

ARTICLES AND REVIEWS

Health Impact Assessments for Environmental Restoration: The Case of Caño Martín Peña

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ABSTRACT

Background: Health Impact Assessment (HIA) is a methodology for predicting the effects of a proposed policy or plan on health. A proposed environmental restoration and development plan presented an opportunity for an HIA in an environmental justice community surrounding the Martín Peña channel in San Juan, Puerto Rico. The HIA focused on the dredging of the channel, debris removal, road, sewer, and storm water infrastructure improvements, housing demolition, and resident relocation.

Objective: The aim of this study was to determine the potential effects of the proposed plan on the community's health to inform the funding decision by the Puerto Rican legislature. As the first HIA in Puerto Rico, a secondary objective was to build HIA capacity in Puerto Rico.

Methods: This HIA used community training, literature reviews, existing local studies, focus groups, interviews, and disease surveillance data to assess baseline health, determine expected effects, and build capacity.

Findings: The Martín Peña community is experiencing deteriorating environmental conditions. Flooding and negative environmental exposures, such as mold, limits to physical activity, stress, chemical toxicants, pathogenic bacteria, and pests, are worsening. The higher rates of diseases, such as asthma and diarrhea, in the community compared with elsewhere in Puerto Rico appear to be largely attributable to these factors. Overall, the proposed plan is expected to improve many of these health disparities but the successful implementation depends on continued community acceptance and participation, particularly with the relocation process. Recommendations are for full financing and several mitigation efforts to avoid negative and preserve beneficial health consequences.

Conclusions: As the first HIA in Puerto Rico, this assessment provided specific recommendations to benefit the health of the community affected by an environmental restoration and development plan and also capacity building for a larger audience in Puerto Rico. This approach could be generalized to other Latino environmental justice communities in Puerto Rico and abroad.

Key Words: ecosystem restoration, environmental justice, Puerto Rico, vulnerable populations

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Partners on this project include, in San Juan the Corporación del Proyecto ENLACE del Caño Martín Peña, and the Grupo de las Ocho Comunidades Aledañas al Caño Martín Peña, G-8, Inc., and the Icahn School of Medicine at Mount Sinai Pediatric Environmental Health Specialty Unit (Mount Sinai PEHSU) from New York. This work was funded by the Health Impact Project, a national initiative of The Pew Charitable Trusts and the Robert Wood Johnson Foundation to promote the use of HIAs in policymaking throughout the United States. Additionally, the authors acknowledge the assistance of Ana Elisa Pérez and Kimberly Fischer during preparation of this manuscript. All authors had a role in writing the manuscript.

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INTRODUCTION

Developed in the 1990s, Health Impact Assessment (HIA) is a practice that combines different methods to determine and recommend measures to mitigate the potential effects of a policy or project on human health.^{1,2} The use of HIAs has been increasing globally to address such issues as new land use, housing projects, economic policies, changes to transportation systems, and labor issues. Becoming more common in the United States, HIAs are already well-established in a number of other countries such as Thailand, the United Kingdom, and New Zealand.^{3,4} Social, economic, and environmental determinants of health are factors that can be influenced by decision-making bodies.⁵ HIAs arose to help influence such health determinants and avoid unanticipated health effects of new policies or actions.^{1,6} The World Bank and the World Health Organization advocate for the use of HIAs.⁶ Multiple examples of completed HIAs and their

impact on policy and project implementation can be found on the Human Impact Partners website (<http://www.humanimpact.org/projects/hia-case-stories/>). The following principles have been highlighted as essential components of an HIA:^{1,3}

1. Public engagement.
2. Address social and environmental justice and health disparities.
3. Address the sustainability of proposed changes.
4. Provide a comprehensive analysis of the effects of the proposed change on health.

This HIA focuses on a proposed environmental restoration and community development plan called the ENLACE Caño Martín Peña Project.⁷ This area was originally populated by migrants from rural Puerto Rico who settled along a 3.7-mile strip of the Martín Peña channel in San Juan beginning in the early 1900s. Today a large migrant population from the Dominican Republic has also begun to settle along the borders of the channel. Located only 2 miles from the island's main financial center, it is one of the poorest areas in Puerto Rico.⁸ Almost 65% of the population reported an annual income below the US poverty level, and, of these, 42% reported an annual income of \$10,000 or less.⁹ The community adjacent to the channel has more than 25,000 inhabitants and the highest population density in metropolitan San Juan¹⁰ distributed among 8 communities. Together, they are represented by the G8, Inc., a nonprofit grassroots organization.

Over time, the channel has become filled with debris, initially by new migrants and by government policies to create additional surfaces on which structures could be built, and later as a covert location for trash dumping. Furthermore, there is a lack of sanitary sewers within a good portion of the community, and the storm water system is inadequate to efficiently drain the community during rainfall events. Flooding has become more frequent and severe as the channel has become more clogged and the surrounding development in San Juan has increased the speed and volume of water runoff.

Between 2002 and 2004, the Puerto Rico Highway and Transportation Authority led the process to dredge the channel and shepherded the creation of a comprehensive development and land-use plan. The plan and the law that created mechanisms for its implementation resulted from more than 700 citizen engagement activities that included community assemblies, round tables, and capacity-building workshops. The proposed plan includes the environmental restoration of the channel through dredging and removal of thousands of tons of contaminated sediment, numerous infrastructure and other community improvements such as the development of a *paseo*, or bike path and walkway, adjacent to the restored waterfront, and the demolition of hundreds of structures and relocation of residents for the

proposed work. It also includes socioeconomic development strategies. Implementation costs were estimated at the time to be \$744 million. Cost estimates for the key components, which are divided roughly in thirds between the channel dredging, infrastructure improvements, and resident relocation, are currently estimated at \$600 million. Funding is expected to come from a variety of sources. The resulting Corporación del Proyecto ENLACE del Caño Martín Peña, a public corporation and a partner on this HIA (PR Law 489-2004), leads the implementation of the plan.

This HIA examined the potential health effects of the dredging and various infrastructure interventions of the proposed environmental and development plan in this environmental justice community. Other HIAs have examined environmental restoration projects and changes planned in environmental justice communities.^{11,12} However, this HIA was the first of any type of HIA to be conducted in Puerto Rico, which has potential generalizability to other Latino communities in the United States and elsewhere in the Americas. To that end, this HIA had an additional goal of building HIA capacity in the broader Commonwealth of Puerto Rico.

METHODS

This Caño Martín Peña HIA included the standard 6-part HIA methodology: screening, scoping, assessment, recommendations, reporting, and monitoring and evaluation.^{1,13} Our team conducted it during a 15-month period in 2013 and 2014.

Screening

As a first step, we identified an important decision point to which an HIA could contribute. That decision point was the Puerto Rican legislature's pending vote regarding the funding of the proposed environmental restoration and development plan. Next, our review of the published and grey literature regarding health of the population found that a sufficient body of evidence existed on which to draw conclusions within the HIA. We subsequently established 2 groups for guidance. The first, a community advisory committee (CAC), consisted of local community residents. The second, a steering committee, was comprised of health and urban planning professionals. These 2 groups convened as needed throughout the project to provide input on all stages of the HIA.

Scoping

In June 2013, an HIA training session served to launch this second HIA step called *scoping*. This training included approximately 40 participants who were representatives from government agencies, multiple public health academic institutions, nonprofit advocacy organizations, and community members. The purpose was to simultaneously train the team conducting the HIA and

others who would potentially use HIA methodology in Puerto Rico in the future. The training identified numerous health determinants relevant to the proposed environmental restoration and development plan and the community including housing, education, water quality, flooding, land use near the channel, local economy, structure demolition and relocation, food safety and security, and social capital. For feasibility, we limited the scope of the HIA to address 3 key elements of the proposed plan: 1) dredging and debris removal; 2) road, sewer, and storm water drainage infrastructure changes including development of the waterfront *paseo*; and 3) housing changes including resident relocation due to the necessary demolition of homes located along the channel. This scope permitted us to create preliminary theoretical pathways through which the proposed plan might influence health. These pathways were then subsequently refined based on the next step, the *assessment*.

Assessment

Our assessment used health data from previous studies in the community, a literature review of epidemiologic data, interviews with school administrators regarding the effects of flooding, Department of Health dengue surveillance data, and focus groups with community members. Baseline health data specific to the community came primarily from prior work of Ponce School of Medicine and Health Sciences and the Graduate Schools of Public Health at the University of Puerto Rico available as grey literature. Our literature review of peer-reviewed studies provided the scientific basis of links between environmental exposures and health outcomes. We conducted semistructured interviews with school representatives for each of the elementary, middle, and high schools in the community to explore frequency and severity of flooding that affected children's education. For the focus groups, we developed a moderator's guide with input from the advisory committee and carried out 5 groups. Participants were community members with specific recruitment from different areas around the channel as well as subgroups such as mothers and health care providers. The questions explored current environmental conditions and health concerns, vulnerable groups, and perceptions of how the proposed plan would affect the community. Sessions were transcribed and transcriptions were analyzed to identify environmental health linkages and expand on the information from the grey and peer-reviewed literature review. Additional details about each of these methods are included in the full HIA report.¹⁴

Recommendations, Reporting, and Monitoring and Evaluation

Following the assessment and with ongoing input from the advisory committees, the team created recommendations to promote positive health aspects and mitigate negative health impacts identified in the HIA. These were vetted with community members for additional input.

Additionally, we created a communication and dissemination plan as well as a monitoring and evaluation plan.

The Icahn School of Medicine at Mount Sinai Program for the Protection of Human Subjects determined that this project was exempt human research.

RESULTS

Environmental Conditions

The channel's congested waterway floods during even modest rainfall events, meaning that flooding events are very frequent in the Caño Martín Peña community. Additionally, portions of the community suffer from critical environmental conditions related to inadequate sanitary infrastructure and sewer discharge, contaminants in the storm drain systems, illegal disposal of garbage, and other factors affecting water quality. Testing performed on the waters from the channel found *Escherichia coli* levels as high as 1,500,000 colonies per 100 mL, which exceeds standards set by the state Environmental Quality Board.¹⁵ Raw sewage from several thousand structures within the community as well as untreated sewage from other areas of the city flow into the channel. Additionally, high levels of copper, selenium, organic contaminants, and pesticides were found in sediment in the community.¹⁶ More than half of the community reports flooding in their homes each year and the number of flooding incidents has increased over the past decade.¹⁵ Overall, many residents who participated in the focus groups and served on the CAC reported that their homes are a source of environmental stress, citing mold, insect, or rodent infestation and general deterioration that is exacerbated by flood waters.

Baseline Health Conditions

Based on the limited studies and personal communication with local community health care providers, we found that this community has rates of chronic disease as high as or higher than other Puerto Rican communities.¹⁷ These include conditions and risk factors such as diabetes, hypertension, elevated cholesterol, coronary heart disease, asthma, depression, arthritis, overweight, obesity, and lack of physical activity, which have a high burden throughout Puerto Rico.¹⁸⁻²⁰ Additionally, rates of diarrheal illness and childhood asthma and allergies are also elevated.^{15,21}

Environmental Health Links

Our literature review demonstrated that environmental conditions that exist in the community—deteriorating housing, frequent flooding, inadequate sewage and storm water drainage systems, frequent school and work disruptions due to the flooding, and exposures to sewage contaminated flood waters—are linked in the epidemiological literature to infectious, allergic, and mental health problems as well as negative economic and school performance effects, which also influence health.¹⁴ Flooding,

contaminated water or sediment, and damp environments increase risk for exposure to mosquitoes, heavy metals, pesticides, other chemicals, and harmful bacteria.^{22,23} Diseases transmitted by mosquitoes such as dengue and chikungunya are increasingly of concern in Puerto Rico.^{24,25} School attendance is important for academic success, and frequent absences during a child's early years in school may substantially effect educational success.²⁶ Furthermore, higher educational attainment is linked to multiple health indices—higher overall life expectancy, better self-perceived health status, and lower infant mortality.²⁷ Apart from the health effects from flooding, the baseline infrastructure of a neighborhood has been shown to influence walkability and thus physical activity levels.²⁸

Local health studies have demonstrated that some specific illnesses are associated with proximity to negative environmental exposures. For example, diarrheal illnesses are higher in individuals living closer to the channel; asthma rates for community children under 5 the age of years are twice that for the same age group elsewhere in Puerto Rico; and dengue infections are clustered around flood areas and illegal dumpsites in the community.^{15,17,21} Furthermore, focus group participants gave many examples of specific symptoms or generally feeling ill when at home and feeling better when spending time outside of the community.

Projected Health Effects

This HIA focused on determining the effects within 3 areas of the proposed plan: 1) dredging and debris removal; 2) road, sewer, and storm water drainage infrastructure changes including development of the waterfront *paseo*; and 3) housing changes including resident relocation due to the necessary demolition of homes located along the channel. The projected health effects are summarized in Table 1. Negative environmental exposures such as bacteria in contaminated floodwaters, mosquito habitats, property damage and resulting school and work disruption, and mold will likely be reduced as flooding and accumulated debris in the community is reduced. These changes are projected to result in reduction of diarrheal disease, risk for dengue or other mosquito-transmitted infections, asthma attacks, allergic symptoms, and psychosocial stress. Additionally, positive environmental exposures such as access to recreational space and overall walkability of the community are expected to increase with the creation of the *paseo* along the waterfront and improved roadways. These positive exposures are associated with increased physical activity and could result in reduction in chronic disease such as obesity, diabetes, and depression.²⁹

There are also some potentially negative health effects. For example, the dredging and debris removal could potentially liberate toxic substances, such as hydrogen sulfide or heavy metals, from the sediment and also displace pests, such as rats, into neighboring residential areas. These types of exposures are associated with asthma attacks and subclinical symptoms such as

neurodevelopment effects from elevated blood lead levels. Furthermore, the proposed plan will require relocation of approximately 375 additional households and land values and housing costs are expected to increase. Relocation can be associated with stress, anxiety, and depression from disruption of social support systems and uncertainty associated with change. Higher cost of living can be associated with economic insecurity, stress, homelessness, or overcrowding. These exposures can lead to an increase in physical and mental illness.

However, the community, in partnership with the government and ENLACE, has already taken considerable measures to avert these negative consequences associated with housing changes. The relocation assistance is closely regulated by specific guidelines known as the ENLACE bylaws, which offer additional protections and assurances for affected community members beyond the Uniform Relocation Assistance and Real Estate Acquisition Act (U.S. Public Law 91-646). The ENLACE bylaws call for provision of decent, safe, and sanitary housing for any community members relocated by the dredging and associated development project. Thus, if these regulations are respected, poor housing conditions, which affect a number of the community members being relocated, are expected to improve. Community members to be relocated are given a choice of leaving or staying within the community and the process is overseen by group of community members who help explain the steps and guide the families throughout the relocation. Although change of any kind can increase stress levels, a systematic approach can help alleviate anxiety by preparing community members for and during the relocation process.^{30,31}

To address the expected land value increase, the Caño Martín Peña Land Trust was created under the same law as a private nonprofit, designed to address land-tenure issues, prevent gentrification, and avoid involuntary displacement.³² Through community land trusts, the affordability of housing is permanently maintained for low-income families. Members of this community land trust include residents and businesses of the community, ensuring that the land trust serves the interests of the community and its inhabitants. Although surface rights and homes can be sold, they must first be offered to the land trust. This system guarantees that affordability is built into the surface rights and will perpetuate for all housing turnovers.

RECOMMENDATIONS

The HIA leadership, in conjunction with the advisory committees, developed the following key recommendation:

The Commonwealth of Puerto Rico, with federal support, should finance the implementation of the

Table 1. A Description of the Health Effects Determined by the Caño Martín Peña Health Impact Assessment*

Health Determinant	Health Indicator [†]	Direction of Impact [‡]	Magnitude [§] (how many)	Severity (how much)	Comments
Toxicant Exposure	Blood lead level, skin problems	Short term: ↑	Low	Low	Contaminated sediment disturbed during dredging
		Long term: ↓	High	Medium	Dredging, infrastructure, and housing quality improvements
Bacteria exposure	Diarrheal disease	↓	High	Medium	
Mosquito habitat	Cases of dengue	↓	High	High	
Pesticide use	Pesticide body burden	↓	Moderate	Medium	
Lack of physical activity	Obesity, heart disease, diabetes	↓	High	High	Wider streets and sidewalks increase walking and biking
Property damage and mobility impairment from flood	Stress, anxiety and depression	↓	High	Medium	
Allergen exposure	Rates of asthma and allergies	↓	High	Medium	Reduced damp conditions caused by flooding and relocation to better quality homes
Educational attainment	Number of missed school days	↓	High	Medium	Greater continuity of education
Resident relocation	Stress, anxiety, and depression	Short term: ↑	High	Medium	Stress associated with lifestyle change and changes in the social support system
		Long term: ↓	High	High	Relocated residents would be placed in better quality homes
Economic insecurity due to higher land values; higher housing costs	Stress	↑	Low	High	Increased land values may lead to homelessness or overcrowding for some residents

*This chart is included in the full project report.¹⁴

[†]Health indicators cited here are examples, not a comprehensive list.

[‡]Direction of impact refers to whether the proposed project will increase (↑) or decrease (↓) the burden of disease.

[§]Magnitude reflects a qualitative judgment of the size of the anticipated change in health effect (eg, the number of people affected): low, moderate, or high.

^{||}Severity reflects the nature of the effect on function and life expectancy and/or its permanence: low, medium, or high.

Comprehensive Development Plan in its entirety, including dredging, the CMP [Caño Martín Peña] with careful safeguards to minimize harmful exposures to residents and workers; infrastructure improvements to roadways, sewer and storm water drainage systems; and the demolition of structures and relocation of households according to the ENLACE regulations.

Furthermore, we emphasized that continued community support is critical and, to that end, the activities and projects being implemented by ENLACE are vital to the success of the proposed plan.

Additionally, we had a number of subrecommendations grouped by the 3 key categories of focus: dredging, infrastructure, and housing. Most recommendations reinforced potentially positive health benefits of the proposed plan. However, we also made specific recommendations to mitigate potential negative health effects.

1. The implementation of the proposed plan should include measures to secure the work site to minimize trespassing into the dredging area, especially for children; remove debris and prune mangroves before dredging begins to minimize the scattering of animals and insects that currently reside there; nontoxically reduce migration of pests from the area being cleared; and construct sound barriers, especially in critical areas, to minimize construction noise.
2. The implementation of the proposed plan also should include measures to minimize both worker and public exposure to dredged sediment, which will likely contain elevated levels of toxic materials. This includes measures for safe transport and also disposal in areas where neither immediate nor delayed exposures will occur such as through groundwater contamination.
3. The Municipality of San Juan and Puerto Rico Health Departments should plan for targeted fumigation when key vector habitat is being disturbed to reduce vector-borne disease risk to the community.
4. Maintain an equitable, sensitive, and well-organized approach to relocation by having ENLACE lead the relocation process. ENLACE is well integrated, works in close collaboration, and has a long-standing trusting relationship with the affected community.
5. Assign a social worker to assist the families being relocated and provide support groups to help all families cope with the stress of the transition, including those who may be losing their neighbors due to relocation. Promote the role of the land trust by conducting outreach to the community to educate residents about its role in serving the needs of the community by maintaining affordability and preventing displacement, homelessness, overcrowding, and poor living conditions.

Reporting, Dissemination, and Monitoring

As stated, the decision point that this HIA was originally intended to inform was the Puerto Rican legislature's funding decision regarding the proposed plan. Due to the fiscal situation of the Commonwealth of Puerto Rico, it became clear that public support would be critical for any future appropriations and alternative funding sources should also be strongly pursued. Therefore, the emphasis shifted to using the HIA to help inform a broader audience regarding the health impacts of the proposed plan and to mobilize key entities in order to fill critical shortages in funding even if the Puerto Rican legislature approves a portion of the funding. To that end, the release of the HIA findings was coupled with the visit to the community by the Environmental Protection Agency (EPA) federal and regional administrators. A press conference was held at the ENLACE office where representatives from ENLACE, Mount Sinai Pediatric Environmental Health Specialty Unit, and the G8, Inc. as well as the EPA all participated. This effort was followed with a presentation in New York to a diverse group of federal and Puerto Rican government agencies to be followed with a summit in San Juan several months later aimed at convening groups that will be able to mobilize appropriate funding. The monitoring and evaluation intended both to assess the process of the HIA itself as well as to monitor the implementation and success of the recommendations are in process.

DISCUSSION

This HIA concluded that the degraded environmental conditions in the Martín Peña community appear to be a key factor in many of the chronic and acute diseases experienced by the community and may help explain why some of these illnesses seem to disproportionately affect this community. This HIA revealed that the proposed environmental restoration and development plan—specifically the dredging and debris removal; infrastructure changes including an improved sewer and storm water drainage system, and creation of a *paseo*; and the necessary housing demolition and resident relocation required by the project—could have significant short- and long-term health effects on residents. By and large, the physical changes to the community would be expected to result in improved health. Where potentially negative health effects were identified, we made specific recommendations to mitigate the effects.

We acknowledge that \$600 million is a significant price tag for a project and that often projects such as these are not funded in their entirety. The team considered the evaluation of alternatives such as partial plan implementation. However, we decided to focus on the plan as a whole because the proposed plan had already been narrowed considerably and our perception of the critical role

of community buy-in to mitigate potential negative health effects from this plan. Resident relocation and the expected increase in land values are projected to be 2 of the largest contributors to health effects in this proposed plan. To avoid unintended consequences in this environmental justice community as have occurred in other redevelopment projects,³³ the community involvement, through the mechanism of the relocation bylaws and the land trust as discussed, is critical.

This HIA, as the first conducted in Puerto Rico, sets an example of how such a methodology can be used to “bring health to the table” during policymaking and other government-led interventions and also to engage stakeholders using this new health perspective. Similar to HIAs conducted in other low-income communities,^{13,34,35} it highlights the utility of this approach for both identification of potential health hazards and benefits, and engagement of the community with the HIA process and the proposed changes. This approach could be generalized to other Puerto Rican and Latino communities facing environmental justice issues on the island and abroad.

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