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Water Sanitation and Waste Management in Latin America, Colombia, and Cartagena: A Study of the Relationship Between Environment, Health, Poverty, and Policy

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WATER SANITATION AND WASTE MANAGEMENT
IN LATIN AMERICA, COLOMBIA, AND CARTAGENA:

A STUDY OF THE RELATIONSHIP BETWEEN
ENVIRONMENT, HEALTH, POVERTY, AND POLICY

by

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A thesis submitted in partial fulfillment of the requirements
for the Honors in the Major Program in International and Global Studies
in the College of Science
and in the Burnett Honors College
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ABSTRACT

The objective of this research is to identify the need for stricter environmental standards and regulations in three areas of study. Organized by their level of analysis, these areas are Latin America (at the System-Level-of Analysis), Colombia (at the State-Level-of-Analysis), and the city of Cartagena (at the Sub-National-Level of Analysis). This research was accomplished in two phases. The first involved conducting an exhaustive literature search of sources, germane to the objective, published in Spanish and English. The second featured a site inspection conducted over a 10-day period during the month of May 2016 to Cartagena, Colombia. The purpose of the site inspection was to interview locals and to photographically document waste disposal practices. The results of this research determined that government at all levels (system, state, and subnational) play a significant and sometimes determinant role in managing waste and water pollution that are responsible for health problems primarily among the poor; these health problems are discussed in detail. This research discovered that the lack of government intervention is responsible for reducing the efficacy of waste management and water sanitation services. This research concludes with a discussion of how proactive waste management and water sanitation policies and practices can have a significant benefit not only to improving health but also has significant economic, social and environmental benefits that may reach beyond local levels.

DEDICATION

This research is dedicated to Sarah Isaac, my biggest inspiration.
Thank you for instilling in me a respect and love of nature;
For showing me the beauty in every flower;
For being the greatest example of a hard working, loving, and self-less human;
For teaching me countless invaluable lessons;
For loving me unconditionally and being my Grandma.

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CHAPTER 1

INTRODUCTION

Thesis

Environmental health, human health, levels of poverty, and the economy have significant relationships with environmental standards and pollution in Colombia. As with many other developing states where high levels of poverty and low levels of health exist, so do high levels of pollution. Also, with Colombia's current regulations and government initiatives and priorities, possible economic opportunity in employment, new industries, and technologies pertaining to environmental sustainability is lost.

The objective of this research is to evaluate the government roles, at the system, state, and sub-national levels in combatting environmental and human health deficits attributable to pollution. The featured studies and levels of analysis are the geopolitical international region of Latin America, the state of Colombia, and the city of Cartagena. This research analyzes efficiency and actual usage of water sanitation and hygiene services (WASH) and solid waste management services (SWM). Vector-borne illnesses associated with WASH and SWM are then identified. Finally, levels of poverty are documented as WASH and SWM-related pathogens most severely affect the impoverished.

The purpose of this research is to identify the need for improved environmental policy. More efficient and regulated WASH and SWM services can significantly improve planetary health. Lower levels of air, water, and waste pollution can mitigate health deficits attributable to

illnesses such as diarrhea, malaria, respiratory, and cardiovascular diseases among countless others. Cleaner environments can mitigate socioeconomic disparities that include limited access to WASH by the impoverished. Additionally, new services and greener technologies can provide employment opportunities for the poor, and mitigate public health expenditures associated with pollution-related illnesses. I believe that if consciousness increases and stricter government programs and regulations for waste management and water sanitation are implemented, then health issues, the economy, and levels of poverty will improve.

Significance

With growing global awareness of and attention toward the realities of human impact on the environment and the externalities of industrial, cultural, and social practices, political action is essential to reversing past and preventing further damage. Legislative and governing bodies not only set standards and regulations, but they also oversee public education and health. Ultimately, they guide the economic sector with policy. With Colombia's current levels of poverty, human and environmental health issues, and economy, fueled by industries with little to no regulation or incentive for sustainable and environmentally friendly practices, improved SWM and WASH services can potentially provide a solution.

Theoretically, national and local governments should not be tolerant of socioeconomic injustices that are worsened by a lack of efficient environmental policy, including SWM and WASH infrastructure, as well as environmental education and other clean resource programs. Likewise, health issues and morbidity rates stemming from uncontrolled waste and pollution

should be enough incentive for higher government attention, if not for environmental benefit, then for economic benefit. The economic benefit not only stems from less government expenditures on public health, but on higher tourism from maintained biodiversity and clean ecosystems, and perhaps most significantly, on cheaper industrial practices associated with recycling as opposed to extraction of raw material.

Politically, the Colombian government has implemented several policies such as Act 1713 of 2002 requiring each municipality to devise a Plan for Comprehensive Management of Solid Waste, Law 1505 of 2003 integrating *recicladores* into the waste management process, and law 1549 of 2012 emphasizing the fortification of environmental education in schools through the *Proyecto Ambiental Escolar* (Government of the Republic of Colombia). However, with Colombia's inefficient SWM and WASH systems and resulting pollution problems, it is clear that stricter or different policy must be enacted to standardize, regulate, and incentivize a new environmentally conscious economy, improved environmental and public health environments, and lower levels of poverty,

Current Literature

The *Ministerio de Ambiente y Desarrollo Sostenible de la República de Colombia* [Ministry of Environment and Sustainable Development of the Republic of Colombia], or *MinAmbiente*, was created in 1993. MinAmbiente, currently under the leadership of Minister Luis Gilberto Murillo, is the ministry responsible for the oversight of environmental health and urban development which relate to this thesis through: public health affected by the state of

environmental health, urban development via the level of poverty reduction through an increase in jobs in the waste management sector, and a greater economy focused on greener technologies. The complete responsibilities of the MinAmbiente currently include sectorial and urban environmental issues; coastal marine issues and aquatic resources; forests, biodiversity, and ecosystemic services; climate change; integral management of hydric resources; territorial environmental order and coordination of SINA [*Sistema Nacional Ambiental* or National Environmental System]; and green and sustainable affairs.

In 2007 the MinAmbiente released a bulletin titled “*Gestión Integral de Residuos o Desechos Peligrosos: Bases Conceptuales* [Comprehensive Waste Management or Hazardous Waste: Conceptual Bases].” The bulletin clearly defines the difference between *desecho* -objects that have served their maximum purpose or are no longer useful to the owner-, and *residuo* –the remaining part of a whole that is no longer useful or debris.¹ As is often the case, direct translation between languages is not always possible. In the English language the term “waste” refers to both *desecho* and *residuo*. The publication goes further to define and list types of hazardous waste. Forms of ingestion of hazardous waste include exposure to precipitation, evaporation, spills, sedimentation, and direct contact with contamination.²

In accord with these definitions, MinAmbiente’s release also described the principles of the national *Política Ambiental para la Gestión Integral de los Residuos o Desechos Peligrosos* [Environmental Policy of Comprehensive Waste and Hazardous Waste Management] approved by the National Environmental Council in December of 2005. According to the strategic hierarchy of the policy, prevention is the most essential and base principles of the chain, followed by minimization, good use, treatment, and final provision.³ The principles embody

action at the source including separation of waste and production of longer lasting, more efficient, less toxic, and reusable materials; minimizing the use of primary materials or fossil fuels for production and waste in general; recycling and reusing; and engaging in clean production based on global standards and goals while reducing societal and environmental risks.⁴

Actors responsible for the oversight of waste and toxic waste include the producers of waste, formal private or public receptors of waste, the informal sector of waste management that includes *recicladores*, municipal authorities, environmental authorities, and sanitary authorities.⁵ Other actors include nongovernmental organizations, one of which mentioned in this research is Women in Informal Employment or *WIEGO*. WIEGO is an NGO that has advocated for the rights and responsibilities of, helped unionize, and equipped the *recicladores* of Colombia, among the *recicladores* of many other countries. Media and channels of communications play a strong role in transmitting environmental policies and ideologies to the public and political figures hold the responsibility of setting said policy and legislation as well as leading and guiding the public to more efficient and beneficial habits. Also responsible for the oversight of waste management and sustainable practices are the academic sector and educators; notwithstanding national project implementations such as PRAE, which will be discussed further. The academic sector and educators are responsible for instilling knowledge and proper understanding of environmental ethics and civil duties.

MinAmbiente works with several other departments including the Ministry of National Education or *MinEducación*. Decree 1743 of 1994 formally established the *Proyecto de Educación Ambiental* [Environmental Education Project] or *PRAE* for all levels of education. The goal of the project is to integrate all levels of society to care for both national and local

environmental issues; it uses schools, education, and local communities as the source of environmental advocacy. In 2005, however, only 475 total PRAE programs in 14 of the 32 departments were consolidated by the Ministry of National Education.⁶ In 2012, the Colombian Government emphasized the fortification of PRAE and environmental education through Articles Seven and Eight of Law 1549.

More recently, in 2015, the Minister of Education and the Minister of Environment and Sustainability signed the National Alliance for “The Formation of Responsible Citizens: a More Educated Country and a Sustainable Environmental Culture for Colombia.” This plan will be developed with 5 main goals: (1) national and territorial alliances oriented toward environmental education, (2) fortification and consolidation of educative strategies based on the National Laws of Environmental Education, (3) creation of stimulus and incentive to participate in environmental activities and education, (4) exchanges of environmental education to promote public knowledge, and (5) the consolidation of a communicative strategy and information system in accord with the Laws of Environmental Education.⁷

The Colombian government has passed legislation pertaining to poverty and unemployment and informal employment. In 1992, the Universidad Libre de Barranquilla murdered 11 waste pickers bringing light to the longstanding social issue of recyclers in many developing countries. The incident called for the start of legal attention of Colombia toward recyclers through Law 511 of 1999, which established March 1st as the “Day of the Recycler”. In 2002, Act 1713 obligated each municipality of Colombia to create a Plan for the Comprehensive Management of Solid Waste. Shortly following, in 2003 *recicladores* were guaranteed integration into waste

management processes through Law 1505, and organizations were allowed to administer public services according to Verdict C-741.

The significance of Law 1505 and Verdict C-741 illustrates the government's capacity to control for the waste management sector and, in effect, the government's responsibility to take stronger action to reduce poverty levels and advocate for informal workers that comprise part of such a high rate of poverty within the country. According to the Logistics Capacity Assessment of Colombia, the unemployment rate is 11% and the daily wage for an unskilled worker is approximate \$20.533 COP.⁸ In U.S. currency, this translates to \$6.56. The Monetary and Multidimensional Poverty Assessment of Colombia in 2015 released by DANE reported that 27.8% of the national population lives in poverty and 7.9% of overall population lives in extreme poverty; poverty rises significantly in areas outside of the country's principal cities, with about 40.3% of this population living in poverty and 18% living in extreme poverty.⁹

Along with high levels of poverty, and despite the legislation that has already been passed pertaining to environmental education programs, and integration of *recicladores* into formal waste management procedures, the country also suffers from health issues related to pollution control. Studies report that 44.5% of Colombia's greenhouse gas emissions are attributable to agriculture; 6% of Colombia's greenhouse gas emissions are attributable to industrial emissions (which include the production of metals, minerals, and chemicals); 43% of GHG emissions are attributable to energy (which include transportation, energy industries, and manufacturing and production); and 6.6% of GHG emissions are attributable to waste emissions (emissions from landfills and wastewater handling).¹⁰ Separate data gathered for the Solid Waste Management

NAMA proposal in 2013 indicated that 5% of Colombia's greenhouse gas emissions come from landfills alone, which are filled with over 90% of compostable and recyclable material.¹¹

Combining the data suggests that GHG emissions can be significantly reduced with the implementation of stronger waste management systems. Implementing policy and promoting greener technology to reduce landfill use can have a significant result on overall GHG emissions. For example, as more materials are recycled and reused, industrial and energy emissions are reduced because extraction from the source becomes less necessary. Also, composting and exploiting organic material can offset toxic emissions from fertilizers historically used in the agricultural sector, which are a part of huge issue in contaminated waters.

Considering that environmental health and human health is interdependent, GHG emission and contamination reduction does not only positively impact the environment, but the public as well. Several studies have shown that pollution in the air and water are contributing to illnesses including, but not exclusive to, respiratory illnesses, cardiovascular issues, diarrhea, dengue, hepatitis A, typhoid, malaria, and species endangerment of flora and fauna essential for healthy ecosystems and human sustenance.¹² Approximately 7,600 premature deaths are attributable to environmental pollution, which not only raises morbidity levels but also takes a toll on the economy with about 2% of the nation's GDP channeled toward these avoidable public health issues.¹³ Consequently, more efficient waste management systems can not only reduce morbidity levels of the population of Colombia, but can allow for effective use of government funds elsewhere.

Literature shows that sanitation, morbidity and mortality levels, the economy, natural resources and the state of the environment are all connected to waste management and pollution

at some level, be it directly or indirectly. Informal employment, mostly of those within the impoverished population of the country, is directly associated with waste management and garbage pollution as well. Government policy, the education system, NGOs, IGOs, and workers unions have focused on waste management and garbage pollution, however the current situation of the majority of the country remains in dire need of improvement.

Research and Current Literature

The significance of analyzing and improving Colombia's waste management system incorporates current literature relating to poverty and employment (formal and informal), environmental education and social activism, current and future economic implications of the current waste management processes, and health issues arising from the mismanagement of waste and its pollution.

The high levels of poverty indicate that there is greater opportunity in creating jobs through better integration and recognition of *recicladores*. *Recicladores* formally trained, educated, and supplied with proper equipment can potentially reduce the levels of poverty and alleviate environmental and health issues associated with the current levels of waste pollution.

The amount of GHG emissions attributable to waste practices can be significantly reduced by encouraging integration of *recicladores* and creating a mandatory environmental education curriculum that instills sustainable practices into the community, superseding the current levels of PRAE programs. Recycling and reusing materials not only reduce the use of landfills, it reduces industrial emissions by reusing materials in place of creating new ones. It allows use of

organic waste for energy production further reducing GHG through reuse instead of resource depletion.

Additionally, health problems arising from GHG emissions or direct garbage pollution such as air and water contamination, are affecting the health of biodiversity by depleting natural resources and are giving rise to many diseases including respiratory, cardiac, and digestive illnesses.¹⁴ Economic turmoil accelerates species endangerment, and human morbidity and mortality rates. It is more expensive in the long run to repair health issues than prevent them. Therefore, analyzing the relationship between waste management and the economy, poverty, and health can provide a solution that benefits the nation by, bringing “soft” politics to the forefront of governmental attention at all levels

Research Design

This research design uses Kenneth Waltz’s methodology regarding levels of analysis in the field of international relations. Following this recipe, the first case study examines the entire Latin American and Caribbean Region (LAC). The second case study examines the Republic of Colombia, a state within the LAC region. The third and most narrow case study examines the Colombian city of Cartagena, the capital of the department of Bolívar, and its surrounding area. By examining levels of analysis, the efficacy of the above-mentioned Colombian law can be compared to a broader context of LAC as well as a narrower context of Cartagena and its surrounding area.

The three case studies are used to represent three progressively narrowing levels of analysis: system-level-of analysis, state-level-of-analysis, and sub-national-level-of-analysis. In the context of this study, these systems are referred to as the geopolitical regional level analysis, the national level of analysis, and the local level of analysis, respectively. The geopolitical regional level is Latin America, the national level is Colombia, and the local level is Cartagena.

The first case study, which is also the broadest, evaluates Latin America and the Caribbean's waste management and environmental sustainability standards. The objective of this case study is to understand the standards of the geographic region of which Colombia is a part. By analyzing the overall condition of LAC, a greater understanding of the following, more specific levels of analysis is established.

The second case study evaluates the Republic of Colombia's national relationship with waste management and sustainability standards. The focus is on the state as a whole (including all departments), and its programs, treaties, responsibilities, and attitudes toward the issue. Colombia is comprised of 32 political departments and a capital district within five regions.

The third, and most narrow, case study, evaluates the city of Cartagena and its surrounding areas, and the relationship with waste management and environmental sustainability standards. This local level of analysis compares the environmental health, human health, and poverty levels of the capital of the department of Bolívar to its six surrounding departments, also referred to as the *Region Caribe* of Colombia. The study reveals that there is less information in the local level of analysis compared to the first two levels.

The conclusion of this research provides a comparison of waste management and environmental sustainability standards as they affect human health, poverty, and the economy

from the three levels of analysis. It will also provide recommendations to the city of Cartagena that improves government efficiency in WASH and SWM resulting in a stronger economy, less poverty, and improved health

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⁴ Ibid. , 56.

⁵ Ibid. , 63.

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¹⁰ Robert William Collin, *Trash Talk: An Encyclopedia of Garbage and Recycling Around the World* (Santa Barbara: ABC-CLIO, 2015), 132.

¹¹ Adriana Soto, “Colombia Waste NAMA – Strengthening the Solid Waste Sector while Reducing Emissions,” (presentation, Global NAMA Financing Summit, Copenhagen, Denmark, May 15-16, 2013),
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¹² Claudia P. Campuzano Ochoa, Gabriel Roldán, Andrés E. Torres Abello, Jaime A. Lara Borrero, Sandra Galarza Molina, Juan Diego Giraldo Osorio, Milton Duarte, Sandra Méndez Fajardo, Luis Javier Montoya Jaramillo, and Carlos Daniel Ruiz, “Urban Water in Colombia.” In *Urban Water Challenges in The Americas: A Perspective*

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¹³ Elena Golub, Irina Klychnikova, Gerardo Sanchez-Martinez, and Juan Carlos Belausteguigoitia, “Environmental Health Costs in Colombia: the Changes from 2002 to 2010,” *World Bank Group: Latin America and Caribbean region Environment and Water Resources occasional paper series* Vol. 1, No. 1 (2014): 3.

¹⁴ Campuzano et al., “Urban Water Colombia.”

CHAPTER 2:

**IMPACT OF WATER SANITATION AND WASTE MANAGEMENT AT
THE REGIONAL LEVEL**

CASE STUDY: LATIN AMERICA AND THE CARRIBBEAN (LAC)

The Latin American and the Caribbean Countries, or LAC, are comprised of 26 South American, Central American, and Caribbean states. Together, the states represent a population of about 525.2 million, or about 7% of the total global population. Of this population, 80% live in urbanized areas making Latin American and the Caribbean one of the most quickly urbanizing regions in the world, while simultaneously, poverty in urban areas swells as well. Despite 90 million people entering into the middle class over the past decade, ten of the 26 LAC countries make the list of the 15 most unequal countries in the world. According to the United Nations Development Programme's label of LAC as a "biodiversity superpower," as well as the region's goals to achieve sustainable development, waste management and a properly regulated system is essential to the region's prosperity. Enforcing and regulating proper waste management can significantly reduce the 12% of the region's contribution to global carbon dioxide emissions, reduce poverty and inequality levels, and enhance the public health sector through better interconnected human and environmental health related to waste pollution.¹⁵ Although no central governing body exists for the LAC region, geophysical location, culture, trade, and neocolonial histories provide certain similarities among states.

Environmental Health

The Latin American and Caribbean region is comprised almost entirely of underdeveloped states and territories, which commonly lack both the infrastructure and incentive to focus on environmental health issues above crime, internal conflict, poverty, and economics (almost always including government and other forms of corruption). However, care for the environment is interconnected with public health, poverty alleviation, and economic endeavors. Collectively, they are a huge part of the well being and proper functioning of any society.

Wastewater

One of the largest environmental concerns is potable water. In LAC, not only is it a life source, it is a major economic resource for transportation and especially the agricultural sector, which grew regionally by more than 50% from 2000-2012, and up to 70% nationally (such as in Brazil).¹⁶ A growing agricultural sector with lenient environmental and waste regulations is contributing to unsustainable practices that are detrimental now and in the long term as water footprints (WF) are increasingly exceeding water availability. The goal of Water Footprint Assessment (WFA), as described by Mekonnen et al. is to compare water consumption, pollution, and availability to “understand current water allocation and pollution in LAC, assess the environmental sustainability, economic efficiency, and social equity of water use in the region and identify future challenges.”¹⁷

The countries with the largest water footprints in LAC are Brazil, Argentina, and Mexico. Parts of each of these countries do not actually have the quantity of water available for the size of

footprint. Further, as a whole, the LAC hosts 77 water basins, 26 of which experience scarcity lasting at least a whole month per year, three of which face year-round shortages.¹⁸ Along with water shortages and unsustainable practices, agriculture expansion is contributing to the depletion of biodiversity and the loss of forests at approximately four million hectares per year as recorded from 2000-2010.¹⁹

Unsustainable agricultural practices are significant to environmental health because the amount of water used to maintain this industry, among many other smaller industries, there is not much left for domestic use, or enough to sustain biodiversity dependent upon polluted bodies of water. With knowledge of water scarcity, water pollution then becomes more alarming. Water pollution takes the form of runoff, sedimentation, lack of water treatment, and direct pollution, among others. For reference, a study that measured levels of water pollution through levels of nitrogen and phosphorous, which can come from pesticides and fertilizers (such as those used for agriculture), will show the devastating effects of lack of environmental policy and effective government regulation.

First, it is important to understand the effects of nitrogen and phosphorus on water sources as published by the United States Geological Survey. Despite dependence on nitrogen (about 78% of air composition), and its role in plant growth, too much can be detrimental. Nitrogen can enter water streams through fertilizer runoff, lack of wastewater treatment, and through the burning of fuels at large scales through industry, or typical everyday automobile usage given the rate of usage. Nitrogen is an inert gas that helps respiration, and promotes algae and aquatic plant growth, creating food for many species of marine animals. Too much nitrogen however, creates algae blooms reducing the amount of oxygen in bodies of water, resulting in

less for animals. Further, algae blooms block sunlight from reaching life beyond the water surface, harming ecosystems.²⁰

Phosphorus, like nitrogen, is also essential for plant growth and contributes to eutrophication -or “reduction in dissolved oxygen in water bodies caused by an increase of mineral and organic nutrients.”²¹ Phosphorus is commonly found in runoff generally linked to erosion from fertilized agricultural soil and wastewater. The USGA points reports that levels of phosphorous correlate positively with increases in agriculture, which as mentioned is significant in Latin America and the Caribbean (up to 70% in some areas). USGA also reports that phosphorous is found in wastewater.²²

Wastewater pollution is another issue requiring attention. As of 2015, LAC was capable of treating 35% of its wastewater; however, only 20% was actually effectively treated.²³ Wasting the capacity of an already inadequate waste management infrastructure (relative to the WF and high amount of biodiversity at risk), is only one example of a lack of overall infrastructure efficiency in the majority of LAC, and other developing states. The result of poor systematic waste management in LAC is that over 70% of sewage water is expelled into local bodies of water.

To put this in perspective, in 2011 Mexico, one of the top three contributors to LAC’s water footprint only treated about 40% of municipal water and 30% of non-municipal water.²⁴ In 2008, Brazil, often regarded as an up and coming superpower of LAC, and one of the largest polluters in the region, only treated about 30% of its municipal wastewater.²⁵ Guatemala, one of the region’s most poverty stricken countries marginally treats wastewater. FAO reports that the

majority of urban zone water is extremely contaminated, especially with high levels of mercury and phosphates.²⁶

The mismanagement of wastewater in LAC states is significant compared to its developed counterparts such as the United States. The United States passed the Clean Water Act in 1972, and has since modified it ensuring that all municipal waste, unless otherwise legally permitted, is both treated and monitored by the national government's Environmental Protection Agency (EPA). The EPA identifies and controls for industrial wastewater pollution in the form of mining, oil and gas, pesticide applications, vessels incidental charges, and animal feeding operations. The EPA also monitors the treatment of municipal wastewater from local homes, businesses, and industries. Requiring all municipalities to treat water, the CWA resulted in 75% of the US population being connected to a central treatment facility, and 25% being served by septic tanks or other forms of wastewater treatment by 2004.²⁷

Solid Waste

In addition to wastewater pollution, LAC deals with severe air pollution from lack of waste management. Landfill GHG emissions constitute the largest portion of waste pollution as a whole, and are not facing strong, if any, state action advocating other forms of waste disposal, such as stronger recycling programs. The following statistics in this section are largely based on data released by the World Bank in 2008 covering the actual and future goals of landfill impact in the region.

Only 23% of municipal solid waste in LAC is disposed of in sanitary landfills, most of which do not actually fit global standards to fall under this category.²⁸ In terms of disposal of waste, sanitary landfills are among the best options due to their function of monitoring and separating harmful waste from the environment. 24% of MSW goes to controlled landfills,²⁹ which are landfills that are monitored and controlled by national or local regulation. Although better than no control, these landfills are still subject to each state and municipalities' degree of concern for proper waste management or repercussions from lack thereof. The rest of the waste is disposed in open dumps or directly into the environment, frequently in bodies of water.

Only 3% of waste is recycled throughout the region; out of which Brazil, Colombia, and Mexico have notably high recycling rates, with 10% of Mexican waste being recycled, and 5% and 20% of municipal Brazilian and Colombian waste, respectively, being sorted by recyclables at the source.³⁰ It is noteworthy that recycling at the source is a significant indicator of civilian cooperation and awareness of recycling and participation in the waste management sector. This can be a reflection of the education, social, and political programs advocating environmental sustainability. Interestingly, Mexico, Brazil, and Colombia also had significant increases in social programs from 2000-2011. Almost triple the amount of the previous decade in each- which Vakis et al. describe as the LAC attempting to improve the living conditions of the poor.³¹

Human Health

The afore-mentioned environmental pollution issues are interconnected with public human health. Air and water pollution can be directly manifested in human bodies in the form of

impaired respiratory, heart, digestive, and nervous systems. Apart from direct impact on human health, climate change, deforestation, and ecological manipulation can lead to habitats more hospitable to pathogen carrying species.³² Opening environments to these pathogenic species once again places humans in contact with disease. This raises not only mortality and morbidity levels, but increases government spending on public health.

In Merrill Singer's *The Anthropology of Cultural Diseases*, he reports that higher contact with pathogens is closely related to environmental manipulation. For example deforestation, which occurs in LAC at over 3.6 million hectares/year, eliminates certain species, and gives rise to species that are sometimes more adaptable to the newly established conditions.³³ Vector borne diseases transmitted through newly thriving or introduced mosquitos, livestock, and snails represent examples of species that adapt better to new deforested conditions and spread diseases in LAC such as malaria, schistosomiasis, lyme disease, cutaneous leishmaniasis, buruli ulcers, etc.³⁴ Not only is deforestation contributing to water pollution with nitrogen and phosphorous runoff, deforestation is also creating vectors for disease.

Lack of sewage treatment and waste collection is contributing to pathogen transmission. To reiterate, only 20% of wastewater is effectively treated in LAC, contaminating local bodies of water, and, in effect contaminating local communities that rely on the bodies of water for everyday use. Given the high levels of inequality prevalent in the region, it is not surprising that the high WF is distributed unevenly, and those that suffer most from the untreated sewage dumped into local bodies of water are the poor. Diseases that emerge from contact with contaminated waters in LAC include: dengue, malaria, typhoid fever, parasitosis, hepatitis, leptospirosis, cholera, salmonella, and gastroenteritis.³⁵

In Colombia the most common water-transmitted disease is chronic diarrhea, which 90% of the time is attributable to water quality.³⁶ Due to the dehydration and malnutrition, it is also the cause of 7.2% of Colombian infant deaths.³⁷ In Brazil, lack of waste management is leading to the spread of the rat-borne disease, leptospira, which is caused by open sewers and uncollected waste.³⁸ In Guatemala, one of the least developed states in the region, five children die every day from water-related illness caused by poor quality and lack of sanitation; 50% overall disease related deaths are also caused by unsanitary water conditions.³⁹ Despite these numbers, the amount of chemical and biological water contamination in urban centers still has not received enough attention to be calculated as of 2015. However it has been confirmed that high levels of phosphates and mercury are present.

Air pollution is another significant cause of concern in LAC. In many countries, like Colombia, it has been labeled as the health issue in most need of concern due to causation of cancers, respiratory, and cardiac diseases. A Clean Air Institute publication stated that over 100 million people in the region are exposed to levels of air pollution above World Health Organization standards.⁴¹ The *OECD Environmental Outlook to 2050* went further stating that globally, air pollution will become the world's leading cause of premature death, surpassing lack of sanitation and poor water quality.⁴² The publication estimated that by 2050 global air pollution levels would only worsen and premature mortality would double from respiratory failure caused by particulate matter.⁴³ Methane and carbon dioxide released by landfills, surplus of nitrogen in bodies of water from agricultural runoff, indoor cooking using coal or wood, and lack of regulation on industrial and public transport pollution are contributors to this major global issue.

With government intervention, solutions such as converting gasses released from landfills into energy that replaces fossil fuel depletion are possible.

Poverty

Despite significant disparities among impoverished populations in the LAC region, the World Bank published a book averaging the standard of daily living expenditures. The categories include extreme poverty, including those who live under \$2.50 USD per day; moderate poverty, including those living under \$4 USD per day; and vulnerability, including those living with \$4 to \$10 USD daily. Individuals in the middle class, for comparison, live on \$10 to \$50 per day.⁴⁴ According to 2012 reports, Guatemala hosted the highest proportion of its population living in poverty, whereas Uruguay experienced the least amount of poverty.⁴⁵ The following extreme and moderate poverty rates per state in the LAC region are provided by the World Bank's Socio-Economic Database for Latin America and the Caribbean (SEDLAC). SEDLAC statistics used in the following are based on the updated 2016 poverty statistics headcount ratio, calculated with the SEDLAS methodology and show own poverty estimates at the country level.⁴⁶

Also included are social program implementation rankings, displaying the degree to which countries are focused on alleviating poverty, and association with the NGO WIEGO. WIEGO -Women in Informal Employment: Globalizing and Organizing- is a leading organization advocating for, educating, and influencing local, national, and international policy that benefits the informal sector and working poor. WIEGO is included along government implemented social programs alleviating poverty to show the level of political action per LAC state regarding poverty. One of the largest focuses of both WIEGO and other programs aimed at

alleviating poverty is on waste pickers or *recicladores*. WIEGO may be one of the most prominent advocates of *recicladores* all over the world, known to support the Global Alliance of Waste Pickers. Therefore, the rate of programs and presence of WIEGO per country can represent a country's current alleviation of poverty via waste management initiatives, or its potential to do so.

For comparison, this section will include the three least impoverished and the three most impoverished states, according to the 2013 World Bank publication, mentioned previously. The three most impoverished states were Guatemala, Honduras, and Nicaragua. The three least impoverished states were Uruguay, Argentina, and Chile.⁴⁷ The Republic of Colombia, which will be studied in further chapters, was ranked as the fourth most poverty stricken LAC state.⁴⁸ Figure 1, below, is a graphic representation of this information and includes Colombia as a benchmark of comparison.

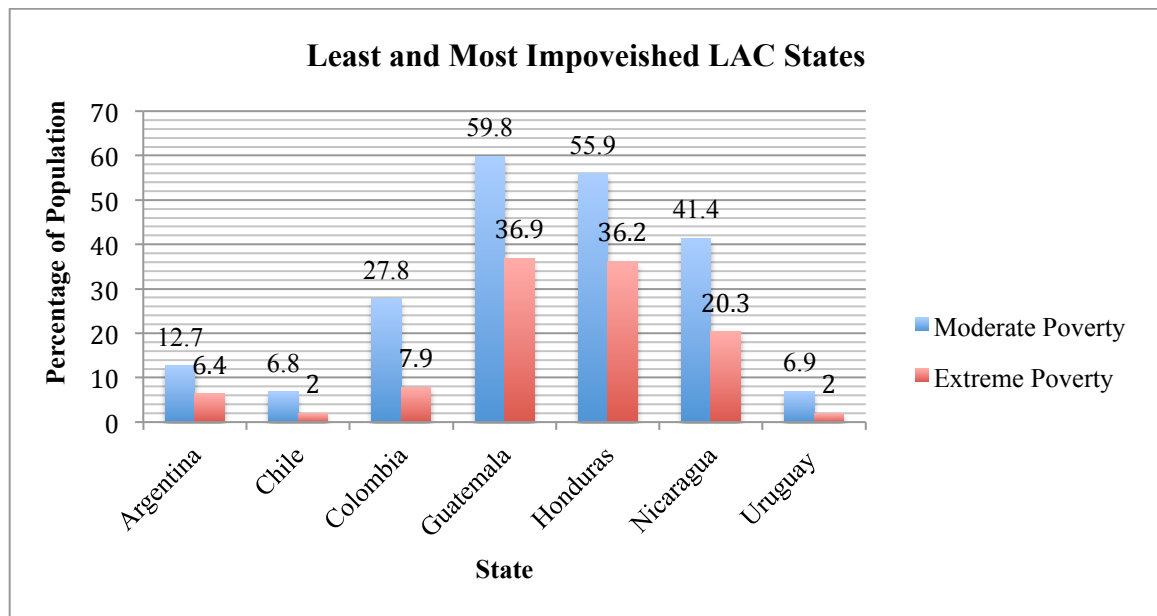


Figure 1: Least and Most Impoverished LAC States

Argentina

In 2014, 12.7% of individuals in Urban Argentina lived in moderate poverty while 5.4% lived in extreme poverty.⁴⁹ Along with being in the top three least impoverished LAC states, Argentina is the country with the highest amount of new social integration programs implemented from 2000-2011 aimed at alleviating poverty.⁵⁰ WIEGO holds a strong presence in Argentina where *recicladores* are known as *cartoneros*.

Chile

In 2013, 6.8% of individuals in Chile experienced moderate poverty while 2.0% experienced extreme poverty.⁵¹ Chile is among the three least impoverished states within LAC, and is among the highest ranked in implementing social programs that help alleviate poverty. As in Argentina, WIEGO holds a strong presence in Chile.

Guatemala

In 2014, 59.8% of individuals in Guatemala experienced moderate poverty while 36.9% experienced extreme poverty.⁵² Guatemala is neither among the top 10 countries with increases in social programs after 2000, nor is WIEGO present to represent informal, poor workers such as *recicladores*. Objective information about organizations for waste pickers in Guatemala is difficult to find.

Honduras

In 2014, 55.9% of individuals in Honduras experienced moderate poverty while 36.2% experienced extreme poverty.⁵³ Despite its relatively low level of new social assistance programs, the number did multiply by almost three times from 2000-2011 compared to the previous decade.⁵⁴ WIEGO is not present in Honduras.

Nicaragua

In 2014, 41.4% of individuals in Nicaragua experienced moderate poverty while 20.3% experienced extreme poverty.⁵⁵ The amount of social assistance programs in Nicaragua was not accounted for in the World Bank's chronic poverty book, however, WIEGO does hold a presence in the country. According to WIEGO, Nicaragua holds the largest waste picker population - 10,500- in all of Central America.

Uruguay

In 2014, 6.9% of individuals in Uruguay experienced moderate poverty while 2.0% experienced extreme poverty.⁵⁶ Uruguay, like Honduras, has a relatively low level of new social assistance programs, however, that has nearly doubled,⁵⁷ and WIEGO is also present.

¹⁵ "About Latin America and the Caribbean," *United Nations Development Programme*, Accessed August 10th, 2016, <http://www.latinamerica.undp.org/content/rblac/en/home/regioninfo/#Introduction>.

¹⁶ Mesfin M. Mekonnen, Markus Pahlow, Maite M. Aldaya, Erika Zarate, and Arjen Y. Hoekstra, “Sustainability, Efficiency and Equitability of Water Consumption and Pollution in Latin America and the Caribbean,” *Sustainability* 7, no. 2 (2015): 2087.

¹⁷ Ibid., 2087.

¹⁸ Ibid., 2094.

¹⁹ Ibid., 2098.

²⁰ “Nitrogen and Water,” *USGS Water Science School*, last modified May 2, 2016, <http://water.usgs.gov/edu/nitrogen.html>.

²¹ “Phosphorus and Water,” *USGS Water Science School*, last modified May 2, 2016, <http://water.usgs.gov/edu/phosphorus.html>.

²² Ibid.

²³ Mekonnen et al., “Water Consumption Pollution,” 2100.

²⁴ “Mexico,” *Food and Agriculture Organization of the United Nations*, last modified 2014, http://www.fao.org/nr/water/aquastat/countries_regions/MEX/indexesp.stm.

²⁵ “Brazil,” *Food and Agriculture Organization of the United Nations*, last modified September 2015, http://www.fao.org/nr/water/aquastat/countries_regions/BRA/indexesp.stm.

²⁶ “Guatemala,” *Food and Agriculture Organization of the United Nations*, 2015, http://www.fao.org/nr/water/aquastat/countries_regions/GTM/indexesp.stm.

²⁷ “Primer for Municipal Wastewater Treatment Systems,” *United States Environmental Protection Agency*, 2004.

²⁸ “Solid Waste Management in LAC: Actual and Future CH₄ Emissions and Reductions,” The World Bank, August 2008, http://siteresources.worldbank.org/INTUWM/Resources/3402321221149646707/Solid_Waste_Management_in_LA_C.pdf.

²⁹ Ibid.

³⁰ Ibid.

³¹ Vakis, Jamele Rigolini, and Leonardo Lucchetti, *Left Behind: Chronic Poverty in Latin America and The Caribbean* (Washington DC: World Bank, 2015), 31.

³² Merrill Singer, *The Anthropology of Infectious Disease* (AbeBooks, 2014).

³³ Mekonnen et al., “Water Construction Pollution,” 2098.

³⁴ Singer, *Anthropology of Infectious Disease*, 128.

³⁵ Claudia P. Campuzano Ochoa, Gabriel Roldán, Andrés E. Torres Abello, Jaime A. Lara Borrero, Sandra Galarza Molina, Juan Diego Giraldo Osorio, Milton Duarte, Sandra Méndez Fajardo, Luis Javier Montoya Jaramillo, and Carlos Daniel Ruiz, “Urban Water in Colombia.” In *Urban Water Challenges in The Americas: A Perspective from the Academy of Sciences* (Mexico City: IANAS and Paris: UNESCO and Montevideo: UNESCO, 2015), 183-184.

³⁶ Ibid.

³⁷ Ibid.

³⁸ Singer, *Infectious Disease*, 152-153.

³⁹ “Guatemala,” *FAO*.

⁴¹ Joanne Green and Sergio Sánchez, *Air Quality in Latin America: An Overview*. (Washington D.C.: Clean Air Institute, 2013), 1.

⁴² OECD, *OECD Environmental Outlook to 2050* (OECD Publishing, 2012), 276.

⁴³ Ibid.

⁴⁴ Vakis et al., *Chronic Poverty*, 8.

⁴⁵ Ibid. 12-13.

⁴⁶ Socio-Economic Database for Latin America and the Caribbean SEDLAC, *Poverty Headcount Ratio: Individual Estimates* (CEDLAS and The World Bank, accessed August 10th, 2016).

⁴⁷ Vakis et al., *Chronic Poverty*, 13.

⁴⁸ Ibid.

⁴⁹ Ibid.

⁵⁰ Vakis et al., *Chronic Poverty*, 31.

⁵¹ SEDLAC.

⁵² Ibid.

⁵³ Ibid.

⁵⁴ Vakis et al., *Chronic Poverty*, 31.

⁵⁵ SEDLAC.

⁵⁶ Ibid.

⁵⁷ Vakis et al., *Chronic Poverty*, 31.

CHAPTER 3:

IMPACT OF WATER SANITATION AND WASTE MANAGEMENT AT

THE NATIONAL LEVEL

CASE STUDY: REPUBLIC OF COLOMBIA

The Republic of Colombia is a country within the LAC region, and situated at the northern coast of South America. Colombia was colonized by Spain in 1499, and later gained independence in 1810. The native language, certain aspects of modern culture, as well as the colonial style architecture of historical buildings are reflections of Spanish imperialism, still prevalent today. The country hosts approximately 50 million residents, seven million residing in the capital of Bogotá, the largest city by area in all of South America.⁵⁸

Divided along two separate oceans, the country is host to several of the most important ports of the Americas. The ports of Buenaventura and Tumaco are located in the Pacific and the ports of Santa Marta, Barranquilla, and Cartagena are located in Caribbean Sea, connecting the country and the continent to the Atlantic. These sources of trade, commerce, and tourism make Colombia an important asset to all of South America, especially its bordering neighbors of Venezuela, Ecuador, Peru, Panama, and Brazil, despite several ongoing and past political conflicts. Colombia engages in trade with many states of all continents. Its location and ports have proven to effectively engage the United States of America as its closest partner, and have made Colombia the United States' third largest trading partner.⁵⁹ In 2012, the US-Colombia Trade Promotion Agreement was enacted and enabled free trade between the two countries

eliminating tariffs on imported and exported goods. The country has free trade agreements with the European Union, Mexico, Chile, Canada, the Northern Triangle, the European Free Trade Association, and, most recently, the Pacific Alliance, making the health and efficacy of its ports all the more important.

Colombia enjoys a considerable amount of biodiversity within five distinct regions: the Andes region, the Amazon region, the Pacific region, the Atlantic/Caribbean Region, and the Orinoquía region. With the Andes mountain range, Caribbean and Pacific coastlines, savannas, and several types of natural forest as part of the 352 ecosystems in the country, Colombia is the world's second over-all most bio-diverse country (behind Brazil). It also holds the highest level of bird and orchid biodiversity in the world (Republic of Colombia). Colombians enjoy steady temperatures all year round with the average annual climate in mountainous Bogotá ranging from 12-15 degrees centigrade, to Caribbean Cartagena's average annual climate ranging from 27-29 degrees centigrade. Some of the country's largest industries such as petroleum, coal, coffee, sugar, gold, and emeralds are illustrative of the vast amount of natural resources.

With such strong international connections and biodiversity, it is alarming to discover that Colombia is ranked as an underdeveloped country. Unfortunately, internal political conflicts, socioeconomic inequalities, political and economic corruption, extraction of natural materials, and inadequate regulation, in addition to lack of focus on many areas of development, make this true.

As the state focuses on "hard power" via the solutions to corruption, violence, and political turmoil, "soft power" has been undermined to allow for poverty, education, health, and environmental stability issues to remain unsolved. This research advocates that the

implementation of stricter environmental policy is a political solution that encompasses all of above, soft power focuses. In order suggest or implement policy however, an understanding of the processes of government is necessary.

The Colombian government became a democracy in 1958, making it the first and longest lasting democracy in South America. However, the constitution has been changed and amended several times since, with the last adopted constitution being that of 1991. Currently, the state is a unitary republic that grants limited responsibilities to subnational governments that take the form of departments.⁶⁰ The capital district of Bogotá hosts the central government, which is comprised of 3 branches and several other independent bodies: the Executive Branch, the Legislative Branch, the Judicial Branch, the National Comptroller's Office, The Office of the Inspector General, and the Central Bank.⁶¹

Within the executive branch are the 16 ministries that are responsible for setting sectoral policy. One of which is the Ministry of Environmental and Sustainable Development, or *MinAmbiente*. The following issues would therefore serve as indicators for implementation of policy by the *MinAmbiente*.

Environmental Health

Environmental health in the state of Colombia is reflective of standards in LAC. The following evaluates the low levels of wastewater sanitation and sustainable waste management. Mismanagement of forest production, loss of biodiversity, and agriculture, among much else within the region, contribute to the solid waste and sewage water issues.

Solid Waste

According to the Global Waste Management Outlook published by the United Nations Environmental Programme alongside the International Solid Waste Association, disposal of waste in an environmentally sound manner was introduced in the 1970's.⁶² Although Colombia is certainly not a part of the most-developed or wealthiest nations, it was not until 2005 that regulation was passed to ban waste disposal in open and uncontrolled dumps.⁶³ In 2012, 6% of the daily 24,600 tons of waste was still inadequately treated, which directly affect both environmental and human health, for example through untreated sewage and garbage polluting water and air. In the 94% of formally disposed waste, is a significant amount of marketable recyclables and reusable organic material that end up in landfills, which alone contribute to 5% of Colombia's Greenhouse Gas Emissions. Approximately 66% of landfills are comprised of compostable organics, and approximately 24% of recyclable paper, cardboard, plastics, glass, and rubber.⁶⁴

In addition to the 5% of GHG emissions from landfills in Colombia, 6% of GHG is attributable to industrial emissions, such as metal production, and 43% is attributable to energy emissions,⁶⁵ which can also be reduced through recycling materials. By exchanging the exploitation of natural resources with reusable material, GHG emissions in total can be significantly reduced from each sector of origin directly and indirectly. GHG reduction through proper waste management and recycling is significant to Colombia's soft power, in that it correlates with national environmental and public health, economic advantages of a strengthened

ecological industry and culture, and employment of poor leading to a reduced level of poverty.

Wastewater

Overall, as a nation, Colombia does not adequately treat sewage before it enters the main bodies of water, meaning that polluted water is allowed to flow into rivers, lakes, and oceans. This impacts the health of locals and wildlife dependent upon each body of water. Examples of this include the practices of Barranquilla, Cartagena, and Sincelejo, which are the three largest cities of the Caribbean Region. In Barranquilla only 17% of wastewater is treated, and Cartagena and Sincelejo do not treat water at all., setting the example for the rest of Caribbean municipalities, and facilitating the spread of diseases such as hepatitis, malaria, typhoid fever, and most often, diarrhea.⁶⁶

Accompanying untreated sewage water as cause for inadequate public and environmental health associated with waterways, are leachate, industrial dumping, and sedimentation and erosion. Many rivers and tributaries flow through Colombia before reaching the Atlantic and Pacific Oceans, transporting chemicals, as well as large amounts of direct garbage pollution in the water as well as along the waterways. One of the largest examples of the significant levels of waste pollution is the state of the Magdalena River, Colombia's largest commercial waterway. The river starts in the Andes Region and ends at the mouth to the Caribbean Sea in the Atlantic Region.

In addition to polluted internal commercial waterways, Colombia is host to two of the largest ports in the continent, bringing in pollution from international cargo and cruise ships. As

tourism, imports, and exports increase the status of the economy, uncontrolled pollution left behind decrease the cleanliness of water. Advisor of the Colombia Commission of the Ocean (CCO), Lili Rodríguez stated that lack of water treatment was not the only source of water pollution; litter from residents and tourists and pollution from ships are depleting biodiversity with foreign microorganisms and contaminating natural resources.⁶⁷ This is an economic issue in that environmental rehabilitation is far more costly than environmentally sound standards and regulation.⁶⁸ With domestic waste contributing to the majority of waste pollution, it is surprising and unacceptable that political actors via policy, the education system, and economic sanctions and incentives, do not focus more attention on the foundation and source of waste pollution.

Despite the physical appearance and chemical contamination of waterways, more emphasis is still placed on navigability as opposed to health, holding the government accountable for focusing more on immediate economic advantage as opposed to long-term sustainability. According to an interview with *El Heraldo* news, the executive secretary of CCO, Juan José Saltau attributed the coastal contamination problems to each city's responsibility of proper waste management.⁶⁹ Saltua emphasized the need for government action via environmental campaigns, better education programs, consciousness of transport of sediment and garbage from cities to oceans via rivers, and better waste management and control by city governments.⁷⁰ The need for government intervention in garbage pollution is lacking and necessary for public and environmental health. Currently, private and public entities have little regulation for health standards, however, health and economics are closely connected, which can perhaps draw more attention to waste management.

Human Health

Not only will the economy suffer from a greater need of environmental rehabilitation as commercial waterways lag on environmental standards, it will suffer additionally as more funding for public health becomes necessary. Water Sanitation and Hygiene (WASH), along with Urban Air Pollution (UAP), and Indoor Air Pollution (IAP) affected and enhanced by improper waste management and increased GHGs are severely affecting human health. UAP can result from issues such as overcrowding and unsustainable industrial and transportation practices; WASH can be caused by untreated or inadequately treated wastewater and sedimentation; and IAP can be caused by burning fires or using gas stoves indoors. In 2010, the World Bank reported an annual average of 5,000 deaths attributable to UAP, 1,600 deaths are attributable to WASH, and 1,000 deaths attributable to IAP in Colombia.⁷¹ According to a publication by the Inter-American Network of Academies of Sciences, the National Political and Economic Council 3343 established “that the average cost of public health due to “inadequate, unhygienic water supply and sanitation services reaches \$1.96 billion pesos (approximately \$890 million dollars).”⁷²

In 2015, the fatality rate increased, as the World Health Organization estimated 8,100 premature deaths by 2030 due to outdoor air pollution.⁷³ When waste is improperly disposed of or overflowing in landfills and waterways, air and water contamination is difficult to control. This can significantly contribute to air pollution, resulting in respiratory illnesses such as chronic bronchitis and asthma, and water contamination and leachate, which can result in illnesses such as diarrhea, which leads further to malnutrition and dehydration.

Government costs go further than public health, however, as government funded extracted water is seldomly used efficiently, meaning that government dollars spent on water extraction and extracted water intended for good use are going to waste. The amount of potable water sold in comparison to the amount of water extracted in 2011 was less than 50% in the Caribbean Region, meaning that over 50% of government funding for WASH purposes were wasted.⁷⁴ Despite other reasons for these statistics, the most probable reasoning is the high level of corruption in the country. As corruption and inefficiency persist, and waterways lack proper waste management, regulation and sanitation, the economy and overall health of residents will diminish interconnectedly, and socioeconomic injustice will spread further.

Poverty

Currently, Colombia hosts the highest amount of internally displaced persons in the world, which is attributable to internal political conflict that began in the mid 20th century as a revolutionary movement, and later stemmed into the drug trade and violent internal terrorism in the form of several hostile rebel groups still active today. In 2015, it was ranked 97th on the United Nation's Human Development Index identifying a relatively high rating of living standards for an underdeveloped nation through the measures of life expectancy at birth, expected years of schooling, mean years of schooling, and Gross National Income per capita. However, the index itself lowers from a value of .72 to .542 when the HDI is converted to an IHDI adjusted for inequality, and eliminating the mask created by the national average.⁷⁵ The World Bank found similar degrees of inequality in Colombia, with it's GINI index rating of

53.5.⁷⁶ The GINI index measures equality from a scale of zero to 100, with zero being perfect equality and 100 being perfect inequality; it is based off of income distribution.

Many problems have stunted Colombia's progress, primarily the amount of hostility against the government by opposition groups since the 1950's (as made apparent by President Manuel Santos' Peace Talks with the FARC or *Fuerzas Armadas Revolucionarias de Colombia*), affiliated (or independent) drug cartels, and internal corruption. A direct result from these problems is the highest amount of internally displaced persons of any country, which correlates with overcrowding and increased poverty, as most displaced persons are farmers moved to urban areas.

Colombia is also suffering the economic consequences of less advanced waste management and recycling. The UNEP has stated that "cleaning up sins of the past can be significantly more expensive than disposing of waste in an environmentally sound manner."⁷⁷ This can relate directly to Colombia's current tariffs that are deterring the sorting or disposal of garbage in any manner more sustainable than landfill use. Further, the World Bank has already reported that 2% of Colombia's national GDP is used to combat health issues resulting from UAP, IAP, and WASH alone.⁷⁸

In 2013, Colombia's Solid Waste NAMA proposal was introduced, intended to sway waste management away from disposal and towards reduction, recycling, and reusing. The 2015 report suggested the use of landfill taxes, introduction of new technology, integration of informal workers into the formal economy, and the use of alternative treatment to employ 6-10 times as many people.⁷⁹ The implementation is currently contingent upon international financing, donor support, and private investments; however, the Colombian government and culture must first be

focused on the efforts of the NAMA project for it to succeed. With stronger government emphasis on more sustainable waste management, tax incentives and tariffs that support it, incentives to spark private industry interest, community involvement through stricter requirements and curriculums for environmental education through the PREA programs, the Colombian economy has much to benefit from the technology, employment, and profit offered by sustainable waste management and recycling.

Proof of the effectiveness of the Colombian government's intervention in environmental affairs is shown in a 2007 study analyzing the economic and health benefits of subsidized access to household natural gas (HNG), which produces less sulfur dioxide, less nitrogen oxides, and is more efficient and safe than oil or coal. By providing the lowest socioeconomic strata (1 and 2) with access to cleaner gas, the environment became less at risk, and about 47,000 to 90,000 disability adjusted life years (DALY) were avoided during the time of the study alone.⁸⁰ However, not only did reducing cases of acute respiratory disease (ARI) and outpatient cases of pulmonary disease (COPD) save years of life, it benefitted the economy significantly as well. Prior to governmental subsidies for HNG, the public health costs of COPD and ARI could have reached up to 23.6 million US dollars, however government intervention reduced that by 32%.⁸¹ Should the government act the same way with other forms of pollution, such as enacting stricter regulation for waste management, the results could be similar.

Further incentive for government ecological intervention, in addition to alleviating health issues for the poor, can be found in alleviating levels of poverty themselves. The percentage of the national population that lived with monetary poverty was 27.8%, meaning that over a fourth of the national population lives with \$223.638 COP or less per month, or approximately \$77

USD.⁸³ The percentage of the population living in extreme poverty -under \$102.109 COP per month, or approximately \$35 USD- is 7.9%.⁸⁴ 48% of Colombia's unemployed are living in poverty, and 21.2% of Colombia's unemployed suffer from extreme poverty,⁸⁵ leaving many in desperate need of income.

One of the most popular informal jobs is that of waste pickers, or *recicladores*, who informally work by finding recyclable waste in exchange for cash, usually by weight of what he/she collects. Unfortunately, *recicladores* all over the world have suffered from discrimination, laws against their work, and are in danger of health and hazard risks involved in waste picking without proper education, equipment, and regulation. According to Colombia's Ministry of Environment and Sustainable Development, about 22,000 families depend on the income of a *reciclador*.⁸⁶

In 2002, Colombia passed National Decree 1713 that obliged each municipality of Colombia to create a Plan for the Comprehensive Management of Solid waste, however the plan hurt *recicladores* as public waste cleaning services favored private companies,⁸⁷ which is an adequate representation of the socioeconomic disparity present in the country. Shortly afterwards, in 2003, the national government guaranteed the integration of *recicladores* in the process of garbage recollection through National Law 1505, and rendered public services to include organizations through Verdict C-741. Waste Picker Unions and Organizations were formed giving momentum to recognition of the informal sector of employment, however private industries as well as societies continued to denounce *recicladores* and an environmental subpoena for unsuitable waste management practices was created. The subpoena was especially harmful to the informal sector due to the fact that it sanctioned those who inadequately handled

and transported waste. Without formal training, and funds for professional and adequate vehicles and sorting facilities, *recicladores* were targeted with fines, however, the constitutional court reacted again in 2009 and sanctions imposed upon *recicladores* were lifted.

Because waste picking alleviates poverty, cleans urban areas, and provides much of the national recycling services, programs and organizations were created to advocate for the *recicladores*. In 2012, Zero Basura was started in Bogotá, and expanded both nationally and internationally shortly afterwards. Zero Basura was successful because of its multidimensional approach to garbage pollution and waste pickers. Not only did the organization provide a platform for *recicladores*, it created educational programs on the importance of managing waste properly and maintaining a clean environment, provided equipment and formal training, and helped change negative societal views towards *recicladores*. Zero Basura, alongside other NGOs and IGOs like WIEGO, provided an organized system to mobilize waste pickers as formal parts of municipal waste management and the economy.

The Colombian government has passed national legislation recognizing the work of *recicladores*, however, as with all other aspects of waste management, the solution must be more concentrated than the national level of interaction.

⁵⁸ Robert William Collin, *Trash Talk: An Encyclopedia of Garbage and Recycling Around the World* (Santa Barbara: ABC-CLIO, 2015), 131.

⁵⁹ Clint W. Relyea, Sandra Liliana Tejada, Kelly E. Fish, Gauri-Shankar Guha, “Laissez faire and international trade: a critique of the proposed United States Colombia free trade agreement,” *Journal of International Business Research* Vol. 10, No. 1 (2011).

⁶⁰ Antonio Ramírez and Hernando Otero, “UPDATE: An Introduction to Colombian Governmental Institutions and Primary Legal Sources,” *GlobaLex* (2015), <http://www.nyulawglobal.org/globalex/colombia1.html>.

⁶¹ Ibid.

⁶² David C. Wilson, Ljiljana Rodic, Prasad Modak, Reka Soos, Ainhoa Carpintero Rogero, Costas Velis, Mona Iyer, and Otto Simonett, *Global Waste Management Outlook* (United Nations Environment Programme, 2015), 65.

⁶³ Adriana Soto, “Colombia Waste NAMA – Strengthening the Solid Waste Sector while Reducing Emissions,” (presentation, Global NAMA Financing Summit, Copenhagen, Denmark, May 15-16, 2013), <http://ccap.org/assets/Colombia.Soto.ColombiaWasteNAMA.pdf>.

⁶⁴ Ibid.

⁶⁵ Collin, *Trash Talk*, 132.

⁶⁶ Claudia P. Campuzano Ochoa, Gabriel Roldán, Andrés E. Torres Abello, Jaime A. Lara Borrero, Sandra Galarza Molina, Juan Diego Giraldo Osorio, Milton Duarte, Sandra Méndez Fajardo, Luis Javier Montoya Jaramillo, and Carlos Daniel Ruiz, “Urban Water in Colombia,” in *Urban Water Challenges in The Americas: A Perspective from the Academy of Sciences*, (Mexico City: IANAS and Paris: UNESCO and Montevideo: UNESCO, 2015), 184.

⁶⁷ Jahel Mendoza, “Los residuos: el principal problema del mar de la region Caribe,” *El Herald* (Colombia, SA), June 8, 2016, <http://www.elheraldo.co/tendencias/los-residuos-el-principal-problema-del-mar-de-la-region-caribe-265099>.

⁶⁸ Wilson et al., *Global Waste Management*, 65.

⁶⁹ Leonor De La Cruz, “Basuras y sedimentos ‘ahogan’ las playas,” *El Herald* (Colombia, SA), June 9, 2014, <http://www.elheraldo.co/local/basuras-y-sedimentos-ahogan-las-playas-155314>.

⁷⁰ De La Cruz, “Basura ‘ahogan’ playas.”

⁷¹ Elena Golub, Irina Klytchnikova, Gerardo Sanchez-Martinez, and Juan Carlos Belausteguigoitia, “Environmental Health Costs in Colombia: the Changes from 2002 to 2010,” *World Bank Group: Latin America and Caribbean region Environment and Water Resources occasional paper series* Vol. 1, No. 1 (2014): 4.

⁷² Campuzano Ochoa et al., “Urban Water Colombia,” 184.

⁷³ Ibid. , 6.

⁷⁴ Ibid., 178.

⁷⁵ “Human Development Report 2015: Colombia,” United Nations Development Programme, 2015, 5, http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/COL.pdf.

⁷⁶ *GINI index*, World Bank Group, 2015, <http://data.worldbank.org/indicator/SI.POV.GINI>.

⁷⁷ Wilson et al., *Global Waste Outlook*, 65.

⁷⁸ Golub et al., “Health Costs,” 3.

⁷⁹ “Colombia’s Solid Waste NAMA Proposal,” *Center for Clean Air Policy*, 2015,
http://ccap.org/assets/fact-sheet-Colombia-waste-March2015_FINAL.pdf.

⁸⁰ Nelson Alvis-Guzmán, Luis Alvis-Estrada, and Fernando de La Hoz, “The cost of connecting poor households to natural gas in Colombia and its impact on health, 2007,” *Revista Salud Pública* Vol. 14, No.1 (2012).

⁸¹ Ibid.

⁸³ “Pobreza Monetaria y Multidimensional en Colombia 2015,” *Departamento Administrativo Nacional de Estadística* (Bogotá DC, Colombia, SA), (2016): 5,
http://www.dane.gov.co/files/investigaciones/condiciones_vida/pobreza/bol_pobreza_15_.pdf.

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⁸⁵ Ibid. , 18.

⁸⁶ “Colombia celebra Día Mundial de Reciclaje,” *Ministerio de Ambiente y Desarrollo Sostenible*, 2015.
<https://www.minambiente.gov.co/index.php/component/content/article?id=1793:colombia-celebra-dia-mundial-del-reciclaje>

⁸⁷ Wilson et al., *Global Waste Outlook*, 200.

CHAPTER 4:

IMPACT OF WATER SANITATION AND WASTE MANAGEMENT AT

THE LOCAL LEVEL

CASE STUDY: CARTAGENA, BOLÍVAR

The northern border of the Republic of Colombia makes it one of the few states that is surrounded by two oceans: the Atlantic and the Pacific. The coast to the west of the division set by Panama is the Pacific, and the coast to the east of the division set by Panama is the Caribbean Sea of the Atlantic. The land along the *Región Caribe* [Caribbean Region of Colombia], also referred to as the *Costa Atlántica* [Atlantic Coast of Colombia], is comprised of seven of the 32 departments and one capital district that make up the country. The seven departments of the Caribbean departments are as follows: *Atlántico, Bolívar, Magdalena, La Guajira, Cesar, Córdoba, Sucre, and San Andrés y Providencia*. The capital of Atlántico -Barranquilla- and Bolívar –Cartagena- make up the fourth and fifth largest cities of the country, respectively.

As discussed in Chapter 3, the president and central government agencies and ministries hold ultimate authority, and can issue Decrees, Resolutions, Directives, and Orders that must comply with existing laws.⁸⁸ At the subnational level, departmental assemblies and municipal councils can then “exercise regulatory power within their jurisdictions through Ordinances and Agreements respectively that must conform to national norms.”⁸⁹ All of the above can be challenged before administrative tribunals.⁹⁰

The Caribbean Region is host to two UNESCO World Heritage Centres, both are located in the department of Bolívar. One includes the port, fortresses and monuments in the city of Cartagena and the other includes the Historic Centre of Santa Cruz de Mompox. This world heritage port of Cartagena is one of the largest ports in the entire continent of South America. It is essential to commerce, trade, and the economy. The second UNESCO site, the Historic Centre of Santa Cruz de Mompox, is also essential to commerce, trade, and the economy, as it lies along the bank of the *Río Magdalena*, one of the most important rivers in the country

In addition to world-renowned historical and cultural sites, industrial centers and large ports, the region is home to invaluable ecosystems. Ranging from jungle, to desert, to tropical islands, the region enhances Colombia's claim as one of the most bio-diverse countries. This makes environmental health in this area significant. Unfortunately, however, the region is severely plagued with pollution, the systematic mismanagement of waste, and poverty. This results in serious health issues.

Local governments not only hold great responsibility in protecting the health of the socio-ecological system they are apart of, but the national government holds significant responsibility protecting and setting regulations for the benefit of domestic as well as foreign relations pertaining to these socio-ecological systems. This chapter will focus on the city of Cartagena in the department of Bolívar, within the *Región Caribe* of Colombia. The reason for which this chapter extends to areas surrounding Cartagena and Bolívar is the shared Caribbean coastline of 6 of the 7 departments in the *Región Caribe*, as well as very similar culture unifying the departments. *Costeño* is a slang form of identification for those inhabiting this part of Colombia.

This local level of analysis is the most specific level of the study, as well as the level with the least amount of information pertaining to environmental sustainability and waste management practices.

Environmental Health

Objective and reliable information directly related to wastewater sanitation and solid waste management in Cartagena is very difficult to find. Publications state that Cartagena does not treat any wastewater and quality of life reports do not include recycling initiatives or landfill standards in evaluation of waste management.

Cartagena hosted the Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region (WCR), also known as the Cartagena Convention, in 1983.⁹¹ By 2000, Cartagena ratified all parts of the convention.⁹² However, in 2016 reported pollution levels are high and water sanitation and waste management infrastructure are not addressing the issues.

Wastewater

Wastewater is connected to any human activity polluting or contaminating a body of water. On the Caribbean Coast of Colombia, runoff and sedimentation are issues polluting the ocean creating problems for native species as well as deflecting tourists from dirty beaches. Domestic and industrial pollution, waterways carrying toxic substances and petroleum (one of Colombia's largest exports) products, and solid waste directly or indirectly, are also sources of

wastewater pollution.⁹³ All seven departments in the *Región Caribe* of Colombia, apart from César, share the Caribbean coastline.

According to IANAS, Barranquilla, the largest city in the *Región Caribe* of Colombia, only treats 17% of its wastewater, and Cartagena does not treat any of it at all.⁹⁴ A 2014 quality of life evaluation of Cartagena, conducted by the *Cartagena Cómo vamos* program, found that fecal coliform bacteria are highly present in all bodies of water in the city; the only acceptable level of the bacteria was found in the Caribbean Sea.⁹⁵ Reflecting the lack of waste management and environmental regulation infrastructure, this means that untreated, polluted water is dumped back into bodies of water, which have high illness-related bacteria. Unable to afford or access sanitized, filtered water, much of the Colombian population is then directly exposed to the damaging health effects of water pollution.

Solid Waste

Apart from many and frequent local periodicals calling for stronger waste management services, and better trash recollection, little information is found specifically on waste in the city of Cartagena. One of the most recent periodicals, published in June 2016, gave perhaps the greatest insight into the current status of Cartagena via the annual beach cleanup of Playa Blanca sponsored by official national parks, organizations, and governmental departments and offices in commemoration of the UN's World Oceans Day and World Environment Day. The article states that significantly more trash was collected in 2016 than in 2015, which might be attributable to the construction of a new bridge connecting the city to the island of Barú, where Playa Blanca is

located. The periodical also states that there are no garbage cans on Playa Blanca. He says tourists and lower socio-economic standing might contribute to the problem, but that the state of Playa Blanca is actually a reflection of practices on the mainland, from those belonging in the lowest socio-economic strata to the most educated belonging in the highest socio-economic strata.⁹⁶ Unfortunately, an annual cleanup is not enough governmental attention in addressing the caliber of the solid waste issue in Cartagena.

Beyond newspaper periodicals and editorials, one of the few works directly addressing solid waste relatively near Cartagena was a Nationally Appropriate Mitigation Act (NAMA) by the Center for Clean Air Policy (CCAP). A Solid Waste NAMA was proposed for the country at a financial summit in Denmark in 2013, with a focus on Barranquilla, the capital of the *Atlántico* department, among other cities outside of the *Región Caribe*; however, the NAMA has not advanced.

The little information about waste specifically in Cartagena was documented by an organization, *Cartagena Cómo vamos*. This organization releases an annual report of changes in the city's quality of life. *Cartagena Cómo vamos 2014* showed increases of solid waste production from 26,638 tons in 2012, to 29,257 tons in 2013, to 31,582 tons in 2014.⁹⁷ The report actually identified this as an accomplishment, perhaps recognizing the recollection of solid waste (as in the annual beach clean ups), yet not addressing recycling initiatives.

Photographs included in this study are of periphery neighborhoods located along the *Vía Perimetral* in Cartagena. The original photographs display the living conditions of poor among solid waste pollution (Appendix 1).

Air Pollution

A study conducted on the levels of air pollutants in Cartagena in 2013 stated that levels of harmful gas concentrations, such as carbon monoxide, sulfur dioxide, and ozone were mostly kept within the national standards. Carbon monoxide and sulfur dioxide both surpassed national standards at certain times during the study, while ozone maintained levels below standard. Most revealing in the study were the results of the high concentration of particulate matter which surpassed not only daily but also yearly emission limits at every point in the duration of the study. Particulate matter was most abundantly present around areas with high vehicular traffic.⁹⁸ As mentioned in chapter two, an OECD publication states by 2050 air pollution will be the world's leading cause of premature death, with double the current amount of mortality rates via respiratory failure caused by levels of particulate matter.⁹⁹

Human Health

Water pollution is responsible for a high amount of mortality and morbidity rates caused by transmission of bacteria. The top five most frequent wastewater-related diseases in Colombia are diarrhea –also accounting for 7.2% of infant deaths, malaria, hepatitis A, dengue, and leptospirosis.¹⁰⁰ A broader range of health issues related to wastewater can be found in the previous chapter studying the whole country of Colombia. In Cartagena, water quality was measured to be worse in 2014 than in 2013.¹⁰¹

Air pollution poses a high risk for the development of respiratory illnesses such as asthma, chronic obstructive pulmonary disease, pneumonia, hypertension and depression. These

diseases are significantly correlated to high levels of exposure to carbon monoxide, sulfur dioxide, ozone, and particulate matter, which all surpassed national levels (except ozone) in the above study of air pollution in Cartagena.¹⁰² Despite high air pollution, *Cartagena Cómo vamos* found that for every 17 citizens, there is only one tree; this can be contrasted with 6 citizens to each tree in Bogotá, and 11.5 trees to every one citizen in Paris. The report also found the rate of death of children under 5 due to acute respiratory disease rose from 2013 to 2014, and that acute respiratory disease, acute diarrhea, and tuberculosis can all be countered by more sanitary conditions.¹⁰³ The necessity for improved sanitary conditions is mentioned in the 2014 *Cartagena Cómo vamos*' 146-page report, yet no measurements were taken on improving waste management and sanitation infrastructure or recycling practices in the released 2015 edition.¹⁰⁴

Despite the lack of government action, smaller, local groups such as the *Club de Jardinería de Cartagena*, for example, are taking the initiative on educating about and enacting sustainable ecological practices through horticulture. The club in Cartagena is one of 21 non-profit organizations in Colombia belonging to the National Garden Clubs, Inc., which is the largest volunteer garden organization in the world. An interview with Sarah Isaac, the Colombian Garden Club's current national vice-president as well as the Cartagena chapter's local president, revealed environmental health efforts of the club in Cartagena. According to Isaac, in 2016 alone, the club has planted 14,000 trees around the periphery of the city (which will hopefully be reflected in future *Cartagena Cómo vamos* reports), has worked with the EPA to eradicate the “*pajarita*” plant parasite which dries out and kills local trees, and has led various projects to bring vegetation and horticulture to public spaces within the city, including the well-known *Paseo Peatonal*.¹⁰⁵ The *Club de Jardinería de Cartagena* uses community projects,

educational pamphlets, exhibitions, presentations, and horticulture classes to convey a message similar to Isaac's personal motto: "La tierra vive sin el hombre más no el hombre sin la tierra [The earth can live without man, but man cannot live without the earth]."

Poverty

Of the seven departments in the *Región Caribe*, poverty levels range from 12.5% of each department's population to 53.3%, with a median of 42.3%; extreme poverty ranges from .47% to 24.3%, with a median of 9.4%. Overall, 31.2% of the *Región Caribe* lives in multidimensional poverty.¹⁰⁶ Despite the cumulative statistics however, it is important to note the significant difference and severity of poverty within each individual department of the *Región Caribe*.

Atlántico is comprised of a population of which 25.7% live in poverty and 2.7% in extreme poverty.¹⁰⁷ Bolívar is comprised of a population of which 39.3% live in poverty and 8.3% in extreme poverty.¹⁰⁸ In the capital city of Bolívar, Cartagena, 26.6% of the population lives in poverty and 4.3% live in extreme poverty.¹⁰⁹ The department of Magdalena is comprised of a population of which 44.8% live in poverty and 12.5% in extreme poverty.¹¹⁰ San Andrés is the last of this category of Caribbean departments experiencing a decline in poverty, and is also host to the lowest levels of poverty being 7.3% and extreme poverty affecting only 1% of the population.

La Guajira starts the category of Caribbean departments with elevating poverty levels with a .3-point increase in poverty from 2014 to reach 53.3% of the population in 2015; extreme poverty did not increase, but is still at the high level of 24.3%.¹¹¹ Poverty levels also rose in

Cesar by 1.4 points to reach 42.3% and extreme poverty affected 11% of the department's population.¹¹² In Córdoba, poverty also rose .3 points to 46.6% of the population, and rose .6 points in extreme poverty to 12.9%.¹¹³ Sucre's poverty increased by .8 points to 44.7%, and extreme poverty .3 percentage points to 9.4%.¹¹⁴

Listing the percentages of department populations living with only the minimum basic necessities or less than what is necessary to survive gives insight into the grave situation faced by the *Región Caribe* of Colombia. Socioeconomic hierarchies maintained by neocolonialism further the gap between the poor and wealthy, only making employment and economic safety more difficult for over half the population in some areas. Not only does economic security resonate with the needs of the poor, so do health needs. With poverty, environmental pollution becomes a harsher reality, as the majority of those dying and suffering from illnesses caused by GHG emissions, leachate from landfills, and polluted water are those who cannot afford safety from it. Extreme levels of poverty and high levels of pollution can find a solution in employment and wellbeing for the poor through environmental advocacy and work.

With the amount of water sanitation plants needed, litter to be recollected and environments cleaned, waste to be sorted, recycling plants to be formally established, and biodiversity to be restored, many opportunities for employment are available with the implementation of stricter waste management and regulation. In developing countries, high levels of poverty and the need for stricter waste management often correlate with a strong presence of *recicladores*. Therefore, with a stronger and stricter political presence, waste management can provide a multidimensional solution to poverty as well as environmental degradation. *Recicladores* in the Caribbean can provide much needed environmental activism

while earning much needed livings in order to lower poverty levels; and with levels of poverty being as high as they are, only minimum salaries are necessary to raise Colombia's HDI and reduce waste pollution.

Recicladores have been included in much legislation and have been integrated into formal waste management since 1999, after Law 511 was passed establishing a “Día del Reciclador [Day of the Recycler].” Nevertheless, the problem of poverty within the Caribbean Region is obviously still significantly present, if not worsening in several departments. As tax continues to de-incentivize the disposal of waste through means other than landfills, waste management conditions do not improve, and *recicladores* are not formally employed and recognized as was possible by Bogotá's *Zero Basura* Program; employment opportunities that can lower poverty levels are being lost. Dividing waste management and environmental regulation among many private and public entities only enables each entity to serve its own purpose, furthering the argument for better stricter roles of local and national government.

The *Región Caribe*, endowed with cities like Cartagena, is too rich in both natural and human resources, too beautiful as a tourist destination and home, and too full of culture and tradition to allow corruption, mismanagement, lesser political priorities, and chaos to overrule the implementation of projects that will help the population as a whole. In Bolívar, more docents are being trained to teach environmental education, however its capital continues to be littered from the historic, colonial streets to the impoverished, periphery neighborhoods; a walk through even the most affluent neighborhoods only shows empty recycling bins. It is the governments' responsibility to recognize more opportunity and benefit in the improvement of waste

management systems and environmental regulation, and integrate more efficient, incentivizing policy that will help the current situation of the coast.

⁸⁸ Antonio Ramírez and Hernando Otero, “UPDATE: An Introduction to Colombian Governmental Institutions and Primary Legal Sources,” *GlobalLex* (2015), <http://www.nyulawglobal.org/globalex/colombia1.html>.

⁸⁹ Ibid.

⁹⁰ Ibid.

⁹¹ Caribbean Environment Programme, “About the Cartagena Convention,” *United Nations Environment Programme*, accessed November 16, 2016.
<http://www.cep.unep.org/cartagena-convention>.

⁹² Ibid.

⁹³ Claudia P. Campuzano Ochoa, Gabriel Roldán, Andrés E. Torres Abello, Jaime A. Lara Borrero, Sandra Galarza Molina, Juan Diego Giraldo Osorio, Milton Duarte, Sandra Méndez Fajardo, Luis Javier Montoya Jaramillo, and Carlos Daniel Ruiz, “Urban Water in Colombia,” in *Urban Water Challenges in The Americas: A Perspective from the Academy of Sciences*, (Mexico City: IANAS and Paris: UNESCO and Montevideo: UNESCO, 2015), 173.

⁹⁴ Campuzano Ochoa et al., “Urban Water Colombia,” 178.

⁹⁵ “Evaluación Calidad de Vida 2014,” *Cartagena Cómo Vamos Organization* (Cartagena, Colombia, SA), 2015,
<http://www.cartagenacomovamos.org/nuevo/wp-content/uploads/2015/07/Evaluaci%C3%B3n-calidad-de-vida-2014-WEB1.pdf>

⁹⁶ “Recoger la basura es deber, no favor,” *El Universal* (Colombia, SA), June 5, 2016.
<http://www.eluniversal.com.co/opinion/editorial/recoger-la-basura-es-deber-no-favor-10689>

⁹⁷ “Calidad de Vida.”

⁹⁸ Jorge Sánchez, Juan Urrego, Josefina Zakzuk, Adriana Bornacelly, Idelfonso Castro, Luis Caraballo, “Levels of Air Pollution in Cartagena, Colombia,” *Revista de la Universidad Industrial de Santander. Salud* Vol. 45, No. 3 (2013).

⁹⁹ OECD, *OECD Environmental Outlook to 2050* (OECD Publishing, 2012), 276.

¹⁰⁰ Campuzano Ochoa et al., “Urban Water Colombia,” 184.

¹⁰¹ “Calidad de Vida.”

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- ¹⁰² Sánchez et al., “Air Pollution Cartagena.”
- ¹⁰³ “Calidad de Vida.”
- ¹⁰⁴ “Evaluación Calidad de Vida 2015,” *Cartagena Cómo Vamos Organization* (Cartagena, Colombia, SA), 2016,
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- ¹⁰⁵ Personal Communication, 2016.
- ¹⁰⁶ “Pobreza Monetaria y Multidimensional en Colombia 2015,” *Departamento Administrativo Nacional de Estadística* (Bogotá DC, Colombia, SA), 2016,
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- ¹⁰⁸ “Pobreza Monetaria 2015: Bolívar,” *Departamento Administrativo Nacional de Estadística* (Bogotá DC, Colombia, SA), 2016,
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- ¹⁰⁹ “Calidad de Vida”
- ¹¹⁰ “Pobreza Monetaria 2015: Magdalena,” *Departamento Administrativo Nacional de Estadística* (Bogotá DC, Colombia, SA), 2016,
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- ¹¹⁴ “Pobreza Monetaria 2015: Sucre,” *Departamento Administrativo Nacional de Estadística* (Bogotá DC, Colombia, SA), 2016,
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CHAPTER 5:

CONCLUSION

The three case studies featured in this research resemble Kenneth Waltz's Levels of Analysis. The levels started with the broad geographic region of Latin America and the Caribbean, then focused on the national level with the state of Colombia within the LAC, and finally narrowed to a local level of analysis with the city of Cartagena, within Colombia. The objective was to create a greater understanding of Cartagena's current environmental standards and their effect on human health and poverty. Because government policy and regulation at all levels influence environmental standards, government action and concern is a significant factor in the health and effectiveness of socio-ecological systems.

Examining Cartagena and its surrounding area of the *Región Caribe* in the context of its national and regional geographic settings are very important when understanding its current state of environmental, health, and poverty standards. Environmental standards analyzed the current condition of wastewater and solid waste. Human health standards analyzed the impact of wastewater and solid waste conditions on human health via related disease, mortality, and morbidity levels. Poverty standards measured percentages of a total population that lived in moderate and extreme poverty. The following table briefly summarizes several important points regarding the above-mentioned standards within each level of analysis.

Comparison of Analysis

<div>Standards</div> <div>Level of Analysis</div>	Environmental	Human Health	Poverty
Regional: LAC	Unsatisfactory and underutilized water sanitation and waste management infrastructure	High levels of morbidity and mortality related to pollution	Poverty ranges from less than 10% to over 50% of populations
National: Colombia	Unsatisfactory level of water sanitation; High landfill use, low levels of recycling	High levels of morbidity and mortality related to pollution	Approximately 30% of the population
Local: Cartagena	No water sanitation; little information about recycling and waste management	Little information about pollution-related morbidity and mortality	Approximately 25% of the population

Table 1: Comparison of Analysis

Findings: Latin America and the Caribbean

The geographic region of Latin America and the Caribbean has a significant waste problem. Wastewater is significantly linked to the agricultural sector of LAC, which has grown 50% regionally and even higher in individual states, such as 70% in Brazil.¹¹⁵ The connection between agriculture and waste is the significant amount of runoff from fertilizers and fecal matter that is polluting water environments including, rivers, lakes, and the ocean. In addition to runoff and fecal matter, the rate of water usage in the region, a significant portion of which is used for agriculture, is exceeding the amount available to maintain sustainability. Consequently, there is a need for the implementation of water conservation practices.

The bodies of water, already suffering from eutrophication from phosphates and nitrates in fertilizers, are then introduced to municipal sewage. LAC has the capacity to treat 35% of wastewater, however only 20% is actually and effectively treated.¹¹⁶ Individual poverty rates of states in the LAC region suggest that large amounts of the region's population -unable to afford sanitation services- are using waste polluted water for daily tasks and needs, such as drinking, bathing, cleaning, and cooking. However, this wastewater, although significantly more dangerous to the poor, is also afflicting members of higher socio-economic class. The water is increasing mortality rates related to illness including child deaths through the spread of diseases that include: dengue, malaria, typhoid fever, parasitosis, hepatitis, leptospirosis, cholera, salmonella, and gastroenteritis, among many others. In Guatemala, the most impoverished state in LAC, 50% of all disease-related deaths and up to 5 children dying daily are caused by unsanitary water.¹¹⁷

In addition to wastewater, the region also lacks solid waste management infrastructure. Only 23% of waste goes to sanitary landfills – the most effective option in avoiding harm to the environment; 24% of waste goes to controlled landfills set by individual national and local standards, which vary and can be either effective or ineffective in avoiding harmful environmental impact.¹¹⁸ Approximately 60% of waste is dumped in unknown sites, and surveys in numerous LAC states have shown that landfills labeled as “sanitary” do not even have the Environmental Impact Assessment approval to be labeled as such.¹¹⁹

Improper disposal of waste furthers pollution through the form of leachate- or leaking of landfills into the environment, direct dumping into bodies of water, and enhanced GHG emissions. Recycling, on the other hands, can help create energy with organic material, reduce resource depletion through reuse, and reduce direct pollution and associated costs from extraction of new natural resources. The average recycling rate in LAC is 3%, meaning that 97% of waste is contributing to GHG emissions associated with climate change, and air and water pollution associated with rising morbidity and mortality rates. All affect socio-economic classes disparately.

Also noteworthy in regard to socio-economic disparity is the predicted population growth in developing nations. LAC, along with Africa and Asia, are predicted to host 90% of the world’s population in 2150, or approximately 9.7 billion people.¹²⁰ The predicted future population density of these areas calls for more attention to environmentally sustainable practices to contain the spread of disease and assure that resources are managed appropriately.

Findings: Colombia

Colombia is a state within the LAC region, located along the northern coast of South America. It is divided into 32 departments and one capital district, each with an elected governor and departmental assembly. The capital and largest city is Bogotá.

Geographically, Colombia is divided by Panama along the Pacific and Atlantic Oceans, and is considered one of the most biologically and ecologically diverse countries in the world. Among its many landscapes are the Andes Mountains, the Amazon Rainforest, and the Caribbean Coral Reefs, all habitats for invaluable assemblages of flora and fauna. Consequently it has become the focus of many conservation efforts.

The problem of waste in Colombia is reflective of the conditions mentioned in LAC. In the three major cities, Bogotá, Medellín, and Cali, only 32% of sewage is treated before being disposed of in local bodies of water.¹²¹ In the fourth and fifth largest cities, Barranquilla and Cartagena, which are discussed in chapter four, even less is treated. Barranquilla treats 17%, and Cartagena does not treat sewage before it is dumped into local bodies of water.¹²² The Rio Magdalena is the largest river, spanning 930 miles. It is the most important commercial waterway in the country, and carries pollution from the Andes Region of Colombia at its start all the way to the Caribbean Region on the Atlantic coast of Colombia, until it empties into the Caribbean Sea.

The impact of contaminated water has led to a list of diseases in Colombia similar to those presented in all of Latin America, with chronic diarrhea accounting for 90% of all water related illnesses.¹²³ The ensuing dehydration and malnutrition associated with diarrhea is the reason for which it causes 7.2% of infant deaths in Colombia.¹²⁴ In 2010, 1600 deaths occurred

due to WASH. Even more concerning that WASH, however, were the amount of deaths attributable to IAP and UAP: 6,000, with a prediction of even higher numbers in the future.

In intervening with air pollution caused by forms of cooking and heat, the Colombian government proved the efficacy of government action in solving the three issues at hand in this project: environment, health, and poverty. By subsidizing the use of HNG in strata one and two households, the government was able to reduce sulfur dioxide and nitrogen oxide emissions, which reduced cases of acute respiratory disease and outpatient cases of pulmonary disease. The government improved the quality of life of the poor by giving them access to cleaner more efficient energy, improving their health through a cleaner environment, and lowering public health costs associated with ARD and OCPD by 32%.

The success of government intervention can be mirrored in water sanitation efforts as well as the good use of the 66% of waste in landfills that are compostable and recyclable. While reducing pollution, leachate, GHG and toxic gas emissions to create cleaner environments, the government can create jobs for *recicladores*, incentivize new green industry with tax incentives to encourage reuse as opposed to the more expensive –financially and ecologically- natural resource extraction, and create better local health conditions by reducing water-related and air-related disease.

Findings: Cartagena

Cartagena is the capital of the district of Bolívar. It is the fifth largest city of the country, home to a UNESCO world heritage site, hosts one of the largest ports in South America, and is

one of the Colombia's most popular tourist destinations due to its heritage, lively culture, beaches, and tropical climate. It represents the narrowest level of analysis as well as the level with the least available amount of information pertaining to wastewater and solid waste conditions. Although few studies have been conducted regarding pollutants in very specific contexts, not enough information is readily available, to create universal standards and statistics about recycling, waste management, and pollution-related diseases associated with contaminated waters and air.

A quality of life evaluation found all waters in the city, apart from the Caribbean Sea, to be contaminated with fecal coliform bacteria, which is the result of human or animal feces –or untreated sewage and agricultural runoff- entering into bodies of water.¹²⁵ These bacteria lead to diseases such as diarrhea, accounting for 90% of water-related illness in Colombia. These illnesses include cholera, typhoid, and hepatitis A, among others. As of 2015, Cartagena did not sanitize any wastewater before releasing it into local bodies of water.

The quality of life evaluation quantified levels of trash collected, which have been increasing annually, as confirmed by the most recent evaluation published after this case study was written. However, what Cartagena *CómoVamos* does not record is the level of solid waste that is recycled. Several local editorials discuss the presence of trash in the city and the necessity for government and civilian action. Government action was also acknowledged in a periodical documenting the training of 50 docents in Bolívar to participate in Colombia's PRAE program.¹²⁶ However, even just the superficial appearance of strata 1 to strata 6 neighborhoods is enough indication of much progress to be made in the waste management sector.

Cartagena and the rest of the *Región Caribe* can benefit from a more pronounced presence of PRAE programs and environmental education, a stronger waste management infrastructure, and policies and regulations that disincentivize detrimental socio-ecological practices. By implementing stricter recycling programs, citizens can become more engaged in recycling at the source, and *recicladores* can be formally hired to remove recyclable litter from beaches, neighborhoods, and the historic walled city. The 26.6% of Cartagena living in poverty and 4.2% living in extreme poverty can benefit from both cheap labor, as well as improved health from cleaner air and sanitized water.

Questions for Future Research

This study concludes with several unanswered questions and the need for further research. Specifically, there is a need for more comprehensive, objective, and reliable information addressing the direct impact of regulation of waste management and water sanitation infrastructure on health in all of LAC. Additional research and standard measures are necessary to compare and contrast information in the future.

In Colombia, policy and tax related to waste management and water sanitation must be studied further. Currently, information is difficult to attain, and consequently progress is not clearly identified. Topics for further research include evaluating the actual implementation and effectiveness of government programs and laws: PRAE programs, Act 1713 which obliges municipalities to create a Plan for Comprehensive Waste Management, and the recently signed national alliance for “The Formation of Responsible Citizens: a More Educated Country and a

Sustainable Environmental Culture for Colombia,” etc. Another future topic for research in Colombia can evaluate the impact of government waste pollution intervention on poverty, the economy, and public health. Similar plans regarding HNG have been proven to be successful, and should be mimicked to reduce various forms of pollution.

In Cartagena, there is little to no objective and reliable information about recycling. Publications state that no wastewater is sanitized before being dumped into local bodies of water. Solid waste littering is an issue of concern that must be addressed, as well as knowledge about and availability of recycling facilities. Access to information and environmental education can be evaluated in respect to waste management practices of residents. A final recommendation for future research involves the study of waste and sewage-related pathogens within the area in relation to mortality and morbidity levels, public health expenditures, and quality of life.

Ideally, future research will encourage the implementation of stricter environmental policy within Cartagena, and other underdeveloped areas severely afflicted by lack of infrastructure controlling for environmental pollution. Policy mandating improved waste management, recycling programs, and water sanitation has the potential to significantly improve public health; lower public health expenditures; maintain biodiversity; encourage sustainable industrial practices and technology; and reduce the gap in quality of life between socioeconomic classes. With the ability to control the spread of disease, lower pollution levels and GHG emissions, and improve quality of life, further research is very much called upon.

The time has to come for government officials at all levels to realize the significance of “soft” issues and the importance of implementing stronger environmental policy.

¹¹⁵ Mesfin M. Mekonnen, Markus Pahlow, Maite M. Aldaya, Erika Zarate, and Arjen Y. Hoekstra, “Sustainability, Efficiency and Equitability of Water Consumption and Pollution in Latin America and the Caribbean,” *Sustainability* 7, no. 2 (2015): 2087.

¹¹⁶ Mekonnen et al., “Water Consumption Pollution,” 2100.

¹¹⁷ “Guatemala,” *Food and Agriculture Organization of the United States*, 2015, http://www.fao.org/nr/water/aquastat/countries_regions/Profile_segments/GTM-EnvHea_eng.stm.

¹¹⁸ “Solid Waste Management in LAC: Actual and Future CH₄ Emissions and Reductions,” The World Bank, August 2008, http://siteresources.worldbank.org/INTUWM/Resources/340232-1221149646707/Solid_Waste_Management_in_LAC.pdf.

¹¹⁹ Ibid.

¹²⁰ David Quammen, “Planet of The Weeds: Tallying The Losses of Earth’s Animal’s and Plants,” *Harper’s Magazine*, Oct. 1998, pp. 67.

¹²¹ Claudia P. Campuzano Ochoa, Gabriel Roldán, Andrés E. Torres Abello, Jaime A. Lara Borrero, Sandra Galarza Molina, Juan Diego Giraldo Osorio, Milton Duarte, Sandra Méndez Fajardo, Luis Javier Montoya Jaramillo, and Carlos Daniel Ruiz, “Urban Water in Colombia.” In *Urban Water Challenges in The Americas: A Perspective from the Academy of Sciences* (Mexico City: IANAS and Paris: UNESCO and Montevideo: UNESCO, 2015), 178.

¹²² Ibid.

¹²³ Campuzano Ochoa et al., “Urban Water,” 183- 184.

¹²⁴ Ibid.

¹²⁵ “Evaluación Calidad de Vida 2014,” *Cartagena Cómo Vamos Organization* (Cartagena, Colombia, SA), 2015, <http://www.cartagenacomovamos.org/nuevo/wp-content/uploads/2015/07/Evaluaci%C3%B3n-calidad-de-vida-2014-WEB1.pdf>

¹²⁶ “Gobernación de Bolívar formó 50 docentes para fortalecer la educación ambiental,” *Caracol Radio* (Cartagena, Colombia, SA), April 24, 2016, http://caracol.com.co/emisora/2016/04/23/cartagena/1461446495_655286.html.

**APPENDIX: PHOTOGRAPHS
OF WASTE POLLUTION IN CARTAGENA**

The following photographs were taken along the *Vía Perimetral* –or perimeter road- in Cartagena, Colombia. The *Vía Perimetral* is well known for passing through some of the most impoverished periphery neighborhoods of the city. The photographs show the quality of life of some of the 25% of the population living in poverty. In addition to inadequate housing, the photographs display the amount of waste pollution in the neighborhoods and within the local bodies of water. The amount of litter in the photographs is only a superficial representation of the further garbage, water, and air pollution that severely affects the health and quality of life of the residents of these areas.











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