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PUBLIC PERCEPTIONS TOWARD THE IMPACT OF DISPLACED PERSONS IN GERMANY ON WATER AND WASTEWATER SYSTEMS

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Abstract: In 2015, approximately 12.4 million people were forcibly displaced due to conflict or persecution. According to the United Nations High Commissioner for Refugees this forced migration, caused by instability in the Middle East, continued into 2016 and continues in 2017. Many of those displaced persons have been hosted in developed countries. In 2015 alone, Germany accepted approximately 750,000 refugees and asylum seekers. This study evaluates how these German hosting communities perceive the impact of displaced persons on their water and wastewater systems. Data was collected in August 2016 via a survey deployed to the general public in Germany. The survey queried whether the additional population was temporary or permanent and whether their impact on water and wastewater systems was thought to be short or long term. Statistical modeling is used to estimate demographic (e.g., income, education) and geographic parameters (i.e., specific states) that affect the perceptions of the hosting communities. Decision makers in charge of trying to integrate displaced persons into their communities may minimize potential opposition by drawing on the implications of the findings of this study.

1 INTRODUCTION

The world is currently facing the highest number of displaced persons ever recorded (UNHCR, 2016). However, the displacement of people is an age-old problem. In recent history this occurrence has dramatically increased, specifically affecting Europe (Migration Report, 2015). In 2011, 42.5 million were displaced; in 2015 that number rose to 65.3 million. Of these, 40.8 million were internally displaced persons; 21.3 million were refugees, and 3.2 million were asylum-seekers (UNHCR, 2016). These people were forced to leave their homes for various reasons, including violence, persecution, and natural disasters. In recent years, the drivers of displacement have included escalating violence in the Middle East and Africa (DW, 2016), the Syrian Arab Republic civil war (UNHCR, 2015a), and the Iraq war (UNHCR, 2015b). 2015 was a record year for industrialized countries hosting displaced persons (UNHCR, 2016). The area of the world most strongly affected by such hosting is Europe (Migration Report, 2015). Germany, the site for this study, was the largest, single recipient of new asylum applications receiving nearly 442,000 applications (UNHCR, 2016).

Infrastructure, such as electric power, telecommunications, transportation, and water, are critical to the economy, nationwide security, and social well-being (Rinaldi et al., 2001). The presence of exogenous changes (e.g., rapid population influx) may impact the overall performance and management of infrastructure. In the context of population dynamics, previous studies have assessed the impact of changing demands on water and wastewater infrastructure (e.g., Hummel and Lux., 2007; Faust & Abraham, 2014). Hummel and Lux (2007) evaluated the effect in Germany of urban decline on water supply systems as measured by financial sustainability (high per capita costs) and decreased

functionality. Faust and Abraham (2014) and Faust et al. (2016a) found that population dynamics had measurable impacts on water pressures, fire flows, water age, and financial sustainability of the utility, among other infrastructure performance and management parameters. Beyond potential infrastructure performance challenges associated with exogenous population dynamics, the local perceptions towards infrastructure performance and management is impacted by the individuals “contextualized surroundings” (Faust et al, 2016b). Faust et al. (2016b) assessed public perceptions toward water infrastructure performance and alternatives in the context of urban decline in United States shrinking cities. They found that perceptions were affected by specific locations (i.e., cities), demographics, and individual awareness of the population dynamics.

In this study, public perception is defined as the understanding of and opinion about a specific issue (Dowler, 2006). Public perceptions are measured at a specific time (i.e., cross sectional sample), but it must be recognized that perceptions are dynamic, changing with new information, social interactions, or events. In the public decision-making domain, there exists an intrinsic relationship between policies and public perceptions (Page, 1983; Hays, 1996; Burstein 2003). Understanding key parameters of public perceptions may aid in decision makers as they address societal concerns and try to mitigate potential opposition toward their public policies or positions, such as hosting displaced persons or aiding in the integration of displaced persons into the community.

This study assesses the demographic and geographic drivers of various perceptions within the industrialized, host community of Germany. It assesses German resident’s perceptions of the following: (1) whether the additional population of displaced persons is permanent, (2) whether displaced persons have impacted the water system of their city, and (3) whether displaced persons have impacted the wastewater system of their city. Statistically modeling these three questions provides a better understanding of the geographic and demographic parameters that tend to increase or decrease the likelihood of a respondent supporting or opposing each statement.

2 METHODOLOGY

The primary methods to conduct this study were survey analyses and statistical modeling (discussed in this section).

2.1 Survey Development and Deployment

A survey was deployed in August 2016 to the general public in Germany to assess the public attitudes towards and perceptions, awareness, and knowledge of the incoming refugees, the permanency of their stay, the provision of infrastructure services to them, and their impact on the water and wastewater system. This survey assesses how permanent the respondents perceived the additional population from displaced persons is permanent, posed on a four-point scale (i.e., strongly disagrees, disagree, agree, and strongly agree). The survey did not include a neutral or “I do not know” option so as to avoid respondent paralysis and to force the respondent to take a stance (Kurien et al., 2014). The second and third statements concerning the impact of displaced persons on water and wastewater systems at the city level (i.e., “The incoming refugees in the past three years have strained my city’s water/wastewater infrastructure”) were posed on a five point scale (i.e., strongly disagree, disagree, agree, strongly disagree, and I do not know), recognizing the fact that respondents may be unaware of the impact on or performance of the infrastructure systems in question.

The survey was deployed using a web-based survey software. All respondents participated voluntarily and were over the age of 18. The survey was conducted in German, with open responses translated to English via a translator. The survey’s content, was reviewed by eight subject matter experts whose expertise spanned survey analyses, water and wastewater infrastructure, human-infrastructure interactions, public perception modeling, and German culture. The survey was then pre-deployed to 15 individuals (not included in the final sample) to assess the correctness of the data collected, the German word choice, and whether individuals with limited knowledge of the water and wastewater sector could easily answer the questions posed. Prior to deployment, the survey underwent an Institutional Review Board (IRB) review at the University of Texas at Austin and at the University of Washington. The final

sample consisted of 416 valid responses spanning 16 states in Germany, providing a confidence level of 95% with a +/- 5% margin of error.

2.2 Binary Probit Model with Random Parameters

The three public perception statements regarding whether (1) the additional population from displaced persons was permanent, (2) the displaced persons impacted the city's water system, and (3) the displaced persons impacted the city's wastewater were statistically modeled. Responses to the questions were collapsed to the binary variables of "agree" and "disagree", with the former comprising of "agree" and "strongly agree" and the later comprising "disagree" and "strongly disagree". "I do not know" responses were removed from the model.

The basis for all the models was a binary probit model (Equation 1). Equation 1 indicates the probability for respondents to support one of the two possible outcomes from observation n . In these models, Φ is the standardized cumulative normal distribution. $\beta_{support}$ represents a vector of estimable parameters for outcome support, and $X_{support,n}$ is a vector of observable or measured parameters that indicates the discrete outcome for a given observation n (Washington et al., 2011).

$$[1] P_n(support) = \Phi\left(\frac{\beta_{support} \cdot X_{support,n}}{\sigma}\right)$$

Random parameters were incorporated to capture the heterogeneity of perceptions across the population through the density function, $f(\beta|\varphi)$, where φ is a vector of parameters of a specified density function. All density functions used in this model for the random parameters were normally distributed. The binary probit model with random parameters can be expressed as follows (Washington et al., 2011):

$$[2] P^{rp}_n(support) = \int_x P_n(support) \cdot f(\beta|\varphi) d\beta$$

The best-fit model selection considered Akaike information criteria AIC values.

2.3 Marginal Effects

Marginal effects were used to quantify the impact of each independent parameter on the dependant variable. The reported marginal effects corresponded to the average marginal effect across the sample, for a one-unit change in the independent parameter (Washington et al., 2011). A positive marginal effect indicates an increase in the likelihood that the respondent perceived the additional population from displaced persons to be permanent or that the respondent perceived the displaced persons to be impacting the city's water or wastewater system.

3 RESULTS

Of the survey's respondents, 54% were male, 51% married, and 22% had a household income level below €19,999. Shown in Table 1 are descriptive statistics of the selected demographic variables for the statistical models. Figure 1 shows the distribution of responses to the statement concerning the permanency of the incoming refugees. Figure 2 shows the distribution of responses concerning the strain that incoming refugees have placed on the water and wastewater systems. The results illustrated in Tables 2-4 show the statistically significant parameters for the three models, and the marginal effects of each variable.

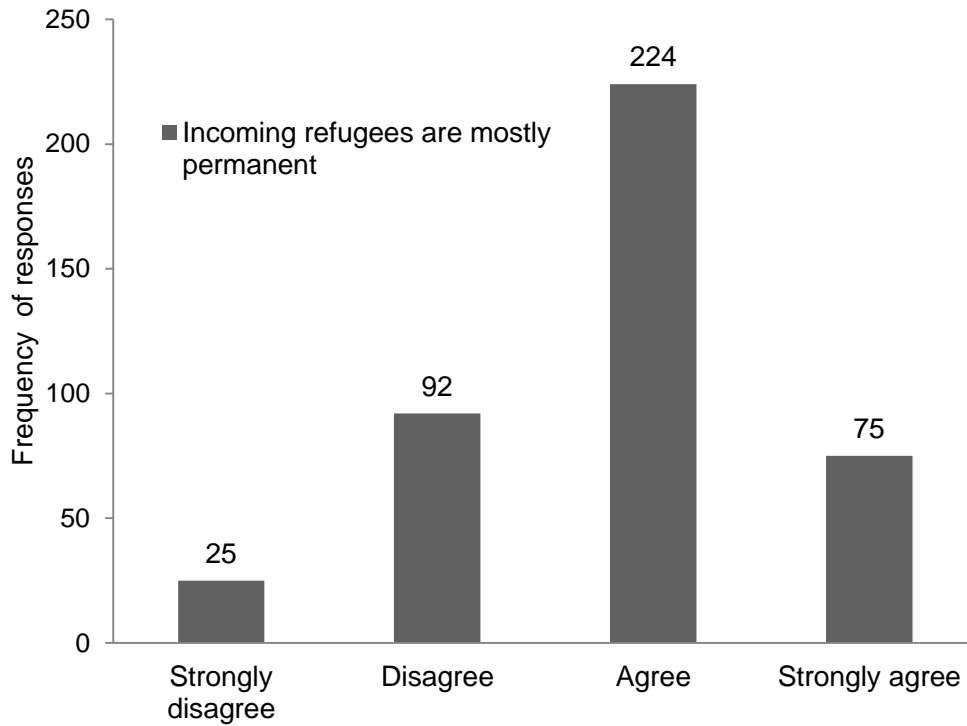


Figure 1: Frequency of responses, *“The incoming refugees residing in Germany are mostly permanent, and will result in long term population change”*

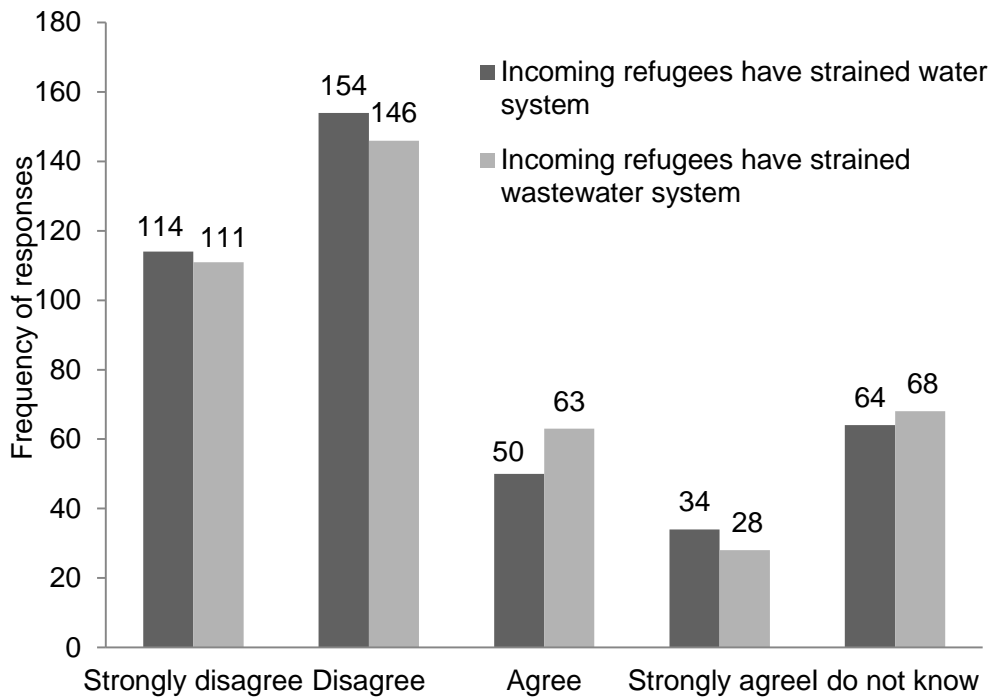


Figure 2: Frequency of responses, *“The incoming refugees in the past 3 years have strained my city's water (wastewater) infrastructure”*

Table 1: Descriptive statistics of select demographic parameters

Independent Parameter	Min/Max	Average	Standard Deviation
Individual parameters			
Gender (1 if male, otherwise 0)	0/1	0.54	0.50
Number of years lived in city (years)	0/99	27.28	19.11
Highest level of education (1 if some high school, otherwise 0)	0/1	0.46	0.50
Individual income (1 if income is less than €34,999, otherwise 0)	0/1	0.68	0.47
Employed for wage or salary (1 if true, otherwise 0)	0/1	0.50	0.50
Responsible for water utility bill (1 if true, otherwise 0)	0/1	0.85	0.36
Internet is the primary source of news (1 if true, otherwise 0)	0/1	0.41	0.49
Household parameters			
Number of people living in the household is 2 or less (1 if true, otherwise 0)	0/1	0.69	0.46
Household income (1 if household income is less than €34,999, otherwise 0)	0/1	0.49	0.50
Household owned by someone in household with mortgage or loan (1 if true, otherwise 0)	0/1	0.21	0.41

Table 2: Model results for the statement, "The incoming refugees residing in Germany are mostly permanent, and will result in long term population change"

Independent Parameter	Parameter (t-statistic)	Standard deviation (t-statistic)	Marginal Effects
Constant	-0.016 (0.942)	<i>fixed</i>	
Geographic parameters			
Residing in Mecklenburg-Vorpommern (1 if true, otherwise 0)	-1.781 (-3.410)	<i>fixed</i>	-0.059
Residing in Brandenburg (1 if true, otherwise 0)	-1.288 (-2.970)	<i>fixed</i>	-0.043
Residing in Bremen (1 if true, otherwise 0)	-1.406 (-1.760)	<i>fixed</i>	-0.047
Individual parameters			
Individual income (1 if below €34,999, otherwise 0)	0.766 (3.800)	<i>fixed</i>	0.025
Employed for wage or salary (1 if true, otherwise 0)	0.424 (2.190)	<i>fixed</i>	0.014
Gender (1 if male, otherwise 0)	0.468 (2.450)	0.533 (3.80)	0.015
Highest level of education (1 if some high school, otherwise 0)	2.961 (3.530)	8.192 (4.79)	0.098
<i>Log likelihood at convergence</i>	-232.080		
<i>AIC</i>	484.200		
<i>Number of observations</i>	416		

Table 3: Model results for the statement, “The incoming refugees in the past 3 years have strained my city’s water infrastructure”

Independent Parameter	Parameter (t-statistic)	Standard deviation (t-statistic)	Marginal Effects
Constant	-2.260 (-4.470)	<i>fixed</i>	
Geographic parameters			
Residing in Rhineland-Palatinate (1 if true, otherwise 0)	1.274 (2.860)	<i>fixed</i>	0.002
Individual parameters			
Gender (1 if male, otherwise 0)	-0.490 (-1.800)	<i>fixed</i>	-0.001
Employed for wage or salary (1 if true, otherwise 0)	0.861 (2.650)	<i>fixed</i>	0.001
Primary source of news (1 if Internet, otherwise 0)	0.996 (3.800)	<i>fixed</i>	0.001
Lived less than 5 years in city (1 if true, otherwise 0)	0.725 (1.800)	<i>fixed</i>	0.001
Individual parameters			
Individual income (1 if below €34,999, otherwise 0)	-1.936 (-3.920)	3.404 (5.880)	-0.003
Highest level of education (1 if some high school, otherwise 0)	-2.268 (-3.620)	6.597 (5.630)	-0.004
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<i>Log likelihood at convergence</i>	-178.909		
<i>AIC</i>	377.800		
<i>Number of observations</i>	352		

Table 4: Model results for the statement, “I agree that the incoming refugees in the past 3 years have strained my city’s wastewater infrastructure”

Independent Parameter	Parameter (t-statistic)	Standard deviation (t-statistic)	Marginal Effects
Constant	-0.774 (-3.070)	<i>fixed</i>	
Geographic parameters			
Residing in Baden-Württemberg (1 if true, otherwise 0)	1.227 (3.230)	<i>fixed</i>	0.086
Residing in Rhineland-Palatinate (1 if true, otherwise 0)	1.670 (3.530)	<i>fixed</i>	0.118
Individual parameters			
Born where currently living (1 if true, otherwise 0)	0.634 (2.470)	<i>fixed</i>	0.044
Student (1 if true, otherwise 0)	-4.716 (-3.350)	<i>fixed</i>	-0.333
Household parameters			
Household Income (1 if below €34,999, otherwise 0)	0.730 (2.970)	<i>fixed</i>	0.051
Number of people living in the household is 2 or less (1 if true, otherwise 0)	-0.967 (-3.740)	<i>fixed</i>	-0.068
Household owned by someone in household with mortgage or loan (1 if true, otherwise 0)	-0.731 (-2.220)	<i>fixed</i>	-0.051
Individual parameters			
Primary source of news (1 if Internet, otherwise 0)	-0.769 (-2.140)	4.377 (6.11)	-0.054
Highest level of education (1 if Some high school, otherwise 0)	-1.127 (-3.200)	2.850 (6.31)	-0.079
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<i>Log likelihood at convergence</i>	-178.884		
<i>AIC</i>	381.800		
<i>Number of observations</i>	348		

4 DISCUSSIONS

Model results are categorized and discussed by geographic, individual, and household parameters. The impact of fixed parameters remains constant across the population, whereas the impact of random parameters varies across the population as shown in Tables 2-4.

4.1 Geographic Parameters

Three German states were statistically significant parameters influencing the perceived permanence of displaced persons. Residents of Mecklenburg-Vorpommern, Brandenburg, and Bremen had a decreased likelihood of considering that additional population from displaced persons are permanent (see Table 2). As of 2015, these states received 2.09% (Mecklenburg-Vorpommern), 3.08% (Brandenburg) and 0.94% (Bremen) of the displaced persons in Germany (Katz et al., 2016). Furthermore, compared with the rest of the country, the states of Mecklenburg-Vorpommern and Brandenburg have a low population density (Destatis 2017). As such the results may reflect the residents' contextualized surroundings as seen in Faust et al. (2016b). However, in light of the relatively low percentage of displaced persons received (as of 2015) and the low population density in two of these three states, this parameter may be capturing other indicators. The geographic parameter may be an indicator of locational factors, such as communications between the city decision-makers and the public.

As to whether the incoming refugees in the past 3 years had strained the city's water infrastructure system, only one geographic parameter was statistically significant, the state of Rhineland-Palatinate. Residents of Rhineland-Palatinate were more likely to perceive such a strain (see Table 3). Neighboring states, North Rhine-Westphalia, Hesse, and Baden-Württemberg have received a combined 41.53% of the displaced persons in Germany (Katz et al., 2016). This parameter may be capturing proximity to states receiving large influxes, yet this parameter may also be an indicator of other factors. For example it could be capturing the conditions or capabilities of the infrastructure systems in this region or communications between the utilities and the public.

And as to whether the incoming refugees had strained the wastewater infrastructure, such a strain was more likely to be perceived by residents of Baden-Württemberg and Rhineland-Palatinate (see Table 4). Baden-Württemberg receives, at 12.97%, the third highest portion of displaced persons within Germany. Rhineland-Palatinate is proximal to states receiving approximately 42% of displaced persons in Germany (Katz et al., 2016). These parameters may be capturing contextualized surroundings based on the number of displaced persons at a local level, or other locational indicators discussed above, such as system capacity or local information dissemination.

4.2 Individual Parameters

Whether the general public perceived the incoming displaced populations to be largely permanent was impacted by four individual parameters: being male, having an individual income level below €34,999, being employed for a wage or salary, and having at most high school education. All four parameters increased the likelihood of perceiving the additional population from displaced persons as being permanent (see Table 2). An income of less than €34,999 is below the national average € 37,613 (OECD, 2017). This parameter may thus be capturing the inability to shoulder the perceived financial burden of the displaced persons. In regard to education level, previous studies have found that people with higher levels of education in general have more positive attitudes toward refugees (Foster, 2008; Berg, 2010). The gender parameter and having an educational level of some high school were estimated as random parameters capturing the heterogeneity across these subgroups within the population.

In the likelihood of perceiving that displaced persons strained the local water infrastructure systems, six individual parameters were found to be statistically significant (see Table 3). The gender indicator, individual income below €34,999, and highest level of education of some high school decrease the likelihood of perceiving that additional population from displaced persons strained the city water infrastructure system. Individuals employed for wage or salary, those who used the Internet as their primary source of news (which indicates flexibility and variability in news sources), and those who lived for less than five years in the city were more likely to perceive that the additional population from displaced

persons had strained the city's water infrastructure system. The parameter of respondents having lived for less than five years in their city may be capturing previous experiences or the lack of longevity in the city to contrast before versus current infrastructure conditions. Parameters for individuals with incomes of less than €34,999 and some high school educational level were estimated by random parameters, indicating heterogeneity across the population for these parameters.

In perceiving that the displaced population impacted the wastewater system, four parameters were statistically significant (see Table 4). Individuals whose highest level of education was some high school, whose primary source of news was the internet, and who were currently students were all less likely to perceive that additional population from displaced persons have strained the city's wastewater infrastructure system. The first two of these were random parameters, indicating the presence of heterogeneity across the population. On the other hand, respondents who were born where they are now living were more likely to perceive the strain. This may be capturing individuals comparing the current population changes with prior knowledge and experiences. Individuals who highest level of education was some high school was consistent in terms of impact on perceived impact towards the permanence of incoming refugees and their impact on water and wastewater systems. In both cases this parameter indicated individuals less likely to perceive the strain in the system.

4.3 Household Parameters

In terms of influencing perceptions towards the impact of displaced persons on the wastewater system three household parameters were statistically significant (see Table 4). Individuals whose household incomes were less than €34,999 were more likely to perceive the additional population having strained the city's wastewater infrastructure system. Individuals from these households may perceive a financial burden being connected with displaced persons. Individuals from households that were paying on a mortgage or a loan and with two or fewer people were less likely to perceive this strain on the city's wastewater infrastructure system.

5 SUMMARY AND CONCLUSIONS

This study has presented various demographic and geographic parameters that impact public perceptions toward whether incoming refugees are permanent, and whether their presence impacts water and wastewater infrastructure systems. As with any study, this one has limitations. First, the survey is a cross sectional study of public perceptions, which, by nature, are dynamic, and may be reshaped by new information, or events. Second, this study is focused on Germany. Due to factors such as culture and the hosting country being an industrialized nation, findings from this study may not be applicable to other areas. Third, this study may be subjected to the omitted variables bias.

Significant parameters include the respondent's gender, their individual and household income level, educational level, primary source of news, and the state in which the respondents live. Furthermore, the presence of random parameters demonstrated the substantial heterogeneity of perceptions across the population. States in which residents are less likely to perceive incoming displaced persons to be permanent have a relatively small rate of incoming refugees: Brandenburg (3.08%), Bremen (0.94%), and Mecklenburg-Vorpommern (2.09%) (Katz et al, 2016). States in which residents are more likely to perceive that incoming refugees have strained their city's water or wastewater systems have a relatively high rate of incoming refugees: Baden-Württemberg (12.97%) and Rhineland-Palatinate (4.83%) (Katz et al, 2016). The state of Rhineland-Palatinate is statistically relevant in terms of increasing the perception that displaced persons strain both the water and wastewater systems. Such a finding may be possibly capturing factors such as the condition, capability, or capacity of the systems or the dissemination of information at the local level.

If decision makers are able to identify and understand the demographic and geographic drivers that impact the public perceptions toward possible impacts from displaced persons on the water and wastewater infrastructure systems, they are better equipped to develop policies and communications for hosting communities that could mitigate potential public opposition. Future research should try to extend our understanding of the parameters impacting public perceptions of incoming refugees across scales.

Such research should consider the perceived impacts that range from a city's infrastructure level to a nation's. Future work should also evaluate public perceptions beyond water and wastewater systems, such as transportation and the local housing systems.

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