Federalism versus Regional Control: Implications for Groundwater Resource in India *

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Abstract

Federal versus regional control over provision of resources can have different implications for long run sustainability of natural resources. This paper examines the trade off between short term growth and long term conservation incentives of elected legislators from regional and national political parties for groundwater provision. Regional legislators have a stronger incentive to promote regional growth, which can lead to a rapid decline of resource stocks. On the other hand, regional parties are limited to contesting elections from the region, and hence have stronger incentives to conserve resources for future periods. These two effects can offset each other. This paper proposes and tests the hypothesis that under high cost of provision to the legislators, regional regimes can lead to conservation because they internalize inter-temporal externalities. I use nationally representative data on groundwater from India, and an increase in the cost of groundwater provision for the legislators induced by the reforms in the electricity sector, to show that private competition induced in electricity sector leads to groundwater conservation under regional regimes.

JEL Classifications: O12, O13, Q01, Q25, Q56, H54

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1 Introduction

There is a fundamental trade-off between resource intensive development initiatives, and sustaining the stock of these resources. Unsustainable access can deplete the very resources that provide livelihood to many poor and vulnerable segments of developing economies. This can potentially compromise food security and enhance vulnerability to shocks. It is important to understand what impact the incentives of locally elected legislators have on the stocks of these resources, especially for a resource like groundwater, which provides livelihood to millions of people in the developing world.

Unlike surface water, where inter-jurisdictional externalities are very prominent due to rapid flow of water from one point to another , groundwater externalities are much more spatially localized at least in short time spans (Brozovic et al, 2006). [1] However, extraction rates in the current period have an immediate effect on the water availability in the subsequent periods. Hence, inter-temporal externalities and water depletion within jurisdictions are the main cause of public policy concern. In many developing countries including India, China, Pakistan, and Northern Africa, groundwater is depleting due to over-extraction.

Political incentives can affect the groundwater extraction trajectories. On one hand, regionally affiliated legislators have very strong incentives to accelerate the standards of living in their constituencies, so they might push for policies that increase current access at the cost of future unavailability.[2] On the other hand, local depletion can affect the chances of re-election and regional party candidates contest elections only from their regions. Therefore, they may take a more long term approach in internalizing the inter-temporal externalities. These two opposing effects can cancel each other. However, if providing groundwater becomes costly for the legislator, then the second effect can dominate, resulting in groundwater conservation under regional regimes. Thus, exploring how regional versus national affiliation of the local legislators within a constituency affects the levels of groundwater warrants a thorough empirical investigation. In this paper, I examine this conjecture using data on groundwater from India. I use the reforms introduced under the Electricity Act of 2003 in 2003 and 2004 as a source of variation in the cost of groundwater provision to legislators. Power subsidies have been historically used to promote agricultural growth as electricity is

[1] Depending upon the medium, the lateral velocity of the groundwater can be as much as 1 cm a year (Todd, 1980).

[2] The effect of tax competition or subsidies to attract businesses on welfare of local residents is debated. Local businesses can increase producer surplus which can be welfare enhancing. But if the subsidies reflect private gains for local governments, then the costs to local residents could be very high and these subsidies will reduce welfare. Gleaser(2001) provides a survey of this literature. In this paper's context, incentives are similarly used to promote agricultural production as groundwater is primarily used for irrigation. However, thin land markets prevent significant new entry.

used as fuel to power irrigation pumps. However, this act raised the cost of subsiding power and made it logistically difficult to provide cheap electricity. Among other features, this act introduced private competition in the generation, and more importantly transmission and distribution of electricity. The provisions of this act resulted in reforming the electricity sector which made it more costly to facilitate access to groundwater for the local legislators. Hence, I compare the groundwater levels in constituencies with regional legislators before and after these reforms to constituencies which had legislators from a national party in a differences-in-differences approach. I find that prior to the reforms, the regional and national regimes do not have any differential effect on groundwater levels. However, regional regimes post the reforms lead to groundwater conservation.

A cross section comparison of constituencies with regional and national party legislators will not yield causal estimates of the regime type on groundwater levels. Omitted variables that are correlated with groundwater, may also influence which type of candidate-regional or national- wins in a constituency. However, the differences-in-differences estimation approach allows me to address this endogeneity concern. In addition to the cross section comparison of groundwater levels across the two regime types at the constituency level, I can examine a second difference for same constituencies under the same regime types, before and after the electricity sector reforms. I use winning party fixed effects to verify that party identities are not driving the results. The identifying assumption that in absence of these reforms, the trends in groundwater in the regional constituencies would be no different than those in the constituencies with national party legislators is tested using the data. Controlling for changes in groundwater levels in the pre reform periods does not change the estimates. In addition, I conduct a placebo test using data from a period prior to the reforms that shows that the effect of the regional regime on groundwater is no different in pre reform periods. In order to mitigate concerns over selection on time varying unobservables into different regime types, I also estimate a generalized differences-in-differences estimator with matching on pre-period characteristics. I find the estimates to be quite robust and very similar across these approaches.

Rest of the paper is organized as follows. Section 2 provides background on elections in India and governance role that legislators may play. Section 3 discusses the conceptual framework and provides details of the Electricity Act of 2003. I discuss the data used in the analysis in Section 4, and present the empirical strategy in Section 5. Section 6 reports the results, and Section 7 offers concluding remarks.

2 Background

2.1 Groundwater Irrigation and Agricultural Productivity

Around sixty percent of India's agriculture is sustained by groundwater irrigation, and 80 percent of the rural population meets its drinking water needs using groundwater. Access to groundwater decreases reliance on rainfall for irrigation, and hence helps reduce vulnerabilities to shocks. Private investment in wells has been increasing in the country and is aided in many ways by government initiatives such as loans for wells or subsidies for fuels to operate mechanized wells (Government of India and the World Bank, 1998). There are more than 20 million private wells in the country (International Water Management Institute, 2002). Indian Council of Agricultural Research conjectures that groundwater irrigation has helped prevent large scale famines in the country. While India uses more groundwater than any other country in the world, the resource is being over extracted and the aquifers are declining. World Bank estimates that around 15 percent of India's food is produced by mining or over-extraction of groundwater. Current trends in groundwater depletion can cause a significant reduction in food grain production. Seckler et al (1998) estimate that the food production can reduce by around 25 percent by 2025.

2.2 Parliamentary Elections

The parliamentary elections in India are held every 5 years. These elections are contested by plurality of parties. The candidates can be affiliated with regional or national parties, or can be independent. The regional parties are state centric and contest elections in their states. The national parties contest elections more broadly in various constituencies of the country. In the period between 1998 and 2004, there were 4 general elections. No single party had majority of seats in 1996 elections. Two successive elections were held in India in 1998 and 1999 due to withdrawal of coalition partners from the government over political issues.[3] The parliament elected in 1999 completed its 5 year term and general elections were held in 2004. In 1999, a national party and its coalition partners formed a government. The electoral turnout was comparable with previous elections at 60 percent. The alliance won 270 seats out of 543,[4] with the leading national party winning in 182 constituencies. It was also supported by some other parties who did not participate in the government. Among

[3] In 1998, Indian National Congress (INC) with drew its support from the United Front due the implication of one of the member parties in the assassination of Rajiv Gandhi, a former leader of INC. The 1998 government was dissolved as a member party withdrew its support over a political row to sack a state government and accusations of corruption implicating the leader of the withdrawing party.

[4] A seat corresponds to a constituency.

the opposition parties, the leading national party won in 114 constituencies. In the 2004 elections, the winning coalition switched. The leading national party heading the central government won 145 seats, and the leading national party in the opposition won 138 seats. The voter turnout was around 60 percent in these elections as well. In the 1999 elections, 369 seats were won by national parties and 162 by regional parties. Regional parties won 30 percent of the seats. This trend remained by and large the same in the 2004 elections. National parties won 364 and regional parties 169 seats. Regional parties won 31 percent seats in the 2004 elections. There was no sweeping shift towards regional or national parties in either of these elections.

2.3 Influence of Members of Parliament in their Constituencies

Within a constituency, the member of parliament has discretionary spending budget of rupees 2 crores per year for development in the constituency under the local area development scheme. These funds can be spent on infrastructure provision of various kinds. Electricity facilities and irrigation are among the priority development sectors. For example, these funds can be spent on installing electricity distribution transformers that are essential for distribution of power on the power grid and boost the grid when the density increases. These funds can also be spent on Minor Irrigation programs like awareness on rain water harvesting or promoting alternate water saving agricultural technologies. The members of parliament do not have formal authority over groundwater provision to the farm sector beyond the discretionary spending allowance, but they can facilitate this in a number of ways by influencing policies. There are a number of local schemes that finance well construction and boring. Since well construction is very expensive, these schemes like the *Free Boring Scheme* and the *Million Wells Scheme* can absorb the fixed cost of wells, and lead to more well construction and groundwater extraction. Public banks also offer loans for financing wells construction (Minor Irrigation Census,1993) . [5] In a recent survey conducted by the author in Uttar Pradesh, 12 percent of the respondents reported meeting with the local member of parliament to get their loan applications for wells approved. The local legislators (members of parliament) can also influence the marginal cost of extraction of water. Pumps are largely fueled using electricity. Electricity supply has historically been managed by the publicly owned and run electricity boards (Kodwani, 2005).[6] Tariff is determined locally. Subsidies to farm sector are common where either free or flat tariffed power is provided

[5] Public banks have been demonstrated to be influenced by the local legislators in disbursement of loans (Cole, 2009).

[6] Power is in the concurrent list and both central and state governments are empowered by the constitution to generate and supply power.

(Kodwani, 2005). Local distribution of electricity to various sectors is done by local public officials. These decisions include sector priorities (allocation across farm, industrial, and domestic consumers), peak load shedding, frequency and duration of power cuts, and area diversions. Local legislators can also promote and influence policies that target conservation like recent mandates for rooftop designs to harvest rainwater, and a cess for using tubewells for irrigation.

3 Conceptual Framework

Regional and national party representatives have different incentives. Regional candidates only contest elections from their regions. Thus, they have strong incentives to promote growth in their specific region. Groundwater provision results in growth, which in turn can translate into strong support from the lobbying voters. However, this is costly and the candidates weigh the cost against the benefits. This *growth effect* can lead to more groundwater extraction in a regional regime relative to a national regime.

On the other hand, regional candidates contest elections from their own region alone, while national candidates can do so from any region in the country. Consequently, regional candidates internalize the effects of current groundwater provision and extraction on future growth. They have stronger incentives to conserve so that groundwater depletion does not result in lower growth in subsequent periods. This *conservation effect* can lead to less groundwater extraction under the regional regime.

The two opposing effects arising from these incentives can cancel out each other. However, when the cost of groundwater provision is low, the *growth effect* can dominate the *conservation effect*, and we would observe more water depletion under a regional regime. Similarly, if the cost of groundwater provision rises, then the *conservation effect* can dominate the *growth effect*. This testable hypothesis of the framework is analyzed in the subsequent sections.

3.1 Power Subsidies and Groundwater

Most of the groundwater extracted is used for groundwater irrigation (Gandhi and Namboodiri, 2009). Access to groundwater increases agricultural production (Sekhri, 2011). Therefore, political parties have used various degrees of subsidies in the power sector to aid groundwater extraction by private farms. The number of hours of electricity provision, duration, frequency, pricing, sector priorities, and seasonal provision can be influenced by the local political regimes. In many regions of the country, electricity provision for the agriculture sector is supplied for free or is flatly tariffed based on the horse power of the pump

used for water extraction (Shah et al , 2004). This subsidy reduces the marginal cost of extraction and in many instances farmers face a 0 marginal cost.[7]Annual losses to Indian State Electricity Boards (SEBs) on account of power subsidies to agriculture are estimated at USD 5.65 billion (Shah et al, 2004). Prior to 2003, generation, transmission, and distribution of electricity were under the purview of the government, and the electricity boards operated as monopolies in power generation and supply. Transmission and distribution grid was solely under public control. Diverting electricity to sectors of choice and charging differential prices across sectors was relatively easy. But the Electricity Act of 2003 changed this status quo.

3.2 The Electricity Act, 2003

The Electricity Act, 2003 was passed and put into effect in June 2003. The act was amended subsequently based on various recommendations and the reforms were enforced from January 2004.[8] The objective was to introduce and promote competition in generation, transmission, and distribution, and to make subsidy policies more transparent. The key features were delicensing of generation, provision for private licensees in transmission, and entry in distribution through an independent network. Trading with fixed ceilings on margins was allowed. Metering of all electricity supply was made mandatory. The act set up a regulatory commission to determine tariff for supply of electricity based on long and medium term contracts. [9] Under the act the tariffs were not allowed to be amended more frequently than once in a financial year. Under Section 65, government could provide subsidy in advance through the budget for specified target groups if it required the tariff to be lower than that determined by the Regulatory Commission.

The features of this act raised the cost of groundwater provision by local political regimes in two ways. First, the competition introduced in generation, transmission, and distribution grids made it challenging to supply free or flat tariffed public electricity by elevating the cost of the subsidy per unit supplied. Second, tariff determination by the regulatory commission curtailed the flexibility in subsidizing power to the farm sector. The subsidized rates for the farm sector could not be altered without provisions in the budget. Pricing and sector priorities were to be determined by the regulatory commission, often through competitive bidding process.

[7] Other approaches followed to facilitate access are provision of loans to instal wells as wells can involve lumpy investments.

[8]It was proposed in 2001 and replaced the three existing legislations: Indian Electricity Act, 1910, the Electricity (Supply) Act, 1948 and the Electricity Regulatory Commissions Act, 1998. The Act can be found at Ministry of Power's website.

[9]No tariff fixation by regulatory commission was needed if tariff was determined through competitive bidding or where consumers, on being allowed open access entered into agreement with generators or traders.

According to the conceptional framework, as the cost of providing groundwater rises for the legislators, groundwater provision would decline. In this case, *conservation effect* would dominate the *growth effect* and we should observe less groundwater decline in regional regimes than in national regimes. In the following sections, I test this implication using national level data on groundwater pre and post these electricity sector reforms, and present evidence that supports this hypothesis.

4 Data

There are two main sources of data. The groundwater level data is from the 16000 monitoring wells monitored by the Central Groundwater Board of India. These wells are fairly evenly spread across India (This excludes the hilly regions in the North and North East). The data provides groundwater levels in 4 different months (pre and post harvest) along with the spatial co-ordinates of the monitoring wells for the years 1996-2006. Groundwater data is maintained in a restricted access database and has been provided by the Central Groundwater Board of India. In addition, decadal means for each well for the period 1985 to 1995 have also been obtained from the Central Groundwater Board of India.

I matched the groundwater data spatially to the election jurisdictions (constituencies) of various states in India.[10] There were 4 elections in this period in years 1995, 1998,1999, 2004. [11] Comprehensive jurisdiction level data on the winning political representatives including their party affiliation, gender, caste, margins of winning, and total votes caste are publicly available for each set of the 4 elections in this period from the election commission of India. The elections data is maintained in the '*Statistical Report on the General Election to the Lok Sabha*'. Constituency average annual rainfall and temperature values are interpolated from the University of Delaware 0.5 degree resolution data for India.[12]

According to the Election Commission of India, a political party is considered to be a national party if it is recognized by the Election Commission in more than 4 states in the country. [13] If it is recognized in 4 or less, it is considered a state or a regional party. Appendix Table A1 provides a list of various parties that contested the 1998, 1999, and 2004 election along with their classification as national and state/regional parties. More regional parties contested elections than national parties in each of these elections. The first wave of the electricity reforms was put into effect in June of 2003, by when the financial

[10] A krigging algorithm was used to obtain constituency level data from the monitoring wells data.

[11] The constituency boundaries were redrawn in 2008 before the 2009 election year. Hence, I restrict the analysis to elections before 2009.

[12] Available at http://climate.geog.udel.edu/člimate/html_pages/archive.html

[13] The criterion for recognition can be found at http://eci.gov.in/eci_main/faq/RegisterationPoliticalParties.asp

year was already underway. The financial year budgeting and planning had been completed. Also, various provisions of the act were being reviewed by the implementing agencies for making recommendations so that the act could be amended adequately. The amended act's provisions were put into effect in January 2004 which was an election year, and the elections were held in April and May. The new regime's budgetary provisions would be effective in the next financial year cycle. Hence, if these reforms have any effect, it is likely to be detected in 2005 or beyond. Therefore, in the main sample for analysis, the data is restricted to parliamentary constituencies with national incumbent and national winner candidates in 2004 elections (N-N type), and regional incumbent and regional winners in 2004 elections (R-R) . The sample is restricted to years 2003 to 2006. Table 1 provides summary statistics by regime types of constituencies. Out of a total of 389, 295 constituencies had national regimes pre and post 2004 elections and 94 had regional regimes. The geographical characteristics like rainfall and temperature were very similar across these types. The constituencies with national incumbents and winners (N-N) were larger in area on the average relative to R-R constituencies, but they had same proportions of male winner candidates. Total votes cast were marginally higher in R-R type constituencies. The average groundwater level in R-R type was 6.43 meters below ground level (mbgl) in 2003 and 5.74 in 2006. This could indicate less extraction and more replenishment of the resource.[14] On the other hand, in the N-N type, groundwater level went from 8.57 mbgl to 8.71 mbgl.

I used *Global Agro-ecological Assessment for Agriculture in the 21st Century* spatial raster data to determine the suitability indices for water intensive crops for India. This data set is jointly produced by Food and Agriculture Organization and the International Institute for Applied Systems Analysis.[15] The geo-spatial data provides suitability indices for cultivation for geographical locations for various crops based on climate, soil and terrain conditions. These indices are provided for 2.2 million grid cells spanning the entire globe and the grids for India were extracted using spatial data for constituency boundaries. Each grid-cell is 0.5 degree by 0.5 degree (approximately 34.8 miles by 34.8 miles), and is assigned an index for several crops, which takes integral values between 1 and 9. An index of one implies the grid is most suitable and an index of 8 implies it is least suitable for producing a specific crop given the climatic and other condition. Water bodies are assigned an index of 9. I extracted the suitability indices for rice and sugarcane as these are the major water intensive crops of India. Subsequently, I generate several measures of central tendencies (average and mode) for the indices of these two crops at the level of parliamentary constituencies using spatial tools. I use this data to evaluate if the results vary by suitability index for these crops.

[14]Groundwater is renewable resource. It naturally replenishes unless over-extracted.

[15]The data can be found at http://www.iiasa.ac.at/Research/LUC/SAEZ/index.html

5 Empirical Strategy

5.1 Differences-in-Differences

The objective is to examine the effect of regional versus national regimes on groundwater levels in scenarios with different costs of groundwater provision for the legislators. I compare groundwater levels in the constituencies that had regional regimes in the elections before the Electricity Act of 2003(i.e in the 1999 elections) and stayed regional in 2004 elections (R-R), to those that were under national regimes before and stayed under national parties in the 2004 elections (N-N). The only difference before and after the act's passing is the change in cost of groundwater provision for the legislators and hence, the incentives that dominate. Table 1 shows that the depth to groundwater from the surface in R-R constituencies is 5.74 mbgl in 2006, whereas in N-N case it is 8.71 mbgl. This suggests that the regional regimes lead to water conservation over this period. But this cannot be interpreted as causal. Omitted variables like characteristics of the constituencies can be driving these differences in averages. I follow a differences-in-differences approach to address the endogeneity concerns.

The formal empirical model for this differences-in-differences estimation for a sample restricted to years 2003 to 2006 is specified as follows:

$$W_{it} = \alpha_0 + \alpha_1 \, Post_t + \alpha_2 \, WCR_i + \alpha_3 \, WCR_i . \, Post_t + \alpha_4 \, X_{it} + \epsilon_{it} \tag{1}$$

Where W_{it} is the groundwater level in constituency i and year t, $Post_t$ is an indicator equal to 1 for the post 2004 election years, WCR_i is an indicator that is equal to 1 if the winning candidate is from a regional party in 2004 elections conditional on the constituency being under a regional candidate in the previous elections, and vector X_{it} includes the time-varying constituency level controls. ϵ_{it} is the random error term. The errors are clustered at the constituency level. α_3 the coefficient on the interaction, is the parameter of interest.

Comparing groundwater level within constituencies across years differences out time invariant constituency characteristics. Comparing the groundwater level within years between reginal and national regime constituencies differences out changes over time that affect the constituencies similarly. I control for winning party fixed effects to ensure that the results are driven by change in incentives of regional parties relative to national parties and not different parties in general. One concern about the validity of this approach might be that the groundwater levels could be evolving differently in the constituencies under national versus regional regimes, and these pre-trends before the 2004 elections drive the results. I explore this possibility by controlling for changes in groundwater levels in the pre-periods. Alternatively, I control for pre-trends in the following specification:

$$W_{it} = \alpha_0 + \alpha_1 \, WCR_i . \, Post_t + \alpha_2 \, X_{it} + \kappa_t + \mu_i + \alpha_3 \, (W_{i2002} . \, (T - 2002)) + \epsilon_{it} \qquad (2)$$

Where W_{it} is the groundwater level in constituency i and year t, $Post_t$ is an indicator equal to 1 for the post 2004 election years, WCR_i is an indicator that is equal to 1 if the winning candidate is from a regional party in 2004 elections conditional on the constituency being under a regional candidate in the previous elections, and vector X_{it} includes the time-varying constituency level controls. κ_t and μ_i are year and constituency fixed effects respectively. W_{i2002} is the groundwater level in constituency i in year 2002. T takes values from 2002 to 2004.

I estimate a year-by-year model to examine the timing of the effect of the regimes on water level. This model is specified as:

$$W_{it} = \alpha_0 + \alpha_1 \, WCR_i + \kappa_t + \sum_{l=2004}^{2006} (WCR_i . \, d_l) \, \delta_l + \alpha_2 \, X_{it} + \epsilon_{it} \qquad (3)$$

In this case, d_l are the year indicators, and the coefficients δ_l are the year-by-year effects of the regimes on water levels. I exclude year 2003 and its interactions as the reference year. I also use a sample from 2000 to 2006 to examine the timing of the effects of the regimes on water level on this longer sample. If the reforms under the Electricity Act, 2003 and its amendment indeed changed the cost of provision for the legislators, then we should discern no effect prior to 2004, and after that we should observe water conservation in constituencies with regional candidates.

As a robustness check, I also carry out a placebo test. I examine the effect of the regional and national regimes pre and post the 1998 elections. I compare groundwater levels in the constituencies that had regional regimes in the 1996 elections and stayed regional in 1998 elections, to those that were under national regimes before and stayed under national parties in the 1998 elections. Since the reforms were introduced in 2003 and 2004, there should be no differential effect of the regional regime relative to the national regime in this case. This also substantiates an implication of the identification assumption that in the absence of the Act passed in 2003 (and then amended in 2004), groundwater levels would have evolved in a similar way over time in constituencies with national and regional regimes.

5.2 Generalized Differences-in-Differences with Matching

In order to mitigate concerns about selection into different types of regimes, I match the constituencies on the pre reform characteristics and then carry out a differences-in-differences estimation on this sample. The first concern addressed by this approach is that there might be no comparable regional constituencies in terms of pre-reform characteristics to national ones and vice a versa. The second concern might be that there are differences in distributions of $\mathbf{X}$ across the two groups. Matching will eliminate any bias resulting from these two issues by pairing regional constituencies with national ones that have similar pre-reform observed characteristics. Using a common support in the distribution of observables will address the first concern. This approach will allow me to eliminate the bias due to different distributions of observables across the regional and the national constituencies within the common support by re-weighting the national regime observations. Following Heckman et al (1998b), I use generalized difference-in-differences matching estimator that combines matching methods and fixed effects approaches in panel data. This estimator conditions on the fixed-effects, and hence, identifies the parameter of interest without ruling out selection into treatment on the basis of time-invariant unobservables.

First, I estimate propensity scores using a probit model to predict the probability that a constituency with a regional incumbent stays regional in the 2004 elections as a function of pre election characteristics. I use area, total voters in the constituency, average rainfall and temperature in 2002 and 2003, and change in groundwater level between 2002 and 2003, and 2003 and 2004 to predict the propensity scores. Then I restrict the sample to the common support of the propensity scores. I exclude all constituencies whose propensity scores are less than the maximum of the first percentile of the propensity score distributions $PS(x)$ of regional and national constituencies, and also exclude all constituencies whose propensity score is greater than minimum of the 99th percentile of these distributions. The difference-in-differences is estimated on the constituencies that lie on this common support.

A kernel density weighting procedure is used to estimate the generalized difference-in-differences matching estimator.[16] Restricting to the common support, the counterfactual outcome for regional constituency i using the kernel matching estimator is given by a weighted average of the entire national regime sample with C observations. The weight for each national constituency is given by:

$$W(i, NN) = \frac{K(PS(x)_i - PS(x)_{NN})}{\sum_{NN=1}^{C} K(PS(x)_i - PS(x)_{NN})} \tag{4}$$

[16] Heckman et al (1997) provide the details.

where $K(.)$ is the guassian kernel function. For any t $\geq$ s, the before and after difference in groundwater level is given by:

$$Y_{1,i,t} - \sum_{j=1}^{S-1} W(i, NN) Y_{0,i,j} \tag{5}$$

Thus, the difference-in-difference estimator with the national constituencies as comparison group $\widetilde{i}$ is :

$$\prod_{it} = [Y_{1,i,t} - \sum_{j=1}^{S-1} W(i, NN) Y_{0,i,j}] - [Y_{1,\widetilde{i},t} - \sum_{j=1}^{S-1} W(\widetilde{i}, NN) Y_{0,\widetilde{i},j}] \tag{6}$$

where $Y_{0,\widetilde{i}}$ is the counterfactual outcome given the kernel matching weighting procedure. This transformation makes the national regime group to be conformable with the regional regimes. The last step is to estimate the average treatment effect as the sample average of $\prod_{it}$ over all i regional constituencies . I bootstrap the standard errors.

6 Results

6.1 Main Results

The results from estimation of (1) are reported Table 2. The groundwater level in constituencies with regional candidates post the reforms in the electricity sector, is closer to the surface implying it declines less. The simple differences-in-differences estimate is reported in column (i), and the estimate implies 0.78 meters less decline significant at 1 percent. Time varying characteristics of the constituencies could be potential confounders. Larger constituencies could be evolving differently than smaller ones. Therefore, I control for geographical variables such as annual average rainfall, and temperature, and other controls including area, total votes cast, and gender of the winning candidate interacted with year indicators, and report the estimate in column (ii). The coefficient is -0.96 and is significant at 1 percent. In column (iii) , I also control for winning party fixed effects to confirm that the results are not driven by party identities. The estimated effect is -0.88 meters less decline, and is statistically significant at 1 percent. This is 0.13 of a standard deviation. The identifying assumption in the differences-in-differences estimates is that in absence of the reform, the trends in water levels in constituencies with regional candidates would be similar to constituencies with national candidates. Figure 1 shows the trends in water levels before and after elections following the electricity reforms. These look very similar prior to the post

reforms elections. To address this more formally, I control for changes in groundwater levels in the pre-periods, and report the results in column (iv). The coefficient of -0.96 is very similar to the specifications in (ii) and (iii), and is significant at 1 percent. These are the benchmark specifications.

I also examine the validity of the identifying assumption by controlling for pre-trends in the estimation using the alternative specification specified in equation (2). The results from estimation of (2) are reported Table 3. Controlling for parliamentary constituency fixed effects and year fixed effects, the results reported in columns (i) are very similar to those in Table 2. I control for a linear pre-trend in water levels starting from the 2002 water levels in each constituency. The estimate is -0.6, and is significant at 5 percent. The results are very similar, and substantiate the identifying assumption for the estimation procedure. The generalized differences-in-differences estimator described in equation (6) with matching on pre-characteristics on a common support of the propensity score distribution is reported in column (iii). The coefficient is -0.8, and is statistically significant at 1 percent. This is very similar to the differences-in-differences coefficient reported in column (i) of Table 2. The results are consistent across these two different approaches, which indicates that the results are not biased due to selection on time varying unobservables. Overall, the effect size is 0.12 of a standard deviation.

I also examine the timing of the effect of regimes on water levels post electricity reforms. This is done by estimating equation (3). The results are reported in Table 4. The coefficient on the interaction of the regional regime with year 2004 indicator is close to 0 and statistically insignificant. However, the post reform regional regime faces different costs of groundwater provision, and we observe a smaller decline in depth of water levels in years 2005 (an effect of -0.64) and 2006 (an effect of -0.83) reported in column (i). This pattern persists on controlling for co-variates in column (ii), and winning party fixed effects in column (iii). I also explore the timing of the effect of regional regimes using a sample from year 2000 to 2006. The results are shown in Appendix Table A2. The coefficients of the interaction terms are plotted in Figure 2. The figure shows clearly that changes in groundwater levels were similar in regional and national constituencies until 2004, after which groundwater declines in national regimes but is conserved in regional regimes.

6.2 Robustness Test: Placebo Experiment

I re-estimate (1) but now on a sample with years 1997 to 1999. Prior to 1999, there were 2 elections one in 1996 and the other in 1998. I compare the constituencies with regional regimes pre and post the 1998 elections to those that had national regimes. Since the

electricity sector reforms took place in 2003 and 2004, we should not expect an effect of the regional regimes post 1998 elections. The results are reported in Table 5. Column (i) reports the simple differences-in-differences estimate. I control for co-variates in column (ii), and winning party fixed effects in column (iii). The coefficients are statistically insignificant across all these specifications. I do not find an effect of the regional regime post 1998 elections prior to the electricity reforms introduced by the Electricity Act of 2003 and its amendments. This test strengthens the credibility of the identification strategy and provides evidence that the the effect of the regional regime on groundwater levels in post 2004 years is driven by the reforms in the electricity sector.

As noted in Section 2.2, reforms do not seem to affect percentage of regional or national wins in the post reform elections of 2004. The number of constituencies in which regional parties win post reform elections is almost the same as the pre-reform elections. Reforms would have the same effect on the growth incentives of both types of legislators. The cost of provision would increase for both types. However, in case of regional legislators, the stronger conservation effect will dominate the weaker growth effect. Reforms are less likely to induce migration of farmers across constituencies. First, land markets in India are very thin. Second, due to frictions in labor markets, factor mobility is low too (Topolova, 2010).

6.3 Heterogeneity: Impact by Suitability for Water Intensive Crops

If the cost of groundwater provision affects extraction rates and that drives the results than we should expect a larger effect in areas that are more likely to grow water intensive crops as a larger number of farms and cultivated area, which could be under water intensive crops, are affected. In order to evaluate this, I extract the suitability index for each grid in India for rice as described in the Data Section (Section 4). Figure 3 shows the spatial variation in the distribution of this index over India. I find out the mode of the indexes associated with the grids within each constituency. This gives me a measure of the overall area that is suitable within a constituency for cultivating rice. The index value 1 indicates most suitable and 8 indicates least suitable. Therefore, I categorize the constituencies for which the mode takes values 1, 2, 3 and 4 as constituencies with larger areas suitable for growing rice , and the ones for which mode takes value 5, 6, 7, and 8 as constituencies with larger areas unsuitable for growing rice. I report the results of the benchmark differences-in-differences model for these categories in Table 6. Panel A reports the results for constituencies with larger areas suitable for growing rice, and Panel B shows the results for constituencies with larger areas unsuitable for growing rice. I find that results in Panel A are twice as large as those in Panel B. Larger the area suitable for growing water intensive crops, larger is the resulting water

saving from the post reforms increase in cost of provision for legislators. [17] These results are consistent with the predictions of the causal model.

7 Conclusion

This paper evaluates the effect of regional local legislators on groundwater. The paper finds that when the regional legislators can use cheap means like power subsidies to provide access to groundwater, their incentives to promote growth in the region are balanced off with their incentives to conserve resources. However, private competition induces a change in this balance by making subsidies more costly to implement. In such a scenario, these two effects do not offset each other and regional regimes lead to conservation of resources. Methodologically, the paper uses the changes in cost of provision caused by the reforms in the electricity sector to evaluate this hypothesis. The results in the paper suggest that in the short run, when the spatial externalities are not very prominent, decentralized decision making on the provision of resources can help in conserving resources only when provision is costly. In the presence of unchecked monopolized public control over inputs like fuels that help in extracting groundwater, decentralized decision making may not result in conservation despite the incentives to internalize the inter-temporal externailties arising from groundwater depletion.

[17] Results are similar for sugarcane and have not been shown here for the sake of brevity.

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Table 1: Summary Statistics by Regime Type between 2003 and 2006

Sample	All Constituencies			Constituencies with Regional incumbent and winner in 2004 Elections			Constituencies with National incumbent and winner in 2004 Elections		
No. of Constituencies	**389**			**94**			**295**		
Variable	Mean	S.D.	# Obs	Mean	S.D.	# Obs	Mean	S.D.	# Obs
Depth to Groundwater in 2003	8.06	6.76	1496	6.43	3.06	356	8.57	7.48	1140
Depth to Groundwater in 2006	8.01	7.67	1508	5.74	3.16	356	8.71	8.47	1152
Average Rain	103.08	65.94	1536	103.64	61.47	376	102.90	67.35	1160
Average Temperature	25.66	3.03	1536	25.86	3.77	376	25.59	2.74	1160
Total Votes Cast	706044.10	184174.10	1556	713230.70	176261.50	376	703754.10	186639.40	1180
Area	6241.37	6718.74	1442	4198.44	2673.92	338	6866.84	7424.25	1104
Winning Candidate is Male	0.91	0.28	1556	0.91	0.29	376	0.91	0.28	1180

Note: Data used from 'Lok Sabha' (directly elected lower house of the parliament of India) elections for the years 1999 and 2004. A political party is called a `National' party if it is a recognized by the Election Commision of India in four or more states. If a party is recognized in less than four states it is called a `State' party (regional in our notation). The data is restricted to Parliamentary Constituencies with a National or Regional incumbent and winner in 2004 elections and the years 2003 to 2006.

Table 2: Differences-in-Differences Estimate of Regional Regime on Groundwater

	Dependent variable: Depth to Groundwater from the Surface (in meters below ground level)			
	(i)	**(ii)**	**(iii)**	**(iv)**
R-R × Post	**-0.78***** (0.23)	**-0.96***** (0.26)	**-0.87***** (0.23)	**-0.96***** (0.26)
Geography & other controls	No	Yes	Yes	Yes
Winning party Fixed Effects	No	No	Yes	No
Change in Water levels in Pre-years	No	No	No	Yes
Winning Margin	No	No	Yes	No
Observations	1472	1430	1430	1430
R-Sqaured	0.024	0.20	0.22	0.66

Notes: The sample is restricted to years 2003 to 2006. Geographic controls include annual average rain and temperature at the level of constituency. Other controls include total vote cast, gender of the winning candidate and area of the constituency interacted with year indicators. Errors are robust and clustered at the level of Parliamentary constituencies. *** indicates significance at 1 %, ** at 5% and * at 10 %.

Table 3: Differences- in- Differences Estimate of Regional Regime on Groundwater controlling for Pretrends and Generalized Differences-in-Differences With Matching

	Dependent variable: Depth to Groundwater from the Surface (in meters below ground level)		
	Benckmark	**Pre-trends**	**Generalized DID**
	(i)	**(ii)**	**(iii)**
R-R × Post	**-0.67****	**-0.6****	**-0.8*****
	(0.27)	(0.26)	(.29)
Geography & other controls	Yes	Yes	
Linear Pretrend in Groundwater	No	Yes	
Observations	1430	1430	1268
R-Sqaured	0.94	0.94	0.24

Notes: The sample is restricted to years 2003 to 2006. Specifications in columns (i) and (ii) control for constituency fixed effects and year fixed effects. Geographical controls include annual average rain and temperature at the level of constituency . Other controls include total vote cast, gender of the winning candidate and area of the constituency interacted with year indicators. Errors are robust and clustered at the level of Parliamentary constituencies. *** indicates significance at 1 %, ** at 5% and * at 10 %. Column (iii) is estimated on a common support of the propensity scores for regional and national regime constituencies. The propensity score is modeled as a function of area, total voters, average rainfall and tempereature in 2002 and 2003, and change in groundwater levels in years 2002 and 2003. A kernel based matching algorithm is used to construct counterfactuals . The standard errors in the estimation of propensity scores are robust and clustered at constituency level. The standard errors reported in column (iii) are bootstrapped erros.

Table 4: Timing of the Effect of Regional Regime on Groundwater by Year

	Dependent variable: Depth to Groundwater from the Surface (meters below ground level)		
	(i)	**(ii)**	**(iii)**
R-R × year is 2004	0.085	0.21	0.21
	(0.18)	(0.27)	(0.27)
R-R × year is 2005	**-0.64****	**-0.61***	**-0.52***
	(0.27)	(0.31)	(0.30)
R-R × year is 2006	**-0.83*****	**-1.12*****	**-1.02*****
	(0.31)	(0.35)	(0.34)
Climatic & other controls	No	Yes	Yes
Winning party Fixed Effects	No	No	Yes
Winning Margin	No	No	Yes
Observations	1472	1430	1430
R- Sqaured	0.024	0.20	0.22

Notes: The sample is restricted to years 2003 to 2006. Geographic controls include annual average rain and temperature at the level of constituency . Other controls include total vote cast, gender of the winning candidate and area of the constituency interacted with indicators for year. Errors are robust and clustered at the level of Parliamentary constituencies. *** indicates significance at 1 %, ** at 5% and * at 10 %.

Placebo Test

Table 5: Differences-in-Differences Estimates of Regional Regime on Groundwater

Sample 1997-1999

Dependent variable: Depth to Groundwater from the Surface
(in meters below ground level)

	(i)	(ii)	(iii)	(iv)
R-R × Post	-0.17	-0.30	-0.23	0.22
	(0.17)	(0.23)	(0.23)	(.44)
Geography & other controls	No	Yes	Yes	Yes
Winning party Fixed Effects	No	No	Yes	No
Change in Water levels in Pre-years	No	No	No	Yes
Winning Margin	No	No	Yes	No
Observations	1179	1164	1164	1164
R-Squared	0.0045	0.21	0.23	0.7

Notes: The sample is restricted to years 1997 to 1999. Geographic controls include annual average rain and temperature at the level of constituency. Other controls include total vote cast, gender of the winning candidate and area of the constituency interacted with year indicators. Errors are robust and clustered at the level of Parliamentary constituencies. *** indicates significance at 1 %, ** at 5% and * at 10 %.

Table 6: Impact by Suitability for Cultivating Water Intensive Crops

Dependent variable: Depth to Groundwater from the Surface
(in meters below ground level)

	(i)	(ii)	(iii)	(iv)
Panel A:				
R-R × Post	**-1.22*** **	**-1.40*** **	**-1.57*** **	**-1.40*** **
	(0.44)	(0.43)	(0.48)	(0.43)
Panel B:				
R-R × Post	**-0.63*** **	**-0.66*** **	**-0.60*** **	**-0.66*** **
	(0.23)	(0.26)	(0.23)	(0.26)
Geography & other controls	No	Yes	Yes	Yes
Winning party Fixed Effects	No	No	Yes	No
Change in Water levels in Pre-years	No	No	No	Yes
Winning Margin	No	No	Yes	No

Notes: The sample is restricted to years 2003 to 2006. Geographic controls include annual average rain and temperature at the level of constituency. Other controls include total vote cast, gender of the winning candidate and area of the constituency interacted with year indicators. Errors are robust and clustered at the level of Parliamentary constituencies. *** indicates significance at 1 %, ** at 5% and * at 10 %. Panel A shows the results for constituencies where the mode value of the index for suitability for rice cultivation takes values 1-4. Panel B shows results for constituencies where the mode of the index takes value takes values 5-8. The index value 1 indicates most suitable and value 8 denotes least suitable.

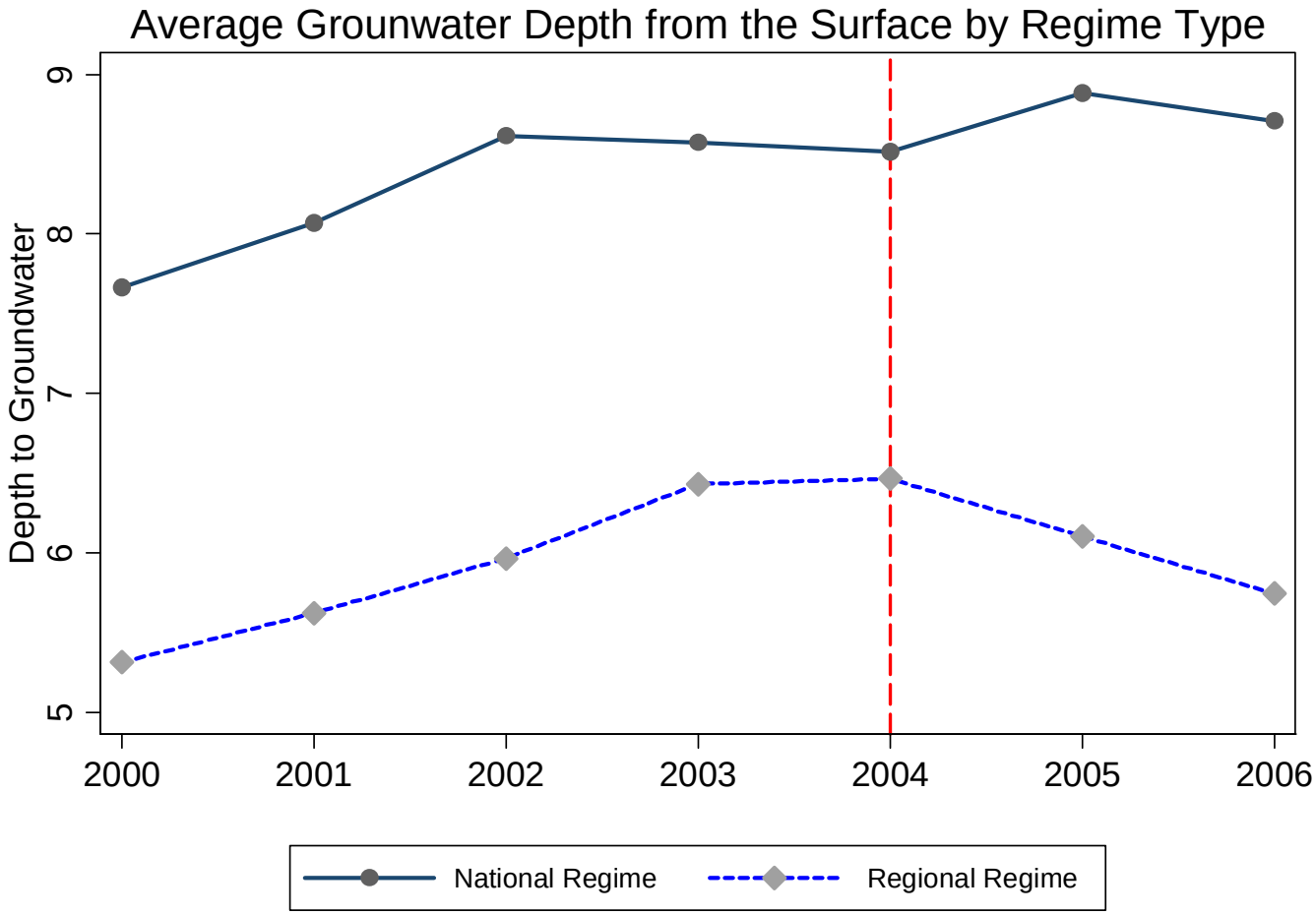

Figure 1: This figure plots the trends in Groundwater levels separately for National and Regional Regimes

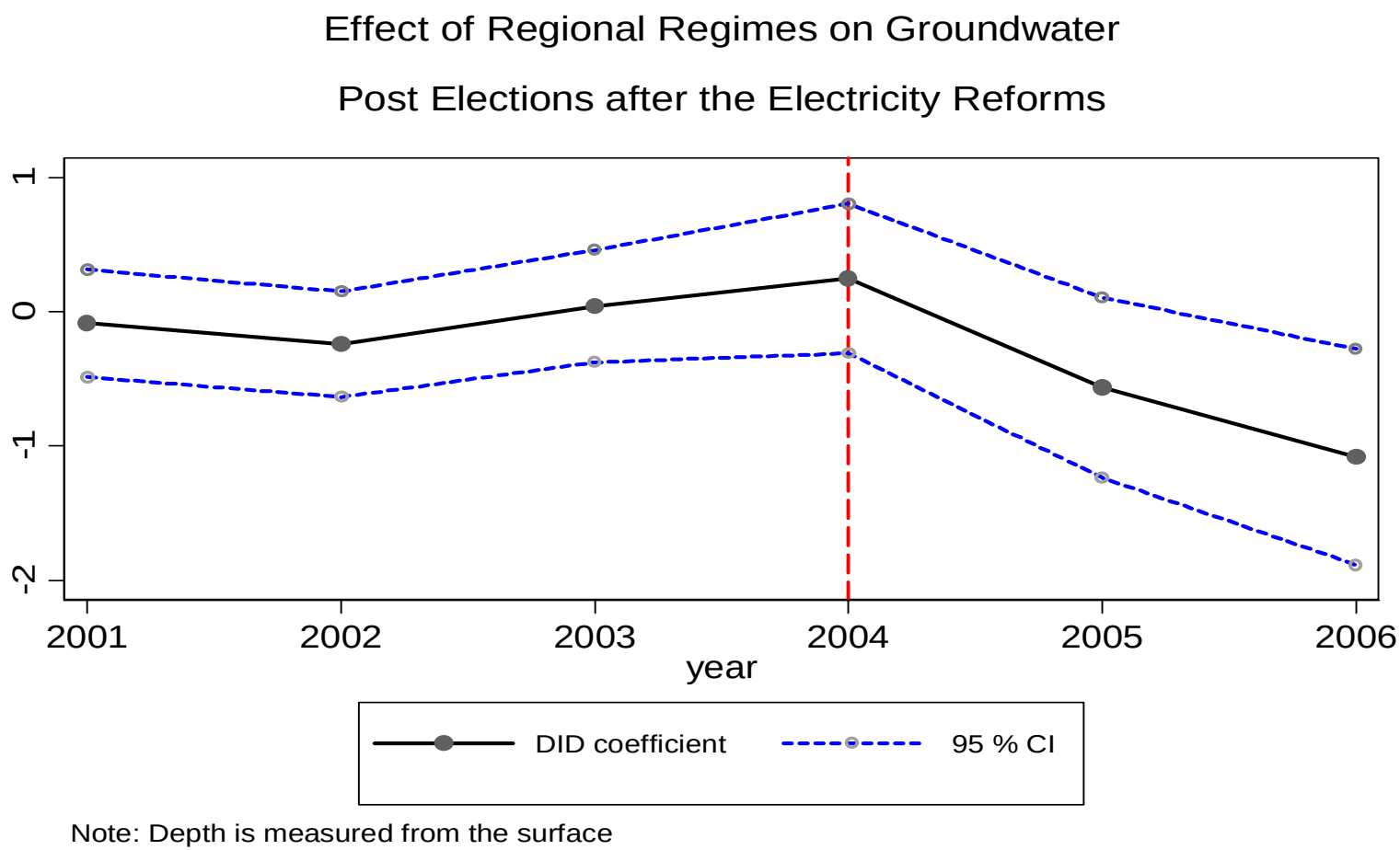

Figure 2: This figure plots the differences-in-differences coefficients of the effect of regional regimes on groundwater levels

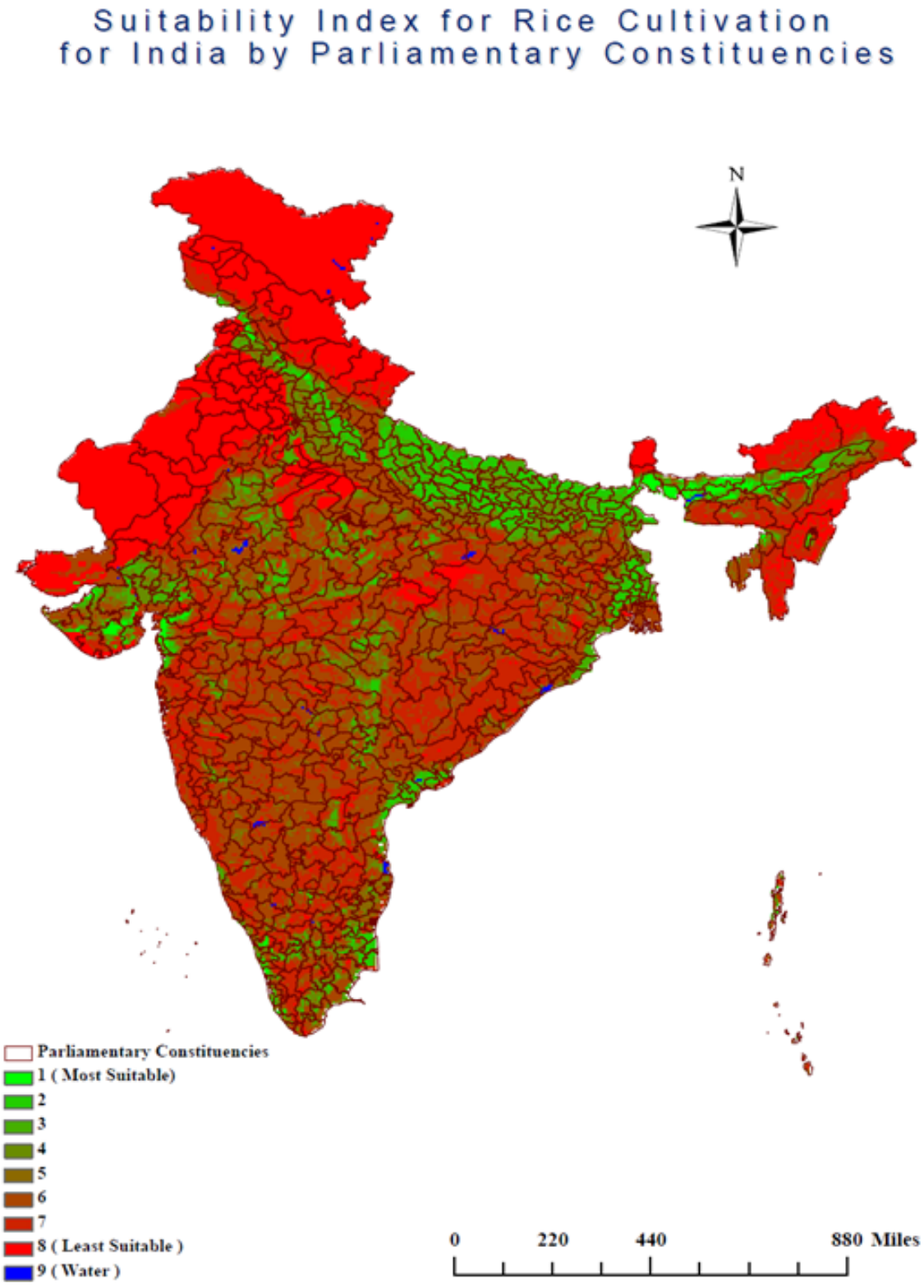

Figure 3: Variation in the Suitability Index for cultivation of Rice

Table A1: Recognition of Political Parties in India by Election Years

Party	Abbreviation	1998	1999	2004
Indian National Congress	INC	National	National	National
Communist Party Of India	CPI	National	National	National
Bharatiya Janata Party	BJP	National	National	National
Communist Party Of India (Marxist)	CPM	National	National	National
Bahujan Samaj Party	BSP	National	National	National
Janata Dal	JD	National	×	×
Samata Party	SAP	National	×	×
Janata Dal (United)	JD(U)	×	National	State
Janata Dal (Secular)	JD(S)	×	National	State
Nationalist Congress Party	NCP	×	State	National
Shivsena	SHS	State	State	State
Revolutionary Socialist Party	RSP	State	State	State
Manipur People's Party	MPP	State	State	State
Samajwadi Party	SP	State	State	State
Dravida Munnetra Kazhagam	DMK	State	State	State
Pattali Makkal Katchi	PMK	State	State	State
Asom Gana Parishad	AGP	State	State	State
All India Anna Dravida Munnetra Kazhagam	ADMK	State	State	State
Sikkim Democratic Front	SDF	State	State	State
United Goans Democratic Party	UGDP	State	State	State
Kerala Congress (M)	KEC(M)	State	State	State
Muslim League Kerala State Committee	MUL	State	State	State
Shiromani Akali Dal	SAD	State	State	State
Telugu Desam Party	TDP	State	State	State
Jharkhand Mukti Morcha	JMM	State	State	State
Jammu & Kashmir National Conference	JKN	State	State	State
Arunachal Congress	AC	State	State	State
Kerala Congress	KEC	State	State	State
Janata Party	JP	State	State	×
Tamil Maanila Congress (Moopanar)	TMC(M)	State	State	×
Ntr Telugu Desam Party (Lakshmi Parvathi)	NTRTDP(LP)	State	State	×
Haryana Vikas Party	HVP	State	State	×
All India Forward Bloc	FBL	State	State	×
United Democratic Party	UDP	State	State	×
Hill State People's Democratic Party	HPDP	State	State	×
Republican Party Of India	RPI	State	State	×
Maharashtrawadi Gomantak	MAG	State	×	State
Mizo National Front	MNF	State	×	State
Autonomous State Demand Committee	ASDC	State	×	×
All India Indira Congress (Secular)	AIIC(S)	State	×	×
Federal Party Of Manipur	FPM	×	State	State

Table A1 Continued

Party	Abbreviation	1998	1999	2004
Marumalarchi Dravida Munnetra Kazhagam	MDMK	×	State	State
Rashtriya Janata Dal	RJD	×	State	State
All India Trinamool Congress	AITC	×	State	State
Indian National Lok Dal	INLD	×	State	State
Biju Janata Dal	BJD	×	State	State
Sikkim Sangram Parishad	SSP	×	State	×
Himachal Vikas Congress	HVC	×	State	×
Samajwadi Janata Party (Rashtriya)	SJP(R)	×	State	×
Lok Shakti	LS	×	State	×
United Minorities Front, Assam	UMFA	×	State	×
Manipur State Congress Party	MSCP	×	State	×
People's Democratic Movement	PDM	×	State	×
Uttarakhand Kranti Dal	UKKD	×	×	State
Jammu & Kashmir National Panthers Party	JKNPP	×	×	State
Rashtriya Lok Dal	RLD	×	×	State
Jammu & Kashmir Peoples Democratic Party	JKPDP	×	×	State
Shiromani Akali Dal (Simranjit Singh Mann)	SAD(M)	×	×	State
All India Forward Bloc	AIFB	×	×	State
Communist Party Of India (Marxist-Leninist) (Liberation)	CPI(ML)(L)	×	×	State
Nagaland Peoples Front	NPF	×	×	State

Note: Data used from Election Commission of India. × implies the party did not contest election. A political party is called a `National' party if it is a recognized by the Election party in four or more states. If a party is recognized in less than four states it is called a `Regional' party.

Table A2:Timing of the Effect of Regional Regime on Groundwater

(2000-2006)

Dependent variable: Depth to Groundwater from the Surface (in meters below ground level)	**(i)**
R-R × Year 2001	-0.086
	(0.20)
R-R × Year 2002	-0.24
	(0.20)
R-R × Year 2003	0.042
	(0.21)
R-R × Year 2004	0.25
	(0.28)
R-R × Year 2005	**-0.57***
	(0.34)
R-R × Year 2006	**-1.08*****
	(0.41)
Climatic & other controls	Yes
Observations	2542
R Squared	0.21

Notes: The sample is restricted to years 2000 to 2006. Geographic controls include annual average rain and temperature at the level of constituency. Other controls include total vote casted, gender of the winning candidate and area of the constituency interacted with year indicators. Errors are robust and clustered at the level of Parliamentary constituencies. *** indicates significance at 1 %, ** at 5% and * at 10 %.