

# The Impact of Climate Variability on Crimes against Women: Dowry Deaths in India\*

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This Draft: 21 October 2011

## Abstract

We examine the effect of local precipitation shocks on appropriation risk faced by women using annual data from 583 districts in India over the period 2002-2007. We use annual deviations of rainfall from the long-term local mean to isolate the impact of rain shocks on crimes against women. We find that dry shocks (below-average rainfall) increase reported domestic violence and dowry deaths, as well as dowry payments. However, sexual harassment declines in dry shock years. These patterns are consistent with a framework of consumption smoothing by those exposed to weather risks, but inconsistent with the alternative hypothesis that general unrest causes these crimes to increase. We examine two mitigation strategies. We find no evidence that women's political representation allays these risks. Access to groundwater irrigation worsens the effects of dry shocks, and mitigates those of wet shocks. These findings suggest that access to groundwater irrigation induces agricultural households to opt into risky agricultural practices that increase income volatility.

JEL classification: O10, O13, Q54

Keywords: Dowry Deaths, Consumption Smoothing, Climate Shocks

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\*We are thankful to Doug Almond for his suggestions during the early stages of the project. We wish to thank the National Crime Records Bureau (NCRB), Ministry of Home Affairs, India, for providing the crimes data, and Mrs. Vibhu Raj for her guidance and help with the documentation. We also wish to thank the Central Ground Water Board (CGWB) of India for providing the groundwater data, and Vijayendra Rao for sharing the dowry data from the Gender, Marriage and Kinship Survey. The paper has benefited from discussions with Nathan Larson, Wayne-Roy Gayle, Steve Stern, Nancy Qian, and seminar participants at the Indian School of Business (ISB), Pacific Conference for Development Economics (PACDEV), and Northeast Universities Development Consortium (NEUDC) conferences. Paul Landefeld, Susan Ivey, and Ting Chau Wan provided excellent research assistance.

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# 1 Introduction

Scientists anticipate that precipitation and temperature patterns around the world will change over the next century as a result of increased greenhouse gas emissions (Stern, 2006). Developing countries typically have less capacity than developed countries to adapt to these changes, so the effects may be more pronounced in the developing countries. Within developing countries, some population groups may be affected more than others. In particular, increased scarcity of resources, especially water, may exacerbate the risks faced by vulnerable groups in agricultural regions. In this paper, we explore whether the risk of appropriation faced by women, as measured by targeted crimes against women, increases in response to weather shocks in India.

Gender inequality is particularly salient in India. Women generally have limited power in household decision making and are often discriminated against in nutrition and education (Sen 1992; Pande 2003). As in many other countries, they also fall victim to violent crime at high rates.<sup>1</sup> Therefore, it is important to understand whether climate variability makes women more vulnerable to crimes, and if so, what types of crimes are crucial.

In the context of global climate change, rainfall is expected to increase slightly in South Asia, but also to become more variable from year to year, potentially making droughts more common (Challinor et al. 2006; Christensen and Hewitson 2007). In this paper, we ask whether the increased variability will have gender-specific consequences, and if so, what mitigation strategies can help. We examine how crimes against women in individual Indian districts respond to plausibly exogenous local precipitation shocks in a given year. Using the conditional maximum likelihood (also called Quasi-Maximum Likelihood, or QML) estimation method proposed by Hausman et al. (1984) to account for zero values in count data, we find that a rainfall deficit of 1 meter/year (m/year) below the local mean results in a 37 percent increase in reported dowry deaths and an 19 percent increase in domestic violence, controlling for district and year fixed effects.<sup>2</sup> However, sexual harassment, which is not economically motivated, decreases in response to below-normal rainfall. These findings are robust to the inclusion of district-specific time trends and the exclusion of big cities and potential outliers. We also show that dowry payments in a limited sample increase in response to these weather-induced shocks.

While our understanding of the costs of climate change in developed countries, in terms of its effects on agriculture, health, and social unrest, has been furthered by much recent economics research (Dell et al. 2009; Deschenes and Greenstone 2007; Deschenes and Moretti 2009; Mendelsohn et al. (1994)) there is a paucity of research estimating the costs in developing countries.

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<sup>1</sup>As of 1993, rape and domestic violence constituted 5 percent of the disease burden among women aged 15 to 44 in the developing world (World Bank, 1993). Karlekar (1998) and Jahan (1991) provide surveys on domestic violence for India and Bangladesh, respectively. A recent article posits that women in India are three times as likely to die from a fire as men (Sanghavi, Bhalla and Das, 2009).

<sup>2</sup>Dowry deaths are killings of married women for bringing insufficient dowry. We provide the legal definition in Section 2.

Some recent work focusing on agriculture and mortality has begun to close this gap (Guiteras 2008; Burgess et al. 2008; Kudamatsu et al. 2009; Burgess and Donaldson 2010; Miguel et al. 2004), but indirect social effects have barely been studied. The paper most closely related to ours is Miguel (2005) which evaluates the effects of weather-related income shocks in Tanzania, and finds that extreme rainfall leads to an increase in religiously motivated murders of elderly women, who are considered witches by their families.

Our study makes several contributions to the literature. We present comprehensive evidence of the effect of weather conditions on a wide variety of crimes across a large country that contains several agroclimatic zones. First, our paper highlights the increased social cost—in the form of more crimes against women—of expected changes in precipitation patterns. Second, our analysis separately identifies the impacts of dry and wet shocks (i.e., rainfall below and above the local mean, respectively) and places them in the context of global climate change. Third, our paper also contributes to the literature on consumption smoothing.<sup>3</sup> Our results provide evidence that at least part of the appropriation risk faced by women arises from economic incentives to smooth consumption, rather than having purely religious or social roots. Previous research has shown that in order to smooth consumption in response to negative weather shocks, rural households resort to a variety of strategies, including supplying additional labor hours (Kochar, 1999), decreasing the nutritional intake of their daughters (Rose, 1999), reducing human capital investment in children (Jensen, 2000), marrying daughters to distant households (Rosenzweig and Stark, 1989), and selling productive assets (Rosenzweig and Wolpin, 1993). We present evidence that crimes against women, especially dowry killings, are an additional consumption smoothing mechanism.

Our findings have important policy implications. Policies aimed at allaying the effects of weather shocks will need to consider elevated risks faced by vulnerable segments of the population. In this paper, we also evaluate two mitigation strategies to inform policy. First, we do not find evidence that female representation in the national Parliament mitigates these risks. The Indian government is considering reserving 33 percent of seats in the Parliament for women, with the objective of promoting equity and protecting the interests of all women in the country. Our results suggest that increased representation may not help reduce crime against women in the face of economic adversity. Second, we find that heavy reliance on groundwater worsens dry shocks and helps mitigate wet shocks. One possible explanation is that access to groundwater irrigation induces agricultural households to opt into riskier agricultural practices that increase income volatility. Groundwater subsidies are currently an important rural policy lever in India and are used to alleviate poverty. Our results suggest it is important that the overall effects of such subsidies be taken into account.

The remainder of the paper is organized as follows. Section 2 provides contextual information on crimes against women, including domestic violence, dowry deaths, and sexual harassment.

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<sup>3</sup>This literature is surveyed in Dercon (2002) and Morduch (1995).

Section 3 proposes a simple framework of an agrarian economy in which increased appropriation can be used as a consumption smoothing mechanism. Section 4 describes the data used in our empirical work. Section 5 presents our empirical strategy. The main empirical results and robustness checks are presented in Section 6. Heterogeneity in the results and mitigation strategies are explored in Section 7. Section 8 provides concluding remarks.

## 2 Background

In this section, we provide background information on the social, economic, and legal context of the crimes we focus on. Women in India are likely to bear higher risks of appropriation for two reasons. First, they are on average smaller than men, and physically more vulnerable to violence. Second, women tend to be subjugated in the household and society. They are less likely to be allowed to make independent decisions, less likely to raise their voices against appropriation, less likely to be politically represented, and often unable to divorce because of social stigma. Therefore, appropriation against women is less costly, and hence they are more likely to be targeted.

### 2.1 Domestic Violence and Dowry Deaths

In India, violence related to dowry surfaces after marriage, when the initial dowry, paid at the time of the wedding, is already in the hands of the husband and his family. The husband and his family demand additional payments, and the husband systematically abuses the wife in order to extract larger transfers. Social stigma associated with divorce prevents women from exiting the marriage even when they are abused.<sup>4</sup> Bloch and Rao (2002) develop a framework in which marital violence is positively associated with dowry transfers. Their empirical findings provide strong evidence that domestic violence in India is an economically motivated crime.<sup>5</sup>

In extreme cases, these dowry disputes escalate to murders. When a wife dies, her husband becomes free to remarry and receive dowry from a new wife's family. This remarriage can be immediate if the husband is not arrested. It is possible that these escalations are unplanned outbursts due to psychological stress, perhaps induced by economic hardship, and are not for economic gain per se, as is the case with domestic violence in Card and Dahl (2011). However, a very extensive sociological and anthropological literature suggests that bride burning, which is the most common form of dowry death, requires meticulous planning in order to make it look like an accident (Oldenburg, 2002).

According to a 1986 law, the legal definition of a dowry death is the death of a woman, within seven years of her marriage, caused by any burns or other bodily injury that do not

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<sup>4</sup>The divorce rate in India is about 1.1 percent and is much lower in rural areas than in cities.

<sup>5</sup>Economic roots of domestic violence are also documented in Panda and Agarwal (2005).

occur under normal circumstances.<sup>6</sup> For a woman's death to be ruled a dowry death, it must also be shown that soon before her death she was subjected to cruelty or harassment by her husband or any relative of her husband for, or in connection with, any demand for dowry. The party found guilty can receive a sentence of seven years to life. Typically, court cases last several years. Domestic violence is punishable by a sentence of at most three years or a fine.

## 2.2 Sexual Harassment

The most common form of sexual harassment in India is known as *Eve teasing* and is defined as unwelcome sexual gestures or behaviors. This includes directly or indirectly sexually colored remarks, physical contact and advances, the showing of pornography, demands or requests for sexual favors, and any other unwelcome physical or verbal sexual conduct.<sup>7</sup> Sexual harassment is typically perpetrated by strangers in public places (Baxi, 2001). In the context of the framework described below, it is a leisure activity, because it does not result in the transfer of resources.

## 3 Income Risk and Gains from Appropriation

A simple framework can explain the mechanics of how income shocks can translate into increased economically motivated crimes against women. Droughts lead to significant reduction in farm profits in India (Rosenzweig and Binswanger, 1993). In this framework, a farmer can spend his time on productive labor, leisure, or appropriation. Productive labor is spent working and producing the consumption good (for example, working on the farm to produce food), while appropriation time is spent on coercive activities to appropriate consumption goods from others (for example, harassing his wife to pressure her parents to provide more dowry). Both productive labor and appropriation yield the consumption good. However, the returns to productive labor are stochastic, depending on uncertain weather shocks. In the event of a bad shock (so that the returns to productive labor declines), for a range of values of the elasticity of substitution between consumption good and leisure, the time spent on appropriation increases, and the time spent on leisure falls.<sup>8</sup>

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<sup>6</sup>This definition is as per The Dowry Prohibition (Amendment) Act, 1986.

<sup>7</sup>According to India's Constitution, sexual harassment infringes the fundamental right of a woman to gender equality under Article 14 and her right to live with dignity under Article 21.

<sup>8</sup>In the absence of appropriation, a negative shock to the productive sector would have two effects. Loss of income makes the farmer increase the hours spent in the productive sector. On the other hand, the low returns in the productive sector make him substitute away toward leisure. The overall change in productive hours depends on whether the income effect dominates the substitution effect or not. In this framework, however, the farmer can increase his consumption by appropriating from others. Therefore, he will spend more time appropriating if the return to the productive sector falls.

## 4 Data

Our sample consists of 583 districts of India as defined by their 2001 boundaries.<sup>9</sup> Crime data come from the National Crime Records Bureau (NCRB), Ministry of Home Affairs. The NCRB maintains records of all reported cognizable crimes in the country.<sup>10</sup> The records provide the number of reported crimes against women by district, year, and category of crime.<sup>11</sup> Our empirical analysis focuses on dowry deaths, domestic violence, and sexual harassment. We also examine murder, robbery, burglary, riots, and kidnapping.

District average annual rainfall values for the years 2002-2007 were calculated from grids generated by Xie et al. (2002). These data combine information from land-based weather stations with satellite imagery, to improve local accuracy and decrease spurious spatial autocorrelation. Values are available for 0.1 degree grid cells (approximately 115 square kilometers). Long-run (1971-2000) mean rainfall, interpolated from station data alone to 0.5 degree grid cells (approximately 2,880 square kilometers), is from the data set CRU TS 2.1, available from the Climate Research Unit, University of East Anglia (Mitchell and Jones, 2005).<sup>12</sup> In the robustness checks, we employ a third data set, also with 0.5 degree resolution, from the University of Delaware,<sup>13</sup> because of its longer temporal coverage. We prefer to use the Xie et al. (2002) data as it is finer and also raises fewer concerns about the endogenous placement of stations.

District-level demographic data (population density, literacy rate, unemployment rate, percentage of population employed in agriculture, percentage of population residing in rural areas, and adult sex ratio) are taken from the 2001 Census of India. We also use dowry data from the Gender, Marriage and Kinship Survey collected by the National Council for Applied Economic Research in 1993 in 10 districts in two states: Uttar Pradesh and Karnataka. The Statistical Report on the General Election provides the demographic characteristics of candidates who ran in national parliamentary elections in 1999 and 2004. We use the gender of the winning candidates in each parliamentary constituency to construct the number of female members of Parliament in a district. We use data from the Central Ground Water Board's technical assessment of the ratio of groundwater use to availability for various districts of India for 2003. We impute these ratios for 2000 for the districts using information on operational wells and groundwater irrigation from

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<sup>9</sup>Districts that split between 2001 and 2007 were consolidated into their parent 2001 districts.

<sup>10</sup>Cognizable crimes are the crimes for which the police have a direct responsibility to act on receipt of a complaint, whereas the noncognizable crimes require the authorization of a magistrate for the police to take any action (National Crime Records Bureau, 2007).

<sup>11</sup>Most of the crimes we focus on are covered under the Indian Penal Code. While we focus on cognizable crimes, there is another category of crimes covered under the Special and Local Laws (SLL). The SLL are aimed at controlling other social practices prohibited by various laws over the years. They include the Dowry Prevention Act of 1961 and the Child Marriage Restraint Act of 1929. We do not have data on the crimes covered under SLL.

<sup>12</sup>Both are available from the International Research Institute for Climate and Society, Columbia University, <http://iri.columbia.edu>.

<sup>13</sup>Available at [http://climate.geog.udel.edu/~climate/html\\_pages/archive.html](http://climate.geog.udel.edu/~climate/html_pages/archive.html)

the second wave of the Minor Irrigation Census of India conducted in 2000.

Table I reports summary statistics for the main variables. An average of 12.1 dowry deaths are reported in each district-year, and 523 out of 583 districts saw at least one dowry death during the sample period. For domestic violence, the corresponding numbers are 101 per district-year and 559 out of 583. Reported sexual harassment is more variable across districts, with only 465 districts reporting any incidents. Reported dowry deaths and domestic violence are increasing over time, while sexual harassment is more stable.

## 5 Empirical Strategy

We exploit random year-to-year deviations of rainfall from its long-term local mean as plausibly exogenous measures of local rain shocks. Our outcome variable, the number of crimes, is a count, so we use a Poisson model specified as follows:

$$E[Y_{it} | X_{it}, R_{it}] = \exp(\pi_1 G(R_{it} - \bar{R}_i) + \pi_2 X'_{it} + \theta_i + \kappa_t) \quad (1)$$

Here  $Y_{it}$  is the outcome of interest in district  $i$  and year  $t$ ,  $R_{it}$  is rainfall,  $\bar{R}_i$  is the long-run mean annual rainfall for district  $i$ ,  $X_{it}$  is a set of district-level time-varying controls, and  $\theta_i$  and  $\kappa_t$  are district and year fixed effects, respectively.  $G$  is a function of the deviation of the rainfall from its mean; in most cases, we use a simple linear spline with a fixed knot at zero. This allows us to distinguish between wet shocks and dry shocks.

Equation (1) cannot be estimated consistently using ordinary least squares (OLS) because of the incidental parameters problem.<sup>14</sup> To address this issue, we follow Hausman et al. (1984) and transform the model to obtain a multinomial distribution for  $Y_{it}$  that takes the form:

$$E[Y_{it} | R_{it}, X_{it}, \hat{Y}_i] = \frac{\exp(\pi_1 G(R_{it} - \bar{R}_i) + \pi_2 X'_{it} + \kappa_t)}{\sum_{\tau=1}^T \exp(\pi_1 G(R_{it} - \bar{R}_i) + \pi_2 X'_{it} + \kappa_t)} \hat{Y}_i \quad (2)$$

where  $\hat{Y}_i = \sum_{\tau=1}^T Y_{it}$  is the number of crimes in district  $i$  over all years in our sample. This transformation removes the district dummies, and the coefficient of interest can then be consistently estimated. We use Quasi-Maximum-Likelihood (QML) to carry out the estimation.<sup>15</sup>

We want to determine the overall effect of the local weather shocks using variation across years within districts. Conditional on district fixed effects, year-to-year deviations of rainfall from the long-term mean are plausibly random and hence, orthogonal to unobserved determinants of crime. Therefore, our estimates will not suffer from omitted variable bias. The

<sup>14</sup>See Neyman and Scott (1948) for a detailed discussion.

<sup>15</sup>QML has good consistency properties even when the true model is not Poisson (Wooldridge, 2002). Another alternate procedure used by Pakes and Griliches (1980) proposes to transform the model so that 1 is added to the number of crimes if the total is 0 and an indicator variable  $d_{it}$  is set equal to 1 for each cell that is transformed. The linear model estimated would then be  $\ln Y_{it} = \pi_i + \pi_2 \ln G(R_{it} - \bar{R}_i) + d_{it} + \pi_3 X_{it} + \theta_i + \kappa_T + \epsilon_{it}$ . Although this is a simple and flexible procedure, the estimates are biased, since  $d_{it}$  is endogenous.

time-invariant unobserved characteristics of the districts are purged out using district fixed effects. We also control for common shocks experienced by all districts by including year fixed effects. It is possible that shocks in both directions (above- and below-normal rainfall) affect the outcomes. We allow for this possibility by including linear splines for above-normal (wet) and below-normal (dry) rainfall years as regressors in our estimation.<sup>16</sup>

## 6 Results

### 6.1 Crimes against Women

We carry out our analysis for three crimes against women: dowry deaths, domestic violence, and sexual harassment. As discussed before, dowry deaths and domestic violence may be committed with economic motives. On the other hand, sexual harassment of women has no obvious economic incentive. In the context of our framework, it is a form of leisure. Consistent with our hypothesis that a negative shock to the productive sector can induce people to spend more time on appropriation and less time on leisure, we find that dry shocks significantly increase the incidence of dowry deaths and domestic violence and decrease the incidence of sexual harassment. We report the results in Tables II, III, and IV. In each table, the reported coefficients are the effect of 1 meter per year deviation away from the local mean.

Table II provides the results from the quasi-maximum likelihood estimation of equation (2) for dowry deaths. Above-normal rainfall can result in flooding, and below-normal rainfall in droughts, depending on the rainfall amount, the institutional capacity, and the topography of the district. In column (i), we find that dowry deaths increase in response to dry shocks, with a 1 m/year decrease in rainfall below its long-term mean leading to a 0.317 log point increase in reported dowry deaths. This is equivalent to a 37.3 percent increase. The within-district standard deviation of rainfall is 0.237 meters. Hence, a 1 standard deviation deviation of rainfall below its long-term mean results in a 7.8 percent increase in dowry deaths. The coefficient on wet shocks is positive but not significant. The coefficients on the two shocks are jointly significant at 1 percent.

Extreme local weather shocks can cause social unrest. This may lead to a state of anarchy and lawlessness, in which case the incidence of all crimes could increase. As a result, crimes against women and minorities could increase as well. But in column (ii) we see that these patterns are robust to controlling for total crimes, so an increase in dowry deaths is not simply a matter of crime generally rising.<sup>17</sup> In order to account for differential trends in the outcomes

<sup>16</sup>In Appendix Table 1, we show that the relationship between dowry deaths and rainfall shocks is nonlinear over the range of rainfall data in our sample.

<sup>17</sup>We also carried out the estimation controlling for total crimes excluding dowry deaths and got similar results. Overall crimes do not increase in response to precipitation shocks, whereas crimes against women do. This finding is reported in Appendix Table 2. Column (i) shows that neither dry nor wet shocks change total crimes. Column (ii) shows that dry shocks increase crimes against women. This effect is significant at 5 percent. A 1 m/year



by socio-demographic factors, we include interactions between the year indicators and district-specific literacy rate, employment rate, percentage of population that is Scheduled Caste, and total population, all from the 2001 census. Data for all these variables are available only for 2001, and thus we are only controlling for differential trends based on the initial values of the variables. Results are reported in columns (iii) and (iv). The patterns observed are stable across these specifications.

In Table III, we report the results for domestic violence. Dry shocks tend to increase domestic violence, whereas wet shocks have no impact. After controlling for total crimes, a 1 m/year deficit in rainfall leads to a 0.171 log points (or 18.6 percent) increase in the incidence of domestic violence (column (ii)). A fluctuation of 1 standard deviation in rainfall below its long-term mean results in a 4.4 percent increase in incidence of domestic violence. Coefficients and standard errors change very little when the socioeconomic controls are added in column (iv), and the rain variables are jointly significant at 2.6 percent. In the framework developed by Bloch and Rao (2002), husbands use domestic violence to signal credible threats of harm in order to extract larger transfers from the wife’s natal family. In this framework, a negative shock to the income of the household (the husband in particular) induces the husband to increase the frequency of the abuse. Our findings are consistent with this hypothesis.

We report results for sexual harassment in Table IV. Dry shocks decrease the incidence of reported sexual harassment in column (i), and this result is robust to controlling for total crimes and socioeconomic characteristics of the districts (columns (ii) through (iv)). The coefficient on the wet shock is consistently positive but only significant at 10 percent, and only without controlling for total crimes and the census-based trends.

These results suggest that the acute economic distress generated by dry shocks increases the economically motivated dowry deaths and domestic violence that can help in smoothing consumption, whereas leisure-related crimes like sexual harassment decline. This finding is consistent with our hypothesis that effort is shifted from the productive sector to appropriation in order to smooth consumption. Hence, these crime patterns are consistent with consumption smoothing behavior in response to income shocks generated by weather events.

## 6.2 Robustness Checks

In table VI, we report the results from several robustness checks on the dowry deaths results.<sup>18</sup> Column (i) replicates the benchmark results from Table II. Columns (ii) and (iii) add district-specific linear time trends.<sup>19</sup> Column (ii) does not include the control for total crimes, while column (iii) does. If big cities were driving the results, it would be unlikely that they are related

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deficit results in a 15 percent increase in crimes against women.

<sup>18</sup>These tests have also been performed for domestic violence and sexual harassment, with similarly small effects, and the results are available on request.

<sup>19</sup>Standard errors are not clustered in these specifications because estimation with clustered errors fails to converge.

to agriculture. In column (iv), we exclude districts containing the 35 cities with populations over one million in 2001. In column (v), we exclude the district which had the highest reported number of dowry deaths for any year. Finally, in column (vi) we control for total crimes against women instead of total crimes. In each case, the effect of dry shocks is very similar to column (i), and the effect of wet shocks is still positive but insignificant. The results reported in Table II are therefore, quite robust to various specifications.<sup>20</sup>

It is unlikely that a 1 millimeter deviation is highly detrimental to agriculture, or that the effect of a given deviation is the same in a very dry region as it is in a very wet region. In order to have a more robust reference category, and to test the effects of magnitudes that are more comparable across agroclimatic zones, in Table VII, we look at bins of deviations of rainfall from the long-term mean, calibrated by the local standard deviation. We use a bin of 0.75 standard deviations centered on the mean as a reference category, and report the results for bins 0.75 standard deviations wide on either side. The effects on dowry deaths are consistent with those in Table II, getting larger for each bin drier than the reference. None of the wetter bins have any effect. This pattern is robust to controlling for total crimes and socioeconomic characteristics (columns (ii) to (iv)) We repeat this exercise with bins 0.50 standard deviations wide and find similar patterns (Appendix Table 5).

The reported crimes data were compiled from police records. Underreporting of various crimes is possible. However, it is difficult to hide a crime like the murder of an adult (Drèze and Khera, 2000). Consequently, it is unlikely that a large number of dowry deaths go unreported. A 1983 law made postmortem examinations compulsory in cases in which a woman dies within seven years of marriage. This law has stopped the rapid disposal of bodies after death and consequently made it extremely difficult for such actions to go unnoticed (Nair, 1996). To the extent that misreporting is not correlated with the transient weather-induced shocks within a district, our estimates are lower bounds. District fixed effects fully absorb any time-invariant components of the propensity to misreport.

We examine the reduced-form effect of local weather shocks on crimes. It is possible that these shocks cause stress migration. To the extent that the affected population migrates within the same district, as is typically the case (Duflo and Pande, 2007), the estimates capture the effects on those migrating households as well. Previous work has shown that migration across districts in India is limited (Topalova, 2010).

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<sup>20</sup>We also interacted the rain shocks with the year 2002 indicator to see if an overall drought year in the country had a differential effect on the outcomes. The interaction is not statistically significant. The results are available on request. We repeated our benchmark specification from Table II using the University of Delaware rain data. The results are very similar and are reported in Appendix Table 3. Using these alternative rain data, in which we do observe 2001 rainfall, we also verify that when one-year lags are entered with or without contemporaneous rain shocks, they do not affect dowry deaths. Results are reported in Appendix Table 4.

### 6.3 Dowry Payments

We also analyze how real dowry payments respond to weather shocks. Dowry data are available for households in only 10 districts for one year, so the results rely on little variation in the data and can only be interpreted as suggestive. One key strategy to cope with weather shocks is to marry daughters to families far away so that weather shocks at the in-laws location are relatively uncorrelated with those in the natal location (Rosenzweig and Stark, 1989). In such settings, the families of the couple can transfer money voluntarily when they experience adverse shocks, and we would not expect dowry payments to rise. Therefore, we examine what happens to dowry payments in response to shocks separately when the natal family of the wife lives more and less than 20 kilometers away.<sup>21</sup> The results are reported in Table V. Columns (i) through (iv) show the results for different types of assets that make up the dowry payments. The “other assets” category in column (iv) includes most prominently cattle and other farm animals. While nearly all coefficients for near families are in the direction that is consistent with the hypothesis that dowry payments are used for consumption smoothing, they are only statistically significant in predicting dowry in the form of other assets. The point estimates of the responses to dry shocks are much larger than those for wet shocks, but the standard errors are large.

### 6.4 Other Crimes

We examine several other crime categories to analyze whether social unrest increases sharply in response to these shocks, and we report the results in Table VIII. In columns (i) through (iii), we see no effect on overall murder (excluding dowry deaths), robbery, or burglary. There is a marginally significant positive effect of dry shocks on riots in column (iv), and a somewhat more robust one on kidnapping in column (v), with a 1 m/year increase in rainfall causing a 0.144 log points (15.48 percent) increase in kidnappings and abductions. These patterns suggest that the increase in dowry deaths and domestic violence is not on account of a breakdown of law and order in the district in general. Out of the crimes that would result in financial benefits, such as, burglary, robbery, and kidnapping, we see an increase only in kidnapping. The crime most likely to involve extortion of the vulnerable is the only one that goes up.<sup>22</sup>

## 7 Heterogeneity Due to Attitudes and Mitigation Strategies

### 7.1 Sex Ratios and Crimes against Women

The crime patterns we observe could be influenced by geographic variation in adult sex ratios or attitudes towards women. Edlund et al. (2007) demonstrate using Chinese data that areas with

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<sup>21</sup>The median distance reported in the data is 20 km.

<sup>22</sup>It may also be that transaction costs differ across crimes. For instance, policing efforts aimed at controlling robberies and burglaries may be more concerted than those targeting kidnapping.

higher (female-to-male) sex ratios have lower crime rates. Sex ratios could also be influenced by underlying attitudes towards women, and these attitudes could have a direct bearing on gender-specific crimes (Drèze and Khera, 2000).

We categorize districts as more female if the 2001 female-to-male sex ratio is greater than the national average for that year.<sup>23</sup> We then interact this female indicator with the dry and wet shock splines. Results are reported in column (i) of Table IX. We cannot reject the hypothesis that dowry deaths have the same response to dry and wet rain shocks in both kinds of districts.<sup>24</sup>

## 7.2 Empowering Women through Political Representation

Political representation of women can also influence the incidence or reporting of gender-specific crimes. Increased female representation could result in harsher punishment or more policing effort directed toward such crimes and consequently decrease them. Also, if the crimes are underreported, female representation could motivate women to come forward and report crimes (Iyer, Mani, Mishra and Topalova, 2011).<sup>25</sup> Members of Parliament (MPs) also have access to significant resources that can be spent on the welfare of their constituents. This spending is discretionary under a program started by the government in 1993. If female representatives have stronger preferences to improve the welfare of women,<sup>26</sup> they may spend more on awareness campaigns or services for the protection of women, or they may provide direct relief to women in times of economic distress. Thus, they may mitigate the risk faced by women.

In order to explore this possibility, we evaluate whether the impact of rain shocks varies by female political representation. For each parliamentary constituency in the country, we find the

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<sup>23</sup>Contemporaneous sex ratios can be endogenous to shocks, as demonstrated by Rose (1999), but we use predetermined gender ratios.

<sup>24</sup>In the United States, Aizer (2010) finds that a relative increase in women’s ability to earn leads to a reduction in domestic violence against women. Luke and Munshi (2011) examine data from tea estates in South India and find that positive income shocks generated by abundant rainfall decrease the incidence of marital violence, whereas positive shocks to female incomes, holding household income constant, increase the incidence of marital violence, which lends support to a “backlash” theory in which men retaliate when women’s relative position improves. We do not examine this individual endowment effect directly. We are examining whether an income shock to the household translates into increased domestic violence and heightened mortality in settings where attitudes towards women, as proxied by the sex ratio, are relatively progressive. The female-to-male ratio can mechanically affect the incidence of crime as well.

<sup>25</sup>Iyengar (2009) uses the timing of the introduction of laws that mandate arrests in domestic violence cases across states in United States to examine the effects on domestic violence. The study shows that incidences of domestic violence increase in response to the change in the law, because of male “backlash” or retaliation in response to a relative change in women’s position. Iyer et al. (2011) focus on the effects of mandated political representation in local governance councils on crimes against women in India. They also find that increased political representation increases the incidence of crime against women. Their findings are consistent with both an “empowerment effect” in which only reporting changes, and a “backlash effect” in which actual crime changes.

<sup>26</sup>Chattopadhyay and Duflo (2004) evaluate a policy that mandated political representation of women in local village councils and find that women and men do have different preferences for public goods.

gender of the elected MP in the 13th (1999-2004) and 14th (2004-2009) Lok Sabha.<sup>27</sup> Parliamentary constituencies and districts do not nest. We determine the number of parliamentary constituencies represented by a woman falling at least partially within the district and whether there is any constituency represented by a women falling at least partially within a district. Elections were not held in all districts in these years, so we first reestimate our benchmark model on the districts in which elections were held. The results are reported in column (ii) of Table IX. The patterns are consistent with results reported in Table II, despite the reduced sample. Next, we include the number of female MPs in a district interacted with year indicators as additional controls in column (iii). The number of female MPs is potentially endogenous in this case, but it is instructive to note that controlling for it in the regression does not change the results. Finally, we construct an indicator for any female MP in these districts for the year prior to that in which the shock is realized and interact it with the wet and dry shock splines.<sup>28</sup> Results are reported in column (iv). In this case as well, we cannot reject the hypothesis that the response of dowry deaths to wet and dry shocks is the same in both types of districts—those with and without any female MPs. Political representation does not seem to change the effect of the shocks on dowry deaths.<sup>29</sup>

### 7.3 Does Groundwater Irrigation Mitigate the Appropriation Risk?

Finally, we investigate irrigation by means of groundwater, a common strategy for increasing access to water in general. Groundwater can provide insurance to cope with the shocks, and thus can potentially reduce the risk of appropriation. We categorize districts based on whether the groundwater usage relative to availability is higher than the average for the country, and we interact this indicator with the dry and wet shocks. We first reestimate the benchmark regression specification for this sample. The results are reported in Table X, column (i). We find that a 1 m/year decrease in rainfall below its long-term mean increases dowry deaths by 30.2 percent, and this effect is significant at 5 percent. On adding groundwater usage relative to availability interacted with year indicators as controls, this effect is reduced to 21.2 percent (column (ii)). In column (iii), we further interact this indicator with dry and wet shocks. Our findings are somewhat surprising. The coefficient on the dry shocks for areas with low groundwater usage is low and statistically insignificant. However, the coefficient on the interaction term is positive and large (0.333). In places with heavy reliance on groundwater, a 1 m/year decrease in rainfall from the long-term mean increases the incidence of dowry deaths by 39.5 percent. On the other hand, wet shocks increase the incidence of dowry deaths in areas with low reliance on ground

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<sup>27</sup>The Lok Sabha is the directly elected lower house of Parliament.

<sup>28</sup>Since the female MP is already chosen before the shock is realized, the shock cannot affect the representation and hence it is not endogenous.

<sup>29</sup>It could be the case that female representation only changes the motivation to report crimes as shown by Iyer et al. (2011). Since we do not observe an effect on dowry deaths, the implication is that the dowry deaths are very unlikely to be underreported.

water. A 1 m/year increase in rainfall over the long-term mean increases dowry deaths by 20.4 percent, and the result is significant at the 5 percent level. The coefficient on the interaction of high groundwater usage and wet shocks is -0.22 and is significant at 5 percent. This means that the incidence of dowry deaths does not rise as much in areas with high reliance on groundwater when they experience a wet shock relative to areas with low reliance on groundwater.

These results suggest that groundwater usage exacerbates the risks faced by women associated with rainfall deficits and mitigates those associated with excessive rainfall. One plausible explanation is that when the farmers can rely on assured irrigation, they take added risks on the margin of inputs complementary to water. For example, they might invest in better seeds even if they have to take a loan. Dry shocks cause wells to dry up and not recharge, creating a shortage of water in the dry season for the rabi<sup>30</sup> crops. On the other hand, wet shocks recharge the wells so the rabi crops can be irrigated better. In addition, groundwater irrigation protects the areas from flooding as the aquifers can absorb the extra water. Hence, the above-normal rainfall shocks translate into higher farm profits in areas with high groundwater usage, decreasing dowry deaths.

These findings have important policy implications. It is expected that South Asia will experience more severe wet spells. If that happens, vulnerable populations may see a heightened risk of appropriation in areas with limited reliance on groundwater, whereas groundwater usage will buffer farm incomes and hence protect the vulnerable populations such as women against violent crimes and heightened volatility risks. Groundwater irrigation is depleting the aquifers rapidly, but these findings suggest that finding ways to maintain access and protect the resources might be very important in the future. One such policy might be to provide access to groundwater irrigation by means of public wells.<sup>31</sup> The effects of dry shocks are exacerbated by heavy reliance on groundwater. To the extent that the country or regions within the country are likely to experience more dry spells, increasing reliance on groundwater could heighten appropriation risk in the absence of other insurance mechanisms.

## 8 Conclusion

Our findings show that rainfall shocks have a significant effect on crime against women. Dry shocks increase reported dowry deaths and domestic violence, but decrease sexual harassment. We interpret these findings as evidence that negative weather shocks increase the risk of appropriation faced by women. This behavior to increase economic returns through appropriation by resorting to dowry killings may be a consumption smoothing mechanism. Since vulnerable segments of society are less able to adapt (Jayachandran, 2006), it is important to estimate what additional risks they face in light of changing climate patterns, and what strategies can mitigate

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<sup>30</sup>The secondary wet season.

<sup>31</sup>Sekhri (2011) demonstrates that these types of policies can help achieve both development goals and sustainability objectives at the same time.

these risks. Policies aimed at allaying the effects of risks and uncertainties generated by weather shocks will need to especially ensure the well-being of women. Increased access to weather insurance<sup>32</sup> may lead to reduced appropriation risks faced by women. Examining how access to coping mechanisms like weather insurance affects the appropriation risks faced by women is an important avenue of future research.

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<sup>32</sup>Some studies, including Lilleor et al. (2005), examine the take-up of weather insurance and the impact on agricultural investments.

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**Table I: Summary Statistics**

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	<b>year</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>Overall</b>
<b>Average rainfall</b> (meters/year)	<b>Mean</b>	1.04	1.36	1.34	1.37	1.36	1.39	1.31
	<b>Min</b>	0.10	0.34	0.13	0.30	0.26	0.36	0.10
	<b>Max</b>	3.25	2.69	3.30	3.41	3.23	3.25	3.41
	<b>Std dev</b>	0.49	0.45	0.54	0.55	0.51	0.52	0.53
<b>Dowry Deaths</b>	<b>Mean</b>	11.7	10.6	12.0	11.6	13.0	13.8	12.1
	<b>Min</b>	0	0	0	0	0	0	0
	<b>Max</b>	83	85	98	87	168	94	168
	<b>Std dev</b>	14	11	12	14	16	16	15
<b>Domestic Violence</b>	<b>Mean</b>	84	87	100	100	108	130	101
	<b>Min</b>	0	0	0	0	0	0	0
	<b>Max</b>	1245	1625	1661	2010	1998	2246	2246
	<b>Std dev</b>	111	137	144	151	162	200	154
<b>Sexual Harassment</b>	<b>Mean</b>	17.2	20.9	16.8	16.8	16.7	18.3	17.8
	<b>Min</b>	0	0	0	0	0	0	0
	<b>Max</b>	1122	980	585	445	236	353	1122
	<b>Std dev</b>	68	60	43	38	33	40	48
<b>Crimes Targetting Women</b>	<b>Mean</b>	200	202	219	218	234	263	223
	<b>Min</b>	0	0	0	0	0	0	0
	<b>Max</b>	1954	2416	2375	2871	2756	2950	2950
	<b>Std dev</b>	205	225	235	242	253	294	245
<b>Overall Crimes</b>	<b>Mean</b>	3025	2917	3113	3101	3197	3377	3122
	<b>Min</b>	28	14	24	32	34	32	14
	<b>Max</b>	29120	31093	31473	33250	32967	32447	33250
	<b>Std dev</b>	3265	3396	3573	3101	3577	3709	3515
<b>Observations</b>		583	583	583	583	583	583	583

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**Table II : Effect of Local Weather Shocks on Dowry Deaths**

	Conditional Fixed Effects Poisson Estimates			
	(i)	(ii)	(iii)	(iv)
<b>Dry Shock</b>	<b>0.317***</b> (0.0917)	<b>0.296***</b> (0.0911)	<b>0.318***</b> (0.0989)	<b>0.291***</b> (0.0972)
<b>Wet Shock</b>	0.066 (0.0450)	0.061 (0.0454)	0.064 (0.0549)	0.074 (0.0557)
<b>Total Crimes</b>	No	Yes	No	Yes
<b>Socio economic Controls</b>	No	No	Yes	Yes
<b>Observations</b>	3138	3138	3138	3138
<b>Districts</b>	523	523	523	523
<b>Joint Significance of Rainfall Coefficients</b>				
<b>F-statistic</b>	<b>12.94</b>	<b>11.43</b>	<b>10.95</b>	<b>9.87</b>
<b>Significance level</b>	0.0015	0.0033	0.0042	0.0071

Notes: Independent variable is the absolute deviation of rainfall from the long run mean (1971-2000) in meters/year. Dry shocks are below normal rainfall and wet shocks are above normal rainfall. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in the parentheses and are clustered by district. All regressions include district and year fixed effects. Socio-economic controls are percent literate, percent employed percent of scheduled caste population, and total population interacted with year fixed indicators. \*\*\* indicates significance at 1 % level, \*\* at 5 %, and \* at 10 % level. Out of 583, there are 523 districts with non zero values of the dependent variable.

**Table III : Effect of Local Weather Shocks on Domestic Violence**

	Conditional Fixed Effects Poisson Estimates			
	(i)	(ii)	(iii)	(iv)
<b>Dry Shock</b>	<b>0.229***</b> (0.0736)	<b>0.171***</b> (0.0605)	<b>0.278***</b> (0.0796)	<b>0.183***</b> (0.0696)
<b>Wet Shock</b>	-0.010 (0.0350)	-0.017 (0.0332)	-0.008 (0.0327)	0.002 (0.0340)
<b>Total Crimes</b>	No	Yes	No	Yes
<b>Socio economic Controls</b>	No	No	Yes	Yes
<b>Observations</b>	3354	3354	3354	3354
<b>Districts</b>	559	559	559	559
Joint Significance of Rainfall Coefficients				
<b>F-statistic</b>	<b>9.91</b>	<b>8.09</b>	<b>12.25</b>	<b>7.30</b>
<b>Significance level</b>	0.0071	0.0175	0.0022	0.0260

Notes: Independent variable is the absolute deviation of rainfall from the long run mean (1971-2000) in meters/year. Dry shocks are below normal rainfall and wet shocks are above normal rainfall. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in the parentheses and are clustered by district. All regressions include district and year fixed effects. Socio-economic controls are percent literate, percent employed percent of scheduled caste population, and total population interacted with year fixed indicators. \*\*\* indicates significance at 1 % level, \*\* at 5 %, and \* at 10% level. Out of 583, there are 559 districts with non zero values of the dependent variable

**Table IV : Effect of Local Weather Shocks on Sexual Harassment**

	Conditional Fixed Effects Poisson Estimates			
	(i)	(ii)	(iii)	(iv)
<b>Dry Shock</b>	<b>-0.879**</b> (0.388)	<b>-0.946**</b> (0.387)	<b>-0.588**</b> (0.266)	<b>-0.649***</b> (0.205)
<b>Wet Shock</b>	0.243* (0.147)	0.234 (0.149)	0.153 (0.147)	0.187 (0.138)
<b>Total Crimes</b>	No	Yes	No	Yes
<b>Socio economic Controls</b>	No	No	Yes	Yes
<b>Observations</b>	2790	2790	2790	2790
<b>Districts</b>	465	465	465	465
<b>Joint Significance of Rainfall Coefficients</b>				
<b>F-statistic</b>	<b>25.97</b>	<b>23.91</b>	<b>8.10</b>	<b>15.57</b>
<b>Significance level</b>	<0.0001	<0.0001	0.0174	0.0004

Notes: Independent variable is the absolute deviation of rainfall from the long run mean (1971-2000) in meters/year. Dry shocks are below normal rainfall and wet shocks are above normal rainfall. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in the parentheses and are clustered by district. All regressions include district and year fixed effects. Socio-economic controls are percent literate, percent employed percent of scheduled caste population, and total population interacted with year fixed indicators. \*\*\* indicates significance at 1 % level, \*\* at 5 % , and \* at 10 % level. Out of 583, there are 465 districts with non zero values of the dependent variable

**Table V: Real Dowry Received as Reported by Males (1000s rupees)**

	<b>Land</b>	<b>Jewelry</b>	<b>Cash</b>	<b>Other Assets</b>
	(i)	(ii)	(iii)	(iv)
<b>Dry Shock</b>	83.8 (210.5)	527.3 (440.3)	756.1 (766.6)	<b>318.8***</b> (62.16)
<b>Wet Shock</b>	-31.7 (49.30)	61.5 (95.56)	76.2 (158.1)	<b>124.9**</b> (44.98)
<b>Far from Parents (&gt;20km)</b>	-8.2 (5.939)	16.6 (15.89)	9.4 (25.15)	16.3 (17.27)
<b>Far from Parents * Dry Shock</b>	-75.3 (172.9)	-554.5 (427.6)	-722.1 (772.8)	-300.3 (183.3)
<b>Far from Parents * Wet Shock</b>	11.2 (40.41)	15.4 (127.7)	311.9 (302.4)	291.1 (329.0)
<b>Observations</b>	910	916	798	592

Notes: Independent variable is the absolute number of standard deviations of rainfall from the long run mean (1971-2000) in meters/year. Dry shocks are below normal rainfall and wet shocks are above normal rainfall. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in the parentheses and are clustered by district. Number of observations are different across the regressions due to missing values not reported in data. \*\*\* indicates significance at 1 % level, \*\* at 5 %, and \* at 10 % level.



**Table VI : Robustness Checks - Effect of Local Weather Shocks on Dowry Deaths**

	Conditional Fixed Effects Poisson Estimates					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	Benchmark	District Time Trends		Excluding Big Cities	Excluding Outliers	Control Crimes against Women
<b>Dry Shock</b>	<b>0.291***</b> (0.0972)	<b>0.310***</b> (0.0766)	<b>0.268***</b> (0.0769)	<b>0.235**</b> (0.102)	<b>0.289***</b> (0.0899)	<b>0.275***</b> (0.0918)
<b>Wet Shock</b>	0.074 (0.0557)	0.028 (0.0347)	0.017 (0.0347)	0.080 (0.0512)	0.058 (0.0445)	0.060 (0.0442)
<b>Total Crimes</b>	Yes	No	Yes	Yes	Yes	Yes
<b>District Specific Linear Time Trends</b>	No	Yes	Yes	No	No	No
<b>Clustered standard errors</b>	Yes	No	No	Yes	Yes	Yes
<b>Observations</b>	3138	3138	3138	2916	3137	3138
<b>Districts</b>	523	523	523	486	523	523
<b>Joint Significance of Rainfall Coefficients</b>						
<b>F-statistic</b>	<b>11.43</b>	<b>16.55</b>	<b>12.12</b>	<b>9.97</b>	<b>12.77</b>	<b>9.73</b>
<b>Significance level</b>	0.0033	0.0003	0.0023	0.0068	0.0017	0.0077

Notes: Independent variable is the absolute deviation of rainfall from the long run mean (1971-2000) in meters/year. Dry shocks are below normal rainfall and wet shocks are above normal rainfall. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in the parentheses and are clustered by district. All regressions include district and year fixed effects and 4 socio-economic controls, percent literate, percent employed, percent of scheduled caste population, and total population, interacted with year indicators. Big cities are the cities with population exceeding 1 million as per the 2001 Population Census of India. \*\*\* indicates significance at 1 % level, \*\* at 5 %, and \* at 1 0% level.

**Table VII : Effect of Local Weather Shocks on Dowry Deaths: non-linear effects**

	Conditional Fixed Effects Poisson Estimates			
	(i)	(ii)	(iii)	(iv)
<b>&gt;2.625 Deviations Below Mean</b>	<b>0.221***</b> (0.0731)	<b>0.193***</b> (0.0715)	<b>0.206***</b> (0.0800)	<b>0.182**</b> (0.0785)
<b>1.875-2.625 Deviations Below Mean</b>	<b>0.146**</b> (0.0600)	<b>0.135**</b> (0.0599)	<b>0.144**</b> (0.0630)	<b>0.133**</b> (0.0629)
<b>1.125-1.875 Deviations Below Mean</b>	<b>0.0805*</b> (0.0436)	0.065 (0.0406)	<b>0.0825*</b> (0.0450)	0.069 (0.0429)
<b>.375-1.125 Deviations Below Mean</b>	<b>0.0634**</b> (0.0309)	<b>0.0563*</b> (0.0305)	<b>0.0662**</b> (0.0304)	<b>0.0603**</b> (0.0298)
<b>.375-1.125 Deviations Above Mean</b>	-0.012 (0.0254)	-0.009 (0.0249)	-0.014 (0.0246)	-0.009 (0.0237)
<b>1.125-1.875 Deviations Above Mean</b>	0.023 (0.0336)	0.029 (0.0345)	0.021 (0.0348)	0.031 (0.0354)
<b>1.875-2.625 Deviations Above Mean</b>	0.009 (0.0304)	0.016 (0.0299)	0.008 (0.0326)	0.021 (0.0323)
<b>&gt;2.625 Deviations Above Mean</b>	0.024 (0.0369)	0.020 (0.0376)	0.014 (0.0423)	0.020 (0.0434)
<b>Total Crimes</b>	No	Yes	No	Yes
<b>Socio economic Controls</b>	No	No	Yes	Yes
<b>Observations</b>	3138	3138	3138	3138
<b>Districts</b>	523	523	523	523

Notes: Independent variables are in terms of standard deviations of rainfall from the long run mean (1971-2000). Deviations within 0.375 standard deviations of the mean are the excluded category. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in the parentheses and are clustered by district. All regressions include district and year fixed effects. Socio-economic controls are percent literate, percent employed percent of scheduled caste population, and total population interacted with year indicators. \*\*\* indicates significance at 1 % level, \*\* at 5 %, and \* at 10 % level. Out of 583, there are 523 districts with non zero values of the dependent variable.

**Table VIII : Effect of Local Weather Shocks on Other Crimes**

Dependent Variable	Conditional Fixed Effects Poisson Estimates				
	Murder	Robbery	Burglary	Riots	Kidnap/ abduction
	(i)	(ii)	(iii)	(iv)	(v)
<b>Dry Shock</b>	0.049 (0.0394)	0.056 (0.0992)	0.019 (0.0516)	<b>0.169*</b> (0.1010)	<b>0.144**</b> (0.0717)
<b>Wet Shock</b>	-0.030 (0.0271)	0.043 (0.0429)	0.014 (0.0267)	0.018 (0.0673)	0.005 (0.0329)
<b>Observations</b>	3498	3468	3492	3408	3486
<b>Districts</b>	583	578	582	568	581
Joint Significance of Rainfall Coefficients					
<b>F-statistic</b>	<b>2.82</b>	<b>1.91</b>	<b>0.39</b>	<b>3.29</b>	<b>4.08</b>
<b>Significance level</b>	0.2441	0.3845	0.8213	0.1934	0.1302

Notes: Independent variable is the absolute deviation of rainfall from the long run mean (1971-2000) in meters/year. Dry shocks are below normal rainfall and wet shocks are above normal rainfall. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in the parentheses and are clustered by district. All regressions include total crimes, district and year fixed effects and 4 socio-economic controls, percent literate, percent employed, percent of scheduled caste population, and total population, interacted with year indicators. \*\*\* indicates significance at 1 % level, \*\* at 5 %, and \* at 10 % level. Number of observations correspond to number of districts with non zero values of the dependent variable in each regression

**Table IX : Women's Political Representation and Dowry Deaths**

	Conditional Fixed Effects Poisson Estimates			
	Subsample with elections data			
	(i)	(ii)	(iii)	(iv)
	Shocks and High Adult Sex Ratio	Benchmark	Control Women MPs	Shocks and Women MPs
<b>Dry Shock</b>	<b>0.326***</b> (0.115)	<b>0.233**</b> (0.109)	<b>0.231**</b> (0.109)	<b>0.229**</b> (0.111)
<b>Dry Shock * High Sex Ratio</b>	-0.087 (0.183)			
<b>Dry Shock * Any Women MP</b>				0.012 (0.277)
<b>Wet Shock</b>	0.064 (0.0683)	0.060 (0.0622)	0.057 (0.0614)	0.021 (0.0586)
<b>Wet Shock * High Sex Ratio</b>	0.017 (0.0913)			
<b>Wet Shock * Any Women MP</b>				0.182 (0.139)
<b>Observations</b>	3138	2352	2352	2352
<b>Districts</b>	523	392	392	392

Notes: Independent variable is the absolute deviation of rainfall from the long run mean (1971-2000) in meters/year. There are also interactions of these deviations with an indicator for presence of a female MP in a district and a high sex ratio. Dry shocks are below normal rainfall and wet shocks are above normal rainfall. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in the parentheses and are clustered by district. All regressions include district and year fixed effects and 4 socio-economic controls, percent literate, percent employed, percent of scheduled caste population, and total population, interacted with year indicators. \*\*\* indicates significance at 1 % level, \*\* at 5 %, and \* at 10 % level

**Table X : Effect of Local Weather Shocks on Dowry Deaths by Groundwater Usage Status**

	Conditional Fixed Effects Poisson Estimates		
	Benchmark	Groundwater as Control	Groundwater reliance Interacted with shocks
	(i)	(ii)	(iii)
<b>Dry Shock</b>	<b>0.264**</b> (0.105)	<b>0.193*</b> (0.111)	0.103 (0.137)
<b>Dry Shock * High Groundwater reliance</b>			<b>0.333*</b> (0.190)
<b>Wet Shock</b>	0.067 (0.0590)	0.055 (0.0586)	<b>0.186**</b> (0.0784)
<b>Wet Shock * High Groundwater reliance</b>			<b>-0.223**</b> (0.0899)
<b>Observations</b>	2975	2975	2975
<b>Districts</b>	496	496	496

Notes: Independent variable is the absolute deviation of rainfall from the long run mean (1971-2000) in meters/year. There are also interactions of these deviations with an indicator for high groundwater usage districts. Dry shocks are below normal rainfall and wet shocks are above normal rainfall. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in the parentheses and are clustered by district. All regressions include district and year fixed effects and 4 socio-economic controls, percent literate, percent employed, percent of scheduled caste population, and total population, interacted with year indicators. \*\*\* indicates significance at 1 % level, \*\* at 5 %, and \* at 10 %

**Appendix Table 1: Effect of Local Climate Variability on Appropriation Against Women**

**Dependent Variable: Dowry Deaths**

	Conditional Fixed Effects Poisson Estimates			
	(i)	(ii)	(iii)	(iv)
<b>Rainfall Deviation from Mean</b>	-0.0714 [0.0445]	-0.0606 [0.0448]	<b>-0.108**</b> [0.0457]	<b>-0.0943**</b> [0.0453]
<b>Squared Rainfall Deviation</b>	--	--	<b>0.188***</b> [0.0700]	<b>0.171**</b> [0.0675]
<b>Total Crimes</b>	No	Yes	No	Yes
<b>Observations</b>	3138	3138	3138	3138
<b>Districts</b>	523	523	523	523

Notes: Independent variables are the deviation of rainfall from the long run mean (1971-2000) and the square of that deviation. Rainfall is measured in meters/year. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in parentheses and are clustered by district. All regressions include district and year fixed effects. \*\*\* indicates significance at 1 % level, \*\* at 5 % , and \* at 10% level. Out of 583, there are 523 districts with non zero values of the dependent variable.

**Appendix Table 2: Effect of Local Climate Variability on Crimes**

Conditional Fixed Effects Poisson Estimates		
Dependent Variable	Total Crimes	Crimes against Women
	(i)	(ii)
<b>Below Normal Rain</b>	0.06 (0.04)	<b>0.15**</b> (0.068)
<b>Above Normal Rain</b>	-0.004 (.01)	0.039 (.026)
<b>Observations</b>	3498	3498
<b>Districts</b>	583	583
Joint significance of rainfall coefficients		
<b>F-statistic</b>	2.03	<b>5.74</b>
<b>Significance level</b>	0.36	0.06

Notes: Independent variable is the absolute deviation of rainfall from the long run mean (1971-2000) in meters/year. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in the parentheses and are clustered by district. All regressions include district and year fixed effects. Socio-economic controls are percent literate, percent employed percent of scheduled caste population, and total population interacted with year indicators. \*\*\* indicates significance at 1 % level, \*\* at 5 % , and \* at 10 % level.

## Rainfall Based on an Alternate Data Series

**Appendix Table 3: Effect of Local Climate Variability on Appropriation Against Women**

<b>Dependent Variable: Dowry Deaths</b>				
Conditional Fixed Effects Poisson Estimates				
	(i)	(ii)	(iii)	(iv)
<b>Below Normal Rain</b>	<b>0.292***</b> (0.0986)	<b>0.280***</b> (0.0985)	<b>0.295***</b> (0.108)	<b>0.284***</b> (0.103)
<b>Above Normal Rain</b>	0.0608 (0.0684)	0.0258 (0.0698)	-0.00866 (0.0754)	-0.0066 (0.0778)
<b>Total Crimes</b>	No	Yes	No	Yes
<b>Socio economic Controls</b>	No	No	Yes	Yes
<b>Observations</b>	3138	3138	3138	3138
<b>Districts</b>	523	523	523	523
Joint significance of rainfall coefficients				
<b>F-statistic</b>	<b>8.88</b>	<b>8.66</b>	<b>8.63</b>	<b>8.57</b>
<b>Significance level</b>	0.0118	0.0132	0.0134	0.0138

Notes: Independent variable is the absolute deviation of rainfall from the long run mean (1971-2000) in meters/year. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in the parentheses and are clustered by district. All regressions include district and year fixed effects. Socio-economic controls are percent literate, percent employed percent of scheduled caste population, and total population interacted with year indicators. \*\*\* indicates significance at 1 % level, \*\* at 5 % , and \* at 10 % level.



## Impact of Lagged Shocks

**Appendix Table 4: Effect of Local Climate Variability on Appropriation Against Women**

<b>Dependent Variable: Dowry Deaths</b>			
Conditional Fixed Effects Poisson Estimates			
	(i)	(ii)	(iii)
<b>Below Normal Rain</b>	<b>0.292***</b> (0.0986)	-- --	<b>0.279***</b> (0.0979)
<b>Above Normal Rain</b>	0.0608 (0.0684)	-- --	0.05 (0.0695)
<b>Lagged Below Normal Rain</b>	-- --	0.00206 (0.0914)	0.0412 (0.0938)
<b>Lagged Above Normal Rain</b>	-- --	-0.157 (0.105)	-0.115 (0.106)
<b>Observations</b>	3138	3138	3138
<b>Districts</b>	523	523	523
Joint significance of rainfall coefficients			
<b>F-statistic</b>	<b>8.88</b>	3.08	<b>10.13</b>
<b>Significance level</b>	0.0118	0.2148	0.0383

Notes: Independent variable is the absolute deviation of rainfall from the long run mean (1971-2000) in meters/year. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in the parentheses and are clustered by district. All regressions include district and year fixed effects. Socio-economic controls are percent literate, percent employed percent of scheduled caste population, and total population interacted with year indicators. \*\*\* indicates significance at 1 % level, \*\* at 5 % , and \* at 10 % level.

Using an Alternate standard Deviation Bin

**Appendix Table 5: Effect of Local Climate Variability on Appropriation Against Women**

	<b>Dependent Variable: Dowry Deaths</b>			
	Conditional Fixed Effects Poisson Estimates			
	<b>(i)</b>	<b>(ii)</b>	<b>(iii)</b>	<b>(iv)</b>
<b>&gt;2.25 Deviations Below Mean</b>	<b>0.146**</b> (0.0694)	<b>0.117*</b> (0.0690)	<b>0.139*</b> (0.0739)	0.115 (0.0740)
<b>1.75-2.25 Deviations Below Mean</b>	<b>0.209***</b> (0.0663)	<b>0.188***</b> (0.0647)	<b>0.211***</b> (0.0684)	<b>0.190***</b> (0.0680)
<b>1.25-1.75 Deviations Below Mean</b>	0.0488 (0.0432)	0.0345 (0.0416)	0.0577 (0.0454)	0.0454 (0.0440)
<b>.75-1.25 Deviations Below Mean</b>	<b>0.120***</b> (0.0412)	<b>0.107***</b> (0.0392)	<b>0.125***</b> (0.0406)	<b>0.115***</b> (0.0391)
<b>.25-.75 Deviations Below Mean</b>	<b>0.0527*</b> (0.0312)	0.0493 (0.0314)	<b>0.0526*</b> (0.0312)	0.0489 (0.0312)
<b>.25-.75 Deviations Above Mean</b>	0.00285 (0.0304)	0.00135 (0.0301)	0.00158 (0.0292)	0.00176 (0.0285)
<b>.75-1.25 Deviations Above Mean</b>	-0.00232 (0.0316)	0.00502 (0.0325)	-0.00849 (0.0318)	0.00292 (0.0324)
<b>1.25-1.75 Deviations Above Mean</b>	0.0237 (0.0440)	0.0324 (0.0442)	0.0215 (0.0457)	0.0366 (0.0459)
<b>1.75-2.25 Deviations Above Mean</b>	0.0337 (0.0339)	0.04 (0.0326)	0.033 (0.0369)	0.0431 (0.0355)
<b>&gt;2.25 Deviations Above Mean</b>	0.00855 (0.0325)	0.00648 (0.0337)	-0.00103 (0.0380)	0.00596 (0.0394)
<b>Total Crimes</b>	No	Yes	No	Yes
<b>Socio economic Controls</b>	No	No	Yes	Yes
<b>Observations</b>	3138	3138	3138	3138
<b>Districts</b>	523	523	523	523

Notes: Independent variables are local standard deviations of rainfall from the long run mean (1971-2000) for the districts. Deviations within 0.25 standard deviations of the mean are the excluded category. Each Column presents the regression coefficients from a separate regression. Standard errors are reported in the parentheses and are clustered by district. All regressions include district and year fixed effects. Socio-economic controls are percent literate, percent employed percent of scheduled caste population, and total population interacted with year indicators. \*\*\* indicates significance at 1 % level, \*\* at 5 % , and \* at 10 % level.