	6.564	3.148*	3.621**	3.587**
	(3.843)	(1.681)	(1.602)	(1.618)
No of Farming Assets	3.986**			
	(0.736)			
No of Earning Members	1.403			
	(4.418)			
No_Electric_equip	1.612			
	(5.190)			
Education Head	-2.773			
	(2.301)			
Education Highest HH	3.876			
	(2.441)			
Age Head	-0.384			
	(0.404)			
Non-Agr-Source	15.45			
	(22.32)			
Year No	-9.959*	-7.201**	-8.352**	-8.004**
	(3.094)	(3.020)	(3.203)	(3.187)
Adopter = o,		-	-	-
Agricultural Land Owned = o,		-	-	-
No Electric Pump = o,		-	-	-
c.After#c.ElecCap			-0.641	-0.439
			(0.485)	(0.489)
c.After#c.ElecCap#c.Adopter			-0.111	-0.285
			(0.689)	(0.738)
c.After#c.AgrLand				-0.890
				(0.638)
c.After#c.AgrLand#c.Adopter				0.894
				(0.950)
Constant	8.342	-90.60*	-75.62	-74.14
	(23.66)	(52.55)	(50.98)	(60.34)
Observations	305	305	305	305
R-squared	0.378	0.116	0.124	0.127
Number of cluster	3			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		61	61	61

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 45:

Impact of Solar water Pumps on Profits of Farmers in Jaisalmer

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-61.81			
	(41.50)			
After	-276.6	-105.7	13.84	105.9
	(515.3)	(194.9)	(173.2)	(283.3)
c.Adopter#c.After	226.6	-287.4	-578.0	-699.9
	(167.1)	(253.4)	(426.8)	(631.6)
Agricultural Land Owned	2.162	11.53	10.19	9.221
	(0.517)	(10.78)	(11.07)	(14.39)
ElecCap	39.47*	-1.429	35.58	36.63
	(3.894)	(17.34)	(38.85)	(41.95)
Diesel Capacity	2.643	13.94	13.02	13.50
	(7.154)	(13.92)	(16.74)	(17.06)
Water Table	-0.192	-42.03	-43.89	-44.20
	(0.142)	(62.64)	(63.20)	(64.17)
Flat Meter	-1,351	-4,461	4,672	5,074
	(344.9)	(3,444)	(11,438)	(12,167)
No Electric Pump	-240.2	98.28	39.78	41.29
	(78.26)	(334.9)	(311.1)	(264.0)
irrigation_new==flood	-46.66	82.35	-5.384	-5.138
	(95.32)	(340.0)	(315.4)	(327.0)
Animals_Possessed	1.875	5.097	6.153	6.084
	(0.953)	(5.850)	(6.074)	(6.075)
No_Diesel_Pump	134.8	610.2	563.1	565.1
	(264.8)	(615.3)	(609.0)	(600.7)
Diggi_Volume	-0.100	-1.227*	-0.996	-0.949
	(0.159)	(0.684)	(0.659)	(0.672)
No of Farming Assets	-20.19			
	(30.86)			
No of Earning Members	-39.05			
	(81.13)			
No_Electric_equip	-7.473			
	(9.234)			
Education Head	-8.981			
	(40.85)			
Education Highest HH	47.89			
	(66.71)			
Age Head	-2.152*			
	(0.207)			
Non-Agr-Source	-52.04			
	(225.3)			

Year No	21.39	59.25	44.08	43.65
	(115.3)	(64.28)	(59.44)	(59.28)
Adopter = o,		-	-	-
c.After#c.ElecCap			-48.31	-45.85
			(52.24)	(52.73)
c.After#c.ElecCap#c.Adopter			102.1	101.7
			(94.43)	(94.84)
c.After#c.dcap			-4.093	-5.007
			(6.503)	(7.439)
c.After#c.dcap#c.Adopter			19.68*	20.46
			(11.56)	(12.77)
c.After#c.AgrLand				-2.396
				(5.055)
c.After#c.AgrLand#c.Adopter				3.602
				(11.92)
Constant	172.7	7,286	7,216	7,278
	(133.7)	(11,216)	(11,255)	(11,433)
Observations	212	217	217	217
R-squared	0.307	0.229	0.236	0.236
Number of cluster	2			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		44	44	44

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 46:

Impact of Solar water Pumps on Profits of Farmers in Bikaner

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-65.75			
	(57.35)			
After	-87.04**	-63.40*	-77.08**	-20.99
	(18.69)	(32.78)	(36.47)	(47.35)
c.Adopter#c.After	95.05***	105.8**	143.4***	16.71
	(7.099)	(42.94)	(53.26)	(53.51)
Agricultural Land Owned	2.576	1.176	0.481	1.845
	(2.475)	(3.295)	(3.698)	(4.294)
ElecCap	5.418**	10.70*	12.21*	10.86*
	(0.759)	(6.100)	(7.153)	(6.315)
Diesel Capacity	1.143	-1.481	-1.372	-1.345

	(0.853)	(1.182)	(1.157)	(1.092)
Water Table	-0.814	-0.919	-0.941	-1.125
	(0.399)	(0.969)	(1.016)	(0.949)
irrigation_new==flood	-51.22	-34.12	-35.74	-46.37
	(80.75)	(31.23)	(29.58)	(30.02)
Animals_Possessed	0.683	0.588	0.608	0.780
	(0.503)	(0.598)	(0.592)	(0.710)
No_Diesel_Pump	27.65	-88.71*	-78.15*	-67.86
	(23.13)	(49.65)	(44.45)	(43.67)
Drip_Area_Acre	-0.0513	-5.188	-4.779	-6.770*
	(4.599)	(5.370)	(3.863)	(3.650)
Diggi_Volume	-0.116	0.195***	0.187***	0.123
	(0.386)	(0.0714)	(0.0657)	(0.0818)
No of Farming Assets	17.65			
	(16.07)			
No of Earning Members	-19.65			
	(10.40)			
No_Electric_equip	20.29			
	(9.316)			
Education Head	-5.531			
	(13.28)			
Education Highest HH	18.89			
	(7.447)			
Age Head	1.169			
	(0.786)			
Non-Agr-Source	-49.04			
	(26.22)			
Year No	-14.66	-32.26	-29.14	-29.46
	(8.497)	(30.83)	(27.92)	(28.14)
Adopter = o,		-	-	-
c.After#c.ElecCap			-1.162	-1.127
			(2.385)	(2.284)
c.After#c.ElecCap#c.Adopter			-0.532	-0.897
			(3.936)	(3.551)
c.After#c.dcap			0.862	0.941
			(1.191)	(1.189)
c.After#c.dcap#c.Adopter			-1.714	-2.046
			(1.301)	(1.278)
c.After#c.AgrLand				-2.969
				(2.970)
c.After#c.AgrLand#c.Adopter				6.932**
				(3.159)
Constant	10.83	357.2**	363.1**	366.9**
	(153.2)	(171.8)	(182.9)	(155.1)
Observations	502	502	502	502
R-squared	0.224	0.100	0.109	0.132

Number of cluster	3			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		101	101	101

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 47:

Impact of Solar water Pumps on Profits of Farmers in Sriganganagar

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-155.1			
	(35.61)			
After	-97.20*	-60.53	-34.22	-104.1
	(10.54)	(64.14)	(71.69)	(81.01)
c.Adopter#c.After	237.6**	155.0*	-32.75	43.37
	(8.994)	(79.48)	(106.8)	(118.2)
Agricultural Land Owned	11.94**			
	(0.792)			
ElecCap	70.38*	76.18***	28.80	28.60
	(9.137)	(6.670)	(23.41)	(24.21)
Diesel Capacity	-5.463	1.903	0.137	0.322
	(2.806)	(1.318)	(1.222)	(1.250)
Water Table	2.365	25.77*	27.81*	28.13*
	(0.873)	(15.18)	(14.58)	(14.89)
Flat Meter = o,	-	-	-	-
No Electric Pump	708.1	503.5***	270.1**	243.6
	(375.1)	(67.45)	(128.5)	(150.2)
irrigation_new==flood	243.0**	-11.40	20.79	28.25
	(14.47)	(78.95)	(78.94)	(80.72)
Animals_Possessed	-5.036	7.698*	5.573	4.646
	(10.16)	(4.305)	(4.311)	(4.398)
No_Diesel_Pump	-373.9	-135.9	-166.9*	-189.4**
	(172.6)	(87.13)	(89.96)	(91.73)
Drip	167.6	-59.87	-52.05	-51.84
	(37.69)	(90.29)	(94.24)	(95.67)
Drip_Adopter	-116.5	-159.5*	-203.0**	-209.0**
	(52.58)	(84.77)	(91.98)	(90.86)
Drip_Area_Acre	9.921	12.19	12.47	12.36
	(10.06)	(10.82)	(10.16)	(10.01)
Diggi_Volume	1.079	-0.644*	-0.559	-0.660*
	(0.552)	(0.357)	(0.375)	(0.355)

No of Farming Assets	43.23			
	(26.84)			
No of Earning Members	-98.05**			
	(3.975)			
No_Electric_equip	2.237			
	(91.61)			
Education Head	-92.06**			
	(6.544)			
Education Highest HH	18.95			
	(55.13)			
Age Head	8.082			
	(3.391)			
Non-Agr-Source	429.5			
	(130.7)			
Year No	2.235	-12.13	-21.57	-23.90
	(5.711)	(22.61)	(21.88)	(22.11)
Adopter = o,		-	-	-
Agricultural Land Owned = o,		-	-	-
c.After#c.ElecCap			0.866	-5.765
			(6.790)	(6.007)
c.After#c.ElecCap#c.Adopter			24.50*	31.20**
			(14.33)	(12.77)
c.After#c.dcap			-0.605	-2.246
			(1.513)	(1.977)
c.After#c.dcap#c.Adopter			4.807*	6.531**
			(2.680)	(3.065)
c.After#c.AgrLand				5.903**
				(2.562)
c.After#c.AgrLand#c.Adopter				-6.111*
				(3.466)
Constant	-769.3	-683.6	-373.1	-344.9
	(156.7)	(425.1)	(417.1)	(444.4)
Observations	380	380	380	380
R-squared	0.484	0.191	0.257	0.267
Number of cluster	2			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		76	76	76

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 48:

Impact of Solar water Pumps on Profits of Farmers in Chittorgarh

	(1)	(2)	(3)
VARIABLES	Model A	Model B	Model C
Adopter = o,	-	-	-
After	7.044	26.57	32.08
	(24.26)	(19.29)	(20.17)
c.Adopter#c.After	12.09	13.35	31.23
	(20.89)	(23.21)	(37.76)
c.After#c.AgrLand			-1.461
			(3.333)
c.After#c.AgrLand#c.Adopter			-1.863
			(4.948)
c.After#c.ElecCap		-2.789	-2.461
		(3.822)	(3.166)
c.After#c.ElecCap#c.Adopter		0.791	2.183
		(5.581)	(4.647)
c.After#c.dcap		-1.447	-1.166
		(1.768)	(1.733)
c.After#c.dcap#c.Adopter		0.232	-0.427
		(2.042)	(2.099)
ElecCap = o,	-	-	-
Diesel Capacity = o,	-	-	-
Agricultural Land Owned	-6.927	-6.079	-5.383
	(5.528)	(8.496)	(9.460)
Water Table	-0.877	-0.647	-1.464
	(0.797)	(0.675)	(1.178)
Flat Meter	-21.68**	-24.51***	-28.40***
	(9.756)	(8.135)	(10.16)
No Electric Pump	-80.86***	-82.32***	-81.65***
	(15.66)	(13.77)	(14.90)
irrigation_new==flood	-80.63***	-105.3***	-111.0***
	(23.56)	(28.07)	(33.10)
Animals_Possessed	-1.602	-1.473	-1.880
	(2.074)	(2.133)	(1.751)
No_Diesel_Pump = o,	-	-	-
Drip_Area_Acre	-4.802	-5.412*	-5.642*
	(2.988)	(3.162)	(3.290)
Diggi_Volume = o,	-	-	-
Year No	-5.399	-5.181	-5.643
	(6.549)	(6.513)	(6.566)
Constant	418.3**	388.8**	524.9**

	(163.6)	(144.7)	(199.4)
Observations	144	144	144
R-squared	0.109	0.123	0.138
Number of Sample	29	29	29
Farmer Fixed Effects	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 49:

Impact of Solar water Pumps on Profits of Farmers in 4 districts (Ja
B
SG
C
)

	(1)	(2)	(3)	(4)
VARIABLES	Model A	Model B	Model C	Model D
Adopter	-69.29			
	(47.76)			
After	-94.08	-81.60	-57.16	-19.22
	(66.86)	(65.49)	(80.00)	(54.03)
c.Adopter#c.After	152.5**	85.85*	-46.49	-173.4*
	(44.26)	(47.58)	(68.13)	(91.46)
Agricultural Land Owned	10.14***	43.55***	25.93***	23.45**
	(2.117)	(14.39)	(9.963)	(9.624)
ElecCap	21.68*	52.11**	28.16	28.07
	(9.615)	(21.06)	(17.84)	(17.54)
Diesel Capacity	-0.835	1.019	0.499	0.510
	(1.433)	(1.919)	(1.989)	(1.959)
Water Table	-0.628**	-9.540	-6.825	-7.033
	(0.215)	(11.51)	(10.11)	(10.11)
Flat Meter	-218.7	-617.3*	-211.0	-199.9
	(224.0)	(362.4)	(229.2)	(222.5)
No Electric Pump	55.05	240.2	195.4	205.5
	(127.4)	(186.4)	(134.3)	(139.6)
irrigation_new==flood	38.70	-38.89	-46.11	-56.03
	(37.93)	(44.72)	(43.80)	(45.92)
Animals_Possessed	0.498	1.606	1.465	1.554
	(0.796)	(1.566)	(1.536)	(1.537)
No_Diesel_Pump	-87.14	-28.90	-28.89	-17.42
	(80.99)	(124.0)	(123.2)	(122.6)
Drip_Area_Acre	2.110	-1.555	2.263	1.048
	(9.280)	(6.949)	(5.912)	(6.171)
Diggi_Volume	-0.107	-0.553**	-0.395	-0.392

	(0.208)	(0.254)	(0.258)	(0.244)
No of Farming Assets	24.24*			
	(12.47)			
No of Earning Members	-10.57			
	(12.55)			
No_Electric_equip	-10.18			
	(21.69)			
Education Head	-13.97			
	(10.97)			
Education Highest HH	35.54			
	(19.90)			
Age Head	0.542			
	(1.120)			
Non-Agr-Source	38.14			
	(78.70)			
Year No	1.662	14.43	-1.670	7.619
	(17.21)	(19.46)	(20.96)	(19.95)
Adopter = o,		-	-	-
c.After#c.ElecCap			-2.712	-2.517
			(3.052)	(2.814)
c.After#c.ElecCap#c.Adopter			23.67***	21.97***
			(7.989)	(7.724)
c.After#c.dcap			-0.692	-0.372
			(1.297)	(1.460)
c.After#c.dcap#c.Adopter			2.549*	1.791
			(1.468)	(1.429)
c.After#c.AgrLand				-1.945
				(2.500)
c.After#c.AgrLand#c.Adopter				6.488**
				(3.133)
Constant	-232.5	121.6	284.3	356.3
	(174.1)	(1,195)	(1,122)	(1,109)
Observations	1,229	1,243	1,243	1,243
R-squared	0.229	0.133	0.155	0.158
Number of cluster	8			
Cluster Fixed Effects	YES	YES	YES	YES
Farmer Fixed Effects	NO	YES	YES	YES
Cluster Specific YearTrends	YES	YES	YES	YES
Number of Sample		250	250	250

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1