YIMBY or NIMBY?

Municipalities' reaction to disaster waste from the Great East Japan Earthquake

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Abstract

This study investigates the determinants of transfer of waste between the affected areas and other municipalities that resulted from the Great East Japan Earthquake. In particular we investigate to what extent economic factors, but also other factors such as reciprocity and pro-social concerns affect municipalities decision to accept disaster waste. The results show that the amount donated to the victims of the disaster, the capacity of disposal sites, and the intentions of the prefecture positively affected the decision to accept the disaster waste. On the other hand, municipalities with a higher number of workers in agriculture did not accept disaster waste. Thus, both economic and social factors were important determinants of the decision.

Keywords: Disaster waste; Wide area treatment; Econometric analysis

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1. Introduction

On March 11, 2011, the Great East Japan Earthquake that occurred off the Pacific coast of Japan triggered a massive tsunami. The most heavily impacted areas were in the three prefectures of Iwate, Miyagi, and Fukushima. In the areas along the coast of these prefectures, many people were injured or died. The Tsunami also destroyed many houses and buildings as well as generated a huge amount of disaster waste. Additionally, the Tsunami damaged the Fukushima Daiichi nuclear power plant, located on the coast of the Fukushima prefecture. The amounts of waste generated were much larger than that of the annual municipal solid waste in these prefectures. Therefore, the Japanese Ministry of Environment inquired municipalities about the possibility of accepting the disaster waste from the Iwate and Miyagi prefectures. The disaster waste generated in Fukushima Prefecture was not been included in the wide area treatment because of the risk of radiation. Initially, 572 municipalities stated that they could accept disaster waste. Later on, as we will discuss, only 54 municipalities actually accepted disaster waste.

The tragic event of the tsunami provides us with an interesting case of movement of waste between regions/municipalities. There is an empirical literature that has investigated the determinants of the transfer of waste between states and countries. For example, Levinson (1999a, 1999b) investigated the influence of the waste disposal tax on the movement of hazardous waste between states in the United States. It was found that factors such as population size and density, land area, and capacity of the disposal site had a positive impact on the amount of wide area treatment while factors such as the distance between states, and income had a negative impact. Baggs (2009) studied the international hazardous waste trade using data collected through the implementation of the Basel Convention. The results suggest that the movement of waste is better

explained by the differences in capital per worker than by differences in income per capita. Jensen and McIntyre (2010) examined a similar study by using the wide area treatment of the industrial waste in Wales.

The focus of the previous studies has mainly been on the impact of economic factors. While they might be of importance for disaster waste, it is also likely that other factors such as pro-social and anti-social behavior, and reciprocity could play important roles. Studies in psychology suggest that disasters can invoke both pro-social and anti-social behavior among individuals; see e.g. Gantt and Gantt (2012). Using economic experiments, Becchetti et al. (2012) find that there are long-run negative effects on altruism of being a victim of a natural disaster such as a Tsunami, while Li et al. (2013) find heterogeneous effects depending on the age of the victim.

In this paper, we investigate the characteristics of the municipalities that responded to the request for accepting the disaster waste of the Great East Japan Earthquake. In particular, we are interested in the importance of economic factors, such as slack capacity of incinerators, as well as altruistic reasons, measured as the amount of donations to the disaster victims, and reciprocity, i.e. if they themselves face the risks of a tsunami.

The next section contains a description of the situation and the request for treatment of disaster waste. Section 3 introduces the data and the empirical strategy. Results are presented in Section 4 and section 5 presents the conclusion.

2. Background on the tsunami and the request for treatment of disaster waste

On March 11, 2011, the Great East Japan Earthquake that occurred off the Pacific coast of Japan triggered a massive tsunami. The most heavily impacted areas were in

the three prefectures of Iwate, Miyagi, and Fukushima. The Tsunami destroyed many houses and buildings and generated a huge amount of disaster waste. The amount of the disaster waste in Iwate prefecture was about 5.25 million tons, in Miyagi prefecture was 11.54 million tons, and in the Fukushima prefecture was 2 million tons. These amounts are approximately 12 times, 14 times, and 3 times larger than that of the annual municipal solid waste in these prefectures respectively. Iwate and Miyagi prefectures requested other municipalities to accept wide area treatment of the disaster waste through the Ministry of Environment. The disaster waste generated in Fukushima Prefecture has not been included in the wide area treatment so far because of the risk of radiation.

The Ministry of Environment inquired municipalities about the possibility of accepting the disaster waste in April 2011. As a result, 42 prefectures and 572 municipalities displayed intentions of accepting the disaster waste. The aggregate capacity of the incinerators in these municipalities amounted to about 2.93 million tons per year, suggesting that the wide area treatment could help a prompt response for disaster recovery. However, when the Ministry of Environment investigated the intentions again in October 2011, there were only 54 municipalities that had already accepted, or began actions towards acceptance. Compared to the investigation results of April 2011, it is clear that negative attitudes among the municipalities had increased. The main reason was the anxiety over the possibility of radioactive contamination of the waste. In June 2011, it was detected that the radiation level in the incineration ashes of the municipal solid waste in Edogawa Ward, Tokyo was higher than the standard level.[§]

[§]According to the guidelines of the Ministry of Environment, radiation levels in the combustible waste must be less than 240Bq/kg for incineration and the incombustible waste must be less than 8,000Bq/kg for final disposal. Although the high radiation level found in the incineration waste of the Edogawa Ward

The incident invoked distrust of the government and suspicion that sufficient information was not provided.

We use cross-sectional data from 1,592 municipalities that does not include the municipalities of Miyagi, Iwate, and Fukushima prefectures. The data on the acceptance of disaster waste is based on the reports from the municipalities, collected by the Ministry of Environment as of June 26, 2012 and October 25, 2013. Table 1 shows the number of municipalities from 2011 to 2013 that are either positive or negative toward accepting some of the waste. For 2011, we only have information about the total number of municipalities that were positive, but not which these municipalities are.

On June 29, 2012, The Ministry of Environment informed that there were enough intentions of acceptance from municipalities to treat the existing tsunami waste and there was no need to examine further acceptance. As of June 2013, 76 municipalities have accepted the tsunami waste. Most of these municipalities are in eastern Japan. Figure 1 shows the rate of municipalities that accepted the tsunami waste in each prefecture as of October 25, 2013.

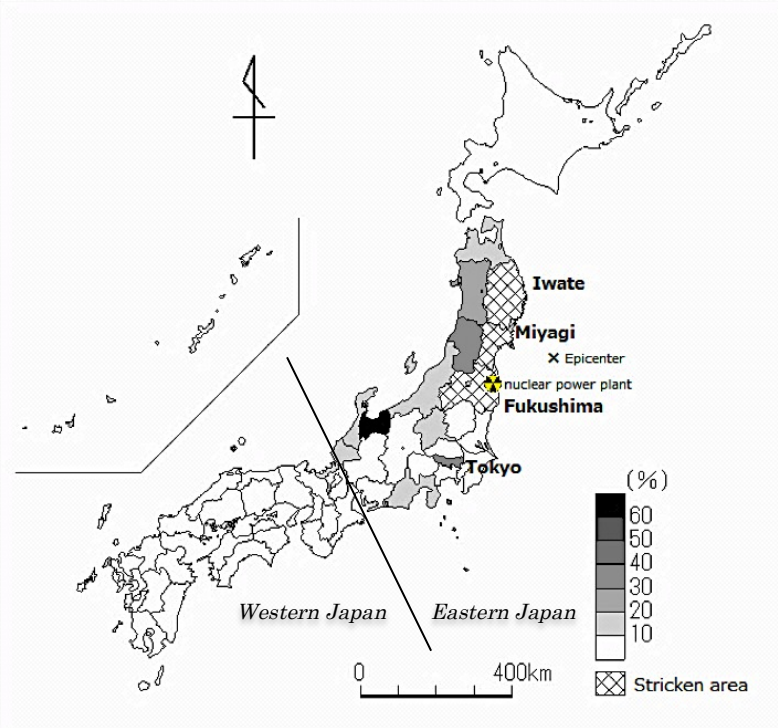
Table 1: The number of municipalities and acceptance

	2011	2012			2013		
	Total	West	East	Total	West	East	Total
Positive	572	25	166	191	2	74	76
Negative	1030	678	723	1401	703	815	1516
Total	1596	703	889	1592	705	889	1592

Note: The number of municipalities change over the years due to municipal mergers. As for the data in 2011, only the aggregated number of the municipalities is known.

does not relate to the wide area treatment, it invoked an anxiety over the radiation risks.

Figure 1: The acceptance rate as of October 25, 2013



The 2012 report by the Ministry of Environment contains the list of municipalities that have considered acceptance, that expressed the intention of acceptance, or that have already accepted the disaster waste. We treat these municipalities as positive towards acceptance. The 2013 report contains a list of municipalities that have already accepted the disaster waste. Since the Ministry of Environment sent a message on June 29, 2012 that there was no need to examine further acceptance, there are no municipalities considering the acceptance or expressing any intention of acceptance in the 2013 report.

The role of the Ministry of Environment in the wide area treatment was to coordinate the stakeholders. The Ministry facilitated the cooperation between the affected municipality and the accepting municipality and requests the acceptance of disaster waste for prefectures. The role of the prefecture was to investigate municipalities

belonging to the prefecture about acceptance. Some prefectures that have their own incineration facilities or waste disposal, have accepted disaster waste. One example of this is Tokyo, which accepted about 25,000 tons of tsunami waste from several municipalities.

The role of the municipality is to accept the disaster waste and incinerate or dispose of it in their facility for treatment of municipal solid waste. In addition, the accepting municipality measures the radiation level of the waste and announces the results to alleviate any anxiety the inhabitants may have. An affected municipality can obtain a subsidy from the Ministry of Environment to cover the entire cost of implementing the wide area treatment. Thus, in principle, the accepting municipality does not need to bear any of the cost of disaster waste disposal.

The practice of wide area treatment is as follows. Table 2 describes the flow of the wide area treatment as in the case of Osaka city, which accepted 15,000 tons of combustible disaster waste from the Miyako area in Iwate prefecture. The required disposal cost was at least 290 million yen. The tsunami combined many materials such as mud, concrete, plants, houses, cars, and various products. At the first temporary site in the Miyako area, the disaster waste was separated into combustibles and incombustibles, hazardous or non-hazardous, and recyclable or non-recyclable (by hand or machine). The separated waste was sent to a second temporary site and further separated by hand. The radiation level of the separated disaster waste was measured at the second temporary site. The radiation level was measured again before loading it onto ships and trucks to transport the waste for wide area treatment.

When the disaster waste arrives at a harbor and a transshipment facility, the radiation level is measured again. In the transshipment facility, machines remove hazardous

waste and incombustibles found in the disaster waste. Lastly, the disaster waste is treated in an incineration plant and sent to a final disposal site, where it is disposed together with municipal solid waste after being measured for concentration of radioactive material.

Table 2: The flow of the wide area treatment

Miyako area	
1. Separation by machine and hand	Fist temporary site
2. Separation by hand	Second temporary site
3. Measurement of the radiation level	
4. Measurement of the radiation level	Harbor in Iwate
5. Loaded onto a ship	
Osaka city	
6. Unloading of containers	Harbor in Osaka
7. Measurement of the radiation level	
8. Separation by machine	Transshipment facility
9. Measurement of the radiation level	
10. Incineration with municipal solid waste	Incineration plant
11. Measurement of the radiation level	
12. Final disposal with municipal solid waste	Final disposal site
13. Measurement of the radiation level	

3. Data and empirical strategy

3.1 Factors affecting the acceptance of waste

As discussed in the introduction, there is evidence that factors such as socio-economic and geographic characteristics of the municipalities and prefectures can affect the likelihood of accepting the disaster waste (see e.g. Levinson 1999a, 1999b). To begin with, we therefore include information on the population density, the rate of primary industry workers, population share under age 15 and the distance from Fukushima Daiichi as explanatory variables. We include these four variables primarily to control for the importance of anxiety over the radioactive contamination. Since the lack of understanding about the situation and the radiation risk may increase for those at a greater distance from the affected area, the location may have negative impact on acceptance. In municipalities with a higher number of children, there may be parents who feel anxiety over the health effects of radiation on their children. Similarly, in the municipalities with a higher number of agricultural workers, there may be more inhabitants who feel anxiety over the impact of radioactive material on the sale of agricultural products. Reluctance to accept may be stronger in municipalities with a higher population density due to the shorter distance to the facility that treats the disaster waste.

The main economic factor that we will include is the slack capacity of the incinerator plants. The idea is that municipalities will try to manage their incinerators efficiently if it is economically rational. If there is a larger slack capacity in incinerators, they can bring the operation of the facility to a more efficient level by accepting additional waste from other municipalities. Data on the slack capacity of incineration plants, the slack capacity of final disposal sites, and the implementation of wide area

treatment of municipal solid waste were available from a survey by the Ministry of Environment. The slack capacity of incineration plants is calculated as the difference between the annual capacity of the facility and the annual throughput.

We also investigate the effects of the pre-existing implementation of wide area treatment of municipal solid waste. While each municipality has responsibility to the treatment of its household waste, the Ministry of Environment has promoted wide area treatment because of the scale economy since 1997. Many municipalities form a coalition to treat household waste and share the incineration plants and final disposal sites that are operated based on the cooperation of these municipalities. Municipality that is used to accepting the solid waste of other municipalities might have less reluctance to the wide area treatment of disaster waste.

Although the acceptance of the disaster waste by municipalities was determined independently, the intentions of the prefecture that they belong to might have an influence. For example, the municipality can receive cooperation and support on the wide area treatment from the prefecture if the prefecture is also in favor of acceptance. We therefore also include information on whether or not the prefecture was in favor of acceptance.

Reciprocity reasons could also be important for why a municipality accepts the disaster waste. Municipalities may willing to accept the disaster waste because they could be harmed by a disaster in the future, and thereby are able to ask other municipalities for help as well. Specifically, this motive would be strong if the municipality is located near the nuclear power plant as the risk is higher. Data on the location of nuclear power plants was sourced from the Japan Atomic Industrial Forum, Inc. This is a dummy variable that takes the value one if there is any nuclear power

plant within the boundaries of the municipality. As of March 2, 2011, there were 54 nuclear power reactors located in 17 municipalities in 13 prefectures.

Finally, it is possible that cooperation for emergency restoration between municipalities is implemented from a humanitarian point of view. An interesting question then is, first of all, if there are differences in the extent of pro-sociality among municipalities in general, and in particular with respect to altruistic concerns regarding the actual disaster in question. Second, if these potential differences affect the likelihood of acceptance. In order to investigate this, we include two measures relating to the extent of pro-sociality among the municipalities and prefectures. The first one is a measure of the extent of volunteer activity in each prefecture. The data comes from the 2011 survey on Time Use and Leisure Activities by the Statistical Bureau of the Japanese Ministry of Internal Affairs and Communications. The data measures the percentage of people above 10 years old who participated in any volunteer activity in that year. Since the October 2011 survey was conducted after the disaster in March 2011, it also contains the volunteer activity for the Great East Japan Earthquake. The second measure is the amount of donations from the inhabitants of the prefecture to the victims of the Great East Japan Earthquake. The Japanese Red Cross Society provides data on the donations for victims of the Great East Japan Earthquake. The amount of donations came from each prefecture in Japan from March 2011 to March 2012. The Japanese Red Cross Society is one of the biggest organizations that collected donations for the victims. The data does not contain the money that was sent directly to the head office of the Japanese Red Cross Society. Thus, if the ratio between the donations to the prefectural office and those to the head office is significantly different among prefectures, it does not accurately represent the exact donations from each prefecture.

While both our measures of pro-social preferences could explain the willingness to help the affected municipalities with handling their waste, the second measure is directly related to the disaster itself. The relationship between donations and acceptance of waste is not clear. On the one hand the size of the donations could be a good measure of the extent of altruistic concerns. On the other hand, psychological studies suggest moral licensing (Monin and Miller, 2001), that is, people who have undertaken a praiseworthy act, receive an implicit license for subsequently conducting a more selfish act. For example, Mazar and Zhong (2010) found that people become less altruistic after purchasing environmentally friendly products than after purchasing conventional products. In the case of the Great East Japan Earthquake, donations to help the victims might have lead to moral licensing. Summary statistics of all the variables are presented in Table 3.

Table 3: Descriptive statistics

	Average	Min.	Max.	SD
Donation (yen/person)	0.81	0.14	2.69	0.52
Volunteer (%)	3.31	2.00	6.90	1.05
Proximity of nuclear plant (dummy)	0.01	0.00	1.00	0.10
Prefecture intention (dummy)	0.40	0.00	1.00	0.49
Slack capacity of incineration plant (1000 t/per year)	31.35	0.00	1,179.67	58.82
Slack capacity of final disposal site (1000 t)	26.37	0.00	4,309.47	182.80
Distance from Fukushima Daiichi (100 km)	5.91	0.73	22.38	3.63
Population under age 15 (%)	12.70	4.25	21.81	2.28
Primary industry workers (%)	11.55	0.10	75.64	10.78
Density (person/km^2)	204.45	0.14	5,007.40	542.64
Wide area treatment of municipal solid waste (dummy)	0.58	0.00	1.00	0.49

Note: SD is standard deviation.

3.2 Model

We estimate the determinants for the municipalities' acceptance of disaster waste using the logit model. The model is:

$$\text{Prob}(Y = 1|\mathbf{x}) = \Lambda(\mathbf{x}'\boldsymbol{\beta}) = \frac{e^{\mathbf{x}'\boldsymbol{\beta}}}{1 + e^{\mathbf{x}'\boldsymbol{\beta}}}$$

Y is a dummy variable that takes the value of one when the municipality is positive toward the acceptance of the disaster waste and $\boldsymbol{x}$ represents explanatory variables. As discussed we will estimate two models. One based on the 2012 data and one based on the 2013 data. Regarding the 2012 data, three kinds of municipalities are treated as positive toward the acceptance: municipalities that have considered the acceptance; municipalities that have expressed the intention of the acceptance; and those that have already accepted the disaster waste. With regard to estimations using the data of 2013, municipalities positive toward the acceptance are those have already accepted the disaster waste.

There are large differences in the acceptance rate between the regions, in particular between east and west Japan. In particular there are very few municipalities that finally accepted waste in 2013 in West Japan. We will therefore also estimate models focusing only on East Japan.

The explanatory variables represented by $\boldsymbol{x}$ are various characteristics of the municipalities. When a municipality already disposes of municipal solid waste by wide area treatment with neighboring municipalities, it is necessary for the municipality to obtain permission from other municipalities to accept disaster waste. Hence, all of these

municipalities belonging to the group of wide area treatment are counted as accepting municipalities because they actually agreed upon acceptance.

4. Results

Table 4 reports the results from the binary logit models with the acceptance of waste as the dependent variable. The first two models report the results from the 2012 and 2013 data respectively, and include all municipalities. The third and fourth model reports results focusing only on the municipalities in East Japan.

Most of the estimated marginal effects have signs that are in line with our hypotheses. The statistical significance varies somewhat between the 2012 and 2013 data. In municipalities with higher amount of donations, the likelihood of accepting waste is higher, but the effect is only statistically significant for the 2013 data for the full sample. However, for the East Japan sample, the effect is statistically significant for both the 2012 and 2013 data. The size of the marginal effects is non-negligible although not huge. For example, for the 2013 model if donations increase by one standard deviation, the probability that a municipality accepts waste increases by almost 0.02 units. The measure of volunteer activity is also positively correlated with the likelihood of accepting waste for three of the four models. In particular if we focus on the sample of municipalities in East Japan, the effect is statistically significant. Thus, both our measures of pro-sociality are positively related to acceptance, and since the amount of donations is positively related, any type of moral licensing is not so strong so that it counteracts the effect of pro-sociality on the acceptance of waste.

Results related to the factor of reciprocity show that proximity to a nuclear power plant has statistically significant and positive marginal effect. A municipality that has a

nuclear power plant within its boundaries may accept the disaster waste because they would expect other municipalities to help if a severe nuclear accident occurred in their own municipality. The results suggest that the concept of reciprocity motivation leads to a municipality's acceptance.

The impact of the prefecture's intention is negative and statistically significant in models that use the data from 2012. On the other hand, the effect is positive and statistically significant in models that use the data from 2013. Since the 2012 data contains municipalities that show intentions of accepting disaster waste and the 2013 data does not, this suggests that the intentions of the prefecture tend to be positive when the municipalities move to the actual stage of acceptance. While the negative coefficient in models with the data from 2012 is difficult to interpret, the influence of different levels of government might not be weak in coordinating the inter-municipal transfer of disaster waste.

While the above variables are mostly related to non-economic motivations for acceptance, the estimated results suggest that economic incentives are also important for the decision to accept disaster waste, at least in some cases. This because either the slack capacity of the incineration plant or the disposal site is positively correlated with the decision to accept waste or not, at least if we look at all municipalities in 2012. However, if we only look at the municipalities in East Japan, this is no longer true. Thus, the municipalities in eastern Japan may tend to accept the waste regardless of economic rationality.

The results related to the influence of the radioactive contamination also support our hypothesis. The estimated marginal effects with the data from all of Japan show that the distance from the Fukushima Daiichi is negative and statistically significant. This

suggests that there is a lack of recognition regarding the urgency of the situation, or a lack of understanding regarding the risk of radiation in municipalities that are far from the affected area. The size of the marginal effect is sizeable, for the 2013 model an increase in distance corresponding to a standard deviation increase, decrease the probability of acceptance by 0.055 units. On the other hand, the marginal effect is positive and statistically significant in estimation with the data of eastern Japan in models estimated with the 2012 data.

The ratio of the population working in the primary industry as well as population density is statistically significant and negative. The agricultural workers might fear that accepting the tsunami waste could create a negative image of their products. As for the population density, many inhabitants worried about the influence of radiation when the distance to the facilities that accept the waste is short. Results of these variables suggest that the reluctance to accept disaster waste is strong in the municipalities with a higher number of workers in the primary industry and a higher population density. On the other hand, those under 15 years of age are not statistically significant in any of the models. While it is conceivable that parents feel anxious about exposing their children to radiation, it does not have a statistically significant impact on the municipalities' decision to accept disaster waste.

Table 4: Marginal effects, logit models on the decision to accept waste in 2012 and 2013.

	All of Japan				East Japan			
	2012 Data		2013 Data		2012 Data		2013 Data	
Donations	0.014		0.038	***	0.103	***	0.066	***
	(0.014)		(0.007)		(0.021)		(0.013)	
Volunteers (*10^2)	3.806	***	0.802	*	6.931	***	2.017	**
	(0.848)		(0.485)		(1.115)		(0.894)	
Proximity of nuclear plant	0.147	***	0.139	***	0.219	***	0.227	***
	(0.050)		(0.025)		(0.067)		(0.044)	
Prefecture intentions	-0.075	***	0.070	***	-0.059	**	0.129	***
	(0.017)		(0.016)		(0.025)		(0.029)	
Slack capacity of incineration plant	0.034	***	0.004		0.018		0.008	
(*10^2)	(0.013)		(0.005)		(0.017)		(0.011)	
Slack capacity of final disposal site	0.002		0.006	***	0.013		0.007	
(*10^2)	(0.003)		(0.001)		(0.008)		(0.006)	
Distance from Fukushima nuclear plant	-0.012	***	-0.015	***	0.016	*	-0.010	
	(0.004)		(0.004)		(0.010)		(0.010)	
Population under age 15 (*10^2)	0.288		-0.006		0.375		0.021	
	(0.402)		(0.278)		(0.587)		(0.483)	
Primary industry workers (*10^2)	-0.666	***	-0.205	**	-0.994	***	-0.364	**
	(0.137)		(0.090)		(0.192)		(0.156)	
Density (*10^2)	-0.002		-0.003	*	-0.002		-0.006	**
	(0.001)		(0.002)		(0.002)		(0.003)	
Wide area treatment of municipal solid	0.009		0.016		0.034		0.026	
waste	(0.015)		(0.010)		(0.024)		(0.018)	
Observations	1592		1592		889		889	

Note: Standard errors are given in parentheses. * p< 0.05; ** p < 0.01; *** p < 0.001.

5. Conclusions

This study investigated the determinants for the municipalities' acceptance of disaster waste resulting from the Great East Japan Earthquake. The results of the analysis show that the municipalities accepted the tsunami waste due to suggested motivations through social preferences as well as economic rationality. Previous studies have focused on economic reasons for transfer of waste between regions or municipalities. Thus, what we show is that other reasons could explain the decision as well.

Many news articles reported that inhabitants protested or opposed the acceptance of disaster waste while hoping for the revival of the stricken area. Our results show that the opposition to some extent comes from the inhabitants' anxiety over radiation contamination from the disaster. Information disclosure and communication about the radiation risks are important, especially for municipalities that are located far from the damaged area. The finding pertains to many NIMBY problem and the wide area treatment of other hazardous waste. On the other hand, variables related to pro-sociality positively affect the municipalities' acceptance of disaster waste. We could not find any evidence of moral licensing or negative relation between pro-social behaviors. Understanding how pro-social behaviors can positively affect cooperation is important for policy interventions for disaster recovery. It can create a feeling of YIMBY, i.e. Yes in my Backyard. It can be helpful for the ministry in the central government when it comes to coordinating the decision making of municipalities in different areas and at different levels.

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