Natural Disasters and Sharia Laws

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Abstract

The paper studies the effect of natural disasters on the introduction of religious laws using a unique dataset on Sharia laws in the largest Muslim country – Indonesia. We find that districts in proximity to a natural disaster are 37 percent more likely to introduce Sharia law in the following year, and the effect persists over the following years. Testing for the mechanism, we use a longitude survey to show that natural disasters are associated with higher self-reported religiosity and frequency of praying in areas closer to the natural disasters. This is the first study to link natural disasters and religiosity to the institutionalization of religious laws.

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1 Introduction

In the wake of democratization, many Muslim countries have seen growing demands for Islamic law and institutions to uphold Muslim values (Buehler, 2013; Kendhammer, 2013). Even though such development may seem to be counterintuitive as religious laws have been found to hinder development (Kuran, 2011), increase corruption (Buehler, 2008, 2016), and weaken the rule of law and democracy (Bentzen & Gokmen, 2023; Mehmood & Seror, 2023), we observe a rise in Islamic law. How can this be explained? The existent literature highlights factors like Islamist parties (Buehler, 2008), institutional change (Buehler, 2008, 2016), socio-economic structures (Buehler, 2016; Buehler & Muhtada, 2016), and critical historical events (Bazzi et al., 2020). We propose an alternative line of explanation: we hypothesize that natural disasters are conducive to the introduction of religious laws. Previous literature has identified the link between natural disasters and religiosity (Aslam et al., 2022; Bentzen, 2019a, 2019b; Sibley & Bulbulia, 2012), yet little is known of how enhanced religiosity translates into the codification of religious laws. We aim to fill this gap.

We test our hypothesis at the subnational level of the world's largest Muslim-majority country – Indonesia. First, we employ a novel granular dataset on local regulations with an Islamic overtone typically enacted in districts and municipalities (Buehler, 2016), covering the whole post-Suharto period (1998-2020). Second, our empirical identification utilizes the exogenous variation in seismic natural disasters, such as earthquakes, tsunamis, and volcanic eruptions (EM-DAT, 2023), controlling for province-year and district fixed effects. We find that districts in proximity to a natural disaster are 37 percent more likely to introduce Sharia law in the following year, and the effect persists over the following years. Testing for the mechanism of religious coping (Bentzen, 2019b), we use a longitude survey (Indonesian Family Life Survey) to show that natural disasters are associated with higher self-reported religiosity and frequency of praying in areas closer to natural disasters.

This study contributes to several strands of literature. First, our findings speak to research concerning natural disasters' economic and socio-economic consequences. Natural disasters affect spending and saving behavior (Filipski et al., 2019), social and civic capital (Bai & Li, 2021; Buonanno et al., 2023), GDP per capita (Barone & Mocetti, 2014), crime (Hombrados, 2020), religiosity (Aslam et al., 2022; Bentzen, 2019a; Sibley & Bulbulia, 2012), institutions (Belloc et al., 2016), public spending (Masiero & Santarossa, 2020), and political outcomes (Cerqua et al., 2023; Masiero & Santarossa, 2021). Compared to previous literature, this study yields novel insights into the influence of natural disasters on political outcomes, specifically regarding the institutionalization of religious law.

Second, we advance the literature on the relationship between religiosity and the institutionalization of religious laws. Bentzen and Gokmen (2023) examine how religion has been used to legitimize political power and its implications for modern institutions through religious laws. While they consider exogenous variation in incentives to use religion for power and differences in religious laws at the country level, this study applies exogenous variation in the timing of a natural disaster to estimate the differences for districts and cities in Indonesia.

Finally, our study contributes to the understanding of the roots of Sharia laws in Indonesia (Bazzi et al., 2020; Buehler, 2008, 2013, 2016; Buehler & Muhtada, 2016; Pisani & Buehler, 2017).

The paper is structured as follows. Chapter 2 reviews the existing literature, while Chapter 3 introduces the institutional setting of Indonesia. Chapter 4 describes the data. Chapter 5 explains the estimation strategy and presents the results. Chapter 6 discusses the findings, and Chapter 7 concludes.

2 Literature Review

This study aims to make contributions to various research fields. The first field relates to analyzing natural disasters' economic and socio-economic consequences. In particular, we focus on exploring the impact of natural disasters on religiosity. According to the religious coping hypothesis, individuals seek solace in religious beliefs and practices when they experience adverse and unpredictable life events (Bentzen, 2019a, 2019b; Pargament, 2001). Bentzen (2019a) explains that this coping mechanism may involve fostering a stronger connection with God through prayer or engaging in religious rit and ascribing the occurrence of events to divine power. By doing so, individuals aim to alleviate emotional distress by using emotion-based coping strategies.

The empirical literature supports this hypothesis. Using data on religiosity from 212,157 persons living in 914 districts in 85 countries, Bentzen (2019a) finds that individuals become more religious following the occurrence of an earthquake nearby. The author utilizes three characteristics of the effect to identify it. First, the effect is considered psychological, implying that individuals do not need to be directly affected by natural disasters to be influenced by them. Second, it is more likely that individuals apply religion as a coping strategy in challenging situations when they are unpredictable. Therefore, the effect is primarily driven by unpredictable disasters. Third, individuals tend to rely more on intrinsic rather than extrinsic religiosity for coping. Bentzen (2019a) also employs a placebo test to demonstrate that

unobservable factors do not distort the results. The placebo test examines whether future earthquakes have an impact on current religiosity. Lastly, the author demonstrates that the effect is persistent but diminishes over time. In summary, Bentzen (2019a) presents compelling evidence supporting the notion that individuals exhibit increased religiosity following natural disasters. While alternative explanations cannot be ruled out, the author argues that the religious coping hypothesis is the only one capable of accounting for all the observed findings.

Aslam et al. (2022) provide further insights by conducting a case study on the population of Pakistan, which is predominantly Muslim, in the aftermath of the 2005 earthquake. According to the authors, natural disasters are attributed to a divine origin within the Islamic context, and seeking help through prayers and patience is advocated[1]. They utilize individual-level data instead of district-level data, including characteristics such as age, gender, marital status, household size, income, and urbanity of the residence. Aslam et al. (2022) report a positive correlation between exposure to the earthquake and religiosity. Furthermore, they discover that the impact of religious coping intensifies with higher levels of education and advancing age. Additionally, a more substantial effect of religious coping is observed among women than men. Therefore, this study presents additional evidence supporting the religious coping hypothesis and highlighting the impact of individual characteristics (Aslam et al., 2022).

Sibley and Bulbulia (2012) find further evidence supporting the hypothesis. They discovered that religiosity increased among the earthquake-affected population in New Zealand during the February 2012 earthquake, while it declined in other population segments. Similarly, Bentzen (2021) finds that religiosity increased globally during the COVID-19 pandemic using Google searches on praying. According to the author, this increase is not due to the closing of churches or the lockdown. Espín-Sánchez et al. (2023) find that a more prolonged drought is associated with a higher likelihood that individuals dependent on agriculture will pray for rain. Additionally, the authors argue that praying for rain can predict the end of the dry spell when the probability of rain increases over time. Finally, Buonanno et al. (2023) consider religiosity an aspect of civic capital. They find that past earthquakes have increased religiosity using historical data from Italian municipalities. A heterogeneous effect across dimensions of space, frequency, magnitude, and time is found. In summary, there is strong evidence for the religious coping effect.

Furthermore, natural disasters influence other socio-economic and economic aspects, such as expenditure and saving behavior (Filipski et al., 2019; Hanaoka et al., 2018), social and civic

[1] Within the Islamic framework, three potential explanations are provided for natural disasters: as a form of divine punishment, as a warning for those who engage in wrongdoing, or as a trial intended to test the faith of believers (Aslam et al. , 2022).

capital (Bai & Li, 2021; Buonanno et al., 2023; Cassar et al., 2017), GDP per capita (Barone & Mocetti, 2014; Kang & Skidmore, 2018), crime (Hombrados, 2020), public spending (Masiero & Santarossa, 2020), institutions (Belloc et al., 2016), voting behavior (Fair et al., 2017), and electoral outcomes (Cerqua et al., 2023; Masiero & Santarossa, 2021).

This study expands upon the existing literature on the religious coping hypothesis by examining the consequences of natural disasters on political outcomes and the role of religious laws in this context. Belloc et al. (2016) find that earthquakes between 1000 and 1300 in central Italian cities delayed the transition from autocracy to communal administration when the political and religious leaders were the same. However, this connection is not observed when political and religious leaders are not identical. Therefore, political-religious leaders can capitalize on the shock to assert and consolidate their political power. Likewise, Masiero and Santarossa (2021) reveal that the occurrence of destructive earthquakes enhances the re-election chances and electoral support for incumbent political officials. The authors state that this effect is attributable to increased media visibility and the facilitated provision of recovery payments. In addition, Cerqua et al. (2023) present evidence showing that regions unable to recover from earthquakes exhibit an increased propensity to vote for authoritarian right-wing parties, potentially leading to the establishment of "authoritarian hotbeds."

Bentzen and Gokmen (2023) examine how religion has been historically employed to legitimize political power and its implication for current institutions. To identify the effect, they employ exogenous variation for the stratification of societies and predict whether societies believe in high gods[2]. Societies relying on irrigation are more likely to evolve into stratified societies (Bentzen et al., 2017). Bentzen and Gokmen (2023) present evidence indicating that more stratified societies are more inclined to believe in high gods and that history with high gods for legitimizing power is associated with a higher probability of incorporating religious laws into institutions. Further, signs of a positive correlation between countries with a high god history and autocracy, as well as religiosity in general, are found. A similar relationship is discovered by Barro and McCleary (2005), who establish a connection between state religion and autocracy. Mehmood and Seror (2023) show, by employing a difference-in-differences approach in Pakistan, that districts with a higher historical presence of religious institutions exhibit a weaker rule of law. Their results indicate that this effect can be attributed to the rise of religious leaders gaining political office and engaging in rent-seeking activities. These findings align with Weber's (1922) stylized theory of legitimization, which posits that leaders can gain legitimacy through democracy, aristocracy, or religion. Holding all other factors equal,

[2] High gods are moralizing, intervene with human behavior, and impose punishment.

in cases where leaders derive legitimacy from religion, the theory predicts a lower probability of legitimization through democracy. However, an analysis of the direct association between natural disasters and religious laws is novel to the existing literature. The findings can provide further insights into the interplay between religion, politics, and the manifestation of religious laws in institutions.

Finally, this study explains the origins and causes of introducing Sharia laws in Indonesia. The following section will provide a more detailed analysis of the institutional setting in Indonesia.

3 Institutional Background

In the past, several Muslim countries experienced a surge in demand for the Islamization of institutions and laws after democratization, aimed at preserving Muslim values and ideals. This phenomenon can be seen in Pakistan, Egypt, and Indonesia (Buehler, 2013; Buehler & Muhtada, 2016; Kendhammer, 2013). Indonesia, the world's most populous Muslim nation, underwent a democratization process following Suharto's demise in 1998, subsequently leading to an institutionalization of religious laws (Buehler, 2016) in some regions. Simultaneously, Indonesia is prone to a variety of natural disasters. According to the World Risk Report (2022), Indonesia ranks as the third most disaster-prone country out of 192 nations. Therefore, Indonesia provides a unique setting for investigating the research question. This section aims to explain potential causes for Sharia law implementation in Indonesia.

Sharia laws in Indonesia usually manifest as local regulations in districts, provinces, or municipalities with an Islamic overtone. These regulations encompass a range of aspects, including the prohibition of alcohol, gambling, drugs, and prostitution, as well as rules governing the collection of religious alms, Qur'an readings, education, and dress codes for women (Buehler, 2016, p. 1).

While in other countries, the emergence of Islamist parties has led to the introduction of Sharia laws, Buehler (2013, 2016) contends that a combination of socio-economic structures and institutional changes have driven this implementation in Indonesia. This perspective also accounts for the significant spatial variance in Sharia laws (Buehler, 2013; Buehler & Muhtada, 2016).

Islamic activism began to gain strength following the Japanese occupation in 1945. In certain provinces, this led to the emergence of local Islamist movements and uprisings. These Islamist movements endured through the New Order regime[3] via schools, foundations, and networks.

[3] The authoritarian regime under former President Suharto lasted from 1966 to 1998.

Consequently, in certain provinces, these Islamist movements developed into Islamist networks deeply entrenched within the electorate (Buehler, 2016, pp. 44–68).

Following Suharto's demise in 1998, significant institutional changes ensued. Political and fiscal authority underwent decentralization, empowering subnational levels (Law No. 22/1999). The central government, provinces, and districts (including cities) are the three primary government tiers. While the central government is responsible for law enforcement, the judiciary, monetary and macroeconomic policies, religious affairs, foreign relations, security policies, and defense, subnational levels are tasked with all the remaining functions, including providing public goods such as education, health, and infrastructure. Compared to districts, provinces have a limited role in these responsibilities (Gonschorek, 2021).

Free elections were introduced during the democratization, and the party system was overhauled. The elections for local parliaments and government head positions[4] and the liberalization of party formation gave rise to novel avenues of political engagement. Subsequent institutional alterations at the subnational level resulted in a reduction of checks and balances within administrative layers. These changes elevated local government heads and mayors to powerful positions in local politics. The Law No. 22/1999 enables local district heads and parliaments to issue local laws. Law No. 32/2004 and Law No. 12/2008 then shifted local authorities strongly to district heads, limiting the ability of local parliament. As a result, legislatures have a more limited ability to draft local laws than district heads. These changes prompted state elites, who had previously acquired power and wealth through the New Order regime, to again strive for positions of power through these elections (Buehler, 2016, pp. 69–89).

This new political landscape necessitated these state elites to display receptiveness to the electorate if they wanted to stay in power positions. This obligation called for the formation of local alliances and garnering mass support. They had to accumulate political, cultural, and economic capital to organize the electorate. However, due to various scandals and financial weaknesses, Islamist parties could not meet this requirement. Consequently, the state elites were coerced into seeking counsel from alternative power holders. Thus, the state elites turned to Islamist networks operating outside the conventional political arena, which had established their presence in specific provinces. These networks could supply essential political resources, but in return, they demanded the implementation of religious laws (Buehler, 2016, pp. 90–131).

[4] Governors, district mayors, and regents have been directly elected since 2005 by popular vote (Law No. 32/2004) (Gonschorek, 2021).

The Islamist networks were the most coordinated and established societal actors with whom the state elites could collaborate to build political power. Typically, they refrained from direct involvement in politics but pressured candidates by acting as gatekeepers for religious authenticity (Buehler, 2016, pp. 132–157).

Hence, "trades" emerged between the Islamist networks and the state elites occupying influential local government head positions. On the supply side, Islamist networks could offer political capital through well-connected Islamist leaders who act as power brokers. Additionally, they could provide cultural capital by enhancing and rebuilding reputations after scandals. Economic capital could be supplied through Sharia laws, which grant greater discretionary control over funds and create rent-seeking opportunities, such as regulating entertainment venues or alcohol. Moreover, the Islamist networks organized direct collections to raise funds for the campaigns of selected candidates. On the demand side, the Islamist networks sought to institutionalize religious laws, which the state elites were willing to fulfill (Buehler, 2016, pp. 158–186; Pisani & Buehler, 2017).

In this context, Buehler (2008) argues that Sharia laws are introduced to consolidate political power and can be characterized as political corruption. This explanation also elucidates the geographical variation in implementing Sharia laws, as they are mainly introduced in jurisdictions where Islamist networks are firmly rooted within society (Buehler, 2013; Buehler & Muhtada, 2016).

In summary, according to Buehler (2016), two conditions can explain the introduction of Sharia laws in Indonesia. First, the institutional changes following the end of the New Order regime, which bolstered local government heads and mayors while intensifying competition among state elites, can be identified as a driving force. Second, the profound entrenchment of Islamist networks and movements outside the political arena in specific provinces rendered them capable power brokers for state elites seeking support.

Bazzi et al. (2020) delineate another potential cause that could have facilitated the introduction of Sharia laws in Indonesia. During the 1960s, rural elites transferred substantial agricultural land to Islamist institutions to shield them from expropriation. These agricultural lands could then be utilized as a continuous income stream, furnishing capital to Islamist activists and enabling them to compete with other political actors and disseminate their ideology.

Bazzi et al. (2020) ascertain that regions facing a higher threat of land expropriation in the 1960s exhibit a greater likelihood of supporting Islamist parties, endorsing the implementation of Sharia laws, and having a more pronounced endowment of Islamist institutions such as mosques and religious schools. The authors explain this effect by attributing it to an elevated

demand for religion in politics rather than heightened religiosity or greater piety among the population.

In summary, scholars highlight critical junctures in Indonesia's history, including the post-1998 democratization and the agricultural land expropriations during the 1960s, as potential causes of the institutionalization of religious laws. Further, socio-economic structures like Islamist institutions and networks are identified as contributing factors. Nonetheless, a comprehensive understanding of the underlying causes requires additional research. This study aims to delve into another such factor.

4 Data

4.1 Sharia Laws

The dataset we use for the primary analysis is from Buehler (2020). This dataset contains information on the introduction date of Sharia laws at the administrative level of Indonesian districts (*kabupaten*) and cities (*kota*). For simplicity, we will refer to both as districts in the paper. It is an unbalanced data set covering 1998-2020 across 497 Indonesian districts in 34 provinces. Therefore, the dataset includes many of today's 514 second-level administrative units. Buehler (2020) identifies 19 different types of Sharia laws[5]. In total, there are 768 Sharia laws at the district level. The most common Sharia laws are regulations imposed on the bureaucracy (169), alcohol (148), and religious alms (101). The total number of Sharia laws per type is shown in *Appendix 1*. *Figure 1* identifies the districts that have experienced the introduction of Sharia laws over the specified period.

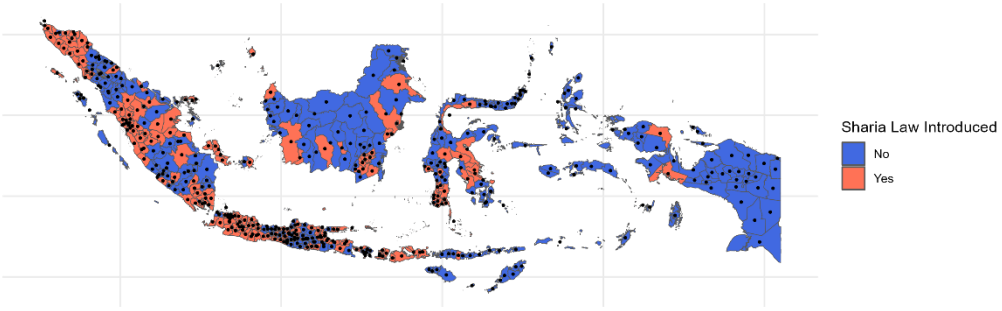


Figure 1: Sharia Law Introduction Indonesia

In *Figure 1*, it is evident that Sharia laws cluster in specific regions or provinces. Similar observations are also described by Buehler (2016). Although the phenomenon of Sharia law

[5] The different Sharia laws that Buehler (2020) identifies are on the prohibition of alcohol, religious alms, welfare to the poor, dress code, religious bureaucracy, public order (good and evil deeds), religious cults and sects, the prohibition of drugs, religious worship, religious education, Islamic banking, religious tourism, Hallal certification, gambling, *Khalwat* (proximity to the opposite sex), entertainment industry, Islamic criminal code (*Jinayat*), prostitution and female circumcision.

introduction appears to be region-specific, these regions have a higher population. The average population in the districts affected by Sharia laws (649,994.4) is higher than in those not affected (508,352.7). Furthermore, nearly half (around 45%) of the Indonesian population is affected by the introduction of Sharia laws. Thus, it can be argued that introducing Sharia laws constitutes a national trend[6].

We calculate the sum of all Sharia laws per year for each district and create a dummy variable (*Dummy Sharia*) that takes the value of one if a Sharia law is introduced in a district in a given year. We will use the *Dummy Sharia* variable throughout the paper as the primary dependent variable. The study results remain qualitatively consistent when we use the number of Sharia laws per year as the dependent variable. The result table for the number of Sharia laws (*Number Sharia*) is in the Appendix *3*.

4.2 Natural Disaster

We derive the intensity measure for natural disasters using the information on catastrophes in the EM-DAT (2023) dataset from the Centre for Research on the Epidemiology of Disasters (CRED). The EM-DAT database provides information on all disasters that have killed ten or more people, affected one hundred or more, for which a state emergency has been declared, or for which an appeal for international assistance has been made. This dataset enables gathering information on the date, epicenter, total number of fatalities, and the disaster type for all natural catastrophes in Indonesia between 1998 and 2020 that satisfy the previously stated criteria.

Since the unpredictability of the timing of natural disasters forms one of the identification strategies, we employ only earthquakes[7] and volcanic eruptions. According to Bentzen (2019a), the timing of earthquakes and volcanic eruptions is considered unpredictable, while for storms, droughts, landslides, and floods, it is far simpler for professionals to foresee them. Excluding these predictable disasters, therefore, deals with endogeneity concerns, thereby strengthening the validity of the analysis.

We capture the intensity of a natural disaster in two dimensions. The first dimension is the distance of a district's center to the epicenter of the natural disaster. The distance to the epicenter is exogenous and can be calculated with rather basic methods. The centers of districts are available through the Global Administrative Areas (2022) dataset. This dataset contains the longitude and latitude of the district centers. The black dots in *Figure 1* mark the district centers.

[6] Utilizing the 2010 population figures obtained from Gonschorek (2021), originally sourced from INDO-DAPOER. Population data is available for 387 out of 497 districts. The calculations include the province Aceh. The total population is calculated as the sum of the available district population figures from 2010. Additionally, in *Appendix 2*, a heat map depicting the 2010 population figures of the included districts can be found.

[7] Tsunamis are listed as earthquakes in EM-DAT.

Based on this, the distance to the epicenter measured in kilometers is calculated for all disasters retrieved from EM-DAT (2023)[8]. The second dimension of intensity is the fatality of the disaster, thus an indicator of the severe consequences. This indicator is measured by the total number of deaths from the disaster provided by EM-DAT (2023). Since the fatalities of a disaster are connected to factors such as disaster mitigation or some development indicators (Cevik & Tovar Jalles, 2023) that are potentially correlated with the introduction of Sharia laws, we use the magnitude of earthquakes measured in the Richter scale as a robustness check.

To compute the *Disaster Intensity* for a specific district *(d)* within a province *(p)* during a given year *(t),* we employ the following *Equation (1)*:

$$Disaster\ Intensity_{dpt} = \sum \frac{Disaster\ Fatalities_{e,d,p,t}}{(Disaster\ Distance_{e,d,p,t})^2} \quad (1)$$

Firstly, we utilize the squared inverse distance of district *(d)* to each disaster *(e*) happening in a year *(t)*, which accommodates non-linear associations between distance and intensity. The gravity equation for trade inspires the idea for this approach. The squared inverse distance signifies that districts near the epicenter are more severely affected than those at greater distances. The impact then diminishes in a non-linear fashion as the distance increases. We do not observe an effect of natural disasters on the introduction of religious laws when the disaster distance is not squared in the calculation. The result for assuming a linear relationship between intensity and distance is provided in the *Appendix 4*.

Subsequently, we multiply this distance metric by the total fatalities associated with each disaster *(e)*. The *Disaster Intensity* for the given district *(d)* in that year *(t)* can be determined by summing this up for every disaster occurring in the specific year. All disasters that do not have a specified number of fatalities are excluded from the sample. This exclusion also includes non-fatal disasters, which are recorded as unavailable. The calculation mentioned above enables the determination of an indicator of disaster intensity for each observation. Throughout the paper, this will be the primary variable of interest.

Regrettably, the EM-DAT database only provides the overall fatality figures for each disaster event instead of district-specific numbers. However, we have partially mitigated this limitation by including the distance to the natural disaster in *Equation (1)*. It is reasonable to assume that areas close to the epicenter would experience the highest fatalities, while more distant districts might report no fatalities at all. Therefore, the derived *Disaster Intensity* can be considered a sensitive proxy for actual disaster intensity.

[8] The distance is calculated in R with the distm() function of the package geosphere and the Haversine method.

The two datasets are merged based on the name of the district and the year. The names are adjusted for all observations that could not be merged due to different spellings. Finally, the province of Aceh is excluded from the sample due to its status as a special autonomous province (Gonschorek, 2021).

4.3 Descriptive Statistics

Table 1 shows the summary statistics for the primary dataset.

Table 1: Summary Statistics

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
Number Sharia	8401	0.067	0.31	0	0	0	6
Dummy Sharia	8401	0.055	0.23	0	0	0	1
Disaster Intensity (Fatalities)	8401	0.029	0.56	0	0.0000035	0.00087	40
Disaster Intensity (Richter)	8401	0.022	0.61	0	0.00042	0.0042	52
Dummy Natural Disaster	7927	0.34	0.48	0	0	1	1

After omitting the province Aceh, 8401 district-year observations are remaining. The average number of Sharia laws introduced yearly in the sample is 0.067, with a standard deviation of 0.31. The maximum number of Sharia laws was in the District Dompu of the province Nusa Tenggara Barat in 2005, with six regulations. In addition, the overall average probability of introducing a Sharia law is 0.055, with a standard deviation of 0.23. The highest likelihood of Sharia law introduction is found in the districts of Dompu (0.5), Hulu Sungai Utara (0.48), and Bulukumba (0.44), as well as the provinces of Nusa Tenggara Barat (0.20), Jawa Barat (0.17), and Kalimantan Selatan (0.17). Furthermore, the average *Disaster Intensity* in the fatality specification is 0.029. The standard deviation is 0.56, corresponding to an earthquake at 100 kilometers distance and a total of 5600 fatalities. Or about, for the case of Kota Semarang, the intensity of the Yogyakarta earthquake in 2006 with 5778 fatalities and a distance to the epicenter of 104 kilometers. Similarly, the average *Disaster Intensity* in the Richter specification is 0.22, with a standard deviation of 0.61. This intensity is approximately equivalent to an earthquake at a distance of 30 km with a magnitude of six on the Richter scale. For example, the earthquake in March 2007 near the district of Kota Sawahlunto had a distance to the district center of 31.29 km, a magnitude of 6 on the Richter scale, and 67 fatalities.

Lastly, to provide preliminary evidence, we have created a dummy variable that takes the value of one if a natural disaster occurred within 500 kilometers of the district's center in the previous year. In total, 34 percent of the observations were affected by a previous year's natural disaster. *Figure 2* compares the probability of introducing a Sharia law (average of *Dummy Sharia*) between observations affected by a natural disaster in the previous year (disaster within 500 km distance) and those unaffected by such a disaster.

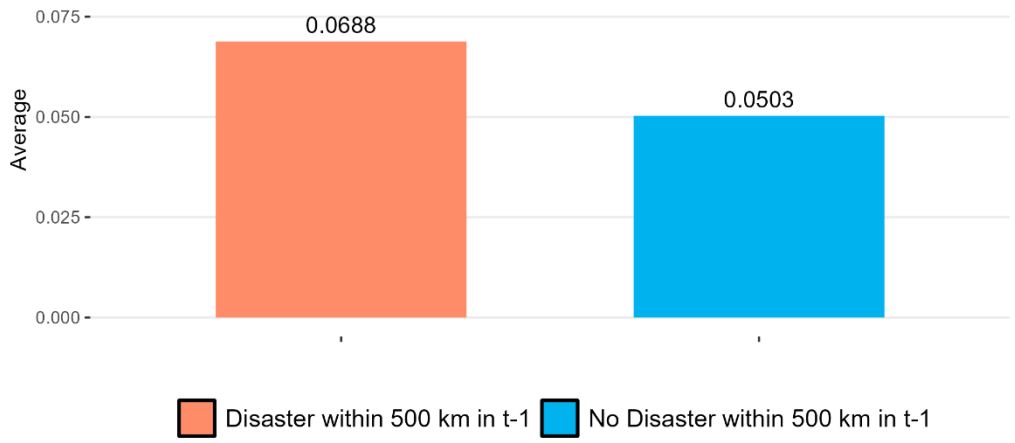


Figure 2*:* Comparison of Average Dummy Sharia

The probability of Sharia law introduction is, according to the Fisher exact probability test[9], statistically significantly larger for those observations that are affected by a natural disaster in the previous year. The true odds ratio is greater than one at a 5% significance level with a calculated odds ratio of 1.4, a risk ratio of 1.37, and a lower 95% confidence interval bound at 1.18. Based on this, the probability of introducing Sharia laws increases by approximately 1.37 times if a natural disaster occurred within 500 km in the previous year. This provides preliminary indications that natural disasters could be conducive to the introduction of Sharia laws.

In *Figure 3*, we compare the probability of Sharia law introduction in the full sample to the probabilities for Sharia law introduction in the first, second, third, and fourth years following a disaster (when the epicenter is less than 500 km away).

[9] A Welch two-sample t-test shows a significant mean difference, but the normal distribution assumption may be violated. Alternatively, a Pearson chi-square test with Yates continuity correction indicates an association between the categorical variables.

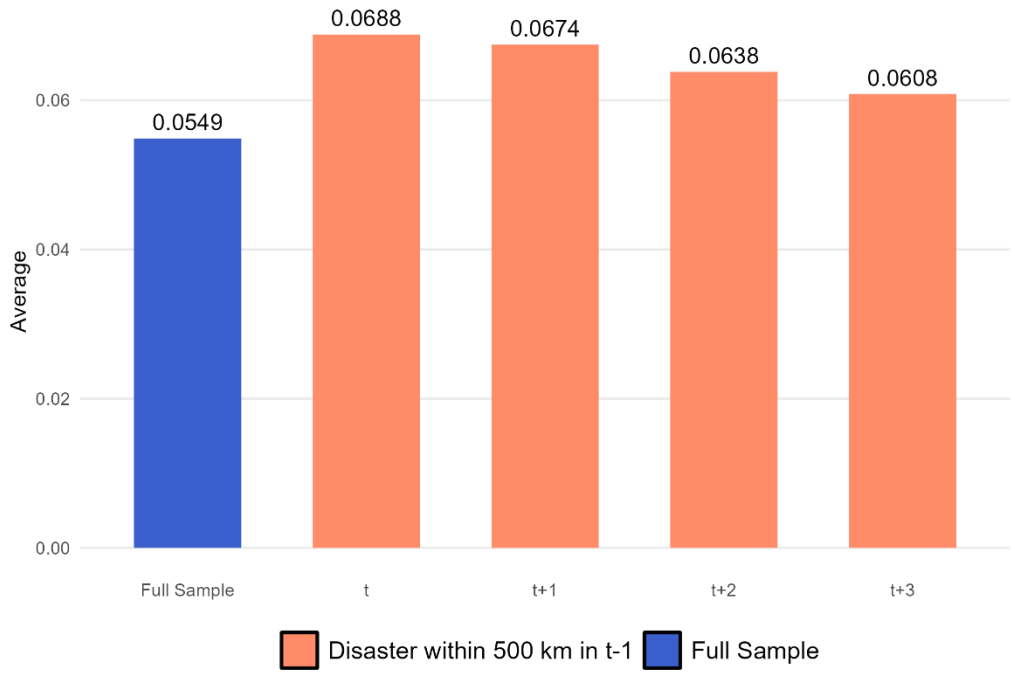


Figure 3: Comparision Dummy Sharia for 1st - 4th Year after Disaster

Figure 3 suggests that the increased probability decreases over subsequent years in the aftermath of the disaster but remains persistent.

However, these are only preliminary indications, and more advanced statistical methods need to be applied to establish a causal relationship. Such an approach will be described in the following sections.

5 Main Results

The following section will describe the empirical strategy for identifying the causal relationship between natural disasters and introducing religious laws. Furthermore, the results will be reported, interpreted, and checked for robustness. Moreover, it is examined whether religious coping could explain the findings.

5.1 Identification and Methodology

We apply various strategies to identify the causal relationship between natural disasters and religious laws. While the location of a natural disaster depends on ground characteristics, the timing is considered exogenous (Bentzen, 2019a). Therefore, we use the timing of natural disasters as a natural experiment by incorporating a multidimensional fixed effects model to analyze the within-district variation. In addition, the analysis focuses exclusively on earthquakes and volcanic eruptions, which are regarded as unpredictable. Conversely, floods, storms, landslides, and droughts exhibit a seasonal pattern that can be partially anticipated (Bentzen, 2019a).

Additionally, we implement a placebo test to assess whether district-level trends align with the occurrence of natural disasters. Through this analysis, we provide evidence that future natural disasters do not affect the introduction of current religious laws (Bentzen, 2019a). Furthermore, a potential concern is that the number of fatalities may be endogenous to economic development and disaster mitigation. First, the multidimensional fixed effect model captures some of these aspects. Second, to address this issue, we show evidence that the results remain robust when using the exogenous magnitude of earthquakes to calculate the disaster intensity proxy.

To estimate the effect of the intensity of earthquakes and volcanic eruptions[10] on the introduction of Sharia regulations, we employ the following Equation (*2*):

$$\begin{aligned} Dummy\ Sharia_{d,p,t} \\ = \beta\, Disaster\ Intensity_{d,p,t-1} + \mu_d + \gamma_t * \lambda_p + \eta\, X'_{d,p,t-1} \\ + \varepsilon_{d,p,t} \end{aligned} \tag{2}$$

Equation (2) regresses the *Dummy Sharia* for district *(d)* in the province *(p)* in the year *(t)* on the *Disaster Intensity* indicator for the same district *(d)* in the province *(p)* in the previous year *(t-1)*. In this context, we include the lagged *Disaster Intensity* variable to accommodate the time necessary for political changes to develop. Formulating and implementing newly introduced laws typically requires some time. This approach also prevents situations that could disrupt the chronological order, for instance, the introduction of Sharia laws before the occurrences of natural disasters within the same year. Furthermore, the baseline specification includes district *(μ_d)* and year-province fixed effects *($\gamma_t * \lambda_p$)*. This enables the analysis of the variation within districts. District fixed effects control for unobserved time-invariant heterogeneity at the district level, such as geological and environmental characteristics, infrastructure, or cultural and religious beliefs. Including year-province fixed effects differences out common trends within each province over time. This approach is particularly advantageous as Sharia regulations cluster in specific provinces. Therefore, controlling for the province-specific characteristics that might influence the introduction of Sharia laws improves the robustness against omitted variable bias.

The set of control variables ($X'_{d,p,t-1}$) includes district-specific trends. We control for the lagged log change in revenue per capita (*Revenue per Capita*), the lagged log first differenced regional GDP (*GRDP*), and the lagged log change in population size (*Population*). These control variables are extracted from Gonschorek (2021) and initially sourced from the

[10] Based on the *Disaster Intensity* calculation of *Equation (1)*.

Indonesian Database for Policy and Economic Research (INDO-DAPOER)[11]. The variable *Revenue per Capita* captures preceding changes in the districts' local revenue budget or fiscal capacity. Similarly, the variable *GRDP* captures former shifts in the size of the economy. On the other hand, *Population* accounts for previous changes in population and migration flows. We include these three variables as controls to mitigate the possibility of them driving the acceptance of religious law introduction. *Chapter 6* discusses the possibility of including additional control variables.

To estimate *Equation (2)*, we employ a multidimensional fixed effects Poisson model, even though logistic regression is typically used for binary outcome variables. Zou (2004) and Zou and Donner (2013) recommend applying a Poisson model with robust standard errors to directly calculate a relative risk, as it offers a more straightforward interpretation than odds ratios. Reporting results in terms of relative risk has become the preferred approach in epidemiological and medical studies. The Poisson method is deemed appropriate for rare events like introducing Sharia laws with an overall probability of 5.5 percent and many zeros in the dependent variable. However, using the Poisson method for a binary dependent variable may lead to overestimated standard errors (Zou, 2004). To address this and potential spatial dependence, we cluster the standard errors (given in parentheses) at the province level, ensuring the robustness of the error term.

Moreover, using the Poisson model excludes all observations from districts that have not introduced Sharia laws. Hence, all blue-colored districts in *Figure 1* are excluded. While this may lead to the omission of several provinces and districts (276 districts and 5,665 observations) from the regression, the findings can be interpreted as a national trend. As discussed in Section 4.1, the introduction of religious laws affects close to half of the Indonesian population. Therefore, excluding districts that have not implemented Sharia laws can be justified. The *Appendix 5* includes regression results using an alternative negative binomial regression model[12] to provide evidence that addresses concerns about potential bias in the results arising from violating the equal dispersion assumption.

[11] Utilizing the dataset compiled by Gonschorek (2021) is advantagous as it already incorporates the unique district identification used in the Sharia dataset. This facilitated the seamless integration of control variables directly into the Sharia dataset. The control variables are only available for 4334 observations in the case of *Revenue per Capita*, 4555 observations for *GRDP*, and 4501 in the case of *Population*, leading to a reduction in the sample size.

[12] There are no signs of overdispersion, and the results remain robust.

5.2 Baseline Results

Table 2 provides the results of the baseline regression as relative risk ratios. The column (1) shows the resulting relative risk ratio without controlling for district-specific trends. In the second column (2), the specification includes district-specific control variables.

Table 2: Baseline Results

Dependent Variable:	Dummy Sharia	
Model:	(1)	(2)
Variables		
Disaster Intensity (t-1)	3.5161***	17.5699***
	(1.2658)	(2.5041)
Revenue per Capita (t-1)		0.6746
		(1.4889)
Population (t-1)		0.5811
		(1.8823)
GRDP (t-1)		2.4648
		(1.7485)
Fixed-effects		
District	Yes	Yes
Year-Province	Yes	Yes
Observations	2,262	1,426

Clustered (Province) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Note: Coefficients are relative risk ratios.

The simple regression analysis reveals a statistically significant relative risk ratio of 3.516. This result implies that a one-unit change in *Disaster Intensity* is associated with a 3.5 times increase in the probability of Sharia law introduction. Furthermore, a one-standard-deviation change in the *Disaster Intensity* variable (0.56) leads to a substantial two times increase in the likelihood of Sharia law implementation. Such a *Disaster Intensity* corresponds to a level of *Disaster Intensity* similar to that of the Yogyakarta earthquake in 2006 experienced in Kota Semarang with 5,778 fatalities and a distance of 104 kilometers from the district center. These findings provide evidence supporting the hypothesis that natural disasters are conducive to the introduction of Sharia laws.

After controlling for district-specific trends, the statistical significance remains, and the relative risk ratio increases to 17.57. This finding shows that a one-standard-deviation change in *Disaster Intensity* is associated with an approximate five times increase in the probability of Sharia law introduction.

Additionally, the results indicate that an increase in *Population* and *Revenue per Capita* lowers the likelihood of Sharia law implementation. At the same time, a positive change in regional

GDP (*GRDP*) in the previous year is predicted to have a conducive effect on Sharia law introduction. However, for the control variables, no statistical significance is reached.

In an alternative specification, we seek to assess the persistence of the heightened probability of implementing religious laws in the aftermath of natural disasters. To examine this, we extend *Equation (2)* by incorporating three additional lagged values of the *Disaster Intensity* variable. *Equation (3)* presents the modified equation incorporating the additional lagged values of *Disaster Intensity*.

$$Dummy\ Sharia_{d,p,t} = \sum_{i=1}^{4} \beta_i\ Disaster\ Intensity_{d,p,t-i} + \gamma_t * \lambda_p + \mu_d + \eta\ X'_{d,p,t-1} + \varepsilon_{d,p,t} \quad (3)$$

Table 3 presents the regression analysis results based on Equation *(3)*, displaying the relative risk estimates.

Table 3: Persistence Results

Dependent Variable:	Dummy Sharia	
Model:	(1)	(2)
Variables		
Disaster Intensity (t-1)	12.68***	47.12**
	(2.592)	(4.670)
Disaster Intensity (t-2)	4.723**	5.208
	(1.998)	(2.812)
Disaster Intensity (t-3)	4.150**	4.627
	(1.975)	(2.735)
Disaster Intensity (t-4)	5.557**	6.028*
	(2.068)	(2.886)
Revenue per Capita (t-1)		0.7194
		(1.497)
Population (t-1)		0.6211
		(1.875)
GRDP (t-1)		2.413
		(1.756)
Fixed-effects		
District	Yes	Yes
Year-Province	Yes	Yes
Observations	1,689	1,425

Clustered (Province) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Note: Coefficients are relative risk ratios.

In column (1), the risk ratios are presented for the regression model that exclusively incorporates the four lagged *Disaster Intensity* variables. All exhibit statistical significance,

indicating that *Disaster Intensity* substantially enhances the probability of introducing religious laws over multiple years. After including the control variables, all lags except the first lag of *Disaster Intensity* lose statistical significance at conventional significance levels. Nevertheless, all risk ratios are greater than one, providing some evidence that natural disasters have a persistent conducive effect on the introduction of religious laws over several years. The results thus remain robust for a model that assumes an over multiple years persistent relationship.

5.3 Robustness Checks

To address the concern that unobservable heterogeneity correlates with the natural disaster variable, we conduct a placebo test. The placebo test examines whether future natural disasters impact current Sharia laws, similar to the approach of Bentzen (2019a). This approach allows researchers to assess whether the effect is genuinely causal or could be attributed to unobservable confounding factors. Introducing a situation that violates the natural temporal order can render any observed relationship spurious or indicative of confounding factors. If the placebo test reveals a significant relationship between *Disaster Intensity*$_{d,p,t+1}$ and the *Dummy Sharia*, it suggests the presence of unobserved confounding trends. Conversely, a non-significant association found in the placebo test strengthens the argument for a causal relationship. We employ *Equation (4)* for this approach. *Table 4* shows the resulting relative risk ratios.

$$Dummy\ Sharia_{d,p,t} = \beta\, Disaster\ Intensity_{d,p,t+1} + \gamma_t * \lambda_p + \mu_d + \eta\, X'_{d,p,t-1} + \varepsilon_{d,p,t} \quad (4)$$

$$with\ Disaster\ Intensity_{d,p,t+1} = \sum \frac{Disaster\ Fatalities_{e,d,p,t+1}}{(Disaster\ Distance_{e,d,p,t+1})^2}$$

The findings reveal that *Disaster Intensity*$_{d,p,t+1}$ does not significantly affect current Sharia laws with and without controlling for district-specific trends. This outcome suggests that unobserved district-specific trends have limited or negligible influence on the *Disaster Intensity* variable or are captured by the multidimensional fixed effects. These results provide evidence supporting the exogeneity of this variable, thereby establishing the study as a reasonable natural experiment.

Table 4: Placebo Test

Dependent Variable:	Dummy Sharia	
Model:	(1)	(2)
Variables		
Disaster Intensity (t+1)	0.2582	0.7343
	(2.3541)	(1.8760)
Revenue per Capita (t-1)		0.6481
		(1.5958)
Population (t-1)		0.5590
		(1.9960)
GRDP (t-1)		2.4411
		(1.8103)
Fixed-effects		
District	Yes	Yes
Year-Province	Yes	Yes
Observations	2,252	1,303

Clustered (Province) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Note: Coefficients are relative risk ratios.

Furthermore, the placebo test provides evidence against another potential concern. According to Espín-Sánchez et al. (2023), religious institutions and practices, such as praying for rain, are predictive of the duration of droughts. Based on the results of the placebo test, we find no evidence that religious laws are predictive of earthquakes and volcanic activity, suggesting that reverse causality is unlikely to be an issue.

To further address the concern regarding the potential endogeneity of the number of fatalities in disasters, we adopt an alternative methodology that leverages the magnitude of earthquakes to calculate the *Disaster Intensity* variable. The utilization of the Richter scale as an indicator of the destructive power of an earthquake offers the advantage of exogeneity. However, it is essential to acknowledge the limitation of neglecting ground characteristics, such as the depth of the epicenter, which can influence the intensity of a catastrophe. Despite this limitation, this specification assesses whether the identified causal effects are subject to distortion due to the imperfect exogeneity of *Disaster Fatalities*. Moreover, this model exclusively accommodates the utilization of earthquakes. We obtain the seismic magnitudes of all earthquakes from the EM-DAT dataset.

Equation (5) represents the revised formulation used to estimate the primary independent variable in this alternative approach.

$$Disaster\ Intensity_{d,p,t-1} = \sum \frac{100 * Richter\ Scale_{e,d,p,t-1}}{(Disaster\ Distance_{e,d,p,t-1})^2} \quad (5)$$

To facilitate the interpretation of the relative risks, the *Disaster Intensity* is rescaled by the factor 100[13]. Like the baseline regression, we utilize *Equation (3)* for the estimation. *Table 5* summarizes the results of this robustness check.

Table 5: Richter Scale Specification

Dependent Variable:	Dummy Sharia	
Model:	(1)	(2)
Variables		
Disaster Intensity (t-1)	1.1637***	1.6338**
	(1.0135)	(1.2187)
Revenue per Capita (t-1)		0.6934
		(1.4852)
Population (t-1)		0.5942
		(1.8857)
GRDP (t-1)		2.4472
		(1.7552)
Fixed-effects		
District	Yes	Yes
Year-Province	Yes	Yes
Observations	2,262	1,426

Clustered (Province) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Note: Coefficients are relative risk ratios.

In line with the baseline regression analysis, we find a statistically significant conducive effect of *Disaster Intensity* on the introduction of Sharia laws. The estimated relative risk is 1.164 in the specification with only the primary independent variable and 1.634 in the one controlling for district-specific trends. Similar to the baseline estimation, the relative risk increases by including the control variables. A one-standard deviation (0.61) change in *Disaster Intensity* leads to an increased likelihood of Sharia law introduction by 1.09 times or 1.35 times, respectively. In this case, a one standard deviation change would roughly correspond to the earthquake's intensity in March 2007 on Kota Sawahlunto, with a distance to the epicenter of 31.29 km and a magnitude of 6 on the Richter scale. This disaster resulted in the loss of 67 lives.

The main result remains robust to the alternative calculation of the intensity indicator. The alternative calculation yields an exogenous proxy for the intensity of earthquakes. Thus, this provides some evidence that the result of the baseline regression is not biased by confounding factors. The multidimensional fixed effects capture part of the relationship between the number of fatalities and aspects of development. However, it is important to note that the Richter scale

[13] This rescaling allows for a more straightforward interpretation of the results, as otherwise, the relative risk would become significantly elevated.

specification has limitations, as it does not consider differences in the depth of the epicenter and other ground characteristics. Nevertheless, the results improve the confidence that a causal effect is found.

5.4 Channel

In this further analysis, we aim to investigate a potential mechanism that could shed light on the relationship between natural disasters and the adoption of religious laws. While alternative mechanisms cannot be ruled out, the religious coping hypothesis is a plausible explanation. According to this hypothesis, individuals turn to their religious beliefs and practices to comprehend and cope with distressing and unpredictable situations (Bentzen, 2019a; Pargament, 2001). The religious coping hypothesis has received extensive support in the literature, as highlighted in *Chapter 2*. To assess its applicability in the context of Indonesia, we propose the following empirical strategy.

To measure the religiosity of Indonesian individuals, we utilize the fourth and fifth waves of the Indonesian Family Life Survey (IFLS) by the RAND Corporation. IFLS is representative of 83% of the Indonesian population and contains 30,000 individuals residing in 13 provinces (Strauss et al., 2016; Strauss et al., 2009) [14]. The IFLS-4 (Strauss et al., 2009) survey was conducted in 2007/2008, while the IFLS-5 (Strauss et al., 2016) occurred between 2014 and 2015. These two survey waves inquire about the religiosity of the same respondents at different points in time, using identical questions. This unique feature allows for the creating of a panel dataset that captures individual-level religiosity over time.

we utilize three questions as a measure of religiosity. The first inquiry asks participants, "How religious are you?". They are provided with four categories: "very religious," "somewhat religious," "rather religious," and "not religious," to self-assess their level of religiosity. Based on the responses, we construct a dummy variable (*Religious Dummy*), taking a value of one for individuals who identify as "very religious" or "somewhat religious." The second measure is based on the question, "How many times do you pray each day?" with the response options "given times," "not every day," and "do not practice." Building upon this, we create a dummy variable (*Prayer Dummy*), taking a value of one for individuals who engage in prayer at specific times during the day. For the final measure, we focus on the same question but consider only individuals who engage in daily prayer at given times. Specifically, we employ the actual number of prayers performed per day. This results in the variable *Number of Prayers*,

[14] The *Appendix 6* illustrates the provinces included in the IFLS dataset.

quantifying the daily number of prayers as a count variable[15]. Moreover, the study exclusively includes individuals who identify as Muslims, as the primary focus revolves around religious laws associated with Islam.

We employ the same *Equation (1)* as in the baseline regression to calculate the measure of disaster intensity. To merge the religiosity dataset with the dataset on natural disasters, we consider natural disasters from 2007 and 2014. There are two main reasons for this choice. First, while changes at the political level take time to establish, natural disasters could have an immediate impact on individuals' religiosity. Second, the IFLS-4 and IFLS-5 surveys were conducted towards the end of 2007 and 2014 to early 2008 and 2015, respectively. Therefore, using natural disasters from 2007 and 2014 is an appropriate choice. To merge the two datasets, we use the district name and the year. BPS codes connect individuals with their respective districts and provinces. If a district does not have a match in the natural disasters dataset, we adjust the spelling accordingly. This merge enables me to match the appropriate *Disaster Intensity* for all individuals. Consistent with the baseline regression, I exclude the province of Aceh from the analysis.

In summary, the dataset consists of 17,796 individuals. There are 30,727 observations for the *Number of Prayers* variable, 35,527 for the *Prayer Dummy* variable, and 35,522 for the *Religiosity Dummy* variable. The summary statistics of the channel analysis can be found in *Appendix 7*.

To identify the effect of natural disasters on religiosity, I employ a fixed effects model with individual and province-year fixed effects. This approach allows for the analysis of the within-individual effect. By including individual fixed effects, I can control for unobservable individual characteristics that do not change over time. Additionally, I control for some individual characteristics. For the estimation, I use the following *Equation (6)*:

$$Measure\ Religiosity_{i,d,p,t} = \beta\ Disaster\ Intensity_{d,p,t} + \rho_i + \gamma_t * \lambda_p + \eta X'_{i,t} + \varepsilon_{i,d,p,t} \quad (6)$$

In *Equation (6)*, one of the measures of religiosity for individual *(i)* from district *(d)* in the province *(p)* in the year *(t)* is regressed on the corresponding district's *Disaster Intensity*. As specified, Equation (*6*) incorporates individual fixed effects (ρ_i) and year-province fixed effects ($\gamma_t * \lambda_p$) to account for time-invariant individual characteristics and effects common to a whole province in a year that may influence the level of religiosity.

[15] To account for outliers, we remove this variable's upper five percent of responses from the analysis. This adjustment restricts the variable to a maximum number of prayers per day of 7 and omits 1949 observations.

The set of control variables ($X'_{i,t}$) includes individual-specific characteristics, such as age, age squared, gender, and marital status, a dummy variable for urban residence, a dummy variable for medium education[16], and a dummy variable for high education[17]. These variables are derived from the IFLS[18]. Hence, the set of control variables is similar to the one employed by Aslam et al. (2022). The error term ($\varepsilon_{i,d,p,t}$) is clustered at the province level.

Equation (6) is estimated using a Poisson method with robust standard errors to ensure consistency with the main regression. This approach allows for the robust direct calculation of relative risk ratios for the binary outcome variables (Zou, 2004). Similarly, the method is applied to the *Number of Prayers* count variable, as recommended by Wooldridge (1999) and Wooldridge (2019).

The estimation results are presented in *Table 6*, illustrating the relative risk ratios. Columns (1) and (2) correspond to the count variable *Number of Prayers* as the dependent variable, columns (3) and (4) pertain to the binary variable *Prayer Dummy*, and columns (5) and (6) depict the results for the binary variable *Religiosity Dummy*. Columns (2), (4), and (6) display the outcomes of the specification incorporating individual-specific control variables.

Table 6: Chanel Analysis

Dependent Variables:	Number of Prayers		Prayer Dummy		Religiosity Dummy	
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
Disaster Intensity	1.0487***	1.0473***	1.1608***	1.1598***	1.1857**	1.1857**
Controls	No	Yes	No	Yes	No	Yes
Fixed-effects						
Individual	Yes	Yes	Yes	Yes	Yes	Yes
Year-Province	Yes	Yes	Yes	Yes	Yes	Yes
Observations	29,745	29,742	33,430	33,426	30,978	30,975

Clustered (Prov) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Note: Coefficients are relative risk ratios.

The results are consistent across all specifications. In line with existing literature (Aslam et al., 2022; Bentzen, 2019a), I find a statistically significant impact of natural disasters on religiosity. Furthermore, this provides some evidence that religious coping is a strategy employed by Indonesian individuals when affected by natural disasters. Columns (1) and (2) indicate that individuals who experience greater intensity of disasters and already engage in daily prayers exhibit an increased average *Number of Prayers*. Moreover, columns (3) and (4) show that there is a heightened likelihood for individuals to initiate daily prayers (*Prayer Dummy*) at given

[16] The medium education dummy takes a value of 1 if an individual has completed high school or adult education.
[17] The high education dummy takes a value of 1 if an individual has a university or college degree.
[18] Unfortunately, the IFLS Survey does not include information about individual income.

times in the aftermath of natural disasters. Additionally, columns (5) and (6) reveal that individuals perceive themselves as more religious (*Religiosity Dummy*) following such catastrophes. Following natural disasters, the affected individuals perceive themselves as more religious and demonstrate their increased religiosity through their behavior by dedicating more time to religious activities and practices. To better understand the magnitude of these effects, consider the following illustrative example. The earthquake that struck Tanah Datar in March 2007, with an epicenter located approximately 7 km from the district center, has a calculated intensity of 1.39[19]. This earthquake had a significant impact, with a magnitude of 6 on the Richter scale and 67 fatalities. The findings predict that such an event would substantially increase religious practices and beliefs among the affected individuals. Specifically, the average number of daily prayers would increase by 6.63%. Moreover, the likelihood of individuals engaging in daily prayers at specific times would rise by 22.88%, indicating a more devoted adherence to religious practices. Finally, the probability of individuals perceiving themselves as religious would experience a notable rise of 26.71%[20].

The observed increase in religiosity following natural disasters aligns with the religious coping hypothesis. The heightened religiosity may serve as a driver for the introduction of new Sharia laws. Political actors may perceive the increased religiosity and opportunistically exploit it to advance their political, economic, or ideological capital, as Buehler (2016) outlined. However, this study does not provide direct evidence of a causal link between religiosity and the implementation of Sharia laws. Other potential channels, such as the provision of financial aid or other socio-economic changes, could also serve as a channel.

[19] This *Disaster Intensity* is the highest value in the years 2007 and 2014.
[20] Using the specification with control variables.

6 Discussion

In this chapter, the findings from the previous section will be thoroughly discussed and contextualized within the existing literature. The empirical methodology and data will be examined, highlighting any potential limitations. Concrete policy implications will be deliberated upon, and future avenues for further research will be outlined.

The predicted positive association between natural disasters and individual religiosity aligns with the religious coping hypothesis and existing literature. Empirical studies such as Bentzen (2019a) for a cross-country analysis and Aslam et al. (2022), specifically within Islam, have yielded similar results to those presented in this study. Furthermore, according to Aslam et al. (2022), an increased religiosity can be anticipated, as Islam prescribes a heightened piety as a guideline following natural disasters. The results thus reflect the expected outcome.

Moreover, I find an increased likelihood of the introduction of Sharia laws following natural disasters. The heightened religiosity could serve as a potential explanation for this. When the religiosity of affected individuals rises, it can bolster the position of Islamist leaders as power brokers. Following the arguments of Buehler (2016) and Pisani and Buehler (2017), this can lead to an increased reliance on these leaders by former state elites to accumulate political, economic, and cultural capital to consolidate their political positions. As detailed in Section 3, this theory can elucidate many instances of Sharia law introductions. Additionally, the heightened religiosity could fortify Islamist institutions. Bazzi et al. (2020) describe these as one of the pivotal actors in implementing Sharia regulations in Indonesia. This channel could be the driving force behind the conduciveness of natural disasters to the introduction of Sharia laws.

These results align with the findings of existing literature concerning the connection between religiosity and political outcomes. Potentially, political leaders may aim to portray themselves as religious leaders to enhance their political power, similar to the observations by Belloc et al. (2016) regarding Italian cities between 1000-1300. In addition, incumbent leaders can utilize the advantage of the possibility of introducing Sharia laws to gain an edge over competitors, similar to the arguments described by Masiero and Santarossa (2021) in the context of media presence.

However, building power structures on the divine origins of natural disasters and the institutionalization of religious laws can have significant implications for the strength of democracy. Bentzen and Gokmen (2023) describe how such legitimization positively correlates with autocracy. Mehmood and Seror (2023) find evidence that the rule of law worsens with more religious institutions. Barro and McCleary (2005) also establish a connection between

state religions and autocracies. These conclusions align with Klicken oder tippen Sie hier, um Text einzugeben.s (1922) stylized theory of legitimization, in which legitimization through religion makes legitimization through democracy less likely. The explanation that state elites recognize the heightened religiosity and introduce Sharia laws through corrupt and democracy-weakening behavior thus integrates well with the preliminary literature.

Nevertheless, I must acknowledge limitations in this study that need discussion and context. One of the limitations lies in the omission of all districts with no Sharia law introduction. As a result, 276 districts and 5,665 observations are excluded from the regression. Although this may affect the representativeness of this study, Sharia law introductions still cover approximately 45% of the Indonesian population, particularly in districts with higher average population sizes. An alternative approach might use a zero-inflated Poisson model. One possible strategy is to create a predictor variable based on the threat of expropriation in the early 1960s, used in the study by Bazzi et al. (2020), to model the probability of districts introducing Sharia laws. While this could enhance representativeness, its feasibility for addressing the research question should be explored in future studies.

Another limiting aspect is the constrained selection of control variables. Additional control variables, such as an indicator of development, would have been advantageous to mitigate all concerns related to endogeneity. One strategy could involve using nighttime light data to control the district's development. This approach can further alleviate concerns regarding the endogeneity of *Disaster Intensity*. Unfortunately, due to time constraints in the study, this was not feasible, but it remains a promising avenue for future research.

The approach for the proxy of disaster intensity in this study differs from applications in prior research. While some studies use epicenter distance (Buonanno et al., 2023; Filipski et al., 2019), others employ ground movement at a specific geographic point, such as the Modified Mercalli Intensity (MMI) scale[21] (Belloc et al., 2016; Hombrados, 2020; Masiero & Santarossa, 2021)[22] and Peak Ground Acceleration (PGA)[23] (Bai & Li, 2021). Bentzen (2019a) combines both measures by considering the distance to high-risk earthquake zones, which are assessed using the MMI Scale. A distance-based indicator offers the advantage of being an objective and exogenous measure. Nonetheless, it does not consider crucial factors like magnitude, subsurface structures, and the differences in consequences on individuals, nature, and

[21] This indicator measures the intensity of ground motion on individuals, nature, and human-made objects on a scale from 1-12 (or 1-10) using Roman numerals. The scale ranges from I “not felt” to XII “total destruction”.

[22] Hombrados (2020) employs the distance from the epicenter and the earthquake's magnitude to predict the earthquake intensity measured on the MMI scale.

[23] PGA corresponds to the maximum acceleration amplitude documented on an accelerogram at a specific location during earthquake-induced shaking (Bai and Li, 2021).

infrastructure. Conversely, intensity measures take into account these factors. However, intensity indicators such as the MMI scale have the drawback of being correlated with development-related factors and disaster mitigation measures. Further, the MMI scale relies on the subjective assessment of individuals, which can introduce measurement errors (Buonanno et al., 2023). Considering these factors and time constraints, I, therefore, utilize the combination of the distance to the epicenter and the total number of fatalities caused by the natural disaster as an indicator of disaster intensity.

Using the total fatalities as the baseline estimation is advantageous compared to the Richter scale for several reasons. Firstly, earthquake magnitude indicates how much energy is released at the earthquake's epicenter, neglecting crucial aspects such as surface structures and the depth of the earthquake's center beneath Earth's ground. An earthquake may have a single magnitude but a distribution of various intensities (Bai & Li, 2021). Secondly, the main interest of this study is in understanding the effects of the disaster on individuals in the respective districts, which leads to changes in local politics. The number of fatalities, therefore, better captures the impacts. Lastly, employing fatalities allows for including different types of natural disasters, such as volcanic activity.

Nevertheless, the drawback of using Disaster Fatalities is its potential weakness to confounding factors like development and disaster management. We find no evidence that the results could be distorted due to this possible endogeneity. Given this context and the time limitations of this study, the deviation in approach compared to existing research can thus be justified.

Future research building upon this paper could explore alternative measures for disaster intensity. For instance, using PGA, as done by Bai and Li (2021), could provide further insights. Moreover, an approach similar to Bentzen (2019a), where the measure of intensity (PGA or MMI) is combined with distance to measure the distance to the next high-intensity hit district, might be valuable. This method could also contribute to identifying the driver of the effect. If non-directly or mildly affected districts also exhibit a significant effect, it may not be explained by financial aid or infrastructure destruction.

Additionally, future research could investigate whether political leaders' rent-seeking behavior can explain the observed conduciveness of natural disasters to Sharia law implementation. This analysis could help to trace the complete causal chain of the relationship. If the increased likelihood of implementation can be attributed to political elites seeking rent, there would be various points at which the negative consequences could be mitigated. Firstly, corrupt behavior could be curbed through anti-corruption measures, which have proven to be effective in addressing misgovernance in the past (Avis et al., 2018; Bobonis et al., 2016; Ferraz & Finan,

2008, 2011; Olken, 2007). Secondly, one could draw lessons from the Indonesian case, where decentralization led to highly powerful local leader positions (Buehler, 2016). Preserving the separation of powers, especially in the context of democratization and decentralization processes, could significantly mitigate the effect. Thirdly, disaster education programs could help reduce the belief in the divine origin of such catastrophes. According to the study by Adiyoso and Kanegae (2012), post-2004 tsunami disaster education programs in Aceh effectively increased disaster knowledge and preparedness. However, these programs could not change the perception that disasters have a divine origin. Therefore, a stronger focus on school and community disaster education could benefit greatly. Lastly, further disaster management and preparedness developments could reduce the impact intensity and thus significantly restrain the possibility of local elites exploiting the situation. However, whether these measures are effective remains a subject for future research. It also remains open whether the observed effect can indeed be explained by corruption and rent-seeking activities.

7 Conclusion

In conclusion, this study investigates the relationship between natural disasters and the implementation of religious laws, specifically Sharia laws in Indonesian districts. The findings reveal that higher earthquake and volcanic eruption intensities are associated with an increased likelihood of Sharia law implementation. Notably, this study is the first to establish a connection between natural disasters and the introduction of Sharia laws.

To address the research question, we employ a multidimensional fixed effects Poisson model, using the exogenous random timing of disasters as a natural experiment. The inclusion of district and year-province fixed effects controls for some potential unobservable confounding variables. We do not find signs that the results are distorted due to omitted variables, demonstrating the robustness of the natural experiment. Future research could enhance the study by considering alternative measures for earthquake intensity like Peak Ground Acceleration (PGA) or the Modified Mercalli Intensity (MMI) scale to measure earthquake intensity.

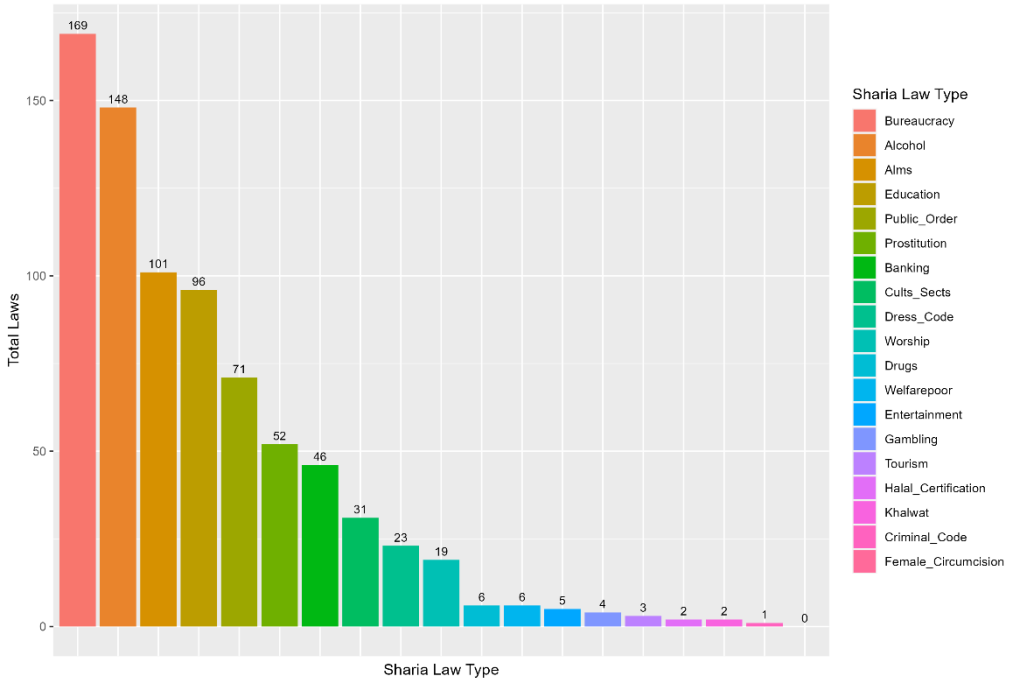
One limitation to acknowledge is the exclusion of non-Sharia law districts, which may affect the representativeness of the study for all of Indonesia. Nonetheless, close to half of the Indonesian population is included, allowing the study to capture a national trend. Future research might explore alternative estimation methods, such as a zero-inflated Poisson model.

While this study can only provide limited proof, it suggests that religious coping may explain the observed results. Amplified religiosity following natural disasters could be exploited by political elites engaging in corrupt practices, raising important concerns about corruption, the rule of law, and economic well-being. Therefore, future research should delve into the rent-seeking activities of these elites to gain a deeper understanding of the underlying mechanisms. This comprehensive analysis is essential for formulating specific policy implications.

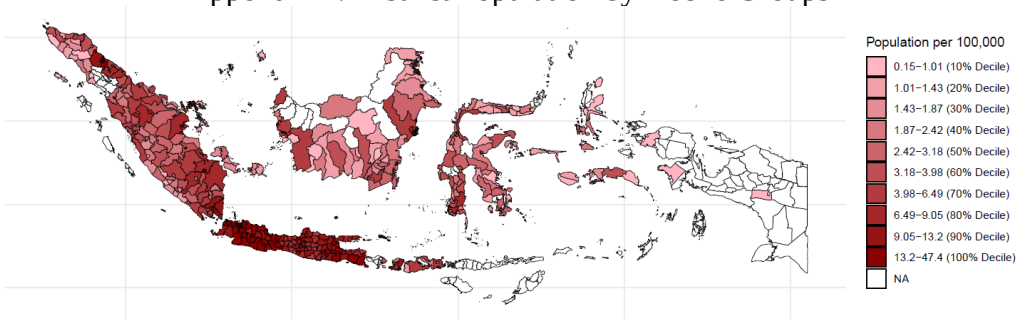
In summary, this study proposes a causal relationship between natural disasters and the implementation of religious laws, calling for further research to explore the mechanisms driving this association.

Appendix

Appendix 1: Number of Sharia Laws per Type



Appendix 2: District Population by Decile Groups



Appendix 3: Number Sharia Results

Dependent Variable:	Number Sharia	
Model:	(1)	(2)
Variables		
Disaster Intensity (t-1)	2.3506***	14.1195***
	(1.2961)	(2.3244)
Revenue per Capita (t-1)		0.5870
		(1.4825)
Population (t-1)		0.5138
		(1.8045)
GRDP (t-1)		2.3023*
		(1.6232)
Fixed-effects		
District	Yes	Yes
Year-Province	Yes	Yes
Observations	2,262	1,426

Clustered (Province) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Note: Coefficients are incidence rate ratios.

Appendix 4: Linear Distance Results

Dependent Variable:	Dummy Sharia	
Model:	(1)	(2)
Variables		
Disaster Intensity (t-1)	1.0045	1.0337
	(1.0084)	(1.0357)
Revenue per Capita (t-1)		0.6740
		(1.4791)
Population (t-1)		0.5795
		(1.8726)
GRDP (t-1)		2.4662
		(1.7523)
Fixed-effects		
District	Yes	Yes
Year-Province	Yes	Yes
Observations	2,262	1,426

Clustered (Province) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Note: Coefficients are relative risk ratios.

Appendix 5: Negative Binomial Regression Results

Dependent Variable:	Dummy Sharia	
Model:	(1)	(2)
Variables		
Disaster Intensity (t-1)	3.5161***	17.5701***
	(1.2659)	(2.5051)
Revenue per Capita (t-1)		0.6746
		(1.4891)
Population (t-1)		0.5811
		(1.8827)
GRDP (t-1)		2.4648
		(1.7489)
Fixed-effects		
District	Yes	Yes
Year-Province	Yes	Yes
Observations	2,262	1,426
Over-dispersion	10,000	10,000

Clustered (Province) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Note: Coefficients are incidence rate ratios.

Appendix 6: Map of 13 IFLS Provinces in Indonesia

From the Indonesia Family Life Survey (IFLS), by RAND Corporation, n.d.(https://www.rand.org/well-being/social-and-behavioral policy/data/FLS/IFLS.html), retrieved 04.07.2023

Appendix 7: Summary Statistics Chanel Analysis

Table 1: Summary Statistics

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
Number of Prayers	30727	4.7	1.2	1	5	5	7
Prayer Dummy	35527	0.92	0.27	0	1	1	1
Religiosity Dummy	35522	0.78	0.41	0	1	1	1
Disaster Intensity	34425	0.0026	0.031	0.00001	0.000041	0.00017	1.4
Age	35588	39	14	14	28	48	94
Female Dummy	35588	0.55	0.5	0	0	1	1
Married Dummy	35588	0.78	0.42	0	1	1	1
Medium Education Dummy	35592	0.24	0.43	0	0	0	1
High Education Dummy	35592	0.12	0.33	0	0	0	1
Urban Dummy	35592	0.52	0.5	0	0	1	1

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