SOLID WASTE MANAGEMENT POLICY:

THE BARRIERS TO SUSTAINBILITY ON REMOTE ISLANDS

A Dissertation
Presented to
The Academic Faculty

by

Jennifer M. Chirico

In Partial Fulfillment
of the Requirements for the Degree
PhD in the
School of Public Policy

Georgia Institute of Technology
December 2011

SOLID WASTE MANAGEMENT POLICY:

THE BARRIERS TO SUSTAINBILITY ON REMOTE ISLANDS

Approved by:

Dr. Juan Rogers, Advisor
School of Public Policy
Georgia Institute of Technology

Dr. Bryan Norton
School of Public Policy
Georgia Institute of Technology

Dr. Gordon Kingsley
School of Public Policy
Georgia Institute of Technology

Dr. Julia Melkers
School of Public Policy
Georgia Institute of Technology

Dr. Rebecca Mirsky
Boise State University

Date Approved: October 6, 2011

To my two fathers,
James Michael Chirico (Georgia Tech, '71)
and Russell Francis Seymour III

ACKNOWLEDGEMENTS

I would like to express my appreciation to the members of my dissertation committee for their support and guidance throughout the dissertation process. I am grateful to Dr. Juan Rogers (chair) who reviewed my dissertation multiple times, provided invaluable advice, and regularly corresponded with me long distance over many miles and countries. I am forever thankful to Dr. Gordon Kingsley for his insightful policy wisdom, friendship, and open office door throughout my PhD program. Dr. Bryan Norton, a top scholar in sustainability, taught me to think critically about sustainability issues and provided invaluable guidance. I am grateful to Dr. Julia Melkers for her strong support of women in science and encouraging supporting through the dissertation process. I am eternally thankful to Dr. Rebecca Mirsky for stepping in at the later stages of my dissertation and providing instrumental local knowledge and advice. Very special thanks go to all of the people who assisted in my data collection, including the interviewees, government officials, local residents, and waste experts from around the world. I could not have completed it without your participation. I am also thankful to Todd Yoshioka for his final editing assistance.

I survived the PhD program and dissertation journey because of the endless support of my family members and friends. My late father, James Michael Chirico, was a Georgia Tech alumni and avid ramblin' wreck. His spirit kept me going during the darkest hours of the dissertation. My late stepfather, Russell Francis Seymour, provided the most encouragement and belief in my ability to finish. My mother, Ellen Seymour, and my brothers, Nick Chirico and Philip Chirico, never stopped believing in me, and for that I am eternally grateful. I am also appreciative of my dog, Petey, who sat next to my side throughout the writing process and never forgot to remind me to take a break and go for a walk. I am thankful for my dearest and closest friends, Amy Long, Heather Gee, and Dawn Carpenter for their listening ears at all times of the

day and night, and to my fellow PhD friend, Alison Riggieri, for the many hours of PhD discussions over the last five years. Thanks to Patty Chirico, Steve Mahaffey, Jeannie Hammel, Bob Love, and Doug Lenhardt. I am indebted to countless more friends, family, co-workers, colleagues, and others who assisted me along the way. Thank you all. I am forever grateful.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY

Waste generation rates continue to grow around the world, creating a need for more comprehensive waste management strategies to meet sustainability needs. Remote islands are profoundly affected by the growth in waste and have a critical need to develop policy that addresses their unique characteristics, such as limited land space for waste disposal, higher per capita waste generation rates due to tourism, and lack of opportunities for interstate waste transport. This case study investigated one Hawaiian County's collaborative approach to adopting a new solid waste management policy. Ostrom's Institutional Analysis and Development Framework (IAD) was utilized to examine the facilitating and impeding institutional factors that affect the adoption of more sustainable waste management approaches on remote islands. The impeding factors that created barriers to sustainability included blueprint models, lack of financial incentives, financial cost, infrastructure, exclusion from waste services, remoteness, and illegal dumping. Facilitating factors were environmental concerns and exemplary waste examples by other communities. Recommendations are provided for addressing these barriers and using the available opportunities to work toward greater sustainable resource management on remote islands.

CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Introduction

Solid waste generation rates have increased exponentially over the last several decades, and identifying more sustainable methods for waste disposal is critical to the environment, public health, economy, and Native Hawaiian culture. Remote Pacific Islands are adversely affected by the growth in waste due to their limited access to world markets (World Bank, 2009), dependence on imports, high tourism, and fragile ecosystems (Diaz, 2007). [1] The pacific region is home to an estimated 20,000 to 30,000 islands that are primarily governed by countries in other parts of the world. Many of the governing entities have been ineffective at ensuring sustainable growth in this region due to lack of financial resources and adequate policies in place that reflect the unique characteristics of remote islands (United Nations [UN], 2009). Multiple institutional factors affect progress toward long-term sustainability on remote islands, and it is essential that policy address these issues and actively work toward achieving long-term sustainability for Hawaii and its future generations.

Waste management in the Pacific Islands was recently recognized by the *United Nation's Partnership for Sustainable Development* as an urgent initiative to protect public health and the environment. A goal of this initiative was to assess institutional and social barriers and develop institutional capacities for effective waste management on Pacific Islands (UN, 2009). This dissertation seeks to achieve this goal by analyzing

[1] Diaz (2007) claims that "[Islands] are challenged by a "severe limitation of natural resources, fragile ecosystems, high dependence of imports, drastic changes in population due to seasonal tourism, high cost related to obtaining physical inputs for waste management, difficulty in locating appropriate waste management sites, limitations related to human and financial resources, lack of feasible uses and markets for materials recovered from solid waste, and diversity of visitors" (p. 325).

waste management policy in Hawaii. One county in the State of Hawaii recently developed a new integrated solid waste management plan. The county brought together a collaborative stakeholder committee to assess various scenarios and provide policy recommendations. The committee spent a year evaluating different alternatives and visiting other waste facilities with more advanced technologies.

This dissertation is a case study that focuses on solid waste management issues on remote islands and how certain factors affect sustainability. It examines the solid waste management decision-making process of one Hawaiian county and answers the following research question: *What are the facilitating and impeding factors that affect the adoption of more sustainable waste management policies?* Answering this question contributes to the literature in several ways. First, Pacific Islanders are an often under-represented group in scholarly research, and advancing solid waste management research in the Pacific Islands contributes to this region's environment and economy. Second, the literature on waste management policy related to remote islands is limited. Few researchers have analyzed solid waste policy with an emphasis on remote islands and the additional challenges faced by policy decision-makers in these locations. Third, there is not a universally accepted meaning of sustainability or sustainable waste management. This study explores the spectrum of sustainability definitions and their applications to remote island waste management issues. Finally, this study advances on Ostrom's Institutional Analysis and Development (IAD) framework by applying it for the first time to waste management on remote islands.

1.2 Solid Waste

Solid Waste is defined as solid items that are no longer wanted. Daily human activities can lead to a large variety of waste from different sources. Municipal solid waste is generated from residential, commercial, institutional, and industrial processes and may include items such as plastics, metals, paper, electronics, sewage sludge, and yard waste. Other types of waste include industrial waste (e.g., factories, mills, and mines), hazardous waste (e.g., toxic waste), and agricultural waste (e.g., organic wastes from farming).

Table 1: Sources and Types of MSW

Sources and Types of MSW	
Residential	Food wastes, paper, cardboard, plastics, textiles, glass, metals, ashes, special wastes (bulky items, consumer electronics, batteries, oil, and tires) and household hazardous wastes
Commercial	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Institutional	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Municipal Services	Street cleaning, landscaping, parks, beaches, recreational areas, street sweepings, landscape and tree trimmings, general wastes from parks, beaches and other recreational areas

Solid waste management refers to the management of solid waste disposal. While there are many methods utilized around the world for managing waste disposal, the most commonly used methods in the United States are landfilling, recycling, composting, and incineration. Many advanced technologies (e.g., gasification, mechanical biological treatment, and landfill gas-to-energy)[2] have increased in popularity as promising solutions for reducing methane emissions and generating renewable energy.

[2] *Gasification* is a technology that can convert carbonaceous material such as coal, petroleum coke, and other materials into a synthesis gas using high temperature and pressure. Synthesis gas can be used as a fuel source or as a building block for other chemical processes (EPA, 2009b). *Landfill Gas-to-Energy* is a

Landfills are the most conventional and dominant approach for managing solid waste. *Sanitary* landfills[3] are engineered waste disposal sites that bury non-hazardous solid waste and provide protection from harmful materials.[4] While various forms of dumping in land holes have been identified since prehistoric times, sanitary landfills have only been in existence for the last century. Today, landfill operators are required to follow EPA regulations in the U.S. They must be lined, have methods for capturing leachate,[5] and be compacted and covered with organic materials each day (EPA, 2011a). After they close, they require regular maintenance for at least thirty more years due to the high levels of leachate and methane gas emissions that continue to pose risks to communities. When they do reach capacity and close, more space is required to build new landfills (Kaosol, 2009).

Landfill infrastructure is well established, and waste operations employ hundreds of thousands of people. It is estimated that there are about 2,000 landfills in operation in the United States (ASCE, 2011). However, this number does not include abandoned or inert landfills,[6] which is estimated to be approximately 30,000. As the amount of waste

---

method for capturing the natural by-product of the decomposition of solid waste in landfills comprised primarily of carbon dioxide and methane (EPA, 2009c). *Mechanical Biological Treatment* is an advanced non-thermal process that mechanically sorts waste into what can be recycled and what can be biologically treated (Juniper, 2005).

[3] Sanitary landfills are engineered landfills that control the disposal of waste on land. An unsanitary landfill means that it is not monitored or controlled for sanitation.

[4] Hazardous waste (HW) is waste that is potentially harmful to public health and/or to the environment. It can be in the form of liquids, solids, gases, or sludges, such as cleaning products, pesticides, or by-products from the manufacturing process (EPA, 2011). Non-hazardous waste is waste that is not deemed harmful to health. Landfills are only supposed to accept non-hazardous wastes; however, many landfills knowingly or unknowingly accept hazardous waste since there are often unavailable methods for disposing of it. In Hawaii, for example, HW collection usually only occurs once per year. Rather than storing HW in their homes, residents often resort to disposing of it in the local landfill.

[5] Landfill liners are usually made of clay and prevent waste from seeping into the land. Leachate pumps catch water that runs through the landfill. After it drains through the waste, it is considered hazardous, and leachate pumps prevent it from run off.

[6] Inert landfills are landfills that hold waste that will not biodegrade, such as concrete, sand, and drywall.

has increased, landfills have shifted in size from small to large over the last several decades.

Recycling is the second most utilized waste management approach. It is a way to minimize waste by reprocessing used goods into new, usable products (EPA, 2011a). Most recycling facilities recover a plethora of materials, including plastics, metals, paper, electronics, and tires. Materials are transported to a Materials Recovery Facility (MRF) where they are cleaned and sorted. Depending on the size and capabilities of the MRF, they are either processed into reusable products or transported to other vendors for processing. While recycling can reduce the amount of waste that goes to a landfill, it is an energy intensive process that requires extensive transport of goods for materials recovery. In addition, many products that go through the process are not 100% recyclable. For instance, when plastics are recycled, less than 50% of the material can be used to create other usable products. Furthermore, chemicals are released during the breakdown of the process, and more chemicals must be added to create new products (McDonough & Braungart, 2002). Because of these issues, it is often debated as to whether or not recycling does minimize waste and is more sustainable than landfilling.

Composting is the third most used waste management approach and has been conducted since prehistoric times. It is facilitated by the breakdown of organic matter, such as kitchen scraps, green waste, and biosolids.[7] The finished result can be used as fertilizer for agriculture. Multiple methods of composting exist, including sheet composting, vermicomposting, toilet composting, windrow heaps, passive aerated windrows, and aerated static pile/forced aeration (Englande & Guang, 2006). It has often been identified as an important approach for achieving greater sustainability, as the

[7] Biosolids are the solid by-products from waste treatment processes, also referred to as sewage sludge.

finished compost product has been found to contain high nutrient levels and provide significant savings to large scale farming operations (Cheuk & Lo, 2003).

Incineration, or the combustion of waste in excess of oxygen, is another common method for waste management. It is also frequently referred to as waste-to-energy (WTE). It was a popular method in the 1980s until stricter federal air quality regulations were implemented in the 1990s. Since then, it has been scaled back significantly due to high emissions that do not meet regulations. Today, there are less than 100 traditional incinerators in the U.S., though new WTE facilities that offer cleaner emissions are being developed and implemented more readily around the world.

Table 2: Key Characteristics of Most Common U.S. Waste Management Methods

Waste Management Method	Definition	Key Characteristics
Landfill	• Sanitary landfills are disposal sites for non-hazardous solid wastes spread in layers, compacted to the smallest practical volume, and covered by material applied at the end of each operating day (EPA, 2011a).	• Over 2,000 in U.S. • ~30,000 inert landfills in U.S. • Most established • Issues with greenhouse gases, leachate, finding land space
Recycling	• Minimizing waste generation by recovering and reprocessing usable products that might otherwise become waste (EPA, 2011a).	• Recovers waste • Energy intensive • "Downcycling"
Composting	• A humus or soil-like material created from aerobic, microbial decomposition of organic materials such as food scraps, yard trimmings, and manure (EPA, 2011a).	• Renews waste • Builds healthy soil • Cyclical approach
Incineration	• A treatment technology involving destruction of waste by controlled burning at high temperatures (EPA, 2011a).	• Burns waste in open or closed process • Produces energy that can provide power for local communities • High emissions, negative public perception, limited materials recovery

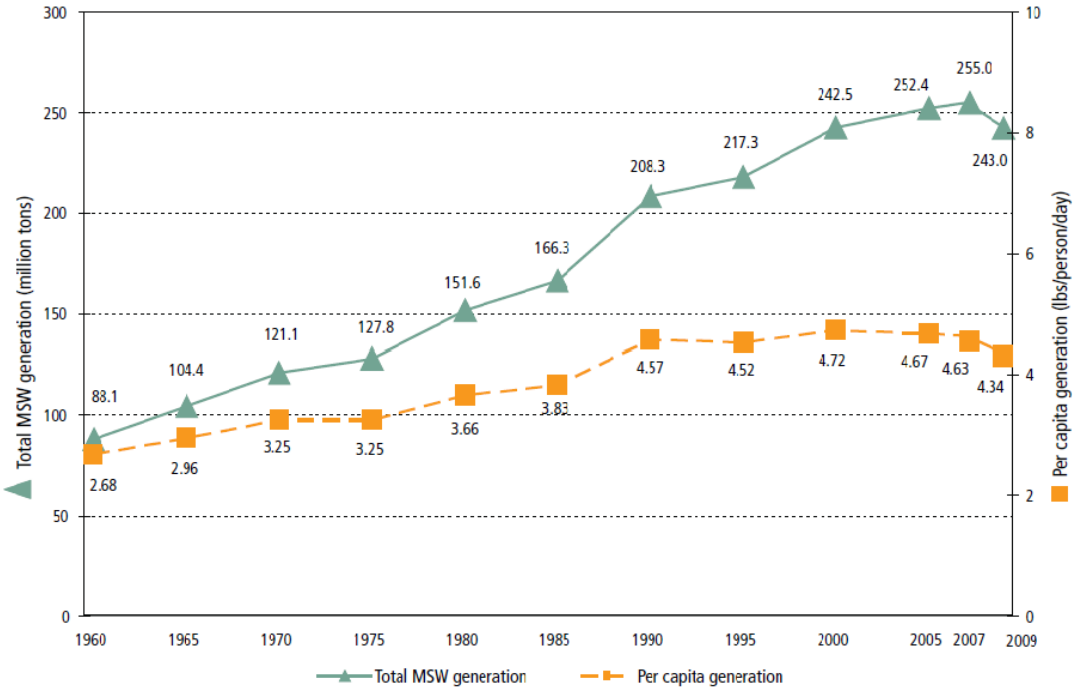
1.3 Waste Trends

Despite various factors, such as socio-economics, industrialization, and geographical location that affect waste generation rates (Ngoc, Schnitzer, 2009), worldwide waste has increased every year and is expected to double by 2030. From 1980 to 2000, the waste produced by OECD countries increased by 2.5% per year. In the United States, the amount of waste per capita increased by 77% between 1960 and 2008

(EPA, 2007a), and the average tipping fee[8] for landfill disposal increased by 250% between 1985 and 2005, from $10 to $35 per ton (Economist, 2009).

In 2009, however, municipal solid waste generation rates decreased slightly, from 255 million tons in 2007 to 243 million tons (EPA, 2011). The shift in waste trends reflects a potential Environmental Kuznets Curve (EKC) (see Figure 1). The EKC hypothesizes that there is a relationship between the use of environmental amenities/disamenities and income that has an inverted U-shape. In the case of air quality, for example, as income per capita increased, air quality initially worsened up to a certain income level. At that point, referred to as the turning point (TP), air quality began to improve (Mazzanti, Montini, Zoboli, 2009). For waste generation, as income increases, it would be expected that waste generation rates would also increase up to a certain TP. At the TP, the rate would begin to decrease while income continued to increase. Until 2009, there were not any signs of an EKC trend for waste generation. As prosperity increased around the world, waste generation and disposal also increased (Ngoc, Schnitzer, 2009), along with the environmental costs of landfilling (Mazzanti, Zoboli, 2009). Previous studies indicated that the relationship between income and waste was far from an inversion. The lack of policy-related targets that prevent waste at the source was a primary contributor to the problem (Mazzanti, 2008; Mazzanti, Zoboli, 2009). Since this shift in the waste trends is so recent, it is difficult to determine whether it is a true TP or just a temporary decline.

[8] Tipping fees are monetary charges for waste disposal at waste processing facilities (e.g., landfills).



Source: EPA (2009)

Figure 1: **U.S. Waste Generation Rates (1960-2009)**

Hawaii's waste generation rates have followed national trends and continually increased from year to year, and the per capita waste rates are much higher. The average person in the U.S. generates 4.6 pounds of waste per day, while in Hawaii the average is up to three times the national amount at an estimated 14.3 pounds per day (Janes-Brown et al., 2010). Some of the largest landfills in the world are located in Hawaii. The largest landfills receive over 150,000 tons of waste per year (Waste News, 2005) and utilize up to 55 acres of land (Dawson, 2007).

1.4 Sustainability and Solid Waste Management

Due to the increasing waste generation rates around the world, sustainability has become a common topic in solid waste management discussions and research. The concept of *sustainability* was first used in the report *Our Common Future* by the World

Commission on Environment and Development in 1987 (Tammemgai, 1999), and was defined as "…development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN, 1987). While this definition is still the most commonly used working definition, a broad variety of definitions have been developed over the last several decades, which poses a considerable dilemma for researchers examining issues related to sustainability. Similar to the issues with sustainability, *sustainable waste management* is regularly discussed in the literature but also lacks a universal definition or framework for measuring sustainability. Chapter 21 of Agenda 21 at the United Nations Sustainable Development Conference on Environment and Development identified four program areas for waste management: 1) protection of the quality and supply of freshwater resources, 2) promoting sustainable human settlement development, 3) protecting and promoting human health conditions, and 4) changing consumption patterns. It summarizes four basic areas of "environmentally sound" waste management: 1) waste minimization, 2) waste reuse and recycling, 3) waste disposal and treatment, and 4) waste collection (UN, 1992). However, the literature is ripe with countless definitions of sustainable waste management and their corresponding metrics. Chapter 3 explores some of these definitions and provides a framework for understanding sustainability in the context of waste management.

1.5 Societal Impacts of Waste

1.5.1 Public Health Impacts

Societies first began actively managing solid waste because it was a public health issue. During the middle ages, streets were covered with household waste, human and

animal excrement, and stagnant water, which led to the spread of infectious diseases (Hamer, 2003). Policies are in place today to better protect the public from these diseases, but improper environmental sanitation remains a chief cause of disease, which in turn also affects the economy through lost workdays, cleanup, and treatment (Joseph, 2006). For instance, landfills still create noxious gases and vapors, dust, and rodent infestation (Tammemgai, 1999). In addition, many areas do not have waste collection services since they are very rural and have poor infrastructure. This potentially leads to higher rates of illegal dumping, which creates health threats to humans, animals, and the environment.

1.5.2 Environmental Impacts

Waste disposal affects land, air, and water. Waste management facilities occupy thousands of acres of land in the U.S. and are continually expanding to accommodate the increasing amounts of waste. As more waste is produced, and more facilities are developed, less land space is available for humans, wildlife, and other forms of development. Air pollution and greenhouse gases are also a result of waste management processes. For instance, landfills emit high levels of methane and carbon dioxide, both greenhouse gases, which continue to increase every year.[9] Methane typically accounts for about 4% of greenhouse gases, but in islands with low industry, it can have a much larger contribution to a community's overall greenhouse gases[10] (Economist, 2009). Recycling often requires extensive transport and processing facilities that break down products, both of which release pollutants. Incineration emits harmful toxins into the air,

[9] Methane and CO2 emissions from landfills increased by 1.9% and 1.4%, respectively in 2009 (EPA, 2009b).
[10] For example, San Francisco's methane emissions account for up to 18% of greenhouse gases (Economist, 2009).

and composting releases substantial amounts of methane when organic materials break down.

Water sources are also affected by solid waste. Underground aquifers and fresh water sources are often threatened by waste through leachate releases, illegal dumping, and other improper disposal methods. Illegal dumps, also referred to as "open dumps," are "disposal sites that operate in nonconformance with any applicable standards, relevant permit conditions, rules, or statutes set by the State of Hawaii" (State of Hawaii, 2011). They are dangerous to human health and the environment, as they often contain hazardous and toxic substances, may create leachate that pollutes the groundwater and soil, may form explosive gases (e.g., methane) due to waste decomposition, or attract insects that carry infectious diseases (ibid). Waste pollution in the sea also creates a problem on land, as waste regularly washes up on the shores of Hawaii's beaches. Several beaches across Hawaii are nicknamed "trash beach" due to the large amounts of waste that wash ashore. On Oahu's north shore, the most famous surfing area in the world, four tons of trash was collected in 2009. The trash composition included 89,253 separate debris items, mostly made of plastic, which originated from other places in the world, yet traveled to Hawaii by the waves and wind (Janiskee, 2010).

1.5.3 Economic Impacts

Waste management is also expensive. The waste industry employs hundreds of thousands of people in the U.S. and spends billions of dollars per year on waste services (Census, 2011). The industry is primarily managed by two public firms that are virtually "recession-proof" due to the continual increase in waste generation. Both companies are

traded on the New York Stock Exchange and hold 41% of the waste market share in the U.S. (Economist, 2009).

Waste transport has become a viable economic option for many U.S. states. Since the early 1990s, waste transport has increased by 30% (Ley et al., 2000). States opt to import waste for profit or export waste to reduce environmental impact. However, remote islands are limited in their abilities to engage in waste transport. Their remote locations make importing and exporting waste an expensive and risky endeavor. These realities place them at an economic and environmental disadvantage compared to other states.

1.5.4 Cultural Impacts

Solid waste can also affect local cultures. For example, Hawaiians consider the land the foundation of their existence, the origin of their humanity. They have a deep faith in the land as a source of economic well-being, physical sustenance, and spiritual well-being (McGreggor, 1995). The health of the land is intimately tied to their belief systems, yet large sections of land are used for landfills, recycling is limited, and many areas are plagued by illegal dumping practices. While driving in remote locations throughout Hawaii, it is not uncommon to see substantial amounts of waste illegally dumped off sea cliffs, in sugar cane and pineapple fields, and in gulches. These behaviors conflict with the culture of the ancient Hawaiian people, and have an impact on their cultural belief systems.

1.6 Solid Waste Policy

1.6.1 National Solid Waste Policy

By the early 20th century, legislation in urban areas was in place to remove waste from the streets, and municipalities began providing collection services. Even so, burning and open dumping was still the most common waste management approach until the 1960s when environmental protection from waste disposal became a national public policy issue. The Solid Waste Disposal Act (SWDA) was instituted by Congress in 1965 and was the first legislation to address solid waste issues at the federal level. This Act primarily assisted state and local governments with developing programs rather than regulation (Jenkins et al., 2009).

Regulation of land disposal began with the Resource Conservation and Recovery Act (RCRA) of 1976. The focus was largely on leachate and gas control from landfills (Wilson, 2007). The RCRA Hazardous and Solid Waste Amendments of 1984 under Subtitle D required that all landfills have liners, regular monitoring, and provide systems for gas ventilation and collecting leachate (Jenkins et al. 2009). Today, solid waste is regulated at the federal level by the EPA under the SWDA and RCRA. Most states and municipalities have additional waste management policies that follow the EPA regulations. While the EPA's primary focus is on monitoring and enforcing landfill regulations, municipalities are usually the entities that manage waste on a day-to-day basis.

1.6.2 Solid Waste Policy in Hawaii

In Hawaii, waste is federally regulated by the U.S. EPA. At the state level, waste is overseen by the Hawaii State Department of Health. DOH activities include

permitting, inspecting, enforcing, regulating and developing policy (HDOH, 2009). At the local level, waste is managed at the county level. There are only four counties in the State of Hawaii, and each one manages their own day-to-day activities of waste. Departments within each county are responsible for all of their municipal solid waste.

1.7 Hawaiian History and the Beginning of "Waste"

The first people to arrive in the Hawaiian Islands were the Polynesians. They traveled two thousand miles in the Pacific Ocean via canoes from the South Pacific Islands, most likely from the Marquesas Islands. Double canoes were built with tools of stone, shells, and bone. It is believed that their arrival to the Hawaiian Islands was not accidental since strong currents and winds would have taken them elsewhere if the trip were not planned. It is not known why they left their homeland in the South Pacific and ventured north, but it is assumed that it was due to famine, war, or population pressures. At least 24 species of plants and some domestic animals (pigs, chicken, and plumages) were brought with them by canoe. The name "Hawaii" came from the Polynesian belief that when a new settlement is established, there is an ancient memory of an original homeland to the west. They believed that when they died their spirits went from the westernmost part of the island back to their ancient homelands (Kane, 1997).

It was at least a thousand years after the Polynesians settled in Hawaii that the Europeans arrived. After Captain Cook's[11] expedition in the eighteenth century, Captain James King estimated that the Hawaiian population was about 400,000. However, he only saw coastal settlements and not the inland settlements, and historians estimate that the real population was between 800,000 and 1.2 million. Whalers began going to the

[11] Captain Cook was a British explorer who had the first documented European contact with the Hawaiian Islands.

islands, followed by Judeo-Christian missionaries in the nineteenth century. By the mid-1800s, diseases brought in by westerners, such as tuberculosis and small pox, infected the majority of the Hawaiian population who had not been exposed to the diseases before. Rampant disease reduced the population to only 40,000 within less than a century (Kane, 1997).

The arrival of westerners also created a clash of belief systems. The Hawaiians did not understand the western concept of owning land. They believed that men could not own land because men belonged to the land. Hawaiians parceled land as territorial custody rather than ownership. The geographical areas were parceled into ahupua'as (pronounced ah-hu-pu-ah-ah). Ahupua'as were land boundaries that went from the top of the mountain to the sea and covered the various forms of terrain. Within the ahupua'a system, every Hawaiian community had fresh water streams trickling from the mountains, community centers and agricultural lands were developed in the center of the ahupu'a to capture the stream water, grow food, and build homes, and oceanside areas were reserved for fishing. They had all of their material needs met within the ahupua'a system. They had banana, coconut, and breadfruit groves that provided housing, household items, and food. Their houses were made of materials from the land, including banana stalks and lava rocks set together with pebbles or sand. They grew sweet potatoes and taro[12] wherever there was topsoil and water. They utilized a cyclical process with nature where nothing was wasted. There were no metals, synthetic chemicals, toxic fumes, and product packaging. Everything was biodegradable and returned to the land to be used as food for the next cycle (Kane, 1997).

[12] Taro is the most common Hawaiian staple food.

The newly arrived westerners brought their beliefs about civilization and religion to Hawaii and quickly began to influence the native cultures. They convinced King Kamehameha[13] that providing land ownership was the humane thing to do. The missionaries began writing down the Hawaiian language, and literacy among the Native Hawaiians grew quickly (Kane, 1997). They also taught the Hawaiians western practices of trade. While trash was a common word in the English language, it was not a common Hawaiian word until westerners arrived. Westerners introduced the concept of waste, which became referred to as *opala* in Hawaiian. Westerners imported metals and guns, glass, aluminum, and other products that were not biodegradable. Little documentation exists as to when the first landfill was built, though historians assume that waste from these products was reused, buried, or burned, as in most western cultures during that time. The first sanitary landfill was not built until the 1960s, whereas the first sanitary landfill on the mainland U.S. was built in 1934 and in 1912 in Europe.

1.8 Opala in Hawaii Today

Hawaii's natural environment is the primary reason that millions of tourists visit the islands each year. It is often referred to as a "paradise" due to its plentiful waterfalls, tropical rain forests, coral reefs, and volcanic mountains (GBB, 2009). Underneath the "paradise," however, there is an ubiquitous waste problem. It is not uncommon to see illegal dumping of waste on roadsides, in gulches, over cliffs, in sugar cane fields, and washed up on beaches.

Many of the islands' landfills are reaching capacity, and finding additional land space for landfills is problematic. Potential solutions have failed due to poor

[13] King Kamehameha was one of the great kings of Hawaii who conquered the Hawaiian Islands and formerly established the Kingdom in 1810.

implementation. Recently, efforts were made to ship waste from Hawaii to Washington State in an attempt to preserve landfill space. The plan called for shipping twenty thousand tons of waste wrapped in plastic bales across the Pacific Ocean and 85 miles up the Columbia River Gorge National Scenic Area, where they would then be transported across land to a landfill in Klickitat County, Washington. As the county waited for permits, the plastic bales sat at a shipping dock for over a year, where they were reportedly torn and ripped (Lind, 2009) and even caught on fire (Hawaii News Now, 2010). The Confederated Tribes and Bands of the Yakama Nation, Friends of the Columbia Gorge, Columbia Riverkeeper, Northwest Environmental Defense Center, Dawn Stover, and Daniel Lichtenwald filed a lawsuit against the Department of Agriculture for allowing the transport of Hawaii's municipal solid waste within the land of the Yakama Nation (Broadman, 2010). Hawaii ultimately lost the lawsuit, and the garbage was eventually transferred to a local WTE facility. The lawsuit resulted in extensive negative publicity to the rest of the world about Hawaii's waste issues. Even so, transporting waste across the ocean continues to be a part of policy discussions in Hawaii as landfills continue to reach capacity and alternative solutions are available or require significant capital to implement.

CHAPTER 2: SOLID WASTE MANAGEMENT LITERATURE

2.1 Waste Management Decision-Making Models

Most solid waste management research focuses on various quantitative models that can be used as waste management decision support systems. The models fall under three types: multi-criteria decision making (MCDA), life cycle assessment (LCA), and cost-benefit analysis (CBA) (Morrissey & Browne, 2004). MCDA models are the most predominantly used. These models use a multi-criteria approach that provides more robust decision making than optimizing single dimensional functions. They allow decision makers to learn several points of view about various waste management scenarios (ibid). Numerous techniques of MCDA have been utilized, such as EASEWASTE (Kirkeby et al., 2006), complex knowledge management (Soderberg & Kain, 2006), ORWARE (Assefa et al., 2004), Electre (Roussat et al., 2009), material input-output models (Ngoc & Schnitzer, 2009), reference point method (Minciardi., 2008), consensus analysis models (CAM) (Hung et al., 2007), material flow analysis (Brown et al., 2005), and analytic network process (Khan &Faisal, 2008).

LCAs are also regularly utilized models that use a systems analysis approach to assess the inputs and outputs of waste and quantify the environmental impacts of waste over its complete life cycle. These models provide a visual tool for analyzing resource limits and emission constraints (Leach et al., 1997) and are typically used for evaluating different waste management alternatives for municipalities (Bovea & Powell, 2006). LCAs are limited in that they typically only address environmental impacts and cannot adequately address sustainability since they do not include financial or social impacts (Morrissey & Browne, 2004).

The third most frequently used waste management model is the CBA and other economic approaches. The CBA allows the researcher to assess positive and negative effects of different scenarios by translating the impacts into monetary measurements (Morrissey & Browne, 2004). Since the environmental impacts of waste do not typically have monetary values, these values are estimated using economic willingness-to-pay approaches, such as contingent valuation (Jin, Wang, and Ran, 2006; Begum et al., 2007; Basili, Matteo, and Ferrini, 2006) and hedonics (Eshet et al., 2007). For instance, Basili, Matteo, and Ferrini (2006) conducted a CBA that evaluated the costs and benefits of shutting down six landfills and increasing incineration in Italy. They used a contingent valuation method (CVM) to determine the net benefit. The authors concluded that the study provided a value that reflected the private costs of waste management, as well as the overall social benefit. CVM was also used to determine how much construction contractors were willing to pay to improve construction waste management in Malaysia. A scenario of waste management benefits was provided to respondents to elicit a willingness-to-pay dollar value. The study suggested that governments should intervene in the waste management sector by increasing landfill charges to construction contractors or providing incentives for recycling (Begum et al., 2007).

Hedonics, another economic approach, has been used to value environmental disamenities of waste, such as noise, odor, and litter related to property values near waste transfer stations. For example, it was used to assess housing preferences with regard to waste facility locations. As the distance of the house to the waste station increased by 1%, the average price of the house rose by .06%. People were willing to pay more to live further away from waste stations (Eshet et al. 2007). Other economic studies have

provided overviews of the costs associated with waste. Results indicate that more local and regional studies need to be conducted to estimate the external costs of MSW to form optimal policy within each region, and policy should differ by region (Kinnaman, T. C., 2009).

The decision making studies discussed above were all quantitative studies typically conducted by engineering disciplines. The multi-criteria and LCA models assess environmental impacts of various waste approaches, but they do not address financial values or include indicators that represent social issues (Morrissey, 2005). CBAs result in an environmental value that can assist with decision-making, but they also do not typically account for social values.

2.2 Policy

Public policy literature associated with waste management delves deeper into addressing social values. It primarily focuses on risk analysis (Petts, 2000; Petts, 2004), environmental justice (Kijak & Moy, 2004; Boer et al, 1997; Daniels and Friedman, 1999; Fabor and Krieg, 2002; Hockman and Morris, 1998; Pollock and Vittas, 1995; Ringquist, 1997), and public participation (Goven & Langer, 2009; Johnson & Wilson, 2000). Risk analysis studies have examined how public participation influences risk decisions related to waste management (Petts 2004), and how societies can develop decision tools that adequately address the risks connected to waste (Petts, 2000).

The environmental justice (EJ) literature represents the majority of waste policy research. EJ is defined as "the fair treatment of people of all races, cultures and income with respect to the development, implementation and enforcement of environmental laws, regulations, and programs and policies" (EPA, 2011c). Environmental degradation can

occur if people do not have equal access to environmental services and resources (Bahia, 1996). EJ studies are usually quantitative studies that identify racial or ethnic disparities with a focus on potential inequities associated with waste disposal siting. Factors such as odor, noise, traffic, and property value associated with waste disposal facilities are issues that have been found to disproportionately affect different populations (Kijak & Moy, 2004; Boer et al, 1997; Daniels and Friedman, 1999; Fabor and Krieg, 2002; Hockman and Morris, 1998; Pollock and Vittas, 1995; Ringquist, 1997). While EJ studies address the social issues with inequity, they do not typically address issues related to sustainability.

Public engagement is another area of policy research that has become a key component of waste management and is necessary for public acceptance of new waste disposal facilities (Goven & Langer, 2009). Learning plays a central role in public participation studies. Participation can lead to inter-organizational and inter-associational learning and can provide the foundation for new norms related to waste disposal and awareness (Johnson & Wilson, 2000). Public campaigns that raise awareness about waste disposal were found to change the perceptions of citizens by making them more aware of current waste issues (Bortoleto & Hanaki, 2007). Strengthening the relationships among government, waste processors, waste generators, non-governmental organizations, and financing institutions that are involved in the social, economic, and environmental aspects of waste is a key component of long-term sustainable waste management (Yousif & Scott, 2007; Joseph, 2006). The key actors that are recommended for waste management stakeholder groups are listed below in Table 3.

Table 3. Key Actors and Their Roles for Environmental Protection

Actor	Role/concern
Environmental regulators	Setting environmental regulations and standards, monitoring and enforcement
Planning agency	Integration of environment in developmental planning
Politicians	Policy guidance with long term view in allocating resources
Sector agencies	Cross-sector coordination and incorporation of environmental considerations in projects
Public	Participation in decision-making, implementation and monitoring
NGOs	Mobilizing community participation, voicing local concern
Private sector	Searching and implementing appropriate actions
Media	Environmental awareness, focus on real local priorities rather than sensationalization
Scientific community	Focus on needs of vulnerable population and communication to wider audience including policy makers, planners and managers
Financial institutions	Supporting environmentally sound developments

Source: Joseph, K. (2006). Stakeholder participation for sustainable waste management. Habitat International 30(4): 863-871.

The policy literature on solid waste management is limited and far less extensive than the literature on waste decision-making. Its primary foundation is in EJ. In addition, while the policy studies often used multi-method approaches to examine many of the environmental and social issues associated with waste disposal, most studies do not focus on sustainability.

2.3 Public Health

Public health issues, such as underground water leachate and harmful landfill emissions, are important waste management issues to address, but with the exception of

EJ studies, few articles are dedicated to these problems. A review of different waste management practices revealed that there is a lack of awareness of public health concerns that each practice entails. Current waste practices, most importantly landfills and mixed waste streams (i.e., pathogen streams mixed with pathogen-free streams), are unsuitable from a safety point of view. Untreated waste streams can potentially cause infectious diseases and no current treatment process can completely eliminate contaminants and the subsequent risks to human health (Hamer, 2003). Since chemical interactions that result from waste management practices are complex, it is difficult to measure the direct toxicological effects of waste on public health. Health impact assessments and involving community members to assess the potential impacts of waste management and develop possible mitigation measures is recommended (Dinis, 2009). Minimizing the toxic impacts of waste management is critical to long-term sustainability. Oftentimes public health officials are not involved in the decision-making process, and health effects associated with waste are not fully considered (Mohan et al., 2006).

2.4 Social Context

Several case studies analyze waste management issues from a more normative perspective. Suggested policy strategies have more emphasis on "upstream" methods, meaning more focus on inputs rather than the outputs of the waste stream. For example, policies that encourage consumers to purchase less packaged goods, repair goods rather than replacing them, use reusable bags, recharge their old batteries, and avoid canned and bottled foods (Jayaraman et al., 2005) might represent more upstream approaches. Adopting more composting approaches, buying recycled goods, choosing goods that use cleaner production systems, and setting up resource recovery systems contribute to a

more sustainable society that benefits from greater community involvement and an ethical base for taking care of the environment (Knowles, 2005).

Other studies that have taken contextual approaches to waste management emphasize community involvement and more participatory approaches that acknowledge the views of key stakeholders (Wallis et al., 2010). For instance, one study explored the perspectives of waste managers and how they feel about various waste management approaches (McDougal et al., 2001). Education was also found to be another important method for moving toward a more sustainable system that acknowledges social values (Martens, 2005).

2.5 Islands

Waste management research specific to islands is limited. Research on Singapore is at the forefront due to its success in managing waste. Waste minimization and industrial waste management are the biggest challenges Singapore faces due to its small island-city state, large population, warm climate, and scarce availability of land for landfills (Bai & Sutanto, 2002). Singapore's government developed an innovative model of waste management that has been an example to other islands and countries with limited land space (Lang, 2005).

Other island studies focused on issues with site selection (Ramjeawon, 2008), tourism (Lee, 1997), and waste treatment (Gunawardana et al., 2009). Research on waste issues related to tourism primarily center on environmental degradation, and how the effects of waste can be more profound due to an island's small size and fragile resources. As transportation options have increased, tourism on islands has grown rapidly, often leading to hasty infrastructure development that has resulted in environmental

degradation. Tourists are willing to pay for greater sustainability, but there are many differences of opinion on who should be responsible for waste issues (Dodds et al., 2010). The responsibility usually falls on local government, which requires additional planning and resources that are often not available.

Several studies have explored the policy implications and decision-making strategies of waste on islands, such as Taiwan's policies for waste minimization (Lu et al., 2006), strategies for waste solutions in the Orkney Islands (Chambers et al., 1995), and waste policy issues in Sri Lanka through dialogues with local politicians and government officials (Vidanaarachchi et al., 2006). These case studies discussed the urgency of finding more sustainable approaches to managing waste on islands. Reducing, recycling, and Extended Producer Responsibilities (EPRs)[14] were key factors in achieving a more sustainable system (Lu et al., 2006). Composting (Vidanaarachchi et al., 2006) and anaerobic digestion systems[15] for sewage sludge were also key factors (Chambers et al., 2008). One study in Hawaii examined the benefits of landfill caps (Ray, 2005), but it did not address social issues or how they affected sustainability. Waste incentives were found to be especially important for island communities. Waste prices must include external costs, and waste reduction policies have more influence on welfare on islands than on mainland territories (Hernandez et al., 2005). Waste was also recommended as a key indicator for measuring overall sustainability on islands since it helps to assess the impact of tourist and the resulting increase of disposed materials (Georges, 2006).

[14] Extended Producer Responsibility (EPR) is similar to the "polluter pays" principle. It requires manufacturers to be responsible for products for their entire lifecycle. The goal is to shift the economic and environmental burden from taxpayers and government to producers (Waste to Wealth, 2011).
[15] Anerobic digestion systems break down biodegradable materials in the absence of oxygen. It can be used for managing green waste and sewage sludge and it also produces renewable energy.

2.6 Local and Regional

Localized case studies on solid waste management issues related to sustainability were mostly conducted in developing countries (Chung & Lo, 2007; Allison, 2008; Marshke & Sinclair, 2009; Goven & Langer, 2009; Klang et al., 2006; Smith, 2008; Hernandez & Martin-Cejas, 2005). Future waste generation rates were determined and suggested for small communities (Saeed et al., 2009). Barriers to proper waste management and long-term sustainability that were identified in developing countries included distance to waste disposal facilities and lack of infrastructure (Parrot et al., 2009), non-involvement of stakeholders in the planning and decision-making process, lack of long-term waste strategies, unskilled staff, low coordination between authorities and local workers (Pasang et al., 2007), and low level of concern about sustainability (Chung & Lo, 2007). In addition, local levels appear to have less influence on managing and implementing policies (Zotos et al., 2009; Forsyth, 2006). Waste collection, local recycling markets, having a municipal solid waste management plan, and collaboration among stakeholders are all factors that lead to successful sustainable waste management in developing countries. Inadequate government policy, low levels of waste collection, education, economics, recyclable markets, and land availability were all identified as potential barriers to recycling (Troschinetz & Mihelcic, 2009).

2.7 Sustainable Waste Management

More studies have begun focusing on sustainability as a central component of scholarly research. Basic searches on the *Web of Science* for the term "sustainability" resulted in over twenty thousand articles in 2010. When the key word "waste" was added to the search, over two thousand articles resulted. Most waste research articles use the

definition provided by the UN (see Section 1.4), provide their own unique definition of it, or avoid defining it at all. Furthermore, how they choose to measure sustainability varies significantly across disciplines.

Some researchers argue that sustainability can only be measured by calculable metrics (Dewulf & Langenhove). These studies typically use some sort of scale to reduce sustainability to one value, such as a willingness-to-pay (WTP). Others develop indicators based on the Triple Bottom Line (TBL)—economics, environment, and social[16]—to measure sustainability (Sergio, 1996; Kijak & Moy, 2004). For example, Kijak & Moyhe (2004) recommend multiple tools for using the TBL approach in waste management; they suggest using a life-cycle assessment (LCA) that is expanded to include economic (full cost accounting models) and social issues (through questionnaires) to determine calculable values of sustainability. However, because of the difficulty in measuring all of the components of the TBL, some researchers only focus on one part of it. For example, Dewulf & Van Langhove (2005) note that metrics "should" cover the TBL, but they only measure the environmental component. They develop metrics on a scale of 0-3 to measure the renewability of resources, toxicity of emissions, input of used materials, recoverability of products at the end of their use, and process efficiency. Likewise, many studies never provide clear definitions of sustainability—they only discuss sustainability as the ultimate goal and develop indicators for measuring it.

Other studies are more contextual in nature and focus more on the social values of sustainable waste management. Goven & Langer (2009) define sustainable waste management as "sustaining the potential of natural and physical resources to meet the

[16] The Triple Bottom Line asserts that the environment (planet), social issues (people), and economics (profit) must be addressed together in order to achieve sustainability.

reasonably foreseeable needs of future generations; safe-guarding the life-supporting capacity of water, soil and ecosystems; and avoiding, remedying or mitigating any adverse effects of activities on the environment." The authors use a public participation process of scenario-based workshops to determine what sustainability means to the community. The participants learned about the various waste management issues, while acknowledging the role of social, cultural, and political values, and then they made recommendations to the Council. Similarly, Johnson & Wilson (2000) used social processes to address sustainability in Zimbabwe. They built a framework and used qualitative data collection methods for testing the shared meanings of sustainability, the individual and collection assumptions about it, the accountability, and the investigation of intervention processes for outputs and outcomes over time.

Overall, sustainable waste management research can be summarized into two categories: a-contextual and contextual. Most studies use a-contextual approaches to determine concrete values for sustainability. These studies are typically grounded in econometrics or other engineering-based models that generate a calculable result for measuring sustainability. Contextual approaches, in contrast, focus on assessing sustainability values that may not be adequately reduced to a price. These types of studies are not as abundant as the former, but they are gradually emerging in the waste management literature.

2.8 Summary of Literature, Gaps, and Future Directions

Research conducted on solid waste management primarily falls under waste analyses and processes. Most studies focus on various forms of waste management decision-making models and are generally conducted by engineers and found in

traditional waste management journals. The rest of the waste management literature is a combination of research that has a more participatory approach, mostly in developing countries, and falls under a variety of disciplines, including anthropology, public policy, and public health. The local and regional studies are the most closely aligned to this dissertation.

The research to date presents significant gaps in knowledge generation for solid waste management issues on remote islands. While many studies focus on policy analysis (e.g., CBA, decision-making models), few have examined the policy processes involved in waste management decision-making, and even fewer have examined solid waste management on islands, especially in the context of sustainability. More local and regional studies need to be conducted to form optimal policy (Kinnaman, 2009). Several case studies examine barriers to waste sustainability and proper management in developing countries, but not as these barriers pertain to islands or remote islands in the Pacific. This research addresses those gaps by analyzing solid waste management policy processes on remote islands and exploring the contradictions among economic, environmental, and social factors that islands face when attempting to adopt more sustainable waste management approaches.

CHAPTER 3: SUSTAINABILITY AND WASTE MANAGEMENT

3.1 What is Sustainability?

The most common definition of sustainability, developed at the United Nations Conference on the Human Environment in Stockholm, is "meeting the needs of the present without compromising the needs of future generations to meet their needs" (United Nations, 1987). While this definition is the most frequently cited, it is not universal; new definitions of sustainability are continually emerging. As with the UN definition, the definitions created by these parties are often vague and do not provide criteria or a framework for measuring sustainability over time.

According to Norton (2005), the core meaning of sustainability "is forward looking living….sustainability is about the future, our concern toward it and our acceptance of responsibility for our actions that affect future people" (p. 304). The overall concern among all parties is about obligations to future generations. As discussed in the literature review, how obligations are measured is essentially the central topic of debate. Conflicts exist among disciplines about how sustainability should be defined and what criteria should be used to measure it.

3.2 Weak versus Strong Sustainability

In an effort to align the various perspectives of sustainability and create greater understanding among disciplines, Norton developed a framework for explaining it across a weak-to-strong spectrum. Table 4 provides a summary of the weak-to-strong spectrum. The thick divide down the middle of the table separates Weak Sustainability (WS) and Strong Economic Sustainability (SES) from Strong Sustainability (SS) and Normative

Sustainability (NS). The left-hand side of the table represents weak forms of sustainability (WS and SES), and the right-hand side represents strong forms of sustainability (SS and NS).

Table 4: Sustainability Spectrum

	Weak Sustainability	Strong Economic Sustainability	Strong Sustainability	Normative Sustainability
Home Discipline	Mainstream Economics	Ecological Economics	Systems ecology	Policy science/ Environmental ethics
Paradigm	Welfare economics	Welfare econ + natural captital	Complex dynamic systems theory/AM	Complex dynamic systems theory/AM
Definition	Maintenance of undifferentiated capital	Weak sustainability + maintenance of natural capital	Weak sustainability + maintenance of resilience	Weak sustainability + maintenance of options
Key Concepts	Nondeclining wealth	Maintaining natural capital	Maintaining resilient ecosystems	Integrity of place
Key Advocates	Solow	Pearce & Barbier	Holling, Lee	Leopold, Norton

Weak Sustainability – Welfare Counters ⟷ **Strong Sustainability – "Stuff" Counters**

Source: Norton, B. (2005). Sustainability: A Philosophy of Adaptive Ecosystem Management. Chicago: University of Chicago Press.

WS is based on the welfare economics paradigm. It represents the maintenance of undifferentiated capital wealth and characterizes a neo-classical economic perspective that "total capital available must be non-declining from generation to generation" (Norton, 2005, p. 307). A key advocate of WS is Robert Solow, an economist specialized in growth theory, who claims that sustainability "is an obligation to conduct ourselves so that we leave to the future the option or the capacity to be as well off as we are" (Solow,

1992). WS theorists believe that there are no limits on substitution.[17] For instance, monetary capital, technology, and natural resources are interchangeable. WS achieves a "Grand Simplification," which states, "since we do not know what people in the future will need, and since resources are substitutable for each other—the only thing we can do is to measure and compare welfare over time" (Norton, 2005, p. 316). This means that environmental values are "commodities" that can be measured by a price or reduced to economic terms, such as a "willingness to pay" (WTP) value. The core meaning of WS is that societal wealth must be maintained across generations to achieve sustainability, and that sustainability can be operationalized into a single, countable measure that tracks aggregated social welfare.

SES includes both welfare economics *and* natural capital designations. Natural capital refers to "natural elements and processes that must be saved because their loss will measurably impact social welfare in the future" (Norton, 2005, p. 311). It might include other "stuff"[18] that is not included in human capital, such as cultural values, adequate wilderness areas for hiking, or protection of endangered species. However, even if natural capital includes other "stuff," SES still falls under a weak sustainability designation because it only counts the "stuff" that has an impact on welfare—there is no inherent difference in the way that natural capital and other types of capital are measured.

Strong Sustainability (SS) theorists, in contrast to WS and SES theorists, believe that while welfare is important, physically characterized and measured "stuff" that cannot be reduced to a price or measured as a contribution to human welfare is also important.

[17] Substitution refers to substituting various types of resources.
[18] "Stuff" refers to things that are valued but cannot be measured in terms of welfare (Norton, 2005). For example, stuff might include a cultural connection to the land, green space for human recreation, adequate wilderness for wildlife, or oceans without pollution.

Things should also be described in physical terms. SS is more aligned with ecology and focuses on moral commitments, resilience, and integrity of place. It is based on the paradigm of systems theory and adaptive management. It specifies limits on substitution and the replacement of natural resources with human-made resources. SS also requires the maintenance of ecological resilience, which represents the amount of disturbances that can occur before a "system centered on one locally stable equilibrium flips to another" (Arrow et al., 1995).

Normative Sustainability (NS) also specifies that "stuff" is important, but communal values[19] and moral commitments by the community are central to the discussion and must be considered in order to know what to preserve for future generations. Certain "stuff" must be saved because it has a social value that may or may not be associated with individual welfare.

The key distinction between weak sustainability (including both WS and SES) and strong sustainability (including both SS and NS) is between measurement in terms of welfare and "stuff," and how they are evaluated over time. Maintaining overall societal welfare is justified by weak sustainability, and maintaining other "stuff," in addition to welfare, is justified by strong sustainability. For example, an economist might say that reducing human welfare to a price is an adequate measure of sustainability, while an ecologist might say other "stuff," such as resilience (see below) that cannot be reduced to a dollar value should be a part of the measurement.

The key second dividing issue between WS and SS is substitutability. WS requires unlimited substitution and a belief that it is okay to substitute human capital for

[19] Communal values are things that are important to individuals but cannot be reduced to aggregated preferences measured by economic rationality.

natural capital (Solow, 1992), whereas SS require limits on substitution. For instance, WS theorists might believe that it is okay to substitute open land space for a landfill on a remote island because it is the most cost effective approach at the time. SS theorists might believe that other "stuff," such as the Hawaiian cultural values connected to the land, should also be considered.

Another distinction between WS and SS is time and scale. Solow (1992), a weak sustainability theorist, asserts that since we do not know what people in the future will prefer, the best option is to maintain non-declining capital. However, some strong sustainability theorists claim that it is important to maintain ecosystems indefinitely. Scale is more important for SS than WS for addressing intergenerational issues, risk and uncertainty. In the past, scientists typically assumed that the best approach to understanding phenomena was through reductionism, which assumes that larger scales are best understood by reducing the phenomenon to smaller scales. Since no specific, correct scales are found in nature, researchers must choose scales appropriate to understand values and human purposes. SS theorists believe that nature should be modeled as multi-scaled, and a more holistic approach must be used to capture the whole system (Norton, 2005). In contract, WS theorists disregard the "size" of the economy with regard to the rest of the ecological system. Calculations are reduced to one scale, rather than multiple scales, that can be measured in terms of individual welfare.

Leopold's (1949) famous essay, *Thinking Like a Mountain*, provides an excellent example of spatiotemporal issues. In his essay, Leopold eloquently describes his experiences working to increase deer population by hunting wolves. It was commonly believed that if all of the wolves were killed, there would be more deer for hunting. In

Leopold's essay, he writes about his experience killing a wolf. While looking into the wolf's eyes as it was dying, he came to the realization that fewer wolves did not necessarily lead to a "hunter's paradise." Instead, when the wolves were killed, the deer proliferated. Even though there were more deer for hunting, the greater number of hungry deer ate all of the vegetation, leaving the mountain a wasteland. The message in Leopold's essay is on the importance of valuing the entire system in nature, rather than just the parts. His essay shows how multi-scalar relationships are significantly affected by human decisions, which is an important component of strong sustainability. Table 4 defines the spatiotemporal relationships described by Norton.

Table 4: **Spatiotemporal Characteristics**

Temporal Horizon of Concern	Time Scales	Temporal Dynamics in Nature
Individual and economic	0-5 years	Human economies
Community intergenerational bequests	Up to 200 years	Ecological dynamics and interaction of species in communities
Species survival and our genetic successors	Indefinite time	Global physical systems

Source: Norton (2005).

Finally, resilience is an important difference between WS and SS. It is emphasized by ecologists, but difficult for economists to comprehend in their models. Resilience is the magnitude of "disturbance that can be sustained before a change in system control or structure occurs" (Holling & Gunderson, 2002). When ecosystems change equilibriums, they reduce the capacity to support human life (and other life forms), and potentially create irreversible changes that may increase environmental

uncertainties (Arrow et al., 1995). Issues with resilience that lead to irreversibilities could also lead to irreversible economic costs (Norton, 1997). The variables disturbed at one scale might affect the variables of another scale. If there is not time for full recovery before more disturbances, the resiliency of the ecosystem decreases.

3.3 Waste Management: Weak or Strong?

Important decisions in solid waste management include the siting, design, and management of both hazardous and non-hazardous waste facilities, and developing practices that do not pose a risk to human health, such as leaking landfills and toxic emissions (Tammemagi, 1999). Millions of tons of waste are generated and disposed of every day, and there are differences of opinion on how it should be managed and what resources should be protected during the process. Futurity issues related to solid waste management might include conserving and protecting land space for future generations, protecting underground water resources, and reducing emissions that contribute to climate change (Bahia, 1996).

The weak-to-strong sustainability spectrum can be combined with a closed vs. open-loop "cycle" approach to classify waste approaches. Closed-loop systems emphasize waste prevention by utilizing all waste as process inputs rather than outputs. It reduces waste at the source so that it never enters the waste stream (Ngoc & Schnitzer, 2009). For example, landfills provide an excellent example of an "open-loop," linear waste management processes (see Figure 2). If the standards of strong sustainability are applied to landfills, they do not pass the test because they assume unlimited substitutability and are a reductionist approach to the overall waste problem. Composting, in contrast, is a good example of a "closed-loop" cycle or "cradle-to-cradle"

approach (see Figure 3). It meets the standards of strong sustainability, as it places limits on substitution and takes into account multiple scales within the ecological system. It is a natural cycle that is driven by the sun. The sun provides energy for the system, and the energy creates a photosynthesis process. Microbes in the soil process the organic matter that becomes food in the next cycle (McDonough & Braungart, 2002).

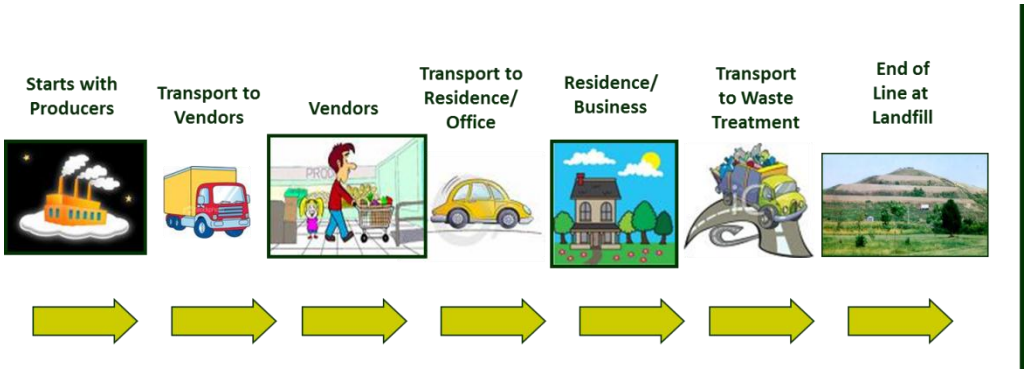


Figure 2: "Open Loop" Linear Solid Waste Management Cycle

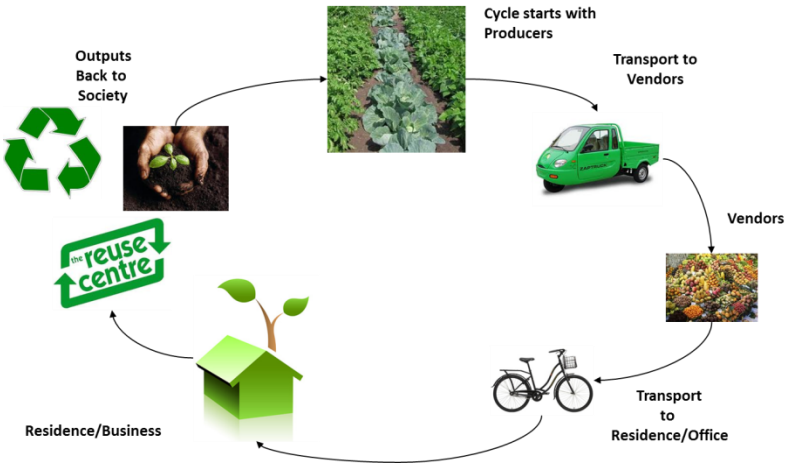


Figure 3: "Closed Loop" Solid Waste Management Cycle

Table 5 lists the sustainability spectrum components with the corresponding symbols that are used to define the sustainable waste management options. Waste management approaches are symbolized using rotating "cycles" that represent weak-to-strong sustainability. They characterize how much a particular approach "closes the cycle."

Table 5: Sustainability Spectrum Applied to Waste Cycles

Type	Symbol
Weak Sustainability	
Strong Economic Sustainability	
Strong Sustainability	
Normative Sustainability	

The three most common waste management approaches—landfilling, recycling, and composting—can be aligned with Table 5. For example, landfills, at best, could be justified under the standards of weak sustainability. They are the predominant choice for managing waste in the U.S.; however, as the community adds waste to the landfill, they also "subtract"[20] from their available land space for other uses. Open land space that might have been used for recreation, agriculture, or other human uses is "substituted" or "subtracted" from the land. On remote islands, landfills are especially problematic

[20] Similar to substitution, subtractability "refers to the extent to which one individual's use subtracts from the availability of a good or service for consumption by others" (Ostrom, p. 23, 2005). Within waste management, subtractability is the constraint of lack of space for waste disposal; it is the extent to which one individual's use "subtracts" from the availability of clean and pristine land space.

because they do not allow for infinite substitution since land and water resources are more limited. Land is not an adequate human-made substitute. "Substituting" landfills for land space may save money in the short-term, but long-term sustainability for waste management on small islands requires the total elimination of landfills.

In addition to the severe limits on substitution, landfills have short lifetimes. They are typically only in operation for 5-30 years.[21] After landfills close, they must be continually monitored for emissions, and they continue to take up land space forever. They also do not address larger ecological issues of waste that affect the island and potentially cause significant problems for the community over time. As the population has increased, so has the amount of waste and the number of landfills. Landfills have led to greater environmental and public health problems, such as greenhouse gas emissions and underground water contamination, and many acres of land are contaminated and unusable to humans and other life forms because of them.

Recycling, on the other hand, can be justified under strong economic sustainability and a partially open system. While it has a longer time-frame than landfilling, it requires the substitution of human-made capital for naturally occurring resources. Recycled products that were originally extracted from the ecosystem are broken down into smaller materials and then added to new products. Recycling is often referred to as "downcycling" since the quality of the material is reduced over time (McDonough & Braungart, 2002). It can also generate tons of additional waste during the process, which is not cost-effective in the long-term. In developed countries that have organized methods for collecting and processing recyclables, it is more cost-effective, but

[21] Landfill-Gas-to-Energy (LFGTE) offers an option for utilizing the methane emitted from the landfill after the landfill is closed. The methane can generate energy during the life of the landfill and for about 30 years post-closure.

in less developed countries that do not have organized processing facilities, it is not as sustainable (Skekdar, 2009). For remote islands, processing recyclables is a very energy intensive process. The energy used to recycle is dramatically higher since all recyclable products are shipped to other, distant locations for processing. So while recycling represents a stronger sustainability stance than landfilling, there are problematic issues inherent in the process that prevents it from being a closed-loop system, especially on remote islands.

Composting, in contrast to recycling and landfilling, is justified under the standards of strong sustainability and represents a closed-loop system for waste management. It does not require any substitution and has an indefinite timeframe. Organic waste is broken down during the composting process, and the finished product becomes food for the soil. The process ultimately closes the loop by replenishing the soil and providing food for humans and other life forms. Waste that can be composted represents 26% of the U.S. waste stream (EPA, 2011f). While composting is not a complete replacement for landfills, it provides an environmentally safe approach for significantly reducing the amount of waste going to landfills.

Overall, the three most commonly used waste management practices in the U.S. range from weak to strong in terms of sustainability and represent open and closed-looped systems. The waste options that a community decides to implement is based on multiple components that vary depending on the decision-making entity. An awareness of how these decisions are made is central to understanding the factors that affect long-term sustainability on remote islands. These concepts are a part of the research design of this study to analyze waste management sustainability.

CHAPTER 4: CONCEPTUAL FRAMEWORK AND RESEARCH DESIGN

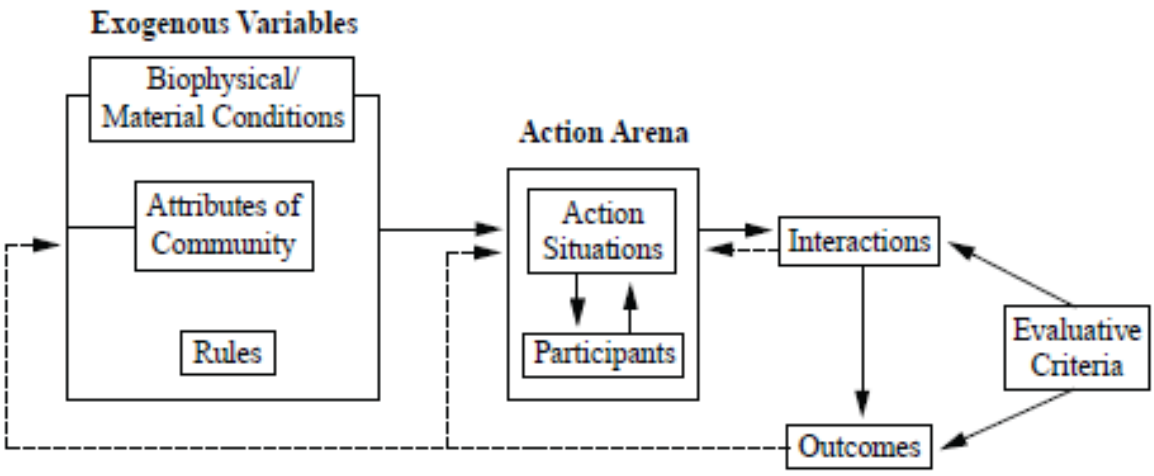
4.1 Overview of IAD

The Institutional Analysis and Development (IAD) provided the conceptual framework for examining solid waste management policy on remote islands. There are two central aspects of the IAD framework: 1) the three decision-making tiers that include constitutional, collective choice, and operational decisions; and 2) the elements used for analyzing the outcomes of the three decision-making tiers. Institutions in the IAD framework occur at different tiers (see Appendix B) and are defined as "the shared concepts used by humans in repetitive situations organized by rules, norms, and strategies" (Ostrom, 2006, p. 23).

The rules are the "shared understandings among those involved that refer to enforced prescriptions about what actions are required, prohibited, or permitted" (Ostrom, 1999, p.50). Norms are shared prescriptions enforced by participants through imposed costs, and strategies are the plans individuals make using incentives that are produced by the rules, norms, and expectations of behavior in situations affected by physical and materials conditions (Ostrom, 2007).

The IAD framework identifies an action arena, exogenous variables, interactions, outcomes, and evaluating criteria. Within the action arena are the action situation and actors. The components of the action situation include participants, positions, and potential outcomes. The attributes of the actors include the number of participants, status, and individual attributes, such as age, education, gender, experience, and stakeholder group (Ostrom, 2005). The exogenous variables include biophysical

attributes, community attributes, and rules. Figure 4 provides an illustration of the IAD framework.



Source: Ostrom (2007)

Figure 4: IAD Framework

Humans make decisions through different layers of internal processing. Many parts of the system make up the whole. The nested subassemblies are referred to as holons. As the holons are dissected, explanations of the phenomenon occur at different spatial and temporal scales and at multiple levels (Ostrom, 2005). Holons provide a polycentric approach to analyzing the multiple layers of government. Identifying relationships among multiple levels at various spatial and temporal scales can help understand why some systems fail and why others are more sustainable (Ostrom, 2009).

4.2 Rival Theories

Theories of the policy process are limited in the public policy literature, and few have been utilized for analyzing waste policy. Other theories for studying policy processes were considered for this research, including the Advocacy Coalition

Framework (ACF) and the Economics of Rational Choice (ERC). While the basic argument of the ACF is that policy change is based on fluctuations in a dominant belief system within a policy subsystem, the IAD argues that policy change occurs as a result of institutions (i.e., rules and norms). Both the ACF and IAD use a bottom-up approach; however, the ACF does not address collective action, and there is an absence of operationalized institutional variables for the structuring of coalition behavior (Sabatier & Weible, 2007). Furthermore, the ACF focuses on opposing coalition behavior in policy subsystems, and this study examines only one collaborative subsystem.

ERC, another rival theory, assumes that self-interested actors rationally pursue simple material interest. Most of the models used in waste research are for policy analysis and use a cost-benefit analysis to value environmental amenities or disamenities. The IAD differs from economic rationality in that it is contextual and assumes that people are boundedly rational, meaning that humans intend to be rational but "fail to accomplish goals because of interactions between aspects of their cognitive architectures and the fundamental complexities of the environments they face" (Jones, 2003).[22]

The IAD provides a superior framework for a local case study of waste management policy processes because it analyzes all types of institutional arrangements using a general list of variables, has a bottom-up approach, encompasses multiple levels of analysis, and can have multiple inputs from diverse disciplines (Ostrom, 2005). Furthermore, the IAD framework allows the researcher to analyze a wide variety of institutional arrangements, emphasizing contextual factors, and providing a diversity of criteria for analyzing institutional performance. It also does not contain normative biases

[22] Bounded rationality is one of many contextual approaches that follow rationality. Newer approaches focus on mental models, heuristics, social learning, and experimentalism.

or presume that one type of institutional arrangement is superior to another (Imperial and Yandle, 2005).

4.3 IAD and CPR

The IAD framework has traditionally been used in conjunction with Ostrom's Common Pool Resource (CPR) theory. Common pool resources are natural or man-made resource systems that are large enough to make it costly to exclude people from their use (Ostrom, 1990). For example, a fresh water lake that is regularly used by the local community for fishing and water needs might be a CPR. While waste management disposal sites are not "technically" common pool resources, they are often referred to as "Sinks For Waste" (SFW). SFWs are essentially a limited resource with the same characteristics of CPRs. They can be landfills, oceans, illegal dumping sites, or anywhere that waste is disposed. The more trash that enters a SFW, the less land space and (potentially) healthy water there is for human use.

Common pool resource characteristics include being managed in one location, and having unique physical characteristics, community attributes, and rules-in-use. Waste management in the Hawaiian Islands is primarily managed individually on each island, has unique physical conditions (e.g., isolation, fragile ecosystem), community attributes (e.g., Native Hawaiian culture, tourism), and rules-in-use that are not necessarily identified in written documents. Similar to CPRs, waste management requires rules for managing SFWs. Recent collective decision-making about the future of waste management policy provides a clear action situation that allows for the isolation of the structure to explain human actions and results. In addition, problems associated with waste management could be at any of the institutional tiers.

CPRs are usually based on three different types of institutional designs: 1) bureaucracy-based, 2) market-based, or 3) community-based (Imperial & Yandle, 2005). Solid waste management is usually bureaucracy-based, market-based, or a combination of the two. In Hawaii, the institutional design for waste management in this study is bureaucracy-based. The property rights of the landfills are held by the county on behalf of the public. The government focuses on developing regulations to control waste through rules and enforcement. The rules established by government can lower administrative costs, improve accountability, and improve equity (ibid). They can also increase or decrease efforts to recycle or landfill waste.

4.4 Design Justification

This study utilizes a single case design. This design is used because the research questions are exploratory, and the case is both unique and representative.[23] An exploratory study has no investigator control and is typically a contemporary event (Yin, 2003). It is unique in that it observes one Hawaiian county that recently collaborated with stakeholders on solid waste management policy, and it provides an opportunity to explore solid waste policy outcomes in the context of sustainability. It is representative of other remote islands that are located in the pacific region and may face similar waste management issues due to their remote locations, similar size, and cultural issues. In addition, this study uses a holistic design, which is useful when there are not any logical subunits, and since this case examines the global nature of a collective action situation (ibid).

[23] Yin (2003) provides five rationales for conducting single case studies that include critical, unique, representative, revelatory, and holistic versus embedded cases.

4.5 Study Area

The Pacific Islands are referred to as Oceania and include the sub-regions of Melanesia, Micronesia, and Polynesia. The islands that comprise Hawaii are small in landmass and relative population size, ranging from 230 residents on the island of Niihau to almost 800,000 residents on the island of Oahu. The total population of all of the islands combined is about 1.2 million (U.S. Census, 2011). The site for this research was one county in Hawaii. The resident population is approximately 144,000 (Census, 2011). About 2.5 million tourists visit the county every year. The county demographics primarily include whites, Asians, and Native Hawaiians (GBB, 2009).

The county currently has five active landfills that serve both the resident and tourist populations. There is one central landfill, a construction and demolition landfill, and three small landfills in remote locations. The central landfill was built within the last 20 years, and the small, remote landfills have been in operation since the 1960s. Prior to the establishment of the central landfill, there were four additional landfills scattered around the island; however, they were closed in the early 1990s because they did not meet the new landfill requirements identified in the 1984 Amendments to the Resource and Conservation Act created by the EPA, such as requiring landfills to be adequately lined. While the central landfill is lined, the smaller, remote landfills remain unlined due to the EPA's exemption on landfills receiving small amounts of waste. All of the landfills require tipping fees. The central landfill reached capacity about five years ago. The surrounding space was acquired to accommodate more landfills. However, the second landfill was almost at capacity within five years. It is estimated that the remaining land space has capacity for additional landfills for only another 20-30 years.

Recycling centers are in each major town. They collect cardboard, plastics, aluminum cans, tin cans, newspaper, plastic bags, and used motor oil. Recycling vendors are typically contracted out, and all of the recycling is eventually shipped elsewhere for materials processing and recovery. Waste generation rates in the county fluctuate with changing demographics and economic factors, as well as the value of recyclable materials, the price of disposal services, changes in product packaging, and changes in consumer behavior.

4.6 Unit of Analysis

The unit of analysis for this case study is at the county level. This is the level at which solid waste decisions are made locally. The particular county observed provides an optimal case to study due to its recent modifications to its solid waste management plan. A stakeholder committee was brought together to develop recommendations for waste policy in the county. The appointees were nominated by the county mayor to represent various interests in the county, including the waste and recycling industries, tourists, and public health. Consultants were selected by the environmental management department to lead the process, and professional mediators were hired to facilitate discussions and develop consensus throughout the meetings (GBB, 2009).

4.7 IAD Components

The model for the phenomena is the IAD framework that leads to the outcomes observed. The action arena, action situation, and actors respond to contextual constraints of the exogenous variables. The actors interact within the action arena and respond to the phenomena with process outcomes, which are the policy recommendations provided by the stakeholder committee.

4.7.1 Action Arena, Action Situation, and Actors

The action arena is the county observed in this study (see Figure 5). The action situation is the collaborative stakeholder committee that was formed to assess various solid waste technologies and make recommendations about solid waste management policy. The actors are the stakeholders that participated in the committee. The participants were men and women of varying educational levels that represented a broad spectrum of interests in the county, including government, industry, and scientific communities.

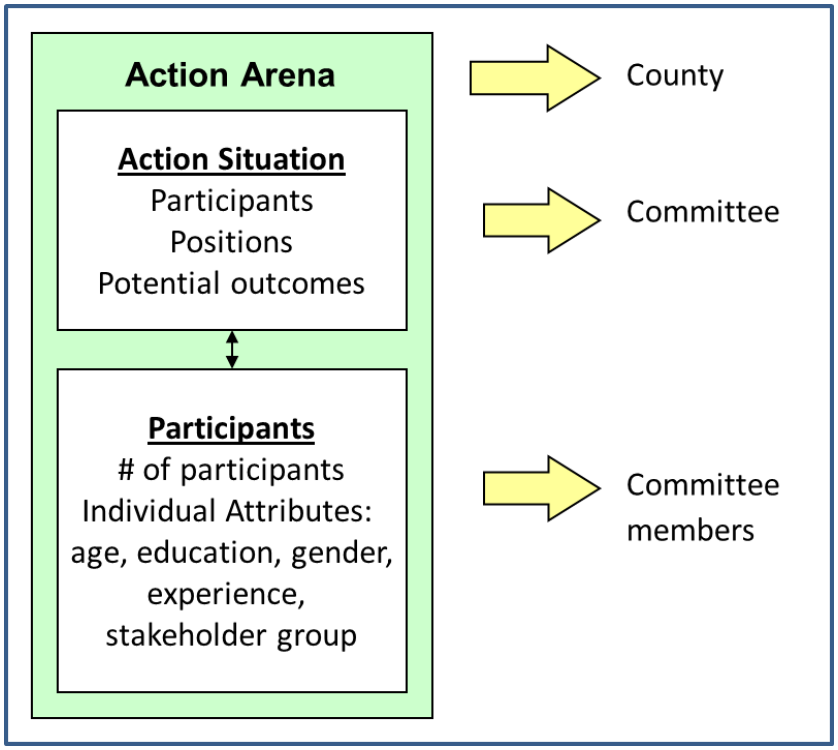


Figure 5: Action Arena

4.7.2 Exogenous Variables (Category Types and Categories)

The exogenous variables in this study are referred to as *Category Types*. Within each category type is a *Category*. The IAD framework identifies four types of categories

that are external to individuals and are expected to have an effect on policy processes and outcomes: 1) attributes of the physical world; 2) attributes of the community; 3) rules that create incentives; and 4) interactions with other individuals (Ostrom, Gardner, & Walker, 1994; Koontz, 2005). Biophysical and material conditions, attributes of the community, and rules affect the structure of the action arena, actors, action situation, the incentives that individuals face, and the resulting outcomes (Ostrom, 1999). The category types and corresponding categories are illustrated in Figure 6 (see Appendix C for a complete figure of the IAD framework applied to the case study).

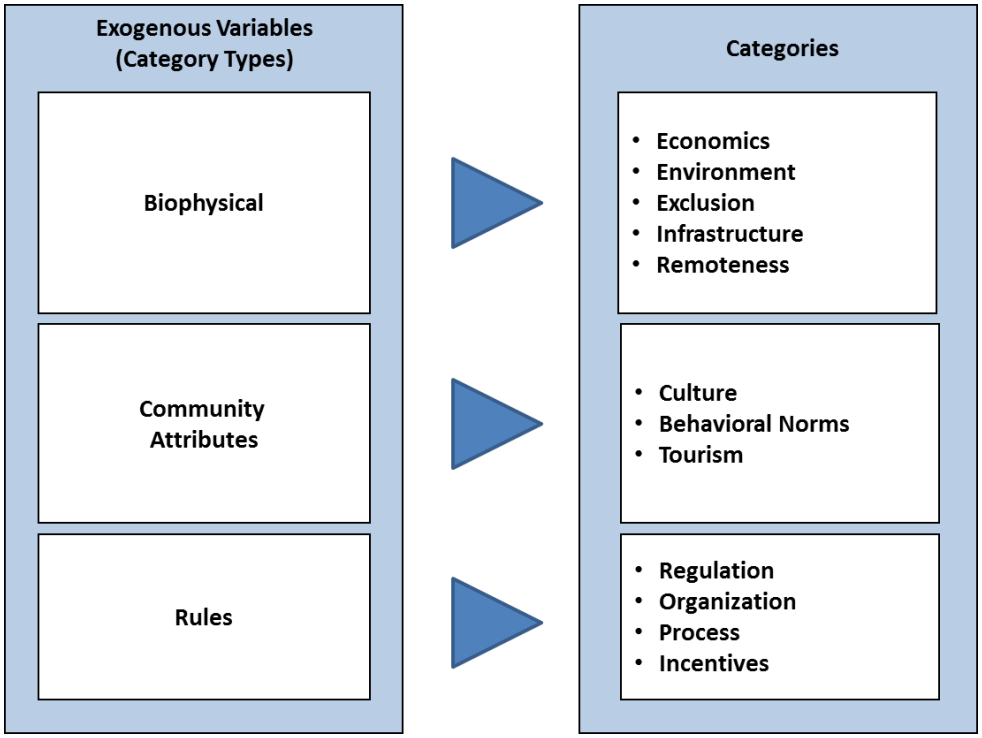


Figure 7: Exogenous Variables

4.7.2.1 Biophysical/Material Conditions

Economics is a key factor in adopting new waste management policies. Economic attributes include economic players (e.g., industry, government, tourism), real

and perceived costs of current and proposed solid waste management options (including, but not limited to, government, industry, public, environment, economy), and economic interests (e.g., tourism, agriculture). Economic, social, and technological developments increase the probability of humans damaging ecosystems (Dietz, Ostrom, Stern, 2003), and income and MSW quantity have a positive and linear relationship (Ngoc & Schnitzer, 2009). It is expected that cost is one of the primary impeding factors to adopting more sustainable waste management approaches.

The ***environment*** includes the land, air, and water quality of the islands. It may also include endangered species, wildlife, and vegetation. Landfills emit toxic substances into the air, decrease natural land space, and can cause underground water contamination, which all greatly affect the environment. A loophole in RCRA is that landfills that serve small populations are not subject to Subtitle D, which requires all landfills to have liners, provide systems for gas ventilation and collecting leachate, and regular monitoring (Jenkins et al., 2009). When RCRA was passed, many argued that creating uniform regulations at the national level prevented states from "racing to the bottom" to attract businesses with lenient disposal laws. "Race to the bottom" implies that if waste is managed locally, rather than nationally, local jurisdictions will sacrifice environmental quality for strategic advantages (Jenkins et al., 2008). Since the primary landfill in the county was expanded and will remain the primary source of waste disposal, it is expected that environmental quality was sacrificed for strategic advantages; however, it is also expected that the environmental values of committee members was a facilitating factor.

Exclusion refers to the percent of residents who are "excluded" from receiving trash collection. There is one central landfill, and many residents live in rural areas of the

island or on unpaved roads, and so they are "excluded" from waste collection services. In addition, low waste collection rates increase the likelihood of illegal dumping (Dangi et al., 2009). To dispose of their waste in the central landfill requires rural residents to drive long distances. Distance to landfills and infrastructure were identified as barriers to sustainable waste management (Parrot et al., 2009). It is expected that exclusion from waste services is an impeding factor to adopting more sustainable waste management approaches.

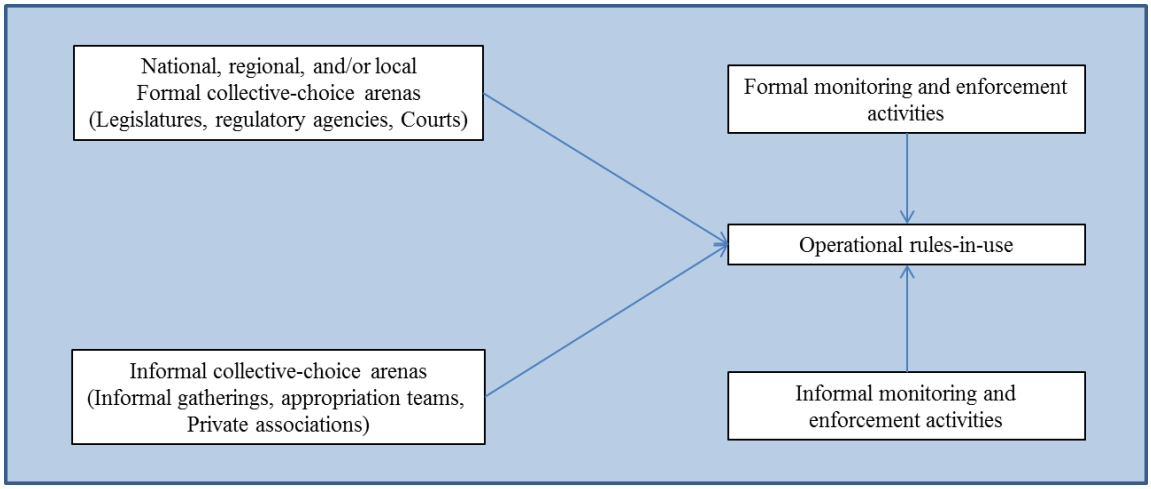
Infrastructure refers to the basic structure needed for waste operations, such as transportation and communication systems. Infrastructure was found to be a barrier to sustainable waste management in developing countries (Parrot et al., 2009). While Hawaii is not considered a developing country, it is behind the rest of the U.S. in many areas of development. The Hawaiian Islands were only adopted as a state less than 60 years ago. Prior to adoption, the islands were much less developed. Even though significant progress has been made, the GDP is lower, and the overall infrastructure is less developed than the rest of the states. Creating better quality infrastructure is expensive and must be integrated into the final costs of new waste management approaches. The county has many rural areas with unpaved roads. Following the results of Parrott et al. (2009), it is expected that infrastructure is an impeding factor for adopting more sustainable waste management approaches.

Remoteness refers to Hawaii being the most isolated land mass in the world. Its remote location can affect waste management because it is not as easy to depend on other states for waste disposal. Today, waste transport is a popular method for diverting landfill waste from one state to another (Ley et al., 2000). Since Hawaii does not have

this same economic benefit and cannot as easily depend on other states for waste disposal options due to its remote location, it is expected that the island's remoteness is a barrier to the adoption of more sustainable waste management approaches.

4.7.2.2 Rules

Rules include rules-in-use and rules-in-form. The rules-in-form are written rules that are meant to regulate behaviors. The rules-in-use are the socialized rules that represent the "dos and don'ts" that are learned in a community but may not be in written form. They may be contrary to the written rules. The rules-in-form include solid waste management rules and enforcement, political organizational design of waste management, and the formal policy making and selection process (Ostrom, 2005). Barriers to sustainability related to these rules may include non-involvement of stakeholders in the planning and decision-making process, lack of long-term waste strategies, unskilled staff, and low coordination between authorities and local workers (Pasang & Moore, 2007). In addition, local levels of management appear to have less influence on managing and implementing policies than non-local levels of management (Zotos & Karagiannidis, 2009; Forsyth, 2006).



Source: Ostrom (2007)

Figure 6: Relationships of Formal and Informal Collective-Choice Arenas

Rules can also be examined through the lens of holons, nested subassemblies (discussed in section 4.1) that assist with understanding phenomenon that occurs at several levels and at different times. Since solid waste management in each of the four Hawaiian counties is overseen by multiple authorities with overlapping jurisdictions, multiple institutional levels contribute to waste policy. It is regulated at the federal (U.S. Environmental Protection Agency) and state (Hawaiian Department of Health) levels, and managed at local levels. Under RCRA, states are required to be "at least as stringent as federal requirements" when managing solid waste disposal facilities (Jenkins et al. 2009, p. 109).

Within the multiple levels of government activities related to waste management, there may be a "blueprint model" for managing solid wastes outlined in federal waste management policies. When information is highly aggregated, it may ignore local information that can potentially identify future problems. Ostrom (2007) refers to single governance models for environmental problems as panaceas or blueprints for a single

governance system, but establishing effective governance has proven to be more difficult on a global scale than on a local scale. Panaceas have failed in multiple arenas related to the environment (Higgs 1996; Bacho 2005; Clark 2006; Ostrom et al. 2007), and single solutions advocated by government officials and policy analysts have often been a part of the problem rather than the solution (Ostrom, 2008). Waste management technological choices in local communities are shaped more by powerful actors. Even when the ultimate decisions are made at the local level, they are mostly influenced by the national level (Forsyth, 2006). Therefore, it is expected that "blueprint" approaches to waste management are impeding factors to adopting more sustainable waste management approaches.

Incentives can be either institutional or financial. Local governments have a key advantage since they have more local knowledge that gives them more insight for developing more adaptable rules (Andersson & Ostrom, 2008). However, decentralized forms of government often lack the financial resources and policy incentives provided by centralized governments. Following Andersson and Ostrom, it is expected that institutional and financial incentives from higher levels are facilitating factors for supporting and investing in more sustainable waste management approaches.

4.7.2.3 Community Attributes

The Native Hawaiian ***Culture*** is a unique component of the Hawaiian Islands. The Hawaii State Motto is "ua mau ke ea o ka ain I ka pono," which is translated as "The life of the land is perpetuated in righteousness." This motto is inscribed on the Hawaii State quarter and is regularly seen throughout Hawaii on bumper stickers and signs. Residents are often heard saying, "Respect the 'aina" (respect the land) or "pono," which

means do what is right for the earth and the community. The abundance of waste and pollution of the land is in direct conflict with the cultural beliefs of the native people. Therefore, it is expected that culture is a facilitating factor that leads to more sustainable waste approaches.

Behavioral norms are shared prescriptions enforced by participants through imposed costs (Ostrom, 2007). Humans will devise ways to evade governance rules (Dietz et al., 2003). A behavioral norm related to waste disposal in Hawaii is illegal dumping. Even though waste collection services exist, the reality is that many people illegally dispose of their waste across the islands. Illegal dumps are a result of people avoiding paying tipping fees and not taking the time or attention to properly dispose of their waste (State of Hawaii, 2011). Other potential reasons for illegal dumping include lack of environmental awareness, inadequate waste management, or lack of enforcement (Ngoc & Schnitzer, 2009). In a recent research survey, 57% of participants attributed illegal dumping to public ignorance, 29% to waste mismanagement, and 12% to national policy failure (Dangi & Cohen, 2009). Another potential reason may be scarcity of land and the NIMBY attitude toward constructing more local disposal facilities (Shekdar, 2009). On the small islands of Hawaii, where land is limited for waste disposal activities, NIMBY may have a stronger effect. In addition, cost of waste disposal is a significant factor. It is estimated that a 1% increase in the price of MSW disposal increases illegal dumping by 3%, and municipal governments must devote additional resources to deter illegal dumping if they increase the price (Kim et al., 2008). Therefore, it is expected that the behavioral norm of illegal dumping is an impeding factor to the adoption of more sustainable waste management approaches.

Tourism is a community attribute that places a considerable burden on waste management resources in Hawaii. In 2006, 7.5 million tourists visited the islands, spending approximately $12.4 billion dollars (State of Hawaii, 2007). The ideal weather, prolific wildlife, and vegetation are key selling points for tourism. As a result, the county has experienced rapid population and tourism growth, which places a great deal of pressure on the physical environment. The average per capita amount of waste generated in Hawaii is more than double the average amount in the U.S. (Janes-Brown et al., 2010), which is likely due to the large influx of tourists that the islands attract each year. While tourists were found to be willing to pay for greater sustainability (Dodds et al., 2010), the responsibility ultimately falls on the government in Hawaii. Since tourism is one of the main income streams for residents, and since tourists generally visit Hawaii because of its pristine environment, it is in the county's best economic interest to place as little pressure as possible on the environment. Therefore, it is expected that tourism is a facilitating factor for adopting more sustainable waste management approaches.

4.7.2.4 Interactions

According to the IAD framework, the action arena affects interactions among actors, and the interactions, in turn, affect the action arena. The actors interact with each other, both within the action situation and the action arena, to provide recommendations on solid waste management policy. The outcomes indirectly feed back into the action arena and the exogenous variables. These interactions within the action arena are observed during the data collection process.

4.7.3 Outcomes and Evaluating Criteria

Institutions within the IAD framework are the shared concepts within the action situation that are organized by rules, norms, and strategies. Through the stakeholder committee, new rules, norms, and strategies are identified, which may change the action situation structure dramatically. Over time, participants may modify their strategies as they learn about past situations (Ostrom, 2007). In this study, the rules, norms, and strategies are the policies that result from the committee interactions within the situation that may or may not be identified in written form. Some may be recommended in the final plan, and some may be a result of the learning process that occurs.

The stakeholder committee was tasked with learning about multiple waste management practices available and developing scenarios for implementation. The committee met regularly for one year and interacted with each other on a weekly basis. The outcome of the process was a new solid waste management plan with recommendations for policy change. Evaluating criteria was applied to the process of achieving outcomes and the outcomes themselves.

The evaluating criterion that was used to assess the various approaches and scenarios during the process was developed by the consultants who led the process (discussed further in the results). The outcomes of the study are also evaluated based on the weak-to-strong sustainability spectrum applied to open and closed-loop cycles. The categories identified in this study are assessed for whether they facilitate or impede sustainability. This means that, if a category is "facilitating," then it facilitates the committee's adoption of more closed-loop waste management cycles. If a category is

"impeding," then it impedes the committee's progress toward more closed-loop waste management cycles.

4.7.4 Expectations

Many potential factors can affect waste management policy. Remote islands, however, have interesting characteristics that may impede the progression of more sustainable approaches. The overall expectations are that economics, exclusion, infrastructure, remoteness, behavioral norms, and blueprint models are impeding factors, and that the environment, incentives, culture, and tourism are facilitating factors that affect the action situation and the actors' recommendations for the adoption of more sustainable waste management approaches. It is expected that economics most significantly affects waste disposal decisions in a small island environment that depends on tourism for its livelihood and is highly sensitive to economic downturns. Since the environment is often sacrificed for strategic advantages (Jenkins et al., 2008), environmental issues may not have been as prominent in committee discussions as the economic costs. Furthermore, the high exclusion rates, poor infrastructure, isolated remoteness, and ubiquitous illegal dumping norms factor into the economic costs required for improving waste sustainability. It is also anticipated that multiple levels of policy affected decision-making, especially blue-print models that are prescribed at central levels.

CHAPTER 5: DATA AND METHODS

Evidence for this case study was collected from multiple sources, including documentation, direct observation, and interviews. All of the data was coded and analyzed in NVivo software. Data collection was approved by the Georgia Tech Internal Review Board (IRB).

5.1 Documentation

Documentation data includes dates from administrative documents, news, and other available data related to the issue. Documentation data adds strength to a case study because it can be reviewed repeatedly, it contains exact names and references, and it can be studied over a long span of time. Its weaknesses are that it can be biased based on available collection and reporting (Yin, 2003). In this case study, all relevant, available data was collected from the following sources:

- Administrative documents
- Agendas, announcements, and minutes of meetings
- Local newspapers and other articles

Policy information and relevant documents on waste management was collected from local, state, and federal government agencies. Local documentation included past and present county integrated solid waste management plans. These documents covered the entire waste management process within the committee and the physical, economic, and demographic characteristics of the county. Most of the documentation data was used for further clarification from interviews or meeting minutes, to examine the differences between past and present plans, and to identify aspects of local waste management that were not identified during other data collection processes. In addition, meeting minutes

were collected from all of the committee meetings. In total, there were twelve official meetings, and meeting minutes were available for all of them. The minutes were coded based on categories (see Appendix D) and queried for results along with the other data collection methods. In addition to the minutes, there was supplemental data provided to the committee members during the meetings. For example, additional data from outside presentations and other relevant research was given to committee members. These documents were available with the meeting minutes and downloaded to be examined with the other data. Finally, searches were conducted for local news reports related to the process.

State documentation data was primarily from the Hawaii Department of Health and state-level news reports. The Hawaii Integrated Solid Waste Management Plan was examined to observe the differences between the state and local levels. The plan provides the basis for developing local county plans. Additional state documentation of rules and regulations related to collaborative committee involvement was also collected, such as the official document on the state Sunshine Law, which governs committee processes. State news reports on solid waste issues in Hawaii from the last decade were collected from local newspapers and the internet.

Federal documentation data was from the U.S. EPA. The Resource Conservation and Recovery Act (RCRA) was examined since it is the primary document for the regulation of hazardous and non-hazardous wastes in the U.S. It also gives the EPA increased authority to enforce solid waste standards. The EPA websites were utilized for obtaining data on solid waste management issues, and for clarification and confirmation on data collected from news reports and interviews.

5.2 Observations

Direct observation covers events in real time and the context of the events (Yin, 2003). They are valuable in that they provide new dimensions for understanding the phenomenon being studied. Direct observation also allows for photographs (assuming permission), which help convey important characteristics of the study area. Observational data was collected at local landfills, recycling facilities, illegal dumping areas, and other identified waste management disposal sites. Direct observation was conducted using the following approaches:

- Site visits at solid waste management sites
- Site visits at illegal dumping sites
- Image documentation
- Solid waste disposal mapping

Site visits were conducted at three of the four landfills in the county. A site summary form was used to document notes (see Appendix E). Notes were taken on the size, number of employees and customers, types of waste at the site, proximity to ocean and residences, and general practices at each site. A tour of one of the landfills was given by a guide, who provided more detailed information about all of the operations. The larger landfills had more operations, such as wells for capturing methane and storage tanks for leachate. The smaller landfills were often in rural locations and had fewer ongoing operations and very little, if any, personnel. Photographs were taken at waste disposal sites. Observational data was collected at seven of the eight public recycling facilities. As of 2010, there were 27 private recycling facilities across the county that

collected recyclables, such as HI 5 redemption items, yard trimmings, appliances and metals, and motor oil. Sixteen of the twenty-seven facilities were visited.

Illegal dumping sites represent a large portion of the waste sites in the county. Twenty-six illegal dumping sites were observed.[24] Data was collected at these sites on the types of waste, distance to the landfill, proximity to the water resources, and size of the site. Photographs were taken at all of the sites to convey the characteristics of the sites and accurately document the findings.

Finally, all of the public, private, and illegal dumping sites in the county were transferred to a map. The map helped to illustrate a general overview of all of the waste management sites, and their proximity to water resources and proper waste disposal facilities in the county. It also helped to visually note how close the sites were to natural resources and other important environmental areas of the county.

5.3 Interviews

Interviews allow the researcher to focus directly on the topic and provide causal inferences. They are one of the most utilized sources for case studies (Yin, 2003). One of the primary ways that a researcher can investigate an organization is through the experience of the people who work within the organization (Seidman, 2006). Utilizing interviews as a research method allows for deeper insights into the experiences of the people who work with waste management policy and helps to develop a better understanding of why and how policy decisions are made with regard to waste. An interview protocol was developed to guide the interview process. A contact summary form was used to summarize questions about each field contact following the interviews.

[24] These sites were often hidden to the visible eye and only known through word-of-mouth. It is certainly possible that more illegal dumping sites exist.

A digital recorder was used to capture the interviews and ensure that nothing was overlooked in the written notes.

Interviews were conducted with the action situation participants. The actors were a part of the county's solid waste management committee, government officials, and one Hawaiian historian. Interviewees were contacted with an invitation to participate in an interview via email one to two months in advance. Of the seventeen people that were contacted, twelve were interviewed. Nine participants were interviewed that were nominated by the mayor to participate on the committee. Two participants were government officials responsible for solid waste management at the county and state levels, and one was a Hawaiian historian. Two interviewees responded but were never available to meet. One declined unless there was payment involved, and two never responded.

Of the twelve interviews, eleven were conducted in person; one interview was conducted via telephone because the interviewee was not available in person. Detailed notes were taken at all of the interviews based on the interview protocol (see Appendix F), and all of the interviews were recorded on the digital recorder with the exception of the phone-based interview, which received too much static. Interview summary sheets were used to document observations of the interviews and note any additional comments that did not follow the protocol, such as the main issues or themes, a summary of the information collected, other salient highlights of the interview, and new questions that might be relevant to future interviews (see Appendix G).

5.4 Analysis

All data was transcribed, documented, and analyzed in NVivo software. A coding scheme was developed to organize materials based on the category types, categories, attributes, and operational definitions (see Appendix D). Explanation building logic was used to analyze the data. This technique helped to explain the phenomenon and analyze any causal links that reflected insights into the policy processes and decision making (Miles & Huberman, 1994). The original categories were derived from the IAD framework; however, as data was collected and coded, many new categories were created to accurately capture the data.

5.5 Validity and Reliability

There are four tests for establishing a case study design: construct validity, internal validity, external validity, and reliability. Testing tactics for construct validity include using multiple sources of evidence, establishing a chain of evidence, and having key informants review the draft report (Yin, 2003). In this study, multiple sources of evidence were used. The chain of evidence was established through the management of the project and the documentation of the data collection procedures in a database.

Internal validity was tested through pattern matching. Pattern matching compares empirically based patterns with predicted patterns. If they are matched, then it strengthens the internal validity. External validity tests for whether the study findings are generalizable. This is a limitation of conducting a single case study. The best way to increase external validity is to test a theory and then conduct future case studies in additional locations. This study tested the IAD theory with plans to conduct future case

studies for greater generalizability. Reliability was achieved by using a case study protocol and developing a case study database (ibid) (see Appendix A).

5.6 Ethical Issues and Human Subjects

A research protocol was submitted and approved by Georgia Tech's Internal Review Board (see Appendix H). Confidentiality was maintained with regard to interviewees. The dissertation committee and the author are the only people who have access to the interview data. Nothing was included in the final report that identifies interview participant responses. To maintain confidentiality and protect subjects, interviewees were not identified in the results. All comments made by interviewees and documented in this study are cited as "interviewee" to maintain confidentiality.

CHAPTER 6: RESULTS

6.1 Government by Consultants

6.1.1 Consultants Take the Lead

The membership of the solid waste stakeholder committee included sixteen participants with varying levels education and experience. They were from multiple stakeholder groups, including waste transport, recycling, composting, tourism, government, and academic groups. The members of the committee were divided into four sections: 1) County Environmental Department; 2) sixteen people appointed by the mayor of the county; 3) professional consultants; and, 4) professional mediators. The Environmental Department organized and facilitated the committee members, consultants, and mediator, and also participated on the council. The appointees were nominated to represent various areas of the county, such as the waste and recycling industry, tourism, remote communities, and economics. Consultants were selected to lead the meetings and facilitate the entire process. They were hired from the mainland before the stakeholder members were appointed. Professional mediators were hired to facilitate discussions and develop consensus throughout the meetings (GBB, 2009).

The interviews provided deeper insights about the membership of the committee. The general perception of the consultants by the interviewees was that the consultants "ran the show" (Interviewee [INT], 2010). Some members accepted the consultants as a standard part of the process, while others did not approve.

> [The consultants] were not familiar with new [waste] technologies. They were limited in knowledge of waste-to-energy conversion and not open to anaerobic digestion or other technologies. Their calculations were way off, and they couldn't provide new numbers [on waste composition]. They said it was too expensive, and it can't be done. They only referred to

> them as "mass burners" and not WTE. But energy conversion is an option (INT, 2010).

Others thought that the consultants completely controlled the meetings and did not allow time for the participants to express their views and opinions on various issues. According to one participant, the Sunshine Law, Hawaii's open meetings law, prevented participants from discussing the meetings with each other and the rest of the community. As one participant stated:

> I wanted [the consultants] to take time to present to the community, but the consultants gave presentations, and we were not allowed to comment on their presentations because these were informational meetings. We have already given our opinions before, and now it would be unfair to go and promote one particular view, and we were not considered part of the general public anymore because we knew too much. Instead of being agents to inform the public, we would have opinions that were personal but were then considered inside information. The consultants were supposed to incorporate our opinions into the presentations. I chose not to go to the public hearings because I couldn't participate, and I could not give my feedback (INT, 2010).

While there were many criticisms of the consultants, the process was guided by the Sunshine Law, which requires an outside consultant to be hired to run the process.

The comments about the mediators were few and generally indifferent. They were present to facilitate consensus among the members during the meetings. One person commented that they were only there to moderate and "didn't know anything about waste technology" (INT, 2010).

The news reported the membership of the committee on several occasions. One quote from the mayor, who appointed the members, stated, "We have been fortunate to have them work together to craft new plans for the county. Each member participated in an involved and demanding process and demonstrated great commitment. I'm pleased

with the results and am grateful to the committee members for their through work" (Hamilton, 2008).

The general theme from the data about the membership of the committee was that, even though the nominated stakeholders had the highest number of people, the consultants controlled the meetings and ran the show. The stakeholders had little time to convey their concerns or local knowledge, and the consultants lacked adequate local knowledge. The mediators were only there to facilitate and had little control over the topics discussed.

6.1.2 Balanced Roles and Responsibilities

The responsibility of the committee was to develop a new model for solid waste management within the county to comply with the *Hawaii Integrated Solid Waste Management Act* that calls for each county to update their solid waste management plan every five years. The purpose of updating the plan was "to review the current operations, research alternative approaches, develop long-term scenarios, and provide capital and operational cot/revenue projections" (GBB, p. 1-1, 2009). This would provide policy makers with a guide for making decisions about future solid waste management issues.

The committee did not have a selected leader, and there was not an elected chairperson. The individual roles of the committee members varied. Some members were quick to state that their specific stakeholder role was to "to represent the hotel industry," or "to be a technology advisor," for example. Others felt that it was their role to be a community member at large. Some thought that they did not have a specific role—that the Sunshine Law prohibited having certain roles because it would promote a specific agenda. One member said that his only role was to "listen and learn and share."

The written roles of the committee members, as stated in the final plan and the Sunshine Law was to attend all of the twelve meetings, read the materials provided, participate during the commenting process, and to provide recommendations based on consensus. Additional responsibilities included a trip to the mainland to tour multiple types of waste management facilities in California and Oregon. The county members were responsible for organizing and monitoring the meetings. The responsibility of the consultants was to run the meetings, develop the presentations for each meeting, compile the results, and disseminate relevant materials to the group. The mediator guided the process throughout the meetings (GBB, 2009).

One of the final questions asked in interviews related to the roles of the committee was: "Who were the key players within the committee?" The responses varied significantly. Some participants said it was "fairly even," while others thought that some stakeholder groups were underrepresented. Most felt that the "big players" on the island were represented in the committee, with the exception of one interviewee, who thought that construction was the biggest player in the waste industry because of the full landfill capacity at the C&D landfill, and nobody was present to represent that industry.

When further probed about the "economic" players within the committee, most of the interviewees felt that they were fairly balanced. Nearly everyone mentioned the waste disposal companies, recyclers, and tourism representatives as being the biggest economic players. "The committee was made up of mostly those people [the economic players], and then there was public testimony" (INT, 2010). Several members thought that some key stakeholders were missing from the committee, including the local electric

company, (which had an economic interest due to the proposed landfill gas-to-energy and WTE facilities). In all, the general sense was that the committee was properly balanced.

6.1.3 Unbalanced Organization

Committee meetings were held at least once per month for almost a year. Each meeting was four hours long. The agenda for the meetings was organized into three parts: 1) the first two hours was for the consultants to present their data, and members were not allowed to speak or ask questions during this time; 2) after the two hours of presentations by the consultants, committee members were allowed to respond for 2-3 minutes each; and 3) after both the members and consultants spoke, the meeting was open to the public for testimony and questions (according to interviewees, a typical meeting only allowed for about 5-10 minutes for public input). When the meetings were over, committee members were given reading assignments to prepare for future meetings.

There was a lot of discussion in the meeting minutes related to scheduling meetings and times. The earlier dated minutes explained that meeting changes were not possible. Later in the process, they discussed having more meetings, more often, and for longer times. Members were also provided the narrative schedule for the entire process:

> Once [the committee] has the full plan presented, then there is a 120 day trigger before it goes to the state. DOH will be reviewing the drafts informally before that time and providing comments. If this becomes a substantial revision, the plan will be placed for public comment for a period of 60 days. Then it goes back to [the committee] for review/revise, then to the State. After this process is completed, it goes to the Executive Branch, and then to County Council where it will be voted upon (Meeting Minutes [MM], 2007).

The organization was discussed at the beginning of the committee process, and changes to the process were generally not allowed (MM, 2008). The final plan

discussed the organization of the committee in greater detail with the dates and topics of each meeting. It also mentions the Sunshine Law (see 6.2) and how discussion among committee members was confined to the formal meetings (GBB, 2009).

Overall, the membership, roles and responsibilities, and organization of the committee were not equal. While the stakeholder roles were fairly representative of the community and balanced, the consultants occupied the majority of the time in the meetings, and appeared to have the most control over the structure and topics of the meetings, leaving the stakeholders with little input for contributing to local knowledge.

In terms of the IAD framework, this section represents the action arena. The action arena was the county observed, the action situation was the collective decision-making process, and the actors were the process participants. A modified version of the action arena base on the results is illustrated in Figure 7.

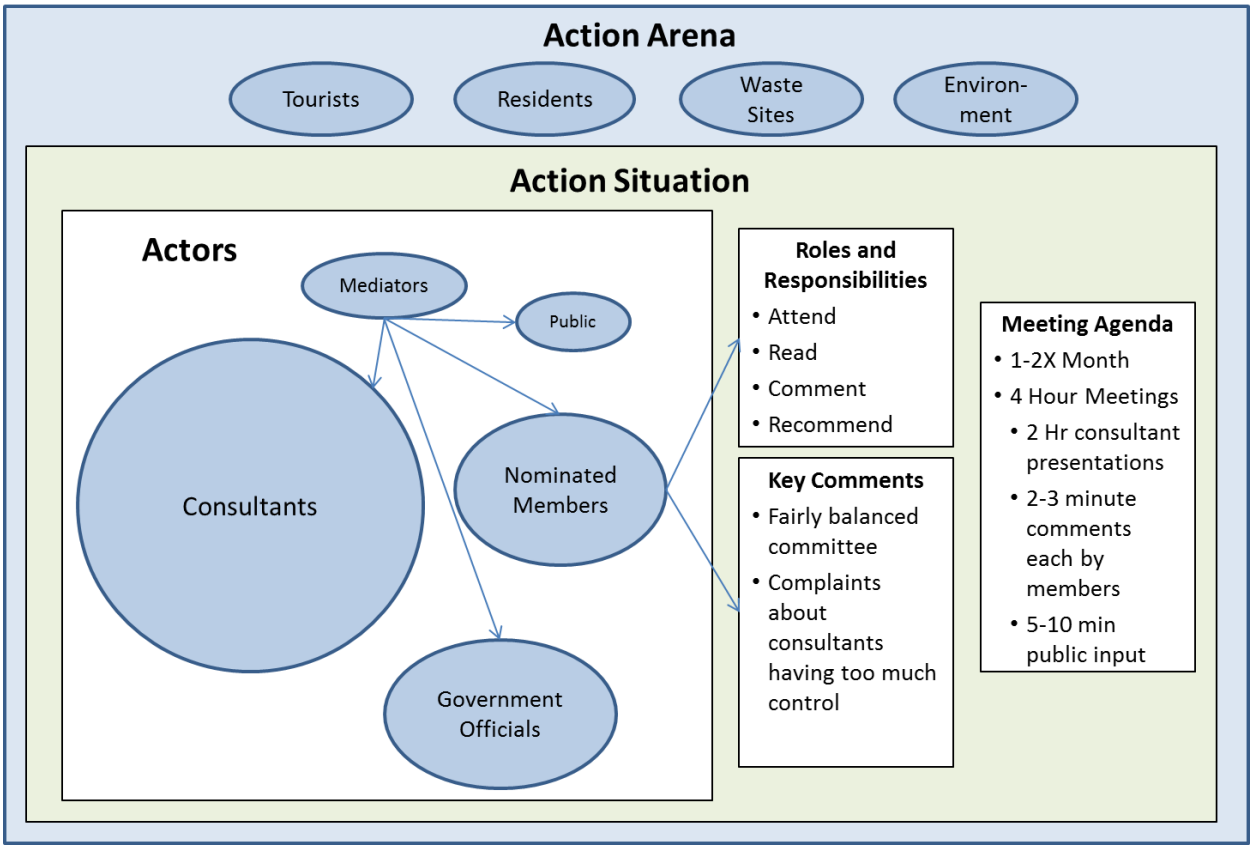


Figure 7: Government by Consultants

6.2 Rules: A Catch-22

Many rules must be adhered to when developing waste management policy. Some facilitated greater sustainability, while others created barriers. Rules were analyzed from two perspectives: rules-in-use and rules-in-form. The rules-in form, the written rules that are meant to regulate behaviors, were what first came to mind for most participants when asked about rules. The rules-in-use, the socialized rules that represent the "dos and don'ts" that are learned in a community, were only discussed briefly by interviewees, but they were addressed indirectly in other interview questions.

6.2.1 Re-Writing the Rules

Rules are often created because of conflicts or disagreement to keep things fair and maintain peace. Written rules at the government level often go through extensive review processes before they become rules. Within the committee, the written rules governed the entire process. When interviewees were asked about specific formal rules related to waste management that were considered within the process, the responses were very broad. The participants discussed four areas of written rules: Sunshine Law, federal regulations, decision-making techniques, and no rules.

6.2.1.1 Does the Sun-Shine Too Bright?

The Sunshine Law was the most cited rule mentioned in interviews, meeting minutes, news reports, and the final plan. The Sunshine Law guides all of the open meetings in Hawaii.

> The intent of the Sunshine Law is to open up governmental processes to public scrutiny and participation by requiring state and county boards to conduct their business as openly as possible. The Legislature expressly declared that "it is the policy of this State that the formation and conduct of public policy – the discussions, deliberations, decisions, and actions of government agencies – shall be conducted as openly as possible" (State of Hawaii, 2011).

Under the Sunshine Law, all meetings are required to include a mediator. One of the primary guidelines about the sunshine law that interviewees mentioned was that they were not allowed to talk to each other about "board business" outside of board meetings. In the meeting minutes, one of the leaders said:

> The sunshine law exists to make sure board business is conducted in plain view of the public. Board meetings have to post their agenda in advance and stick to the agenda and can't stray from the agenda. The idea is to try to avoid deals done behind public view. Board actions can be voided if violated." (MM, 2007).

Many questions followed about whether it was okay to talk in public or in other meetings outside of the committee. The responses were that individuals within the committee could talk outside of the meetings; however, they could not talk about issues that were supposed to be addressed by the committee as a whole—discussions could only be between two members at a time, and no more than two members could meet at once. In later meeting minutes, someone recommended that committee members should not speak to other members at all on a one-on-one basis outside of the regular meetings (ibid).

The Sunshine Law appeared to create apprehension for participants. They were too nervous to talk to one another outside of regular meetings, and often felt hesitant about speaking up at the formal meetings. Many participants said that they had ideas and experiences that would have made a difference, but they never had the chance to voice them.

6.2.1.2 Decision Making by Consensus

The committee decision-making process was guided by Robert's Rules—rules that provide a guide to conducting meetings. Since the statute HRS chapter 342G (Hawaii's provisions on solid waste management) did not specify regulations for decision making, it defaults to 92-15 under the Sunshine Law, which says that a majority is needed to validate a decision. Robert's Rules were discussed extensively in the beginning of the process. They said that the committee should decide on the voting rules about decisions discussed in the meetings. According to Robert's Rules, there had to be at least 50% present for a quorum, and it was not okay to vote with less than a quorum. The rules also required that there be a chair of the committee. Since there was

disagreement about having a chair, the committee took a vote. The result was that there was "no need for a chair," and since they moved forward without a chairman, the mediator filled that role. The committee decided to use consensus, rather than majority rule, for decision-making since it was an "inclusive process," and participants would be informed in advance of meetings if a decision was to be made. At the next meeting, there was further discussion about the decision making process, how consensus worked, and what the ground rules would include (MM, 2007).

Decision making was also mentioned in the interview discussions. None of the interviewees mentioned the Robert's Rules—they only stated that they made decisions by consensus. Several interviewees noted that oftentimes members of the committee abstained from voting during the process because they did not agree, and because the process tended to be very long and onerous. One respondent said that the voting was balanced, "We had to reach consensus in our recommendations. A few times we couldn't, so we had to vote. They tried to make participation as balanced as possible. It was a pretty vocal group and everyone pretty much participated" (INT, 2010). In all, the data indicated that the consensus was the agreed upon method for decision-making, and it generally worked well throughout the process.

6.2.1.3 Fear of Punitive Action

Federal regulations were discussed in regards to punitive action by the State and EPA. The federal government regulates solid waste under Title 40 Code of Federal Regulations (CFR) 258, also known as the Resource Conservation Recovery Act (RCRA, subtitle D). Solid waste regulations and policies are enforced and administered by the EPA under RCRA. At the state level, the State of Hawaii Department of Health (DOH)

regulates landfills, composting facilities, recycling operations, and salvage yards. The Solid and Hazardous Waste Branch is responsible for implementing policies and overseeing integrated solid waste management planning required by HRS 342G (the Integrated Solid Waste Management Act, Hawaii Revised Statutes that created the Hazardous Waste Branch). The goals of HRS 342 are to reduce the solid waste stream, revisit solid waste plans every five years, and have a research advisory council for each policy revision (GBB, 2009). Interviewees discussed how the county was heavily regulated by HRS 342 G. At the time of the committee, the county was 10 years overdue on developing a new waste management plan, and avoiding punitive action was the primary reason for their collaboration.

During interviews, federal regulations with the EPA were discussed when participants were asked about rules. Again, fears of EPA punishment were the basis of the conversations. Respondents said that the county had experienced punitive action by the EPA since the county was behind in keeping up with waste regulations.[25] Other laws that were briefly mentioned included a state law that the committee had to consider incineration as an option for waste management (INT, 2010), though it was not discussed in the meeting minutes, the final plan, or by other participants. In general, it appeared that state and federal regulations were not heavily discussed in the meetings, but when they were, it was generally about avoiding punishment from higher levels of government. (Figure 8 provides an illustration of the waste management policy process.)

[25] No participants specified which regulations the county was punished for—only that it was discussed in the committee meetings.

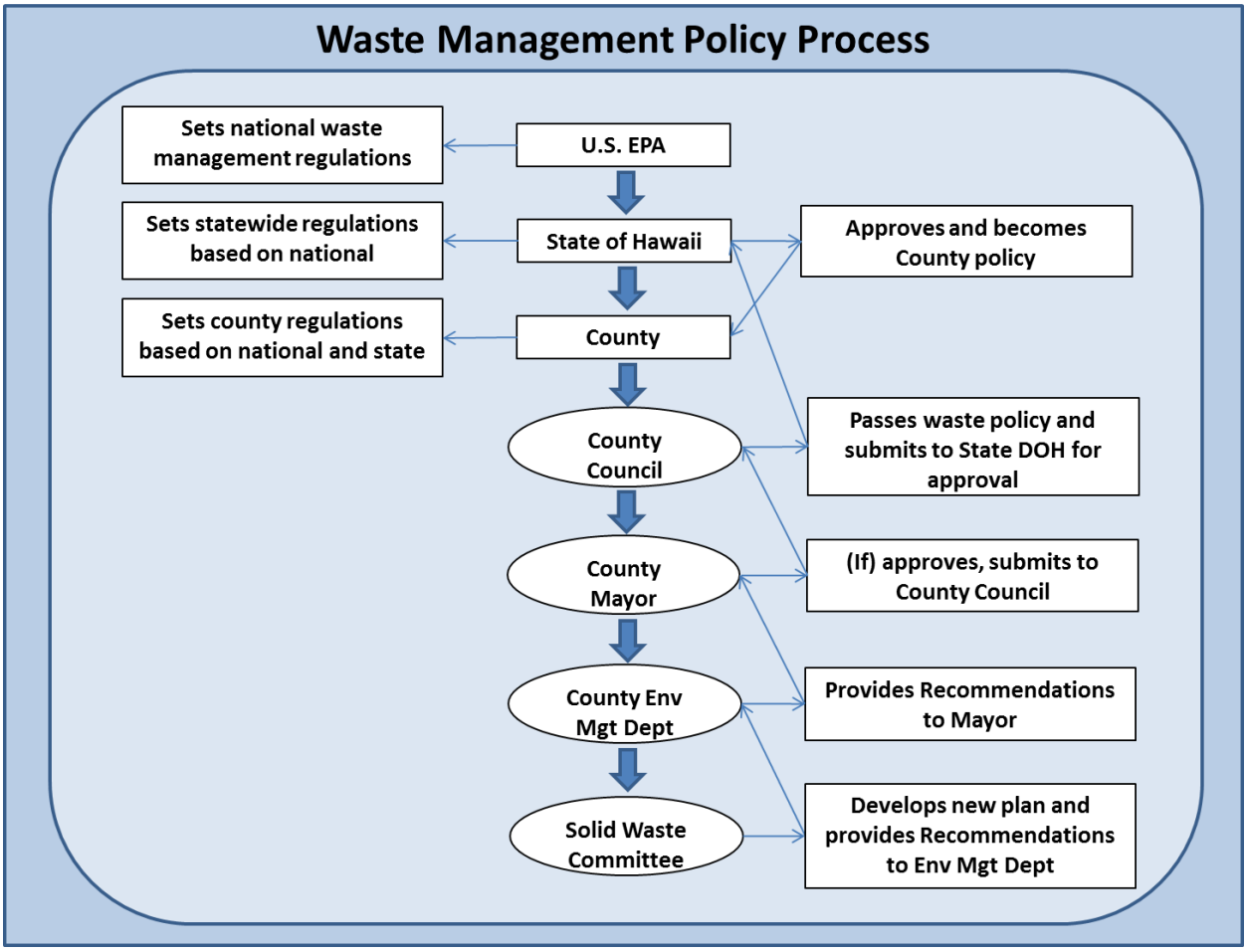


Figure 8: Waste Management Policy Process

6.2.1.4 What Rules?

Many interviewees did not recall discussing any rules throughout the entire process. Some responses from participants included the following statements: "I don't think we had to discuss rules from state or federal government. Maybe some, but I don't remember." "There was nothing ever mentioned about permitting." Another provided a simple two word answer to the rules question, stating, "none recalled," and then asked to move on to the next question. Others interviewees had conflicting answers. Some said that the consultants were there to answer any questions about rules—"they had all of the answers, and they should, since the county paid half a million dollars for the consultants."

Yet, other participants stated that it was the county officials who answered all of the questions related to rules, and that the rules were more for the county to work through rather than the committee (INT, 2010).

6.2.2 Rules-in-Use: The Public vs. Consultants

Rules that were adhered to but not necessarily in writing were that committee members had to try not to upset the public or interrupt the consultants. They were the "rules-in-use"—the norms and shared prescriptions of the process. In interviews, participants discussed the rules-in-use that they had to abide by with the public. "Getting past the general public was more important than any rules with the EPA; there was not a good alternative for the public." The public was brought up on more than one occasion. The general rule was that committee members should not do anything to upset the public if possible.

Another unwritten rule was that the committee members were not allowed to ask questions while the consultants were presenting. According to one interviewee, "We could not stop the consultants during their presentations and ask them to translate their data to our island. They were hired before the process started and already had slides" (INT, 2010). Due to this rule, some participants thought it created substantial constraints on time allowed for voicing their opinions and feedback.

Other unwritten rules were that they had to adhere to set target rates for waste reduction. The general rule was to look at other models of waste management, particularly on the west coast, to observe what would work for a small island community. They were also encouraged to talk to their own communities (MM, 2007). All of the interviewees said that they did not present to the public outside of the regular meetings;

instead, they talked about how they were uncomfortable discussing it in public due to the Sunshine Law.

6.2.3 Incentives Would Facilitate Greater Sustainability

If institutional and financial incentives were available during the process, it might have led to more sustainable waste management approaches. Almost all of the interviewees stated that they did not discuss incentives, institutional or financial, in any significant capacity during the process. The primary incentive mentioned was to avoid more punitive action from the EPA. In response to questions about incentives, one interviewee said, "[There were] none that I recall, but it would have made a difference" (INT, 2010). Another participant stated:

> I don't remember discussing details [of incentives] in that nature. Some of the finances were discussed…bonds and scenarios of how to finance. At no point do I remember looking at anything ….because there was some other money to use this. Not sure if they would have changed the final outcomes. Islands are so particular and our island is so unique they didn't factor into our discussions. We were fairly clear that we needed to decide first (INT, 2010).

One participant explained in detail about how incentives were difficult for waste management. "Credits are not available since municipalities don't pay taxes. Incentives only work for private facilities (e.g., a private WTE facility could get incentives), so it requires public/private partnerships." Yet, as another participant said, "The only incentive could be federal grants, and they are not sustainable. Grants pay for staff, but then the cost goes up for the community, so we are right back to cost."

In the committee meeting minutes, incentives were only discussed a few times, mostly in the context of incentives to consumers rather than from state and federal levels. They discussed modifying consumer behavior based on money incentives—charging a

double fee for uncovered waste loads and holding household hazardous waste for giving away versus going into the landfill (e.g., paints, bleach) (MM, 2007). They also discussed incentives with regard to illegal dumping. Illegal dumping was referred to as "waterfalls of waste" that are disposed over cliffs, and incentives must be provided to end the behavior. One member said during the meetings, "We have to have an incentive to stop the waterfalls of waste, like education and incentives" (MM, 2008). Finally, incentives were talked about in regard to landfill tipping fees and recycling. One participant stated, "We need education and incentives to change attitudes" in response to the county's challenges in getting high-end condos to pay for recycling pick up. Overall, the rules created a "catch-22" for waste management. Rules may be helpful for keeping processes fair and open, but they can also stifle ideas that may facilitate a more sustainable future.

The rules in this section are representative of one of the categories of exogenous variables in the IAD framework. Some of the category attributes were facilitating factors and some were impeding factors during the process. Figure 9 provides a visual overview of the key themes for each attribute and the corresponding causal results.

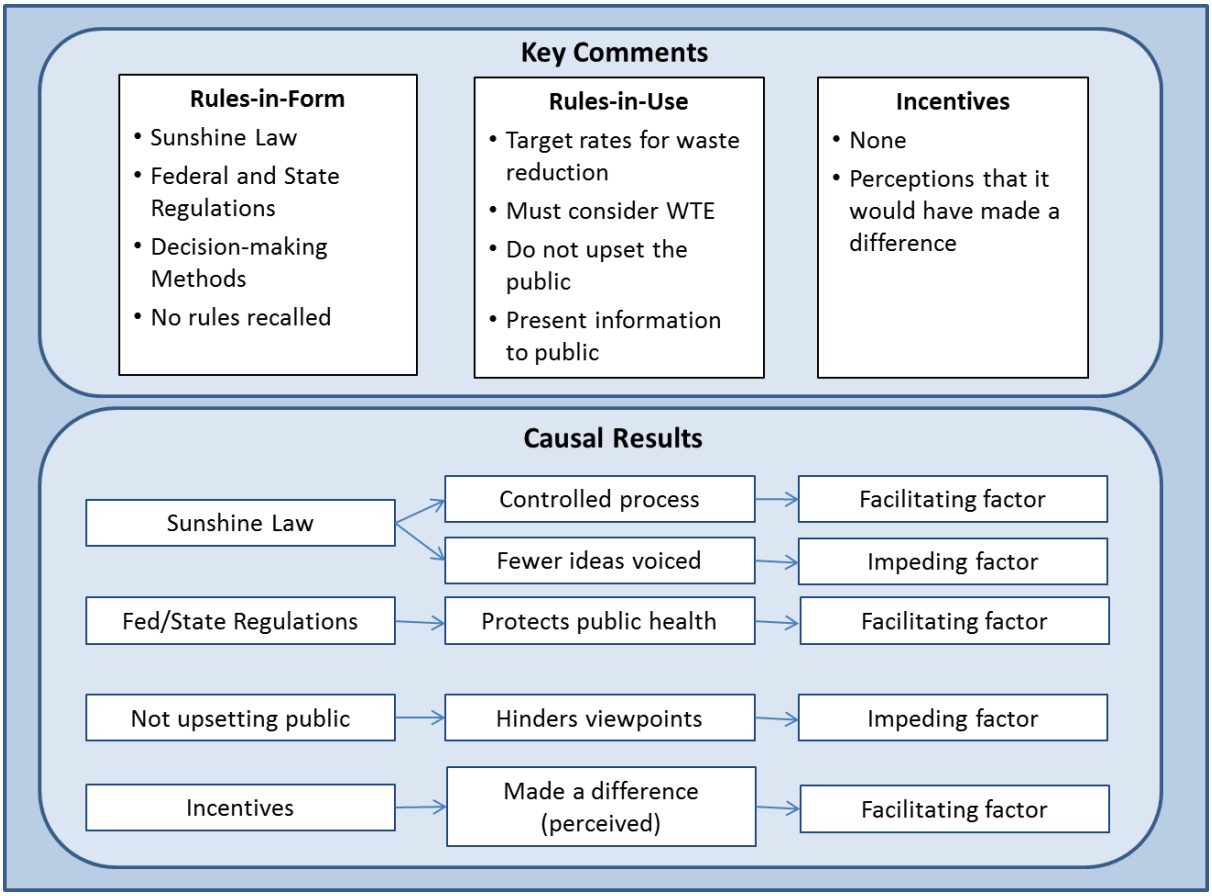


Figure 9: Rules—A Catch 22?

6.3 Biophysical Attributes Matter

Certain material aspects of the physical world affect waste management policy. These include economics, environment, exclusion, infrastructure, and remoteness. Since the economics of waste was the most prominent topic during the data collection process, it was further explored and divided into subcategories that included economic interests, costs, cost models, and waste models. However, while each category played an individual role in the development of new waste policy recommendations, they were all interconnected. Figure 10 provides an illustration from the NVivo analysis on the

biophysical relationships. The "parents" represent primary categories, the "children" represent the sub-categories, and the arrows represent the relationships between them.

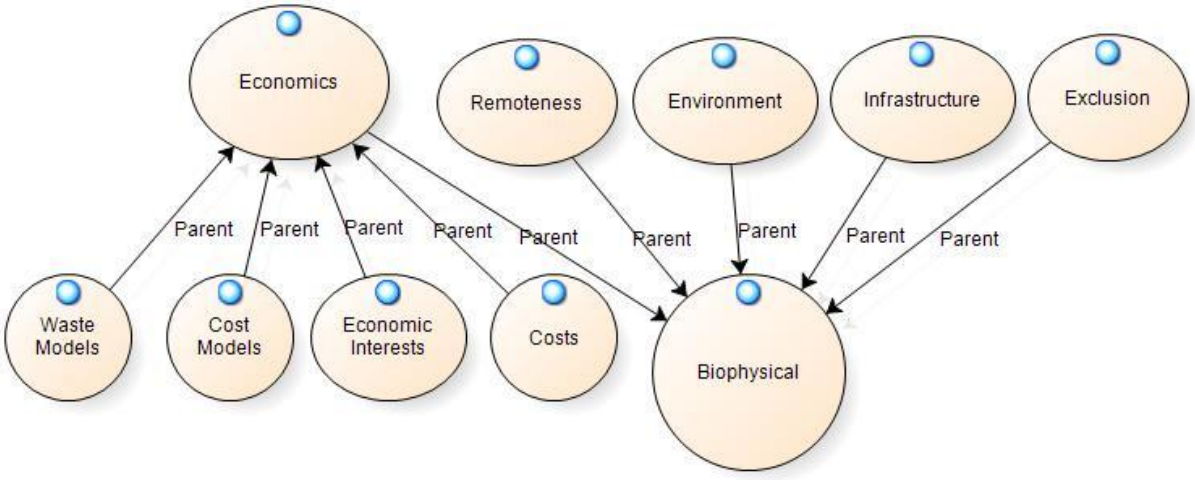


Figure 10: Biophysical Attributes Relationships

6.3.1 The Economics of Waste

6.3.1.1 Who Drives the Island Economy?

The economic interests of the island were important to understand within the waste management process, as it was expected that they would impact the final decisions. When interviewees were asked about the economic interests of the island, most responded with vague answers. Probing questions typically digressed to costs. "Everyone has an economic interest because we are all dependent on sustainability and environmental protection. Can't be successful if not protecting resources" (INT, 2010). Only one person provided specific interests, indicating that tourism, agriculture, and high tech were the economic interests of waste management. Another participant talked about the landfill reaching capacity, discussing how it was in the economic interest of the island

to find land space since there is not enough waste stream to support a WTE facility. The local energy company was mentioned as the primary economic interest for WTE, and they wondered why an energy company representative was not included in the stakeholder group.

Local residents were the second most mentioned economic interest. Residents were the primary recipients of changes to the plan. About thirty percent of the island's waste stream is from residents. The rest of the waste comes from the commercial sector, which accounts for about 70% of the waste stream and is supported by private waste disposal businesses. As one interviewee said, "There are about 25,000 accounts for home services, which equates to about 30% of the island. The commercial sector is 70% handled by private business. The county only controls 30%, but 100% makes its way to our landfill" (INT, 2010). This means that any policy change resulting from the plan would ultimately affect the residents and the businesses that serve the residents, rather than only the commercial sector.

In fact, the primary economic interests of the island are actually tourism and agriculture. Tourism represents the largest industry, followed by agriculture. With regard to waste management, the largest resorts and facilities that accommodate tourist—and handle tourists' trash—would likely have the most significant economic interests, followed by the local utility company that could potentially make money off of a WTE facility or landfill-gas-to-energy facility (LFGTE).

6.3.1.2 Cost Takes Precedence over EVERYTHING else

The cost of managing waste was the top keyword mentioned throughout the interviews, meeting minutes, and in other collected data. The primary components of

costs that were identified during the data collection process were budgeting, technology costs, tipping fees, and Pay-As-You-Throw (PAYT). The "budget" was discussed extensively in every interview and in the meeting notes. One interviewee commented that the budget was "hammered into their heads" at every meeting (INT, 2010). The county allocates a set amount of funding for waste management. The meeting notes indicated that the budget for the county was only $20 million during 2007, while the waste models that the committee visited on the tour were over $80 million. Several meetings included discussions about the debt that the county would incur if implemented, since they would "break" the budget (MM, 2008). Anything in addition to the budget had to be funded with a Capital Improvement Project (CIP).[26] Three types of procurement methods were discussed in the final plan: Architect and Engineering firm,[27] Turnkey,[28] Full Service [29](GBB, 2009). Whenever new ideas were discussed, according to one participant, they were generally rejected due to the investment costs, or that it may hurt various sectors of the industry (INT, 2010).

Multiple technologies were discussed during interview questions about costs. WTE was the most common technology mentioned. Many different scenarios were presented during the process that included some form of WTE, but they were rejected because they were too expensive or experimental. For instance, one interviewee stated:

> Plasma arc was too expensive and experimental. Other WTE were too expensive too, but it depended on the lifecycle. The only one [officially] dismissed from the beginning was plasma arc. Mass burning, anaerobic

[26] CPIs are funded from county bonds or other loan mechanisms.
[27] A& E firms submit bid packages, and the lowest bidder wins. The owner of the firm is responsible for what is built and accepts the risks.
[28] Owners document functional requirements for facilities, providing design and engineering in a "turnkey" package.
[29] Full Service methods extend the turnkey method, and the contractor also operates the facility. Costs include capital and annual operating and maintenance costs (GBB, 2009).

> digestion, and high-tech composting facilities were scenarios presented but did not make the final scenarios due to costs (INT, 2010).

Recycling was also commonly mentioned as a major cost factor. The small population of the island limits the island's ability to build extensive Materials Recovery Facilities (MRFs), also referred to as recycling centers. The recycling vendors must ship recyclable goods to markets in other parts of the world. When there is not a market available, or when prices drop, the vendors cannot break even, and eventually they go out of business. Recycling vendors must obtain support from other means, such as government grants, to stay in business. One interviewee described recycling as a "double-edged sword":

> In an island environment, there is limited ability [for recycling]. We can only recycle 5 basic things, but the problem is recycling certain plastics cost more to send back than it is worth…for example, agriculture tubing (we also line landfills with it), but it will cost more to send back and make into a new product, even though it's easy to recycle. Unlike aluminum, that is easy [to recycle], we are basically putting it into the landfill, and that takes up a lot of space (INT, 2010).

Composting was also mentioned in the meeting minutes as having a lot of additional costs. The notes discuss food waste as having extra transport cost and being capital intensive. However, it also notes that composting only costs 50-60% of the cost of a WTE facility and provides a more affordable option (MM, 2007).

Another commonly discussed issue was the cost of landfill tipping fees. Tipping fees are unit charges that assess per ton disposal. They are associated with the amount of waste disposal. Tipping fees were referred to as a revenue stream in the final plan: "the more waste, the more revenue" (GBB, 2009). They provide a simple approach to paying for solid waste management, but since they are only for waste disposal, they do not

reflect the additional costs incurred by the county to run a solid waste management system, such as the collection and administration costs.

Currently, landfill tipping fees account for less than half the cost that is required to support waste management in the county. There were multiple reasons given for the low tipping fee offered by the county, such as illegal dumping, poverty, and culture (see Section 6.4). Therefore, the county subsidizes the cost difference to the resident. "We get $18 from residents, but it actually cost $40 per resident. The commercial sector pays $3 per ton for commercial tipping fees, yet the county bears the costs with landfill maintenance" (INT, 2010).

Landfill space was also addressed with regard to costs. To save cost, one interviewee said, "We must extend the life of the landfill, and the goal is not to fill it up; recycling bins [pickup] would have been cheaper from the start and helped extend the life of the landfill" (INT, 2010). An example that demonstrated this issue was provided by another participant.

> In San Francisco in the 80s, people paid $32 per month for 1 can of garbage per week. [On this island today], people pay $18 for 6 cans per week. We are not generating revenue for people who bring their own [trash to landfill], but there is a cost to us for handling. Space is worth money, and once the landfill is closed, we must get gas through flare or generator and be responsible for 30 years [after the landfill is closed]. It is constant maintenance. In the economic downturn, people stopped paying the tipping fee and took it themselves, but [the county] still bears the burden (INT, 2010).

The tipping fees were also discussed in the meeting minutes. The costs should reflect the cost of monitoring the landfill for 30 years after it is closed. One participant said that the county is subsidizing $7 million due to the low tipping fees, and that if it was a business, it would shut down. Another person

compared it to a sick person, saying, "a person with appendicitis pays for health care, even if it's expensive, knowing that the alternative is far worse in the long run" (INT, 2010).

The concept of PAYT was often mentioned as a cost solution for residents to save money and for the county to preserve land space. PAYT provides residents with options for choosing sizes and prices of waste bins. Smaller bins cost less, and larger bins cost more. If presented with the option, the PAYT concept entices residents to reduce waste by purchasing smaller waste containers.

There was substantial concern overall about the costs associated with various waste management approaches and staying within the budget. The most dominant cost issues mentioned were landfill maintenance and tipping fees. The added investment costs of new waste management technologies and approaches was also a priority—the most common being WTE, recycling, composting, and PAYT. The cost of completing the solid waste management plan was over half a million dollars in taxpayer money. According to local news reports at the completion of the plan, the county would have to spend at least $200 million to implement all of the recommendations (most of the cost would be for the implementation of a WTE facility) (WM, 2010). The reports also validated the concerns of interviewees regarding tipping fees. The current tipping fee only covers 45% of the actual cost to the consumer. The cost discussions from the interviews can be summarized in these two final statements: "[Our] final outcome was most affected by costs," and "we kept working for the "pie in the sky" and how to afford it. The most important thing about the whole process was the cost factor" (INT, 2010).

6.3.1.3 Old Data Decreases Trust

The committee was brought together to plan for waste management for the county for the next 20 years. The consultants constructed a Full Cost Accounting system (FCA) to determine the fixed costs, benefits, maintenance and the cost per activity (e.g., recycling). The consultants used data collected in the past to project the various scenarios into the future. The population projections were taken from a county general plan for 2030. Waste figures were calculated based on past figures, and all other projections were carried out to the year 2030. The forecasts were based on the number of households and employment in the commercial waste industry. The final plan reports that the amount of disposed waste would increase by 30 percent. However, waste composition rates were collected in 1989. Another waste composition study was conducted in 1994, but it only observed the waste brought to the landfill by self-haulers. During the recent committee process, the county did not conduct a new study to determine current waste composition to use in the financial model. The plan states, "The county decided a new physical waste sort was not required at this time" (GBB, p. 2-9, 2009). Instead, the county used the numbers from 1989, 1994, and studies that were conducted on other Hawaiian Islands and in California with different populations and characteristics.

The cost models were only used by the consultants. The interviewees were not familiar with the specific models used—only the resulting scenarios that were presented at each meeting (GBB, 2009). "[The consultants] did the work and presented to the group. [It was a] large group, all experts; hard to reach consensus because everyone had beliefs and costs that played into it" (INT, 2010). When interviewees were further

probed about statistical models, giving the example of a cost-benefit model, they all agreed that it was used by the consultants, but they did not have any specific details. An example of the cost scenarios was provided by an interviewee: "If we wanted to recycle 50% by 2020, what do we need to do to do that? The financials were attached to those scenarios. The committee looked at them and made comments. The advisory committee would say some scenarios were not good and would demand new scenarios" (INT, 2010).

Several other interviewees had opposite opinions related to cost models. One person stated, "The consultants did not analyze any new numbers and only brought things [financial analyses] from around [their] company" (INT, 2010). Another participant did not think that they focused on the unique characteristics of islands in their analysis; they simply took analysis that had already been conducted for places on the mainland.

> They only used stats from the mainland. Nobody took a minute to look at [island] stats. We asked those questions to compare. Didn't make sense to run cost benefit model on mainland. Never presented on things we have here –pig farms, for example. They had no idea of issues unique to [our island]. They did not talk about food waste, which was small on their pie chart [of mainland waste]. Ours is ~60%. Pig farmers and food waste (INT, 2010).

Several participants were upset that the consultants did not do a study on solid waste composition. "There was one done in the early 1990s, and [the consultants] said it was the same composition, but it is not true; C&D was not included [in previous analyses]. They said it would be $750,000 to do the study, and that was too expensive" (INT, 2010). During the second half of the meetings, one participant said:

> I have a prepared statement distributed to all members. This Draft Plan does not meet the purpose of the revisions as envisions under HRS-342-G because the Draft Plan is based on an outdated waste stream assessment. It is a 14 year old Plan based on 1994 figures for waste composition. It is not accurate with current waste stream and doesn't identify source reduction. It is a high waste per capita (14 vs. 6)…my concern is that the

> data is based on 1994 data (previous Plan). Bottom line is we advise the County on what we think is best for [the County]. It's troubling that some of the most important data is fairly old and no new data collected. My concern is with the financials, going forward, if this very basic data is not collected properly. I don't think we should make a decision today based solely on this basic data. (MM, 2008).

On that same line of thought, another committee member noted that since the numbers were not accurate, they could have been skewed and interpreted in different ways. They noted that the point was to determine what would work locally and keep the realities in mind. The waste composition numbers that were used in the analysis are shown in Figure 11.

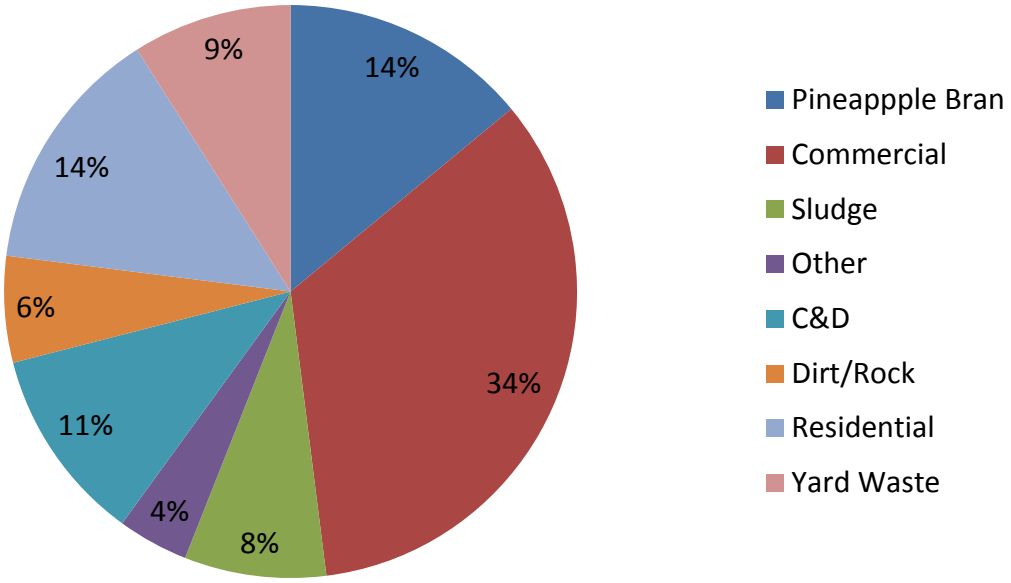


Figure 11: Waste Stream Composition 1989

The percentages in Figure 11 do not coincide with current estimated waste streams. For instance, it shows that residential waste is 14% of total waste composition, yet current estimates suggest that it is closer to 40% (GBB, 2009; INT, 2010). Sewage sludge represents 8% of the waste stream, but today sewage sludge is sent to a composting facility, rather than to the landfill. Food waste is not included in the composition mix, but it is estimated to be 26% in the U.S. (EPA, 2011f). Furthermore, the largest pineapple business in the county is not in operation anymore, yet Figure 11 indicates that pineapple bran is 14% of the waste stream. According to interviewees and the final plan, these were the numbers that were used by the consultants to conduct analyses and develop waste scenarios; however, they appear to fall short on accuracy and adequately reflecting the current waste composition of the county.

Overall, the interviewees were clearly not aware of cost models, though they did discuss them in meetings. The meeting minutes at one of the later meetings reflected many questions about the cost model used by the consultants. Someone asked if the assumptions used in the models were conservative estimates. The response was that they were not real "bullish." Committee members commented that the estimates related to land prices were 3-to-4 times under-estimated. Other questions were about all of the hypotheticals in the model, and whether they were able to do sensitivity tests. The answer by the consultants was a simple "yes" without further discussion. Another question was whether or not the model was available to the county. The consultants responded that the results were available, but not the model itself. The committee asked if there were flaws in the model based on the consultants' assumptions. The response was, "I'm not agreeing that the model is flawed. If the County wants something to

change, I think the County will bear the cost" (INT, 2010). Following this discussion, there was some disagreement about the numbers by the committee—some members wanted more information, and some members asked not to "nitpick." The consultants ended the meeting stating,

> In the end, the citizens of the county will pay for this. The only remaining question is how to get payment? My personal preference for solid waste services is fee for service, and everybody that throws away trash or participates in recycling knows what they're paying for. It's most equitable. (MM, 2008).

The minutes and interviews certainly reflect the frustrations by the committee members of the outdated numbers used by the consultants to develop the scenario projections. In addition, the lack of transparent access to the model to see what was being calculated, or the assumptions that were being made, led to heated debates and disagreements that were reflected in both the interviews and the meeting minutes. The last statement about the cost models says, "Please note that the [committee] have not been given Chapter 13 [the chapter on the financial models]" (MM, 2008). The cost model debates ultimately appeared to end with the acquiescence of the members' acceptance of the numbers provided by the consultants and moving on to look at the bottom line costs for the projected scenarios.

6.3.1.4 Waste Models Spur Sustainability Ideas

Waste models were not included in the original list of biophysical attributes or economics; however, when interview participants were first asked about "models," rather than talking about cost models, they immediately started talking about a one-week tour they took of west coast waste facilities. The committee members visited waste facilities in Portland, Oregon, Marion County, Oregon, San Francisco, UC Davis, and Monterey,

California. Additional data was collected about their experiences, since they appeared to be the highlight of the entire process.

Prior to the tour of the west coast facilities, there was discussion about it in the meetings, primarily about the upcoming sites and their landfill diversion rates. During the interviews, most participants brought up their trip to the west coast, and the "model" waste facilities that they observed, without being asked about it. Interviewees would become enthusiastic when they talked about their trip and all of the possibilities for reducing waste on the island. They returned home motivated to implement the new processes they observed.

Portland was chosen as a site visit because it had a 57% landfill diversion rate (MM, 2007). In Portland, the group reviewed the Product Stewardship Bill (HB2626), visited household hazardous waste facilities and a latex paint processing facility that takes thousands of pounds of used paint and turns it into recycled paint. In Marion, Oregon, they visited a WTE facility, which takes 550 tons of waste per day and produces 13.1 megawatts of energy that is sold to the local electric company. The highlight was the WTE facility for hazardous waste and the MRF. Several interviewees were adamantly against the idea of a similar WTE facility on the island. They feared the facility would blow toxic ash over the island on its way to the landfill,[30] since the islands have some of the highest winds in the Pacific Region (GBB, 2009).

They visited San Francisco because it has one of the highest landfill diversion rates (69%) in the country (MM, 2007). In San Francisco, they met with the recycling director and learned about the city's zero waste challenge. The challenge included the "Fantastic 3" program that serves over 300,000 homes and includes a three colored cart

[30] WTE facilities typically have ash byproduct, which is usually landfilled.

pickup system: blue for recyclables, green for compostables, and black for trash. They also toured the city's 200,000 square foot MRF, and other facilities that handle MSW, C&D, HHW, and composting materials (GBB, 2009). The highlights to the interviewees were the laws and policies in place to support recycling and composting. Laws that were discussed in San Francisco included PAYT, and requiring restaurants to set aside food scraps for compost. They have expedited building permits for people using recycled materials. One obvious difference noted by participants between San Francisco and the Hawaiian Islands was the extensive infrastructure and population support offered in California. It is much easier and cheaper for San Francisco to recycle because of their large population. The group watched boats loading up to 40 recycling containers per week to be shipped to Asia. They have much larger economies of scale, whereas on small, remote islands, there may only be a few containers to fill with recyclable goods, limiting the market for recycling vendors.

In Monterey, the group visited the waste facility that won the "Best Integrated Solid Waste Management Facility" in the U.S. Monterey has an extensive MRF that diverts 61% of waste from the landfill, including recyclables and green waste. They receive 132,262 tons of recyclables per year and process 41,000 tons of green waste. They also have one of the first landfill-gas-to-energy (LFGTE) facilities in the U.S. that generates 4.4 megawatts of power to sell to the local electric company. In addition, they have a HHW facility and a "Last Chance Mercantile" that receives reusable materials and produces revenue of $457,000 annually (GBB, 2009).

Monterey was the waste facility model that was most discussed in interviews. Interviewees avidly talked about its "impressiveness," how it was "well thought out," and

a "commonsense" model (INT, 2010). They thought it was the best waste model since it had a similar population and size. They talked extensively about its MRF, its sorting waste reuse center for construction items (asphalt, concrete, copper, paint, etc.), its LFGTE facility to sell energy from the landfill to the electric grid, and its composting facility and high-tech reusable sewage system. The facility was a small initial investment, and it still made a profit.

In Sacramento, they visited UC Davis, where they toured an anaerobic digestion[31] technology system. Many interviewees commented on the anaerobic digestion facility and how it was the "best in the world." "They were selling compost to all of the farmers and wineries!" (INT, 2010). They all indicated that this would be a good model for all of the food waste on a small island.

In general, the participants were highly impressed with all of the model facilities in each of the locations on the west coast. They observed facilities for WTE, anaerobic digestion, composting, recycling, and materials resource and resale centers. When asked if these visits affected the final outcome recommendations of the committee, interviewees quickly agreed that it did. "The visits provided different strategies and ideas as to what was possible with our population base" (INT, 2010). Even so, they also had reasons why they could not be implemented at home. One interviewee said, "There are wonderful things [happening] on the mainland, but nothing happened here. It wasn't even considered." (INT, 2010). In contrast to the statement, however, most of these models were considered and discussed at some point in the meetings (MM, 2008). The final

[31] Anerobic digestion breaks down biodegradable material in the absence of oxygen. It can be used for managing green waste and sewage sludge, and it also produces renewable energy.

recommendations include some version of most of them, with the exception of anaerobic digestion (GBB, 200).

The meeting minutes reflect a lot of discussion about the tour. The primary topic of discussion was that most of the visited facilities were run like a business. They manage the "business" off of the revenues (e.g., tipping fees). They discussed the impressiveness of the Monterey facilities, referring to it as the "Disneyland" of solid waste. But, even though it had similar population characteristics, some argued their model may not work on the island, largely due to cost, space, and infrastructure. For instance, one participant commented, "Space is important; we aren't like Monterey. We're so tight in our daily operations. [We] will need to acquire land for facilities." Another stated, "In California they made the decision to handle infrastructure….Now 20 years later they have a well-managed system" in reference to the lack of infrastructure to support the same facilities as Monterey on the island (MM, 2007).

During the committee meetings, participants watched videos of a plasma arc gasification process[32] (a WTE technology) that is utilized in Japan (MM, 2007). Interviewees commented to news reporters about the interesting aspects of the Japan plant. They also mentioned the costs involved, "Something like that would cost us in excess of $50 million….of course, we couldn't do that in one budget session, but maybe we could get the funding going and get some help from the state and federal government" (Janes-Brown et al., 2010).

[32] Plasma arc gasification is a method of WTE. It is a modified gasification process that uses electronically generated plasma torches or plasma arcs to convert waste into gas that can be used to generate energy.

In addition, the participants completed a tour survey where they were asked to rate the tour facilities on a scale of 1-to-4 (4=excellent; 1=poor).[33] Some of the results were presented during the meetings. For San Francisco, 100% voted for 4 or 3 for its green building approaches, and 81% voted 4 for their integrated planning approach. When asked whether solid waste should operate as a business, 100% of the respondents said yes. When each member was given a chance to provide one comment about the tour, San Francisco was mentioned twice, and was the only site mentioned. The other participants (in order of frequency) said food waste approaches seen on tour need to be modeled; waste collection needs to be universal and mandated; waste composition needs to be determined (versus numbers used from 1994); and the committee needs more time to discuss the tour (the minutes do not reflect any additional time given to tour discussion after this particular meeting) (MM, 2007).

The interviews, meeting minutes, final plan, and news reports all pointed to San Francisco and Monterey as having the best models for waste management, though Monterey was a better model with regard to size and population. There was a contagious enthusiasm when interviewees discussed implementing the same model as Monterey, but it was always followed by a "sigh" whenever they talked about making it a reality. Overall, the waste examples on the west coast were a positive experience for committee members. It gave the participants new ideas about what was possible, and many of those examples are reflected in the final plan. Economics was one of the key exogenous variables in the IAD model. The various attributes were all found to be in line with the

[33] The actual survey results were not available. The only data available from the survey was what was discussed in meeting minutes.

model with the exception of waste models. A summary of this section's results is illustrated below in Figure 12.

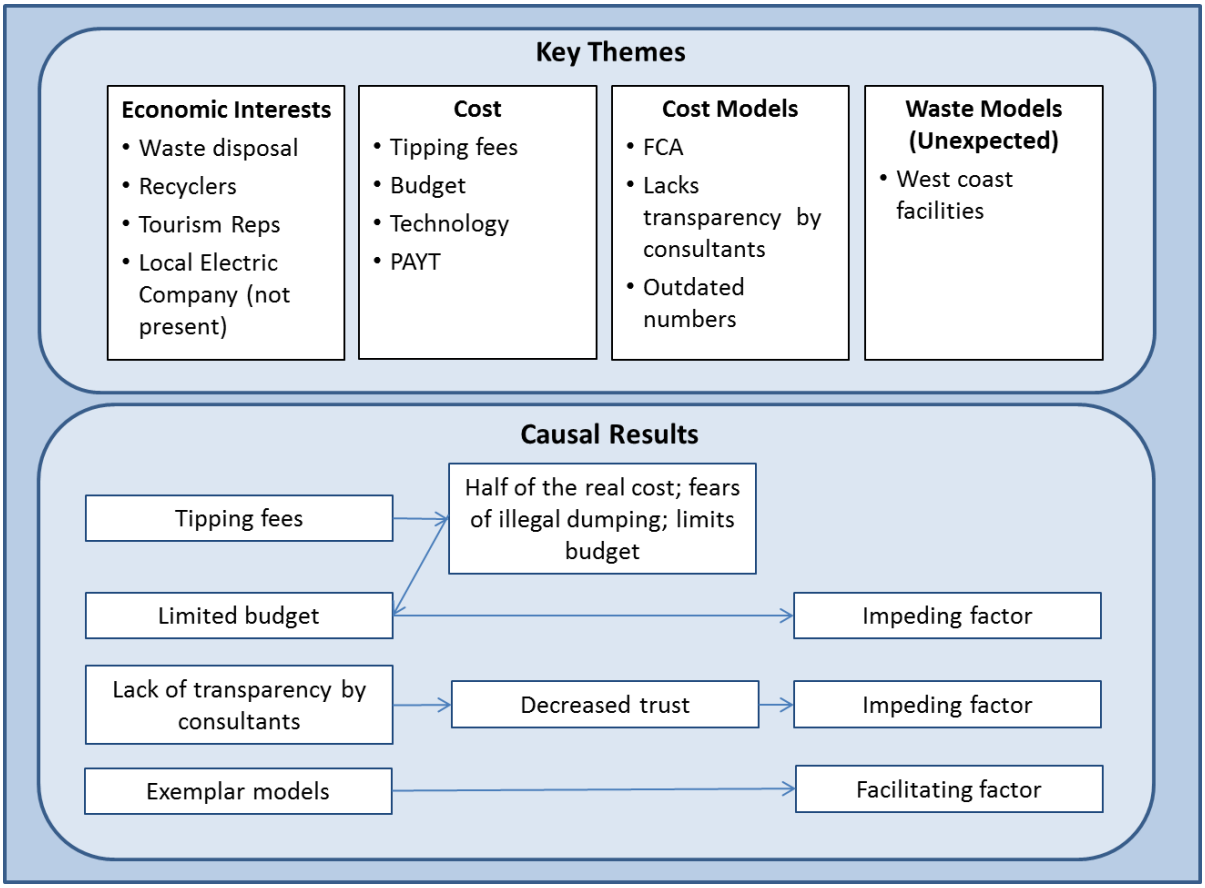


Figure 12: The Economics of Waste

6.3.2 Respect the "'Aina"

"'Aina" means "land" in the Hawaiian language. The slogan "Respect the 'aina," or respect the land, is a common phrase that is used across the Hawaiian Islands. It means to be gentle with the land and have respect and care for the environment. Several interviewees mentioned this slogan.

During the interviews, participants were asked whether the committee considered environmental characteristics during the decision-making process. According to one participant, "Every idea talked about carbon footprint." The participants focused on three primary issues: air pollution, land space, and water resources.

The most discussed topic related to the environment was air pollution. It was a serious concern for a WTE facility due to the potential for toxic air emissions and leftover ash that would have to be transported to the landfill and might be released and blown around the island. Almost every participant mentioned the potential problems with emissions from a WTE facility. Most people were opposed to it because of "pollutants coming out of the air." One participant said, "I don't know if there was much discussion on the environmental impact, but we did look at the emissions from different WTE facilities" (INT, 2010). "Toxic" ash from WTE was also discussed in depth during the meeting minutes (MM, 2008). Some interviewees, however, thought that WTE was very important due to the islands' dependence on fossil fuels to provide energy.[34] In addition, they noted that the WTE facilities they saw on the mainland were very "clean," and they thought it was more of an issue of public perception. There were further comments that only proven technologies should be considered, such as biogas and anaerobic digestion that were seen on the tour.

Land was the second most discussed environmental characteristic. Discussions in interviews centered on where they would find additional land space for more landfills. One interviewee stated, "The island is losing land space every day to erosion. We have a finite amount of land and need to make it last as long as possible." Landfills take up a lot

[34] Imported oil supplies 90% of Hawaii's energy (HCEI, 2011). Diesel oil is imported to the islands and serves as the primary method for generating electricity and transportation.

of space, and land is very expensive and scarce on a small island. "We can't afford to give up more land." Providing more land has also been an issue with recycling facilities. For example, there was a request for a recycling center on one side of the island that is about an hour away from the central landfill, but nobody would provide the land for the facility. According to one interviewee, there was "a lot of NIMBY and the community wasn't willing to make land space [for recycling facilities]" (INT, 2010). The meeting minutes reflected some discussion of land space with regard to WTE and the amount of landfill space that it would take to accommodate ash from the WTE process. They also discussed the space issue in more depth and the lack of available space for landfills (MM, 2007).

The other issue related to land was the proposed WTE ash by-product, and it's potential to spread around the land. There were many "what ifs" during the meetings. What if the ash blew out of the truck on its way to the landfill? It is toxic material that is dangerous on such a windy island. However, some interviewees felt that WTE was a very neat and clean process without any bad odors, and it would work perfectly in a small island environment. As described by one participant:

> We talked at length about WTE and how people think of burning. We visited a WTE in California – the ash was buried in the landfill, but it was a very clean and neat process with no bad odors. The tech scrubbers didn't emit anything harmful, but people were still concerned about air quality. I still disagreed about making it (WTE) profitable, and it not being sensible with waste. But WTE was still recommended in the end. (INT, 2010).

The last characteristic of the environment that was considered was water resources. Concerns about water pollution effects on marine life due to plastic bags, diapers, and other forms of waste blowing into the ocean were talked about in committee

meetings (MM, 2007). One interviewee mentioned the vulnerable aquifers on the islands, indicating some concern over possible water leakage.

While these issues were an indirect result of poor waste management, one of the most hazardous issues directly related to waste management approaches is leachate. Yet, leachate contamination from landfills was not mentioned during the interviews, and when probed, most interviewees did not know anything about leachate (INT, 2010). It can pose serious threats to soil, ground and surface water, public health, and the environment (EPA, 2011g).[35] Leachate was only cited once in the meeting minutes, when the consultant said, "EPA has limits on the way it is used….Algae [on the other side of the island] increases as ocean temperature goes up. Algae bloom because [of] nightshades in water. If leachate got into waste, [the] algae bloom impact is big"[36] (MM, 2007).

Overall, air pollution and land space were the most discussed environmental characteristics, mostly related to a proposed WTE facility and finding additional land space. Water issues were only briefly discussed. Endangered species and the ecosystem were never mentioned, nor were community or cultural values associated with air, land, and water. Even so, the environment mattered to the committee. It was very important to the process and appeared to be an underlying theme and concern throughout the process. Figure 13 provides an illustration of the environmental category results.

[35] Leachate pumps are required for larger landfills that receive over 500 tons of waste per year. However, for landfills that receive less than 500 tons per year, referred to as Conditionally Exempt Small Quantity Generators (CESQG), are exempt from RCRA hazardous waste regulations.

[36] Leachate is collected from landfills in leachate pumps and is considered a hazardous waste. However, leachate pumps are often emptied at waste water facilities. In Hawaii, most waste water facilities treat waste water and then release it into injection wells. There are extensive ongoing debates about whether or not the injection wells are contributing to algae bloom and coral reef destruction.

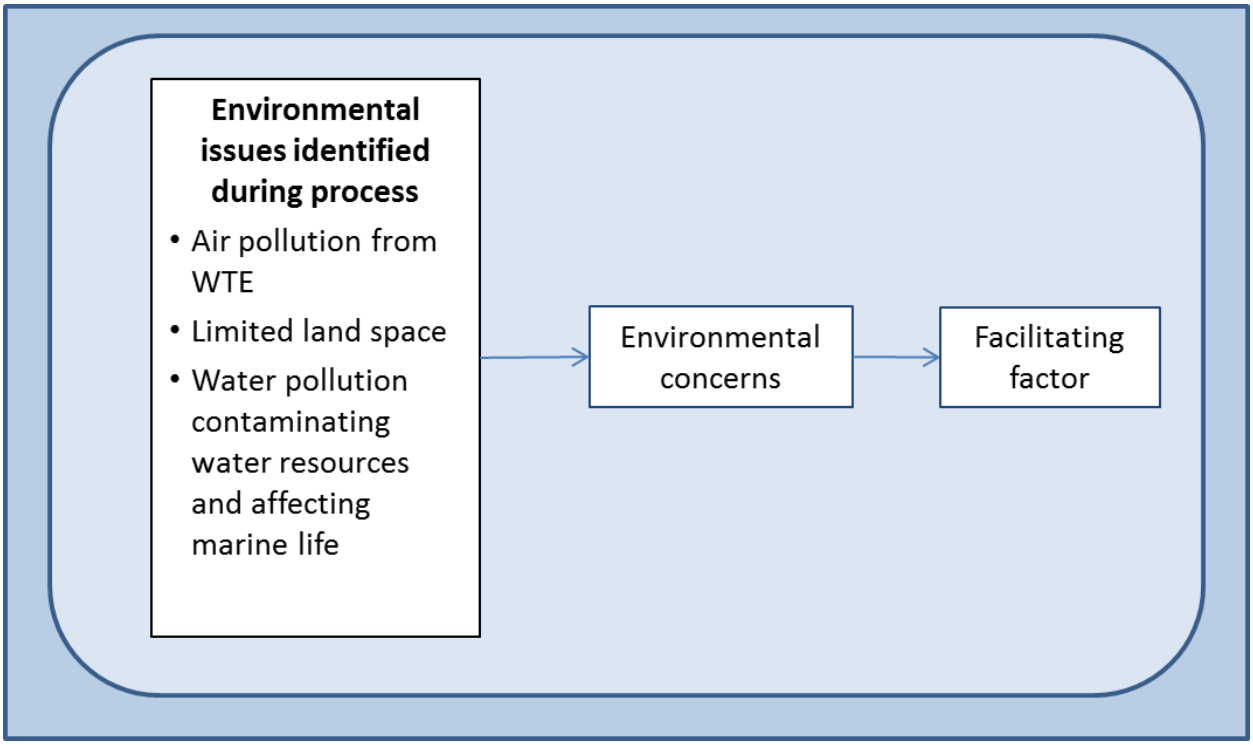


Figure 13: Environmental Issues and Concerns

6.3.3 Overcoming Exclusion: Should Waste Collection be Mandatory?

Exclusion refers to the people who are "excluded" from waste collection services. Data indicated that collection rates, infrastructure, and separate waste collection for hotels and condos were potential causes for exclusion. Interviewees in this study were asked how much of the island was serviced by waste collection, and whether waste collection was discussed in committee meetings. Participants' responses varied substantially. Waste collection services ranged between 20%-80% (INT, 2010). Waste collection was also discussed in the meetings but the percentages were also debated. The meeting minutes documented that 70% of the waste stream was commercial and had private waste collection rather than public. The consultant leading the meeting said that it was hard to determine who actually generates what waste, and thought the ratio was

closer to 50/50 residential versus commercial (MM, 2008). The final plan did not provide an overall estimate of residential/commercial waste collection rates; however, it did provide the percent of households in each community that receive waste collection services (GBB, 2009). The percentages were calculated and summarized in Table 7.

The total number of households was estimated at 50,920, with 24,107 households receiving collection. The percentage of waste collection for each community ranged from 25-80%. The numbers indicate that 47% of residential households receive waste collection (ibid), which means that over 50% of the residential population either has a private waste collection service (which typically only serves gated communities), or the household does not receive any waste collection.

Table 6: Waste Collection Rates per Community

Community	Households	Collection	Percent
Community A	670	249	37%
Community B	7,050	2,421	34%
Community C	1,300	640	49%
Community D	2,400	595	25%
Community E	8,500	6,696	79%
Community F	31,000	13,506	44%
Total	**50,920**	**24,107**	**47%**

Interviewees indicated that the primary cause of exclusion was poor infrastructure. Interviewees talked about the difficulty of waste collection on roads that are narrow and often unpaved. Residents who live on those roads do not pay waste collection fees. They are responsible for taking their waste to the landfill themselves (infrastructure is discussed in more detail in the next section).

Another cause of exclusion was that gated communities, condos, and hotels had private vendors collect their waste. Interviewees claimed that private waste collection services were burdensome to single family homes:

> Single family homes can be picked up by the county, but condos are not serviced by the county so a different waste company picks it up. Tons of waste trucks end up coming through at 5am bothering single family home residents. That is poor planning and causes problems (INT, 2010).

Meeting minutes provided documentation of collection discussions and how legislation should require waste collection by gated communities, since they do not pay for their portion of the cost. The facilities that they visited on the west coast tour required waste collection as an important part of the process. On the mainland, there are ordinances, including system fees, regulation, and education for gated communities that helps to pay for the system costs. It would be made easier if the county implemented an automated waste collection process. Waste collection is a dangerous job, and workers compensation is a huge concern. Switching to an automated collection would decrease the dangers, but due to the poor infrastructure in many areas, it would be difficult to implement (MM, 2007).

One of the consultants presented the challenges to waste collection in one of the meetings. The consultant said that there was a lack of standard for services and transportation problems. The current waste collection process had inconsistencies with scheduling, and everything went to the landfill instead of separating recyclables and green waste first. There is not a scale to measure the amount of waste per household, but they estimated it to be 60 pounds a week per household. The consultant recommended that everyone should have waste collection, and nobody should be excluded. Universal collection would mean collecting waste, recyclables, and green waste for everyone, but

the fees would have to increase by over 100% ($48 vs. $22). The core concern was about how to enforce it (via mandate or property taxes), how to deal with the lack of appropriate infrastructure, and how to pay for increased collection when the solid waste division was already being subsidized (MM, 2007).

Solutions were proposed by interviewees. The first potential solution was that waste collection fees should be a part of property taxes. Over half of the interviewees mentioned this solution, and said it was extensively discussed during the committee meetings. It was ultimately rejected as a final recommendation, but they still thought that it was worth pursuing in the future. The second potential solution was that waste collection, and paying the associated fees, should be mandatory for residents that live on serviceable roads (INT, 2010). But again, while the majority of participants thought that collection should be mandatory, it was not recommended in the end. The final proposed solution was that gated communities should be eliminated. Other Hawaiian islands have considered banning gated communities (MM, 2007). However, it was not discussed in depth and not recommended in the final plan.

6.3.4 Transportation Planners: Key Stakeholders for Waste Policy

Interview questions related to the island infrastructure asked whether the committee considered the infrastructure of the county, since over half of the residential homes do not have curbside collection. Several interviewees said that there was not any discussion about the roads, or updating the roads, to facilitate greater waste collection. One participant said that the waste process was not the process for solving infrastructure problems—that was an issue for the county's general planning commission. Another interviewee stated, "We don't have an infrastructure for transfer of solid waste. No space

for it." (INT, 2010). However, other interviewees said that there was a lot of discussion in meetings about infrastructure and how it affected waste collection (INT, 2010). There are many routes that cannot handle waste trucks, so in many areas of the island, waste trucks do not have access. Transfer stations for waste collection were also discussed. Locations with narrow roads or gated communities are usually covered by private services, and there needs to be more transfer stations to service these areas.

WTE facilities were also mentioned in response to infrastructure questions. While a WTE facility would not require as much land space as a landfill, it could be just as controversial in terms of NIMBY. The same was said about recycling facilities and curbside pickup. The general thought was that there was never enough land space or serviceable roads to handle most waste collection mechanisms.

The meeting minutes reflected comments about infrastructure, such as the roads were "substandard," and there were many "undrivable" roads. The meetings concluded that the transportations systems department would need to figure it out, and not the waste committee (MM, 2007). The infrastructure of the island is generally good in the central areas but poorer in more rural areas. The residents want to keep these areas undeveloped. Expanding roads and proposing new development in rural areas of the island often result in an uproar from the community, according to interview participants. One of the reasons that residents are attracted to rural areas is because large trucks are *not* allowed on the roads[37] and the noise levels are low. There was consensus from committee members that infrastructure was not something that they wanted to address and try to change because they understood the lifestyles residents desired. Because of this understanding, the

[37] For residents who live on these roads, many can opt to receive waste collection if they take their waste to a nearby road that allows waste trucks one day per week.

general conclusion was that infrastructure was a problem, but there had to be more ways to work around it, rather than expanding and building more roads. Having a transportation planning expert on the committee would have helped to address this issue. Figure 14 provides an illustration of the results of the exclusion and infrastructure categories.

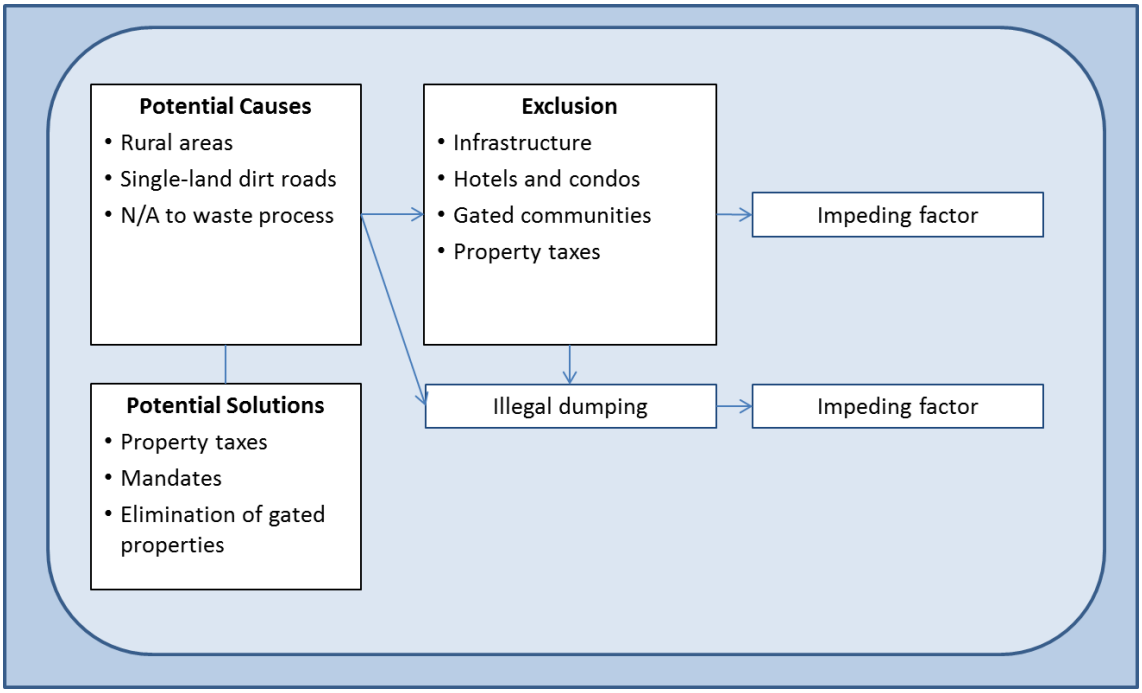


Figure 14: Poor Infrastructure Leads to Exclusion

6.3.5 Isolation Leads to Higher Import/Export Cost

Remoteness is not unique to Hawaii. It is estimated that there are 20–30 thousand islands in the Pacific Region, and many more around the world. In this study, interviewees were asked: "Did the committee consider the remoteness of the county? The responses revealed that people identified with two kinds of remoteness: internal and external.

Internal remoteness was defined as areas of the county that are "remote" in relation to the more industrial areas of the county. Remote areas are rural locations with small populations, many narrow one-lane roads that are often unpaved and are farther away from the central landfill. The remote locations were often described as like being on another island because of the difficulty and time to get to them. Several of them have small landfills, as they are too remote, and it is too costly, to facilitate waste transport to the center of the island. Even so, problematic issues still arise. For example, wood debris ground at one facility cannot easily be transported to the central facility, but purchasing multiple grinders is expensive. Furthermore, some waste disposal sites in remote areas do not have enough work to justify full-time positions. The cost of waste management is also higher in these locations because of the "noncontiguous land mass and lack of regular transportation available" (GBB, 2009).

Hazardous waste collection was another important issue identified with remote areas. Interviewees claimed that the island does not have the population base and funds to support hazardous waste collection. There is typically only one hazardous waste collection event per year, whereas there should be regular events since it must be shipped within a certain timeframe. The time sensitivity makes it extremely difficult to adequately handle.

External remoteness was problematic for importing exporting. There was a deep-seated understanding among all of the participants about the island's external remoteness. One interviewee said, "There wasn't anything to discuss because everyone already understood it," and "[our remoteness] was understood; we didn't have to discuss it." However, importing goods was brought up in most interviews as one of the principal

issues with waste on the island. The committee talked about requiring importers to be responsible for the goods after they were delivered to the island. Most interviewees mentioned the need for stricter policy on imports and packaging. For instance, the county could require manufacturers that shipped goods to the island to take back appliances, electronics, and automobiles after they were used. [38] Even though this option was discussed, the final consensus was that it was too involved politically, and there would be too much of an uproar from business vendors if policies on imports were tightened.

Exporting was another identified issue with remoteness. There was discussion about the difficulty of transporting waste from island to island and to the mainland, and the additional cost that this would incur. The county has "unique needs" compared to other municipalities on the mainland (MM, 2007). Most of the discussion on remoteness during interviews was centered on recycling, and the issues inherent in exporting materials to recycle. One interviewee responded to the question about remoteness, stating:

> Yes, it was taken into account particularly with recycling. There are two components: 1) the population is too small to support a high level of recycling. 2) Recycling is a numbers game. It is very expensive. We lose money and not many businesses are able to make a living recycling. The alternative was to collect the recyclable materials, sort it, bail it, and then ship it off island. However, remoteness plays directly into that because we are so far away. We also discussed shipping waste to Oahu because they have a WTE facility that is not maxed out, but it was not considered as a viable option (INT, 2010).

Recycling is dependent on the market; there may be a buyer one day but not the next day. Most importantly, everything related to waste management is more expensive *because* of remoteness. Interviewees talked about how much more it cost to recycle on the island

[38] The State of Hawaii recently passed a law that requires electronics to be shipped back to the producer for recycling (http://www.capitol.hawaii.gov/session2008/bills/SB2843_CD1_.htm). However, interviewees noted that this law has not been abided by thus far. Electronics are still being disposed of in landfills.

than on the mainland. Only certain items can be recycled. "People don't realize it costs so much to ship off island, and companies have to do that for profit. [Recyclables] must be clean and neat with no contamination – lots of regulating." (INT, 2010). The island can only "import so much and only handle so much recycling."

Shipping waste was more prevalent in the news than in interviews. Numerous articles were published over the last several years about the possibility of shipping waste to the mainland. In one news article, a committee member was quoted, saying, "As islands, we need to be very responsible with our waste. We cannot just ship to another state, like a lot of places do on the mainland" (Janes-Brown et al., 2008). The other articles are mostly related to the planned shipment of thousands of tons of waste from Oahu to Washington State, which was derailed due to a lawsuit (see Chapter 1).

Overall, importing goods and exporting recyclables and waste were the top issues affected by remoteness. Isolation from other major land masses places Hawaii at an economic disadvantage. The islands cannot easily ship waste to other states for disposal and exporting recyclable materials to vendors in other countries is often challenging. While interviewees thought that it was important to recycle, they also saw the intrinsic obstacles that decrease its viability.

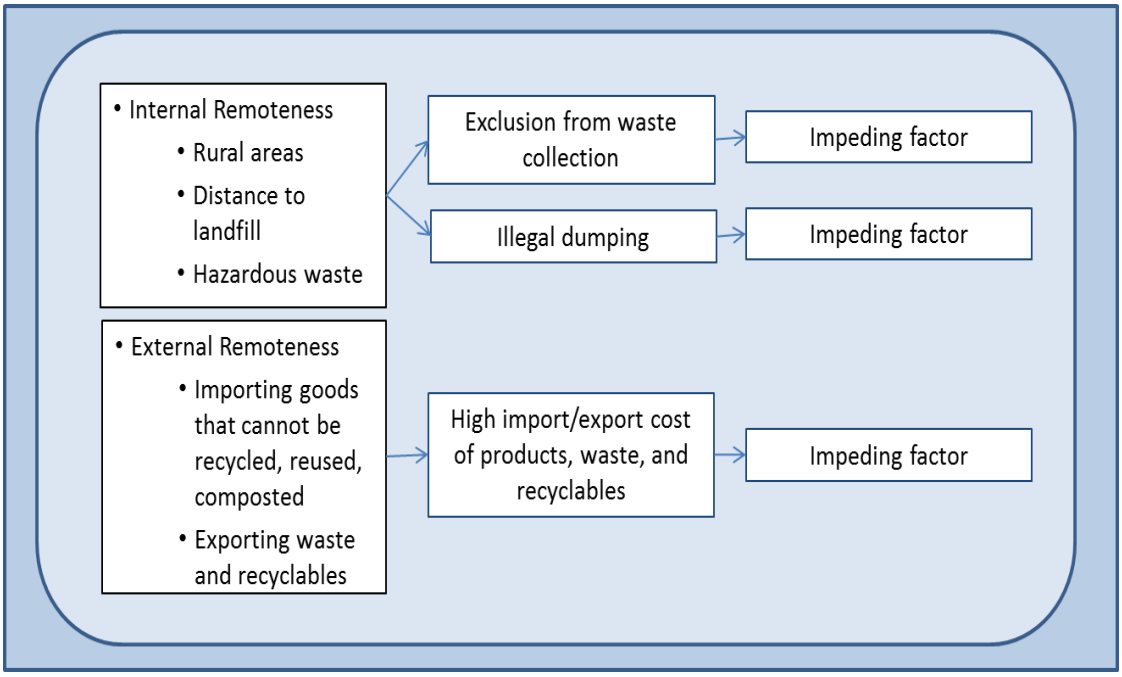


Figure 15: Internal and External Remoteness

6.4 "The Life of the Land is Perpetuated in Righteousness"

The population of the Hawaiian Islands is very diverse. They are essentially a "melting pot" of ethnicities from around the world. However, the ancient Hawaiian culture is alive and strong, and cultural events are regular tourist attractions. The Hawaiian word for "earth" is "honua," which means foundation. Native Hawaiians believe that honua is not separate from them, but a part of them and their foundation. Numerous Hawaiian proverbs are about the sacredness of the land, and the importance of protecting the land. The Hawaiian state motto, ua mau ke ea o ka ain I ka pono, means the life of the land is perpetuated in righteousness. While Asian and western civilizations have migrated to the islands over the last few centuries, exceeding the Native Hawaiian population, there is still a strong loyalty to the traditional Hawaiian culture and beliefs.

During interviews, participants were asked if cultural issues were deliberated on during the waste decision-making process. Most respondents indicated that it was not directly discussed. One participant noted that "within the committee, there was cultural diversity, but it was not explicably discussed; everyone had the same goal of the greater good for the world. Everyone understood what it meant to live here and wanted to sustain our quality of life" (INT, 2010). Another interviewee said, "No Native Hawaiians [on the committee] discussed Hawaiian traditions, but the pig farmers were outspoken."[39] Others couldn't recall, "I'm sure they were discussed, but not sure I remember" (INT, 2010).

If culture was mentioned at all, it was more in terms of education, economics, or land. For example, one participant responded, "There was some discussion [of culture], but most of it focused on the educational aspect of it…no discussion on generations and how they handled waste or how culture didn't keep up with waste. We did discuss the progression of waste composition and how it changed over time." Other respondents said it was more about economic factors—some populations on the island were poorer, and they were the ones that were less likely to pay for waste collection and more likely to illegally dump their waste. Another participant said, "Land is a big concern [with cultural issues]. If you take away from the "aina,"[40] there will be cultural problems because land wasn't meant for that!" (INT, 2010).

Identifying more sustainable approaches to waste management is an important part of respecting the Hawaiian culture. The primary cultural concern about waste management seems to be about the landfills. Local residents are reminded of it daily

[39] It was unclear through the data whether or not there were any pig farmers on the committee.
[40] Aina means land in Hawaiian.

when driving around the island. They are concerned about how large the central landfill has become. One interviewee stated, "My main concern is how large the landfill has grown since I was a kid. It keeps growing and growing and is an eyesore to my view of the ocean. I don't understand why it is in the middle of the island for everyone to see." (ibid).

Although culture was limited in meeting discussions, residents are very concerned about the condition of the land. According to one interviewee:

> Hawaiians have a special affinity for "aina" [land]…Hawaiians think of themselves as "isolates" and have a special relationship with the land and believe it impacts everyone's life. They convey this message to their children and take it very seriously… This has been the case since the earliest history and is an integral part of the culture (INT, 2009).

The participant repeated the Hawaiian motto three times during the interview ("Ua Mau Ke Ea Oka Aina I Ka Pono"–translated as "The life of the land is perpetuated in righteousness"). Local Hawaiian residents, in particular, appear to feel a sense of passiveness about the issue. According to several interview participants, Native Hawaiians have given up caring because they do not feel that they have any control over it. They are not in charge of the process and do not feel that their input is valued or utilized, that it comes from the "higher sources that are out of our control" (INT, 2009). As one participant stated, "The Caucasians who have moved to the island seem to care more about making change happen" (INT, 2009).

One comment was particularly notable because it aligned with the ancient Hawaiian principles of land and ahupua'a systems.[41] The participant said that it is a cultural norm for waste to be taken care of for free. "Everyone expects it to be taken care of for free because government has taken care of it so far." However, it also reflects the

[41] Within the ahupua'a system, land was free; there was no such thing as land ownership.

fact that waste issues were not a problem over a century ago. Waste not a part of the Hawaiian vocabulary before westerners arrived. However, as more people began bringing more products to the islands, waste began accumulating, and eventually the government stepped in and began managing it.

6.5 Island Tourism: An Opportunity for Increasing Sustainability

Tourism places a considerable burden on waste management resources in Hawaii, as the average per capita amount of waste generated in Hawaii is estimated to be up to three times greater than the average rate of the U.S. Each interviewee was asked if tourism was discussed and how it affected waste disposal. The responses indicated that tourism was not discussed in depth. For instance, one interviewee said that it was "not really mentioned," and another said, "[it] was looked at, but I don't remember which factors" (INT, 2010). Two interviewees said that there was a stakeholder on the committee who represented the tourist industry, so there was no real need to discuss it specifically. They both felt that if an issue arose, the stakeholder was there to represent that industry.

However, most interviewees indicated that tourism is important to the economy, and that it also produces the most waste on the island. The tourist industry is the "economic engine of the island," and tourists "generate most of the waste," and "contribute *a lot* to the waste stream." In response to the questions on the economic interests, one participant talked about how tourism is the number one economic interest of the county.

There were some negative insinuations by interviewees that the county was not setting a good example for tourists since they did not have curbside recycling. Some

interviewees thought that the tourist industry needs to stand up as the leader for waste reduction and better waste management practices. "[The tourist industry] should do more and contribute more; they generate lots of waste and especially food waste." Another interviewee said, "Tourists recycle the rest of their lives and freak out when they can't recycle here." Other places have recycling bags in hotels, but that has "never happened here." The committee was not sure how to get the same message across to tourists on the island. Others thought that the tourist industry was already leading the way "in terms of green waste and recycling." Examples were given, such as a condominium guide book that showed tourists how to recycle (INT, 2010).

When probed about how waste activities affected tourists, two participants addressed the comment directly. One said, "Everything we do affects tourism. The island is known as a safe, clean, pristine place. [We] didn't discuss that visitors would be appalled by [mass] burning [of waste], but it is important to preserve islands as much as possible because [tourism is] the economic engine." The other participant said that the visibility of illegal dumping and beach waste was always a concern (INT, 2010). In contrast, another interviewee was disagreeable about tourism, stating, "Tourism was the culprit for waste. Tourism brought waste. Before, everything was composted and went back into the earth and was used again for soil" (INT, 2009).

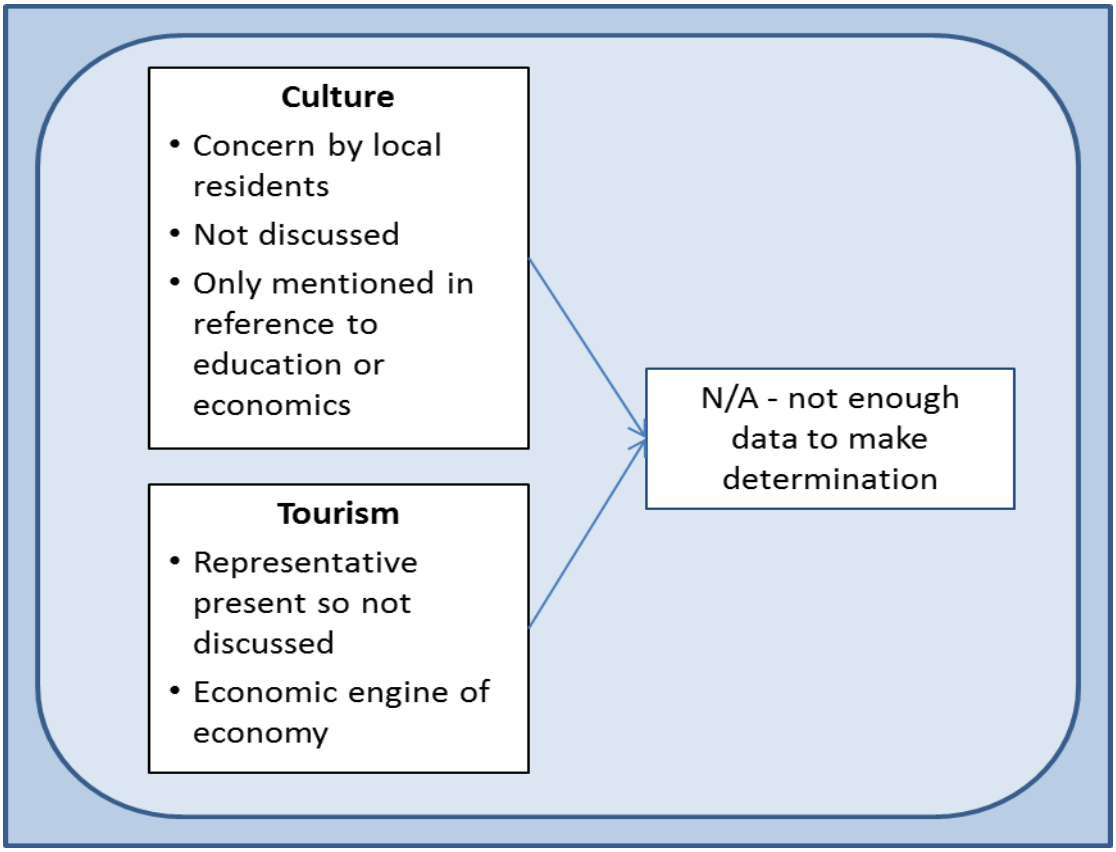


Figure 16: Culture and Tourism Community Attributes

6.6 Illegal Dumping: Not "Pono"

6.6.1 A Behavioral Norm?

Behavioral norms are a key category in the IAD framework. Illegal dumping was the primary behavioral norm identified during the data collection process. It has been an on-going problem for decades in Hawaii. In interviews, participants were asked whether illegal dumping was discussed, who they thought were the culprits, and why people illegally dumped their waste. Results indicated that it was one of the more passionate topics discussed in interviews and committee meetings.

Abandoned cars and appliances were the biggest discussion topics. According to county employees, about 180 cars are abandoned each month. Abandoned vehicles are

common sites on the island, many of which are dumped on commercial agricultural land, such as in sugar cane fields and gulches. Commercial agriculture companies spend thousands of dollars per year replacing fences that are broken by people dumping broken-down or totaled cars. Some interviewees believed that the illegal dumping of vehicles is such a monumental problem that the government should place limits on the number of new cars imported to the island. In addition to cars, illegally disposal of appliances is a problem. Interviewees stated that the problem has improved over the last several years since a metal recycling facility starting accepting abandoned vehicles, and the county began picking up appliances, also referred to as "white goods."[42] According to county officials, they pick up over 1200 white goods per month that they dispose of for free in the landfill. However, even if some are collected, the problem still exists. Observational data confirmed that hundreds of cars and appliances are still regularly dumped at illegal dumping sites (see Section 6.6.2 and Appendix K).

When interviewees were asked who was illegally dumping waste, participants pointed to the island residents. "Visitors don't throw mattresses on the beach" (INT, 2010). Most participants were careful in their responses to this statement and alluded to economic differences within different cultures. As one participant stated, "Everyone was careful not to point to one ethnic group or the other. There are different waves of immigrants to the islands over time, and their behavior is different, but [illegal dumping is] mostly related to socio-economic strata of cultures and not so much race" (INT, 2010). Another interviewee said that illegal dumping was the closest thing to cultural issues that was ever discussed in committee meetings; illegal dumping occurred within certain cultures that were poorer and less informed. In addition to certain cultures, participants

[42] White goods are large appliances, such as old refrigerators, washing machines, and dishwashers.

thought that the residents, living in rural areas with narrow, single-lane, often un-paved roads where waste collection trucks do not have access, were the primary offenders for illegal dumping.

The potential motives for illegal dumping that were identified during the data collection process included tipping fees, lack of enforcement, ignorance, laziness, remoteness, and free-rider problems. Previous research found that one of the most likely reasons for illegal dumping was cost (Ngoc, Schnitzer, 2009). Likewise, interviewees said that cost was the most likely potential cause for illegal dumping in Hawaii. Either they do not want to pay, or cannot afford to pay, the tipping fees. Every interviewee, with the exception of one, said that illegal dumping was driven by costs.

> There are crazy amounts of illegal dumping because people don't want to pay the monthly waste pickup fee….People don't always pay for refuse collection because they think $12 is too expensive. It is not mandatory so we have a lot of people take it directly to the landfill, and we don't charge…it is free to residents. But here we do have a lot of illegal dumping….People dump stuff on the side of the road…trash, sofas, and all that…We have big problems with automobiles and white goods… White good meaning appliances…washers, dryers, water heaters things like that. They just chuck them on the side of the road, even though we take them for free and we pick it up free. People still drop on the side of the road. (INT, 2010).

Many indicated that the county was fearful of raising landfill tipping fees because illegal dumping would increase. This correlates with current research that indicates that people find ways to evade governance rules (Dietz et al., 2003). As tipping fees increase, illegal dumping also increases (Kim et al., 2008). According to interview participants, the county tipping fees have remained steady for over a decade because they want to prevent illegal dumping, even though the expenses incurred by the county for landfill maintenance and waste collection have increased.

The landfill tipping fees during the time of this study were $18 per month per household, although, as one interviewee stated, "$18 only gets you halfway to the landfill." The real cost of transporting waste from residents to the landfill and landfill maintenance is estimated at $35. In other states, landfill tipping fees generally range from $30-$50. However, in Hawaii, "people complain [when rates go up] and then want a credit for their bill. There is a fear [by the county] about increasing fees." Another participant stated:

> People who can't afford service will do more illegal dumping. I like the Pay-As-You-Throw idea. People like the concept for recycling, green waste, and waste. [We] can save money in options. The cost for pickup went from $2 to $18, and the outcry was horrendous. The cost is actually $36. Pick-up is two times a week. People don't know the [actual] costs (INT, 2010).

Several participants mentioned adding tipping fees to property taxes as an effective method for obtaining the full costs (also discussed under exclusion and infrastructure). Other interviewees discussed the poverty level in the county.[43] "[The island] has a large population who can barely afford to live here, and they cut costs where they can. Financials of population are driving this [issue]." (INT, 2010).

The second most mentioned reason for illegal dumping was lack of enforcement. While prohibitive signs and fences are often posted at common illegal dumping sites (see Appendix K), it does not appear to make a difference. Most people know that the rules are not enforced. Interviewees had never heard of anyone being caught. "[Illegal dumping] is everywhere, but we lack the ability to enforce [rules against it]. [To stop it] it would require an enforcement team and for it to be criminal." (INT, 2010). They also indicated that it typically occurs at night when nobody sees it. Suggestions were made

[43] According to the U.S. Census, 9.3% of Hawaiian residents live under the poverty level in Hawaii, which is about 4% lower than the U.S. average of 13.2% (Census, 2010).

that the county start ticketing the people who dump their cars by looking up their registrations. However, as one participant said, "Police don't get involved because there is no political will or they don't think it can be done." Either police do not try to find out who owns the cars, or it is difficult to do since people often do not register old cars, according to interviewees.

Several participants thought that people illegally dump white goods because the county does not pick them up. Even though the county began picking up white goods when requested, some residents claim, "They never show up when they say they will. They say they will pick up on Thursdays, but they don't." (INT, 2010).

Lack of education or ignorance was documented as the third cause of illegal dumping. Interviewees thought that the general public was not aware of their environmental impact with regard to waste. The committee discussed the need for greater public education and awareness about how residents could reduce and recycle waste, and lower their environmental impact on the land. Nobody provided details about specific implementation strategies discussed for educational campaigns, but the overall consensus was that lack of education was one of the primary causes of illegal dumping.

The forth potential cause off illegal dumping was laziness. Residents who do not have waste collection are "too lazy to drive to the landfill" (INT, 2010). If residents knew the long-term environmental impact of illegal dumping and potential land contamination from illegal dumping, they may be more motivated to pay for waste collection or take the time to drive to the landfill.

Laziness may be driven by internal remoteness, which was the fifth reason identified. Rural residents without waste collection may rarely drive into town where the

landfill is located. With some of the highest gas prices in the nation, it is an easier, more "cost-effective" approach to dump waste over a gulch or in a sugarcane field where nobody will see it, rather than to spend the time and money on gas to drive an hour to the landfill.

Finally, the free-rider effect was mentioned as a potential cause of illegal dumping. Free-riding is when consumers shoulder less than their fair share of the cost of a something. People dump their waste, leaving it for others to clean up and bear the cost. As one participant said, it has a "magnet factor–once one person dumps, it draws others." They know they will not be caught, and the county will eventually pick up their trash for them.

The general consensus on illegal dumping was that it is an ubiquitous, irresolvable issue. Only one participant talked about positive improvements that have been made. They said that there was a lot of illegal dumping in the past, but there has been a noticeable decrease in it all over the island due to the efforts by the county to keep things clean. Despite their positivism, they ended their statement with little hope for a total end to it, stating that it will "always be here."

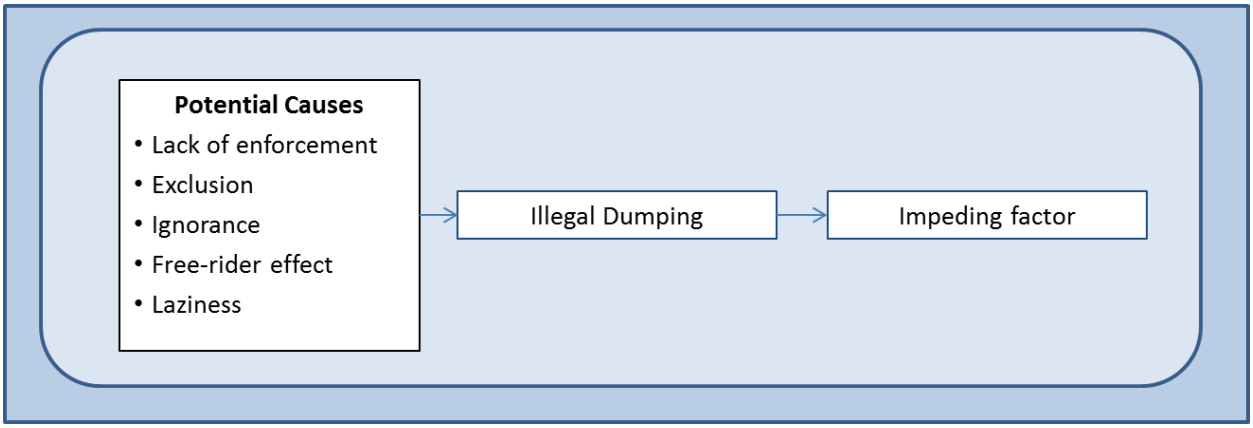


Figure 17: Identified Causes of Illegal Dumping

6.6.2 A Closer "Look" at Island Illegal Dumping

In addition to interviews and document reviews, site visits were conducted around the island at illegal dumping areas. Twenty six dumping areas were observed and documented.[44] The site locations were mapped to provide a visual display of their closeness to landfill and water sources. Site observation summary forms were completed for each location (see Appendix E). The coding categories included *Type, Content, Size, and Distance. Type* was defined as the type of site location. There were four types of locations: 1) sugar cane field, 2) sea cliff, 3) gulch, or 4) roadside. *Content* included the disposed material characteristics of the site. Disposed characteristics included automobiles, farm equipment, appliances, hazardous waste, household goods, automobile parts, obnoxious odor, dumping prevention mechanisms (rail guards, fence, etc.), and signage that prohibits dumping. *Size* was defined as the number of disposed materials at each site.[45] *Small* was defined as under 10 items, medium was 10-100, and *large* was

[44] The actual number of illegal dumping sites is higher. They are often hidden from view and only know through word-of-mouth. Many more sites were located after observational data was collected.
[45] Size only includes the number of waste items, not the actual size of the location. For instance, "small" sites were not necessarily small in size, only that the site had less than ten items. Some small sites had

over 100. *Distance* was defined as the distance to the landfill from the site location: less than 10 miles, 10-30 miles, or over 30 miles (see Appendix I).

Sea cliffs had the highest number of sites (41%), following by gulches (33%) and sugar cane fields (26%). Sea cliff dumping sites are usually easy to spot, which might be the reason it has the highest percentage. Visible sites (58%) could be seen by anyone driving in the area and paying attention. Many of the sites were not in visible locations (33%). These were usually in gulches and sugar cane fields where it is easier to hide waste. These sites were usually found by word of mouth from the local residents. Some sites were identified by odor alone. Thirty three percent of the sites had odors that were so strong, it was difficult to breathe. Several sites were located near fresh water sources (7%).

Household garbage was identified at most of the sites (70%). It was usually in kitchen or outdoor trash bags. Other waste content at the sites included automobiles (41%), appliances (26%), automobile parts (26%), hazardous waste (11%), and farm machinery parts (7%). Some of the waste sites had prevention mechanisms placed by the county or private property owners to prevent dumping. Signs (23%) and gates (19%) prohibited illegal dumping, but they did not seem to deter people from dumping their waste. The site with the most signs also had the largest amount of waste (see Appendix K).

Most of the sites were small (36%) or medium (36%) in size. The large sites (28%) were usually commonly known dumping areas, some at least an acre large with all types of waste content. The majority of the sites were located within 10-30 miles of the

---

abandoned automobiles, which can utilize a lot of space. The size of the locations ranged from several square feet to several acres.

nearest landfill (60%). Some sites were located further than 30 miles away (24%) from the landfill, and others were located within only ten miles of the landfill (16%). Residents who dumped their waste less than 10 miles from the landfill would have had to drive about 10-20 minutes to properly dispose of it, and those who dumped 10-30 miles from the landfill would have had to drive about 30-45 minutes. The sites that were the greatest distance from the landfill could easily be over an hour drive away.

Overall, the observational data indicated that sea cliffs were the most likely place to illegally dump (though this might be due to the visibility effect of finding sites during data collection). Household garbage was the most common type of waste observed at the sites. Most sites were small or medium in size, and only a small percentage had prevention mechanisms in place. The majority of the sites were located about 30-45 minutes away from the nearest landfill. The Illegal dumping site characteristics are displayed in Figures 18 and 19.

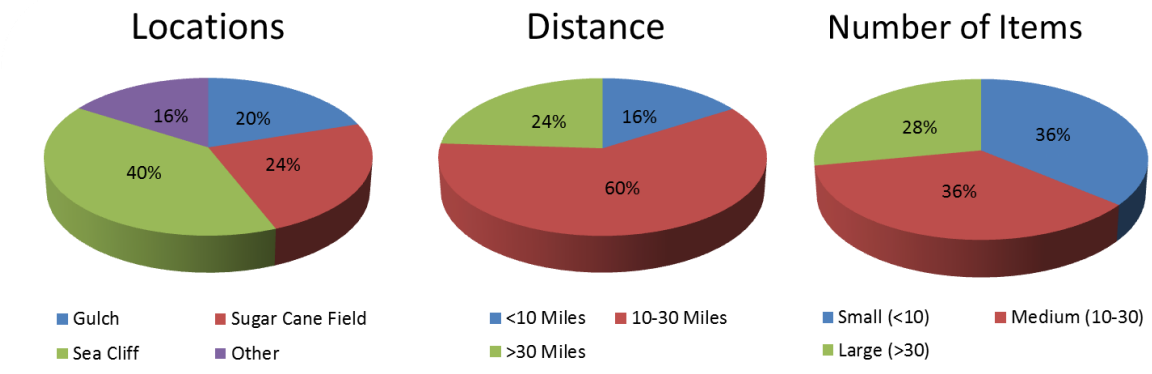


Figure 18: Illegal Dumping Characteristics

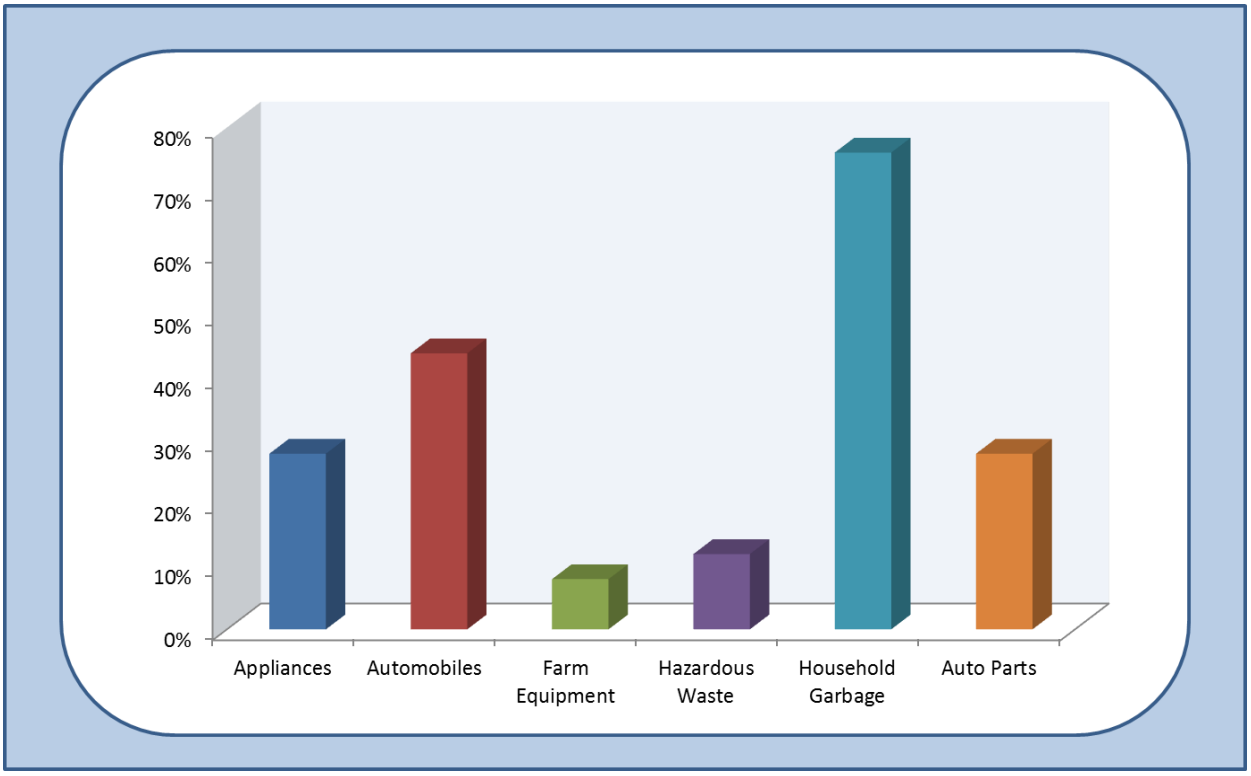


Figure 19: Illegal Dumping Items

6.7 Alternative Waste Management Approaches

Alternative waste management approaches and issues that were identified during the data collection process were also categorized in NVivo. As illustrated in Figure 20, WTE was the most discussed approach during the interviews and in the meeting minutes. It was also the most controversial among the stakeholders. WTE was followed by recycling. It was primarily discussed in terms of how to increase it, since it is often difficult to find market vendors abroad. Composting, PAYT, commercial waste, and zero waste approaches were also approaches that were discussed as viable solutions.

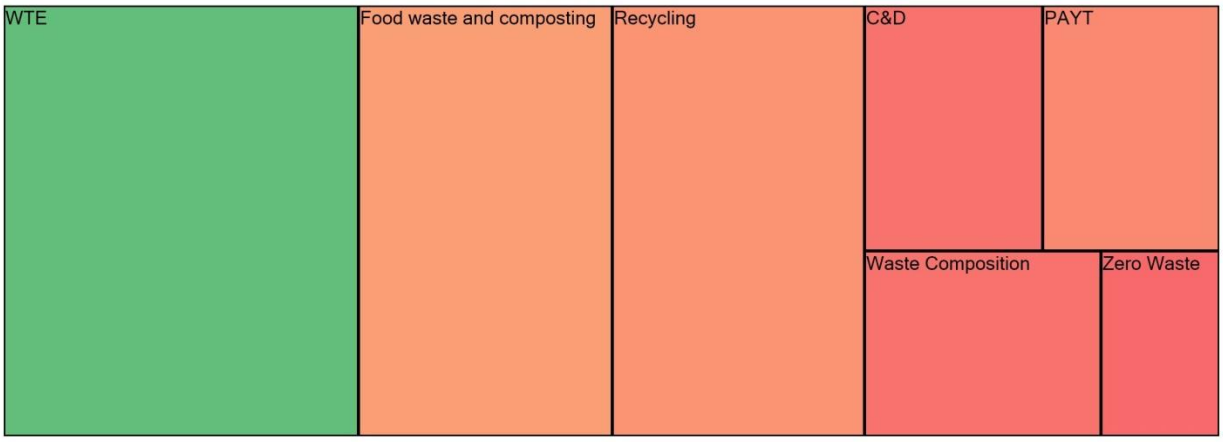


Figure 20: Alternative Waste Management Approaches by Number of Items Coded

6.8 Sustainable Outcomes?

6.8.1 Recommendations

During the time period of the committee process, and before the recommendations were developed by the committee, the central landfill reached capacity and was expanded to four times its original size. At the time, it was expected that the expansion would extend the life of the landfill for at least another 30-40 years. Committee members were not a part of the decision to extend the landfill capacity. It is impossible to determine how it would have affected the outcomes if the committee was involved in the decision.

The final recommendations made by the committee are listed in Table 7. The resulting recommendations were not concrete approaches that could be implemented right away. They were somewhat vague, such as "increase environmental education." This makes it difficult to assess whether they pass the criteria for weak or strong sustainability. As discussed in Chapter 3, landfills can only, at best, meet the standards of weak sustainability, so most approaches that work toward increasing landfill diversion are likely "more" sustainable. For instance, the first recommendation was to increase the

amount of waste materials diverted from the landfill for recycling and composting to 60% percent. Other recommendations, such as supporting waste diversion grants and collecting hazardous waste consistently, are constructive approaches for steering away from landfills and removing hazardous waste from them. Interestingly, there were not any recommendations related to composting, which was one of the methods identified in Chapter 3 that facilitates a closed-loop process and one of the approaches that interviewees raved about from their west coast tour. It was also heavily discussed by committee members as a viable alternative. However, it is important to note that all of the recommendations that the committee made sought to increase sustainability by increasing landfill diversion. They all focus on techniques that assist with decreasing the amount of waste going to landfills and working toward more closed-loop waste systems.

Table 7: Waste Management Recommendations

Recommendations
Increase the amount of waste materials diverted from landfill for recycling and composting to 60% percent.
Provide single-stream curbside recycling on county standard roads.
Provide weekly automated trash collection to all households on county-standard roads.
Provide consistent curbside collection of white goods.
Develop MRF to process recyclable items from residents and construction and demolition waste.
Implement landfill-gas collection system to generate energy.
Collect household hazardous waste consistently.
Increase environmental education.
Support waste diversion grants.
Develop additional transfer facilities.
Develop centrally located solid waste campus.
Address changes in ordinances.
Implement customer call center.
Investigate feasibility of WTE.
Evaluate small landfills for stand-by status.

6.8.2 A New Buzzword"

While sustainability is at the forefront of many environmental policy discussions today, it was not a focal point during the time of the committee meetings. Interview participants were asked, "Did the committee discuss sustainability?" Most members acknowledged that the group was an educated, forward-thinking group. Sustainability was always a part of the theme, and the current policy on waste was not sustainable, but the term sustainability was not ever defined or addressed directly in terms of waste. One participant said, "It was not as much of a "buzzword" then. It was only two years ago, but it wasn't as much discussed." Another respondent said, "[Sustainability] was a new term at that point. It was not discussed. The concepts were there, but it was not defined….rather, a sustainable island life was a constant theme throughout the process." (INT, 2010).

Instead, most participants discussed the many issues with waste and how they were not sustainable. For example, one interviewee said, "The main point was that the current state was not sustainable for when we run out of landfill space or the population increases. Beyond that, the different scenarios that we considered were a strong push to becoming more sustainable." Another participant said that the committee discussed the difference between "renewable" and "sustainable," and that there was never a consensus achieved.

6.8.3 Sustainability is Expensive

Participants thought that cost was one of the primary barriers to achieving sustainability. Being sustainable is expensive, and sustainability is always about the cost

factor. "We talked about it, and the biggest crux was the cost. For residents to pay for sustainability, it is expensive." Several participants brought up WTE when discussing sustainability. For instance, one participant stated, "There is a cost factor in sustainability; we are a small island. How much energy can we really produce?" (NT, 2010). Even though participants were familiar with the concepts of sustainability, there was not any documentation of specific discussions about sustainability in the final plan or meeting notes.

6.8.4 Compromising Sustainability

At the end of the interviews, when participants were asked whether the final outcome was sustainable, responses indicated that there were trade-offs. Many felt that it was impossible to reach a sustainable solution.

> No you can't frame it into sustainable because it was what the county should go for but we were all acutely aware that sustainability [on our island] is not going to happen. It would take 100 years to get to a point at the pace we were suggesting to go. We suggested this, this, and this, but we were very aware that that was not enough, a strong push in a more sustainable island but it was just part it. Garbage alone is just one of the facets of the island. Housing and education and many more things were far more important [on this island]. It's just one of the main things that need to happen to have sustainable island. [This island] is not a sustainable place. (INT, 2010)

Several participants were probed further and asked to provide the top three things that created barriers to sustainability within the process. Every interviewee identified cost as the biggest barrier. Other barriers included land space, political will, EPA and DOH standards, union issues, small population, public buy-in, lack of education, need for a crisis ("for people to wake up"), the environment, and lack of community for sustainability activities.

Some interviewees responded that the final recommendations would be sustainable after they were actually implemented.[46] It will be sustainable "if they keep the recommendations alive." Another participant said, "We settled for recommendations that everyone could live with, but we had to make choices, social and financial conditions." Thus far, the recommendations have not been implemented. According to interviewees, many of the committee's recommendations were rejected during the budget sessions for the last two years due to funding (INT, 2010).

Overall, it seemed that sustainability was not a focal point of the meetings. It was never defined or directly addressed, even though all members said that it was indirectly integrated into the process, and everyone had the same goal of protecting the island and achieving sustainability. Most participants thought that the outcome recommendations were not sustainable, and that they had to compromise sustainability in order to meet the budget and consensus. However, they did believe that the resulting recommendations were *more* sustainable than the current system.

6.8.5 What If There Were No Limitations?

At the end of each interview, participants were asked, "If there were no limitations to what you could do here, what do you think the optimal solutions might look like?" Participants provided a broad range of solutions, many of them the opposite of their fellow committee members. The primary solutions provided by participants are broken down into four areas.

The first solution was to adopt the same models as seen on the west coast tour. The Monterrey waste system was often mentioned as an ideal solution due to the

[46] At the time of this study, the policy recommendations had not been implemented.

similarity in population, culture, and location by the ocean. The second model was San Francisco and using the "Fantastic 3" system of waste, recycling, and composting bins, but it was also noted that the island has different needs and a dramatically different population.

The second most mentioned solution was to implement a WTE facility. One person wanted to follow the model of Japan, which included WTE facilities and tracking all waste from beginning to end. Another participant thought that WTE was simply the "most reasonable thing to do." (INT, 2010). It takes up a small amount of land, the pollution is minimal, and it would make a large contribution to energy production. Energy was also a concern with recycling. Since all recycling is shipped off island, several participants were not in favor of the energy requirements for shipping waste or recycling off island. They said, "Shipping garbage and recycling off the island, and the energy required, is ridiculous when you could be using it for fuel" (INT, 2010).

The third solution was to focus on reducing waste from imports. Several suggestions were provided, including requiring recycling fees on all imported goods. This model is similar to Extended Producer Responsibility (EPR)[47] contracts. This would require all electronics, appliances, cars, and other products that cannot be recycled on the island to be returned to the producer for recycling at the end of their lifespan. While it might create additional cost for consumers, several participants thought it should be a necessary requirement for living on an island. As one participant said, "Adding recycling fees up front on imported products does make the cost of living higher, but if you want to live on [a remote island], that should be a part of the price you pay" (INT, 2010).

[47] Extended Producer Responsibility (EPR) is similar to the "polluter pays" principle. It requires manufacturers to be responsible for products for their entire lifecycle. The goal is to shift the economic and environmental burden from taxpayers and government to producers (Waste to Wealth, 2011).

Another participant said that all plastic should be banned, and anything that cannot be reused, recycled, or composted should not be allowed on the island. They specifically mentioned all of the plastic that is brought in by Costco, and how Costco should not be allowed to bring in any plastics. Another suggestion was to require all imports to be made of biodegradable materials.

Some people thought that the hotel and resort industry should be tapped to pay extra fees for wasteful import packaging. "The hotel industry brings in tons of mattresses, etc., from abroad. They should have to figure out how to bring those onto the island without being wrapped in styrofoam or bubble wrap. Instead, they should be wrapped in cardboard because that is biodegradable." (INT, 2010). It was also noted that, while reducing imports and packaging on products is an opportunity to increase food security and reduce carbon footprint, it also conflicts with the proposed WTE facility, since WTE requires significant amounts of waste to produce energy.

The fourth suggested solution was to simply follow the final committee recommendations. The final recommendations were "simple, affordable, and realistic." The group spent a year in meetings and reached a consensus. As one interviewee stated, "The final plan offers the most optimal solution; there is no need to change anything—only implement what has already been decided."

The final solution provided was to implement all of the available standard waste management practices. This included curbside pickup for recycling and green waste, a hazardous waste facility, a reuse/mercantile facility, a WTE and LFGTE facility, and stricter policy on imports, recycling, and waste prevention strategies. While the optimal solutions provided by the participants varied considerably, many were in complete

opposition to each other. Some participants were radically against WTE, while others were staunch supporters. Some focused on upstream solutions (e.g., imports), while others focused on the downstream solutions (e.g., WTE, recycling, composting). The final plan reflects these conflicting viewpoints, as it is essentially a compilation of all of the solutions mentioned above, with the only exception being policy on imports.

6.8.6 What Good If Not Used?

At the end of each interview, participants were asked if they had anything else they wanted to add to the discussion that was not already asked. Some participants had nothing to add, and others provided an abundance of additional information. The answers to the question were typically either compliments or complaints about the process. The positive comments were that the group discussions were very informative, and that the process was well organized.

The negative comments centered on the consultants and group dynamics. Some participants complained about how it was hard to know if they were missing any pertinent information because the members of the committee were not experts in the field. The experts were supposed to be the consultants, and the meetings were controlled by them, but there appeared to be a lack of transparency that led to distrust among committee members. One participant said:

> It was hard to tell if other things not being presented were out there that the consultants didn't present. The consulting company also owns waste facilities around the country, which is how you become an expert in the field. It's a catch 22 because you want top of the line people so you need people involved in industry, but they are probably going to be biased to certain technologies (INT, 2010).

Other concerns were that the scenarios provided by the consultants did not put enough emphasis on waste reduction or imports. The places that the committee visited on the west coast required import rules on waste, though import restrictions were never included in the scenarios presented by the consultants. These comments revealed a lack of trust in the consultants from the stakeholders about the process. Building trust is a key aspect of successful collaboration processes, and the lack of trust with the consultants indicates a possible breakdown within the process that creates barriers to achieving greater sustainability.

Group dynamics were also mentioned during the additional comments. Some people said that the process was very frustrating because viewpoints were always clashing. They also wished that the public could be more involved with the process to see the complexity and consequences of so many perspectives coming together. The committee members had to compromise significantly on multiple occasions in order to find a solution that everyone could agree on. Each solution was seen as a method that would benefit the community as a whole. In addition, several participants mentioned the current economic crisis. Since the committee period occurred before the current economic crisis, many economic factors did not come into play. These factors might have had a more substantial effect on the final outcome.

Lastly, several interviewees discussed the disappointment that they felt because their recommendations were still awaiting implementation. One participant stated, "It was a rewarding adventure, but it's disappointing that nobody has talked about it since. What does resolution mean? What good is it if it is not used?" (INT, 2010). The final recommendations were submitted and approved by DOH and the mayor, but they were

still waiting for implementation two years later. The primary barrier to the implementation of the recommendations appeared to be cost, according to interviewees. "Every time we talk about cost, we run into a wall. [The county] is not willing to go there to cover the costs of what it will take to make it work on the island. It always comes down to cost." (INT, 2010).

CHAPTER 7: TYING IT ALL TOGETHER

All of the categories were explored during the documentation process through the lens of the IAD framework, which guided the design of this study. The expectations for each category were that blueprint models, economics, infrastructure, exclusion, remoteness, and behavioral norms would affect the committee's decision to adopt more sustainable practices, and that incentives, environment, and culture would facilitate the committee in adopting more sustainable, "closed-loop" waste management approaches. It was expected that economics would be the most important factor affecting waste disposal decisions. The expectations and corresponding results of how the different categories affected the action arena are summarized in Table 8. The action arena column indicates whether or not each category affected the action situation, as some factors bypassed it, even though they still affected the final results. The results column indicates whether the category impeded or facilitated the action situation in the final outcomes.

The factors that facilitated the action situation in making more sustainable decisions included environmental concerns and the observation of exemplar waste management models. The factors that impeded the action situation from adopting more sustainable outcomes included blueprint models, cost, environment, exclusion, infrastructure, remoteness, and the behavioral norms of illegal dumping. Several of the categories had both positive and negative aspects. For instance, rules presented barriers, but they also indirectly benefit remote islands by providing regulations that protect against infectious diseases and other public and environmental health issues. Furthermore, some impeding factors were antecedents to other impeding factors. Illegal

dumping, for example, was driven by landfill tipping fees, poor infrastructure, low enforcement, lack of education, and exclusion from waste collection services.

Table 8: Category Expectations and Results

Category Type	Category	Action Arena (Y/N)	Expectation (I/F/ND)	Result (I/F/ND)
Rules	Blueprint models (rules-in-form)	Y/N	I	I, F
Rules	Incentives	Y/N	F	F
Biophysical	Economics (costs)	Y/N	I	I
Biophysical	Economics (cost models)	Y	ND	I
Biophysical	Economics (waste models)	Y	ND	F
Biophysical	Environment	Y	F	F
Biophysical	Exclusion	Y	I	I
Biophysical	Infrastructure	Y/N	I	I
Biophysical	Remoteness	Y/N	I	I
Community	Culture	N	F	ND
Community	Behavior Norms (illegal dumping)	Y	I	I
Community	Tourism	N	F	ND

(Y= Factor affected the action situation, N=Factor did not affect the action situation, Y/N=Some aspects affected the action situation and some factors bypassed it, I=Impeding Factor, F=Facilitating Factor, ND = Not Determined)

The causal relationships are illustrated in Figure 21. External remoteness led to higher waste management costs, which led to more illegal dumping. To curtail illegal dumping, tipping fees were kept low, which decreased the amount of money available to the county for adopting more sustainable approaches. Internal remoteness and poor infrastructure led to greater exclusion, and exclusion and ignorance led to more illegal dumping. Both costs and illegal dumping affected the collective decisions of the action situation, and led to fewer sustainability options. Costs and illegal dumping also directly

affected the outcomes, since budgets were determined prior to the inclusion of an action situation. Both rules-in-use and rules-in-form, such as the sunshine law and RCRA, affected the action situation process and their decisions. Federal and state regulations led to less expression of ideas by committee members and created fear of punitive action. The personal environmental concerns of the actors affected the action situation, which facilitated the adoption of more sustainable outcomes. Observations of waste models affected the personal beliefs of the actors and the overall action situation, which positively affected the final outcomes.

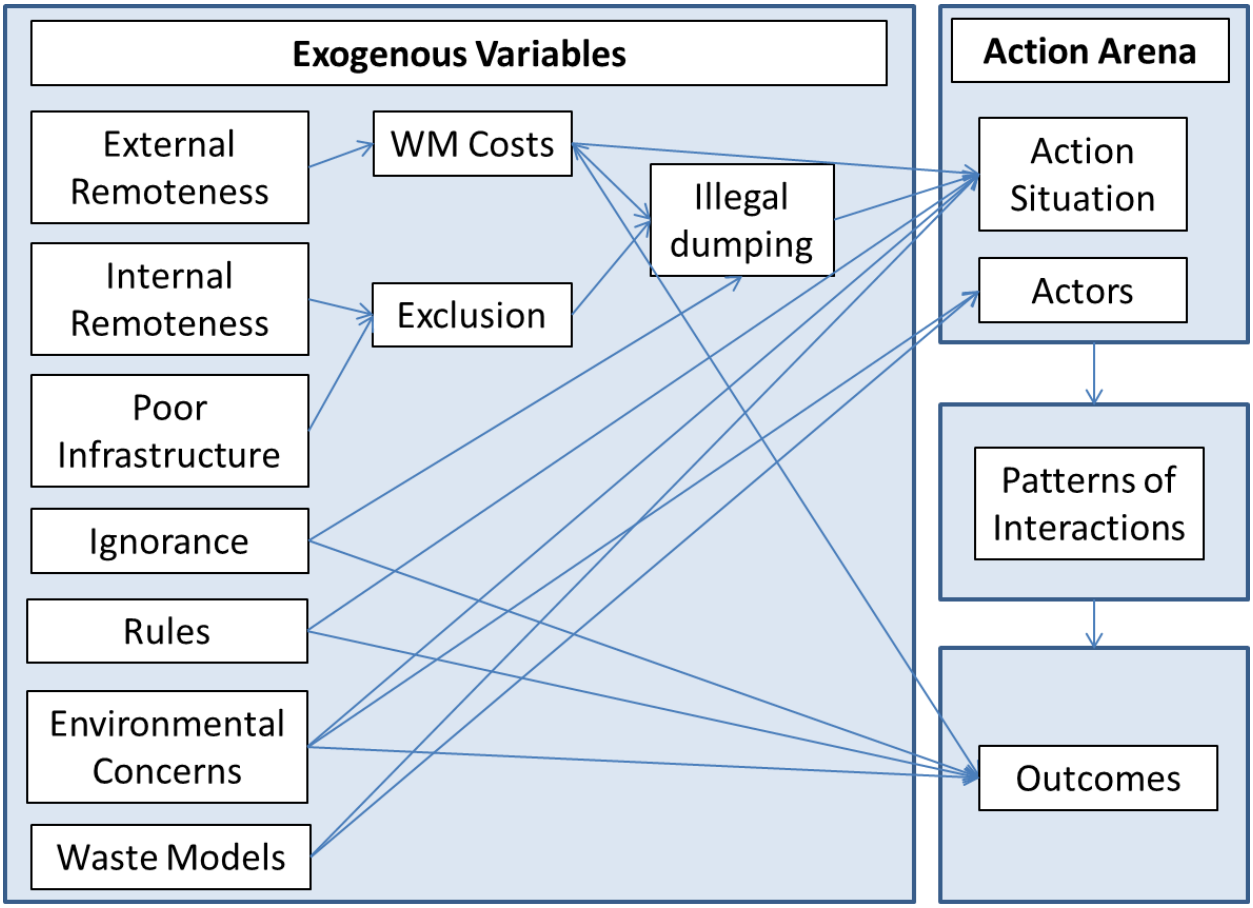


Figure 21: Category Causal Model

The outcomes of the action arena are the recommendations for waste management policy by the action situation. However, as discussed in Chapter 5, the outcomes are the policies that are organized by rules, norms, and strategies. While the IAD model provided an appropriate framework for organizing the data and understanding the relationships among the variables, some of the lines that show causal effects within the original IAD framework did not follow the same path in this study. Some variables affected the rules, norms, and strategies before the existence of the action situation. They directly affected the final outcomes and bypassed the action arena. For instance, economics and infrastructure directly affected the final outcomes. Transportation and infrastructure were not discussed during the committee interactions (since transportation was left to the planning department), but they did affect the final outcomes. Budgets and many of the rules-in-use and rules-in-form were determined before the committee convened. Likewise, tourism and culture are key factors that affect solid waste management, yet they did not affect the action situation in this case.

Since the policy recommendations provided by the action situation have not been implemented to date, it could be argued that the committee did not affect the actual policy outcomes. The Sunshine Law protocol required the county to convene a stakeholder committee to make recommendations for new policy, yet it appeared that the implementation of their recommended policies was out of the committee's control. Given that one the primary rules-in-use was to ensure that the public did not get upset by changes in waste policy, it begs the question of whether the sole purpose of the committee was for public relations—to appear "green" and inclusive of the community in the county's decision-making strategies. In addition, the consultants were hired before

the committee convened. Committee members were not satisfied with the consultants and complained that they controlled the process. There was conflict and lack of transparency between the consultants and committee members, yet the committee did not have the power to terminate them.

The results of this study indicate that multiple factors affected the committee's solid waste management decision-making. Some factors made the action arena act in certain ways, while other factors directly affected policy and bypassed the action arena. The identified factors serve as a benchmark for understanding the barriers that prevent islands from moving toward greater sustainability with regard to waste management and the opportunities available for overcoming those barriers.

Remoteness does matter. The isolated location of Hawaii, referred to as "external remoteness" in this study, requires significant amounts of importing and exporting goods. Additional packaging is required for shipping products thousands of miles *to* Hawaii; and to recycle products, they must be shipped thousands of miles *away from* Hawaii (e.g., Asia). During the documentation process, remoteness was regularly identified as a barrier to recycling. In places such as California, there is an extensive infrastructure established that supports the recycling market, but small islands are often not large enough to support recycling markets, which oftentimes forces local vendors out of business. Hazardous waste is also affected by remoteness. The timing for hazardous waste disposal is critical, and since it must be shipped to other locations, it is difficult and expensive to implement a regular collection system, and unfortunately, large amounts of it end up in the landfill.

Exclusion from waste services versus expansion of county roads was another aspect of remoteness that affected waste management. A key topic of discussion related to exclusion was infrastructure; however, it was rarely discussed during meetings. Many of the roads on the island are single-lane dirt roads that cannot handle large waste trucks. Local residents enjoy living in remote areas and do not want to have their roads expanded to accommodate more traffic. Within the committee, there was not a city planner to represent the county infrastructure on the committee, even though a planner might have added valuable insights during the decision-making process. Due to resident concerns and the lack of infrastructure, the final plan recommended increasing waste collection, rather than providing universal collection that would require road expansions and disrupt rural areas.

Waste management costs and budgets were the focal point of most committee discussions, as they created financial constraints that decreased sustainability options. Financial incentives might have led to the adoption of more sustainable approaches. The primary incentive that was provided at the federal level was to meet landfill regulations to avoid punitive action from the EPA, rather than provide financial incentives. Even though the interviewees thought that incentives would have made a difference, they were not available at higher government levels, and so it was not determined whether they would have affected the final outcome.

In addition, the lack of transparency from the consultants created distrust among committee members. Many alternative waste approaches were rejected early on in the process because they were considered outside of the budget. Participants thought that the tight budget controlled the process, and since the forum for discussion was limited to a

set agenda, they rarely had a chance to adequately explore new ideas. The consultants finalized the numbers outside of regular meetings, and then presented the results to the participants. While some committee members boldly questioned the process, others accepted it as the rule. Since there were not studies conducted to measure environmental impact, they were not likely included in the cost models, and a "net" benefit of the various scenarios could not have been determined. If they had determined a net benefit for living further away from the landfill, it might have changed the costs within each scenario (Eshet et al., 2007). The process also might have benefited from a valuation study that valued the disamentities of landfills for nearby residents, such as noise, odor, and litter, and how it affected local property values. In addition, engaging the participants in a more transparent process might have added value and led to greater trust during the process, giving members more confidence to share their ideas.

In addition to distrust about the data, the Sunshine Law led to less expression of ideas by committee members, which potentially stifled ideas that could have led to greater sustainability. The intentions of the Sunshine Law were to keep the process fair, but it also led to many complaints with participants stating that it constrained their ability to actively participate and provide input. However, the Sunshine Law did help to facilitate a more stream-lined process that ensured fairness across the committee.

These findings are similar to other studies (Zotos & Karagiannidis, 2009; Forsyth, 2006) that found that local levels of management have less influence in managing and implementing policies. The participants in this study generally felt they did not have any control or influence on state or federal policies—they were simply something they had to adhere to and follow. Some polices had positive and negative influences on the

community. For example, RCRA does not specifically address the unique and fragile characteristics of remote islands, such as limited land space, lack of interstate transport, and close proximity to the ocean. The RCRA guidelines require landfills to be lined, and for leachate pumps to be installed by the landfills, but they also give exemptions to small waste disposal operators. The county in this study has several small communities with landfills located within a mile from the ocean that are not lined and do not have leachate pumps. This potentially poses a significant public health threat to the local community and visiting tourists. However, even though there were fears of punitive action by the EPA, states and counties do receive guidance from the EPA on landfill maintenance, which helps facilitate greater sustainability for larger landfills and protect public health and the environment. If the upper level regulations did not exist, old methods of improper dumping methods (prior to the EPA regulations) might still occur.

Ostrom, Pasang and Moore (2007) found that barriers to sustainability included non-involvement of stakeholders in the planning and decision-making process, long-term waste strategies, unskilled staff, and low coordination between authorities and local workers. Contrary to those findings, the participants in this study appeared to be fairly representative of the community and be highly involved and concerned about planning. They focused on long-term strategies, and they were very skilled in their professions.

Observing best practices was one of the primary influences on the committee's recommendations. Questions about waste models were not specifically asked during the interviews, and the research protocol for this study did not include expectations for them; however, when participants were asked about "models" used during the process, most of them readily began discussing the waste "model" facilities that they observed on the west

coast. They were much more influenced and excited by the model facilities than by the cost models. Several of the recommendations in the final plan are similar to the Monterrey model, such as the comprehensive resource center, which has a more "closed-loop" approach. Even so, committee members were reluctant to say that they could be implemented on a small island because they did not fit into the budget, they were not adequate for the island's population, and the island infrastructure was not set up for them. Members were concerned that their participation in the process did not have an impact on the final policy outcomes since their recommendations were still not implemented two years later.

One of the most notable findings was that culture was not a topic of committee discussions, even though there is a rich, profound cultural history in Hawaii that emphasizes the environment. Participants were reluctant to discuss culture issues—not because they are not valued, but more out of fear of being accused of discrimination. The Hawaiian culture offers an excellent example of strong sustainability, and it is unfortunate that it was not discussed in more depth. Learning about the history of the culture, and how waste was managed prior to western civilization, might have influenced the final decisions.

CHAPTER 8: CONCLUSIONS AND RECOMMENDATIONS

Sustainability is about a paradigm change. In the new paradigm, waste is viewed from a systems perspective, and not just as the end result. It is a resource, rather than a useless, unwanted by-product. Hawaii is the most isolated group of islands in the world. The ancient Hawaiians use to live in an ecologically, sustainable system. Everything that they used was from the land, and everything went back to the land. Today, however, the Hawaiian Islands are far from sustainable. They still have the same limited land space and fragile ecosystem as they did two hundred years ago, but now 90% of Hawaii's energy needs are met by imported fossil fuels (HCEI, 2011), about 95% of Hawaii's food is imported from other locations, and most of the imported products eventually end up in landfills where it is forever a part of the land.

Finding more sustainable waste management approaches on the remote islands of Hawaii has not been easy. Even though the ancient Hawaiians lived in a more sustainable environment, the western practices of trade and production that were introduced in the 1800s led to a complex, unsustainable waste management system. Even though sustainable waste strategies are slowly gaining awareness, waste issues often still remain at the bottom of political agendas. Other issues, such as healthcare, affordable housing, and unemployment often take precedence over waste management. Waste management represents the end of product life cycles, and so it often remains "out of sight, out of mind." It is tucked away in a landfill and temporarily forgotten, swept to the side for the next governmental administration to address. Unsustainable wastes practices, however, if left unchecked will only lead to more problems and create greater costs in the future for the environment, public health, and the economy. The Hawaiian economy

depends on tourism, and tourists expect a pristine environment. As the landfills continue to reach capacity, and additional land space becomes unavailable, policy makers must begin addressing these factors and planning for more sustainable waste approaches that will lead to long-term sustainability.

One of the limitations of this research is that it is a single case study. It is difficult to assess how generalizable the results are to other remote islands and other stakeholder situations. Future research would benefit from conducting similar case studies and observing stakeholder committees on other islands to further explore how exogenous variables affect the action situation and final outcomes.

This study concludes that remote islands regions, such as the Hawaiian Islands, have unique factors that affect decision-makers' ability to implement more sustainable waste management systems. Opportunities exist within the new sustainability paradigm for integrating aspects of Hawaiian history with today's modern day society. Recognizing the facilitating and impeding factors that affect the implementation of a more sustainable resource management system is the first step toward addressing the problem. They can provide a focal point for government officials to address the issues as they develop future plans for waste management. Policy recommendations are provided for the global, national, state, and local levels in the following paragraphs.

Explore other waste models from around the world. One unexpected facilitating factor that was identified in this study was the benefit of observing waste models. The committee's tour of the west coast waste facilities provided eye-opening awareness of the possibilities for more sustainable approaches. The information certainly influenced the recommendations, such as the centralized materials recovery center and a solid waste

campus, similar to the model observed in Monterey, that would accept and sort unwanted goods that could be repaired and reused. Future recommendations are to observe other waste management practices on other islands around the world. Understanding how other islands around the world manage waste could provide more ideas and possibilities that can be explored locally.

Address the unique characteristics of remote islands in federal waste policies. The U.S. EPA regulates solid waste management though RCRA. RCRA ensures that all landfills are regulated and monitored. It requires landfills to have linings that protect the ground and leachate pumps that catch water from seeping into underground water sources. However, RCRA has two short-comings. First, it gives exemptions to smaller landfills. This is problematic for small island populations with landfills located within close proximity to the ocean where families fish for their livelihood and participate in ocean sports daily. Since these areas often have depressed economies, financial incentives would encourage implementation and better protection of public health and the environment. Second, RCRA does not provide any specific guidelines for remote islands. If it addressed the unique characteristics of islands, it might foster greater awareness of the issues and provide greater support for remote locations.

Review and collect feedback on collaborative processes. The State of Hawaii manages collaborative processes through the Sunshine Law. The Sunshine Law serves as a guide to keep processes fair and balanced. However, the results of this study found that the strict guidelines often hindered stakeholder views and opinions that might have led to more sustainable ideas and approaches to waste management. When people are fearful to speak up, and feel their input is not valued, the community loses potential knowledge and

ideas that could benefit everyone. Regular reviews of the sunshine law that include feedback from participants will help to address some of these issues and ensure that the processes build trust and allow for greater comfort by participants to share their interests and knowledge.

Include environmental and cultural values in waste assessments. Waste affects the air through emissions, the land through pollution, and water quality through contamination. These are serious issues that can significantly affect the health of humans, the environment, and other life forms in the ecosystem. The goal of sustainability is to decrease the environmental, social, and economic impacts of waste for future generations, while also meeting the needs of the present. The waste management process observed in this study did not appear to take into account cultural values and how local Hawaiians felt about the process. Determining the values of local residents and how they feel about the environment might have added to the discussion and provided a baseline for assessing various waste approaches. For example, the cost model that was utilized by the consultants during the committee process did not include an assessment of environmental values. Valuation studies might facilitate obtaining values for environmental amenities in the local community. In addition, while public hearings were held to obtain public input, they were not held until the final stages of the process, which was after the committee had made recommendations. Providing a public hearing or conducting surveys to reveal local resident views at the beginning of the process might have alleviated some of these concerns and helped to address the public concerns during the process.

Focus on imports. Focusing on imports is one of the most important approaches that island communities can take to reduce waste and work toward more closed-loop waste systems. On remote islands, the waste process typically starts with imports. Extensive product packaging, non-recyclable containers, and products that are ultimately destined for the landfill arrive daily on shipping barges to Hawaii. Stricter policy on imports was identified as a technique that might upset business vendors and be too politically charged. However, planning incremental policy changes on imports, followed by educational initiatives that involve the community, might help to streamline the process and reduce the potential for public upheavals.

Require Extended Producer Responsibility (EPR) agreements with business vendors importing goods to the islands. EPRs require manufacturers to be responsible for their products for the entire lifecycle. They are already in effect in many parts of the world, and California is leading the way in the U.S. Implementing EPRs in Hawaii would shift the waste burden from the government and taxpayers to the producers. It would require producers to take back products at the end of their lifecycle, reducing the economic and environmental impacts on the local community.

Include transportation planners in the decision-making process. Poor infrastructure creates obstacles for managing waste in central locations. Small islands often have rural, remote areas with single-lane, unpaved roads. By focusing on infrastructure improvements in conjunction with waste management, better plans can be put into place that can address infrastructure challenges through road expansions or working toward other approaches that will accommodate rural areas. By addressing infrastructure first, it will simultaneously address many of the issues with exclusion too.

Implement educational campaigns. Educational campaigns are important for addressing the environmental impacts of illegal dumping. Most of the items identified at illegal dumping sites were basic household garbage. Educating residents about the environmental effects of illegal dumping and how it affects their future, and the future of their children, is important to the process. Other campaigns might include teaching residents how to compost organic waste at home and encourage them to look for products that have compostable or small amounts of packaging. Other approaches might be to set up local resource centers where customers can exchange unwanted products that are still usable.

Engage tourists in waste sustainability efforts. Tourists contribute significantly to the waste stream in Hawaii. "Eco" resorts are growing exponentially around the world for tourists who want to experience a "green" vacation and keep their "ecological footprint" light. Tourists want to participate in efforts to reduce waste but often do not know how (Dodds et al., 2010). Hotels could provide tourists with souvenir water bottles to use during their stay that can be refilled with filtered water. Videos and other media outlets aimed at tourists can provide easy steps for tourists to reduce their waste, such as pointing them to recycling facilities and encouraging them to bring their own bags when shopping. Since tourists are some of the largest contributors to waste, providing incentives and educational outlets for tourists can potentially reduce the waste burden considerably.

Regard remoteness as an opportunity instead of a barrier. Hawaii already has a model for a sustainable waste system from its Native Hawaiian history. Hawaii can learn from its past to integrate current technological components of society and develop a more

sustainable future. Hawaii's dependence on other faraway lands for nearly all of its goods is an obstacle to working toward greater sustainability. Finding ways to generate renewable energy, grow local food, and create a cyclical waste system will facilitate a more sustainable island environment for the future.

In summary, waste management is a complex problem that communities struggle with all over the world. Remote islands face unique impeding and facilitating factors that affect their ability to implement sustainable waste management systems. Local, collaborative stakeholder groups that come together to make policy decisions about waste management are faced with institutional obstacles that can hinder progress toward achieving greater sustainability. Remote islands around the world are at risk of severe environmental and economic consequences if more sustainable approaches are not implemented. Hawaii has a rich history of sustainability, and it has the opportunity to use that history to become a model for sustainability around the world and stay true to its motto that "Ua Mau Ke Ea Oka Aina I Ka Pone."

Appendix A: Research Protocol

I. Theoretical Frame

A. Purpose
The main purpose of this research is to explain the selection of solid waste management policy in the county that contradicts the economic interests of a pristine island environment that relies on tourism.

B. Research Question
What are the facilitating and impeding factors that affect the adoption of more sustainable waste management policies?

C. Study Area
The site for this research is one Hawaiian county. The resident population is approximately 140,000. Its tourist population is roughly 2.5 million per year.

D. Units of Analysis

The main unit of analysis is at the county level. This is the level at which solid waste policies are applied. There is a tension between economic and environmental policy with regard to waste policy that this research seeks to explain. The county provides a special case to study due to its recent policy modifications to its solid waste management plan. Stakeholders were selected to participate in the modification of the Plan and involved in waste management policy recommendations and decisions.

E. Theory

The IAD provides the conceptual framework for examining solid waste management policy on the remote islands discussed above and how decisions are influenced institutional tiers. A central aspect of the IAD framework is on the concept of rules that occur at different levels (e.g., constitutional, collective choice, and operational), defined as "shared understandings among those involved that refer to enforced prescriptions about what actions are required, prohibited, or permitted" (Ostrom, 1999, p.50). It identifies an action arena, actors, and an action situation, and provides a framework for examining patterns of interactions and outcomes. Rules and physical and material conditions of a community affect the structure of the action arena, actors, action situation, the incentives that individuals face, and the resulting outcomes (Ostrom, 1999).

F. Categories

The dependent variable in this study is the outcome of the solid waste management policy in the county. The main categories [independent variables] in this study are the attributes of the county that follow the theoretical IAD framework.

1. Biophysical and Material
    a. Environment
    b. Economics
    c. Exclusion
    d. Infrastructure
    e. Remoteness
2. Community Attributes
    a. Culture
    b. Behavioral norms
    c. Tourism
3. Rules
    a. Regulation
    b. Organization
    c. Process
    d. Incentives

G. Data Collection Plan:

Multiple data collection techniques will be utilized. Data will be collected from reviewing materials, direct observation, and interviewing.

1) Document Review
    - History of solid waste management in Hawaii
    - Solid waste management academic literature
    - Government agency documents on solid waste management policy
    - Federal, state, and local waste management policies

Waste management literature will be collected from on-line databases at Georgia Tech. Policy information and relevant documents on waste management will be collected from government agencies and the Environmental Protection Agency (EPA) websites.

2) Observations
    - Site visits at solid waste management sites
    - Image documentation
    - Solid waste disposal mapping

Observational data will be collected across the county at the five local landfills, recycling facilities, illegal dumping areas, and other identified waste management disposal sites.

3) Interviews
    - It is estimated that ~20 interviews will be conducted with stakeholders participating on the recent Integrated Waste Management Plan Committee and local government waste management decision-making officials.

One of the primary ways that a researcher can investigate an organization is through the experience of the people who work within the organization (Seidman). Utilizing interviews as a research method will allow me to gain deeper insights into the experiences of the people who work with waste management policy and to develop a better understanding of why and how policy decisions are made with regard to waste management policy and the barriers to achieving waste sustainability on remote islands.

H. Management

A diary will be kept to record notes and observations, which will then be transferred to an electronic database. The data gathering instruments will be designed prior to observations and interviews. Observations will be handwritten and interviews will be audio-taped. An interview protocol will be developed separately under the supervision of class professors. Notepad will be utilized to document all notes collected from documents, observations, and interviews. A coding scheme will be developed to organize materials. Explanation building logic will be used to analyze the data.

I. Ethical Issues and Human Subjects

Confidentiality will be maintained with regard to interviewees. My dissertation committee and I are the only ones who will have access to the interview data. Anything written in final the report that identifies interview participant responses will be confirmed with the participants.

Appendix B: IAD Tiers and Outcomes

Source: Ostrom (2007)

Figure 22: IAD Tiers and Outcomes

Appendix C: IAD Framework Applied to Case Study

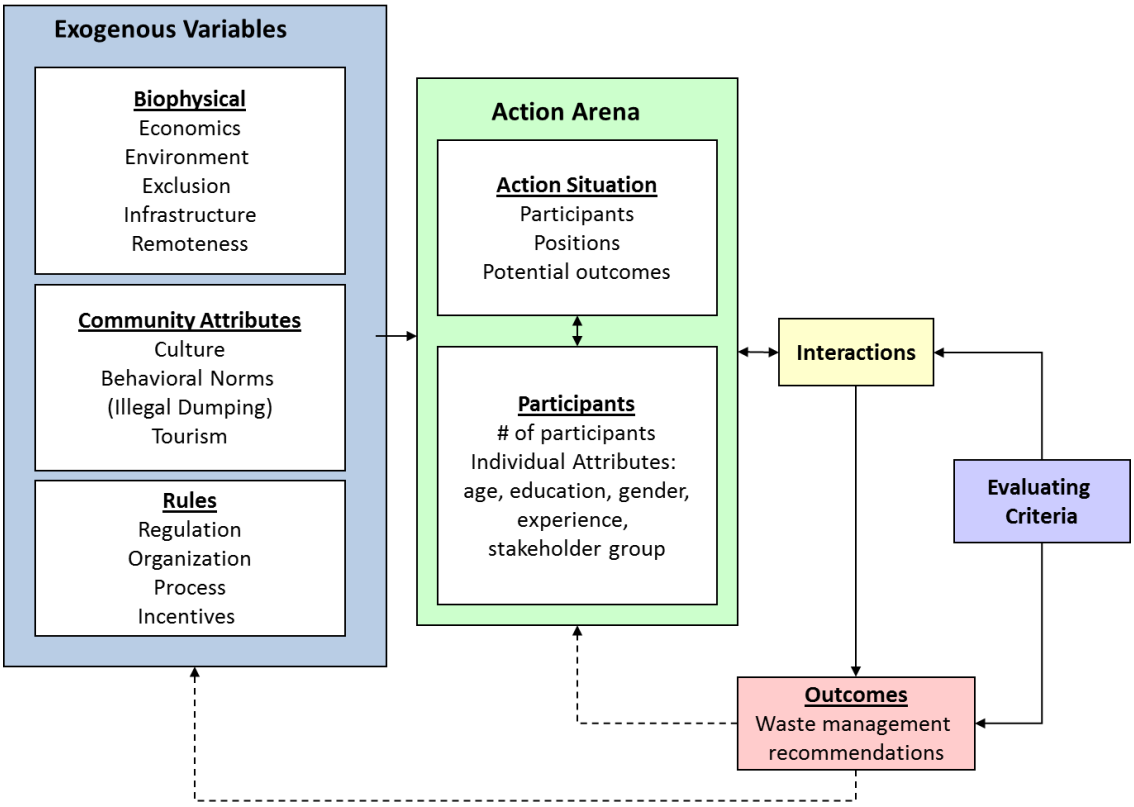


Figure 23: IAD Framework Applied to Case Study

Appendix D: Categories

Table 9: Model Categories

Type of Category	Category	Variation	Question(s)	Method
Outcomes	Sustainability	• Weak to strong •	Did the committee discuss sustainability? If so, how? Was the outcome sustainable? If yes, how?	• Interviews • Documents
Biophysical	Economic Players	• Industry, government	Who are the key MSW economic players?	• Documents • Interviews
Biophysical	Economic Costs	• Low to high	What are the real and perceived costs of current MSW? What are the real and perceived costs of MSW options (e.g., technologies, shipping)?	• Documents • Interviews
Biophysical	Economic Interests	• Tourism, agriculture, etc.	What are the economic interests of the county? Were these considered within the committee? If so, how?	• Documents • Interviews
Biophysical	Environment	• Yes/No	Did the committee consider the environmental characteristics of the county? If yes, which ones (land, air, water, endangered species, etc.)?	• Interviews
Biophysical	Exclusion	• Percent population with collection service	What portion of the population has waste collection?	• Interviews • Documents
Biophysical	Infrastructure	• Yes/No • Quality	Did the committee consider the current infrastructure of the county? If so, how? What is the quality of the infrastructure?	• Interviews • Observations (new roads, proportion paved roads)
Biophysical	Remoteness	• Yes/No	Did the committee consider the remoteness of the county? If so, how?	• Interviews
Community Attribute	Culture	• Yes/No	Were cultural issues discussed in the	• Interviews

Type of Category	Category	Variation	Question(s)	Method
			committee? If so, which ones? Did they affect the outcome? If yes, how much?	
Community Attribute	Behavioral Norms (Illegal Dumping)	• Yes/No	Was illegal dumping discussed? If yes, how? What do people illegally dump? Who does it? Why?	• Interviews • Observation
Community Attribute	Tourism	• Yes/No	Was tourism discussed? How does tourism affect waste disposal? Are MSW activities visible to tourists?	• Interviews • Observation
Rules	Regulation	• Polycentricism (Federal, State, County)	Who regulates MSW? What are the formal and informal "rules in use" and "rules in form"?	• Interviews • Observation • Documents
Rules	Organization	• Levels of organization	How is waste management organized? How is the committee organized?	• Documents • Interviews
Rules	Process	• Policy process (agenda setting, initiation, implementation, evaluation, etc.)	What is the process for adopting waste management policies?	• Documents • Interviews
Rules	Incentives	• Financial, institutional etc.	Were there any incentives for adopting certain waste policies? If so, what kind? Were these considered? Did they affect the final outcome? What were the real and perceived financial incentives?	• Documents • Interviews

Appendix E: Observation Summary Sheet

Contact Type:
Site #:
Site Name:
Contact date:
Today's date:
Written by:

Brief summary of location:

Brief summary of contents:

Additional Questions:

Codes:

Appendix F: Interview Protocol

Part 1: Introduction questions to warm up the conversation (5 minutes)

- How did you become a member of the committee?
- What was your experience with waste prior to serving?
- What was your role in the committee?
- What were your primary responsibilities in the committee?
- How was the committee organized?

Part III- Exploring decision-making issues about waste management (30 minutes)

1. Rules
    a. What rules coming from above (federal and state) discussed? How did these affect decision making?

    b. Were there any statistical models of waste policies that were used? If so, what kind? Were these considered? Did they affect the final outcome?

    c. Were there any incentives for adopting certain waste policies? If so, what kind? Were these considered? Did they affect the final outcome?

2. Biophysical Questions:

    a. Who are the key MSW economic players?

    b. What are the economic interests of the county? Were these considered within the committee? [If so], how?

    c. Did the committee consider the environmental characteristics of the county? [If yes], which ones (land, air, water, endangered species, etc.)?

    d. Was waste collection discussed? How?

    e. Did the committee consider the current infrastructure of the county? [If yes], how? What is the quality of the infrastructure?

    f. Did the committee consider the remoteness of the county? If so, how?

3. Community Attributes

    a. Were cultural issues discussed in the committee? [If so], which ones? Did they affect the outcome? [If yes], how much? Were they considered more important by certain people on the committee? Were they on the agenda?

b. Was illegal dumping discussed? [If yes], how? What do you think people illegally dump? Who do you think is doing it? Why?

c. Was tourism discussed? How does tourism affect waste disposal? Are MSW activities visible to tourists?

4. Sustainability

a. Overall, what were the 3 most common topics discussed?

b. Did the committee discuss sustainability? [If so], how was it defined? What was discussed?

c. Was the outcome sustainable? [If yes], how?

d. Were there better examples of sustainable outcomes?

Part IV- Ending the interview. (5 minutes)

- If there were no limitations to what you could do here, what do you think the optimal solutions might look like?
- What were the three primary barriers to achieving this?
- Do you have anything else you would like to add about the waste management policy? Or if there is anything I forgot to ask that you would like to talk about?

Interviewer will thank participant for their time and interest in participating the study. The recording will be stopped and the interview will end. After interview has been transcribed, a copy will be sent to interviewee.

Appendix G: Interview Summary Sheet

Contact Type:
Site:
Who:
Contact date:
Today's date:
Written by:

1. What were the main issues or themes that struck me in this contact?

2. Summarize the information I got (or failed to get) on each of the target questions.

3. Anything else that struck me as salient, interesting, illuminating or important in this contact.

4. What new or remaining target questions do you have in considering the next contact with this site?

Appendix H: IRB Consent Form

Georgia Institute of Technology
Project Title: Waste Management in Hawaii
Investigator: Jennifer Chirico
Consent title: Waste Management in Hawaii

You are being asked to participate in a research study conducted by Jennifer Chirico from Georgia Institute of Technology, School of Public Policy. The purpose of this study is to learn how local government officials make policy decisions about solid waste management You were selected as a possible participant in this study because you participated in waste management recommendations or decisions for the county. We estimate that approximately 20-30 people will participant in this study.

If you decide to participate, you will be asked to participate in an interview. We will contact you to set up a time for the interview and agree on a place to meet. The interview will last approximately 45 minutes. You will be asked questions about your knowledge of waste management in the county.

You may face some risks or discomforts due to being part of this study. Potential risks involved may include some discomfort due to disclosure of information. Therefore, strict confidentiality will be maintained with regard to interviewees. You may not receive any direct benefits from their participation in the study; however, you may benefit indirectly because you may learn additional information about waste management at the completion of the study.

The following procedures will be followed to keep your personal information confidential in this study: The data that is collected about you will be kept private to the extent allowed by law. To protect your privacy, your records will be kept under a code number rather than by name. Your records will be kept in locked files and only study staff will be allowed to look at them. Your name and any other fact that might point to you will not appear when results of this study are presented or published. The audio-tapes of the interviews will be used to transcribe the interviews. They will also be stored in a locked file and only study staff will be allowed to look at them. They will be erased at the completion of the study.

To make sure that this research is being carried out in the proper way, the Georgia Institute of Technology IRB may review study records. The Office of Human Research Protections may also look at study records. There are not any financial costs to you to participate in the study.

If you are injured as a result of being in this study, please contact Jennifer Chirico at telephone (404) 863-0793. Neither the Principal Investigator nor Georgia Institute of Technology has made provision for payment of costs associated with any injury resulting from participation in this study.

- Your participation in this study is voluntary. You do not have to be in this study if you don't want to be.
- You have the right to change your mind and leave the study at any time without giving any reason, and without penalty.
- Any new information that may make you change your mind about being in this study will be given to you.
- You will be given a copy of this consent form to keep.
- You do not waive any of your legal rights by signing this consent form.

Questions about the Study or Your Rights as a Research Subject

- If you have any questions about the study, you may contact Jennifer Chirico, Co-Investigator, at (404) 863-0793 or Gordon Kingsley, Principal Investigator, at (404) 894-0454.
- If you have any questions about your rights as a research subject, you may contact Ms. Melanie Clark, Georgia Institute of Technology at (404) 894-6942.

If you sign below, it means that you have read (or have had read to you) the information given in this consent form, and you would like to be a volunteer in this study.

_____
Subject Name

Subject Signature Date

Signature of Person Obtaining Consent Date

Appendix I: Illegal Dumping Coding Scheme

Table 10: Illegal Dumping Coding Scheme

Type Code	Description
FRESH	Fresh water source nearby
GUL	Gulch
SALT	Salt water source nearby
SC	Sugar cane field
SEA	Sea cliff
OTH	Other location

Content Code	Description
APP	Appliances (e.g., refrigerators, stoves)
AUTO	Automobiles, trucks
FARM	Farming and agriculture machinery, parts (e.g, tractors, irrigation parts)
HAZ	Possible hazardous waste (e.g., drums, paint buckets)
HG	Household goods (e.g., food container waste, basic goods)
ODOR	Bad odor at site
PARTS	Automobile parts
PRE	Dumping prevention mechanism in place (e.g., guard rails, fence)
SIGN	Sign(s) prohibiting dumping
VIS	Site visible from road

Size Code	Description
LRG	Over 100 items dumped
MED	~10-100 items dumped
SM	Under 10 items dumped

Distance Code	Description
10	Less than 10 miles to landfill
10-30	10-30 miles to landfill
30+	More than 30 miles to landfill

Appendix J: Illegal Dumping Site Summary

Table 11: Illegal Dumping Site Summary

Site #	Type Code(s)	Content Code(s)	Size Code	Distance Code
1	SC	AUTO, VIS	MED	10
2	GUL, NV	APP, HAZ, HG, PRE, SIGN	LRG	10-30
3	GUL, SC, NV	APP, AUTO, FARM, HG, ODOR, PARTS, SIGN	LRG	10-30
4	GUL, SC	HG, VIS, PRE	MED	10-30
5	GUL	HG, VIS, SIGN, PRE	MED	10-30
6	NV	APP, AUTO, HG, ODOR, PARTS	MED	10-30
7	GUL, NV	HG, ODOR	MED	10-30
8	SALT, SEA, NV	AUTO	SM	10-30
9	SALT, SEA, NV	AUTO, HG	SM	10-30
10	SALT, SEA, NV	AUTO, HG	SM	10-30
11	FRESH, SC, NV	HAZ, HG, SIGN	SM	10-30
12	SC	PARTS, SIGN, VIS	SM	10
13	SC	HG, AUTO, VIS	SM	10
14	SC	HG, PRE, SIGN, VIS	SM	10
15	OTH	AUTO, VIS	SM	10-30
16 CLIFF	SALT, SEA, NV	HG, ODOR	LRG	10-30
17	SALT, SEA	AUTO, HAZ, HG, PRE, ODOR, VIS	LRG	10-30
18	SALT, SEA	AUTO, VIS	SM	10-30
19	SEA	APP, ODOR,	LRG	30+

Site #	Type Code(s)	Content Code(s)	Size Code	Distance Code
		PARTS, HG, VIS		
20	SALT, SEA	ODOR, HG, VIS	LRG	30+
21	SALT, SEA	APP, ODOR, PARTS, HG, VIS	MED	30+
22	SALT, SEA	APP, ODOR, PARTS, HG, VIS	MED	30+
23				
24	SALT, SEA	AUTO, FARM, PARTS, VIS	LRG	30+
25	FRESH	HG, VIS	SM	30+
26	OTH	APP, HG	MED	10-30

Appendix K: Illegal Dumping Image Collection

Figure 24: Abandoned Vehicles

Figure 25: Appliances

Figure 26: Household Garbage

Figure 27: Hazardous Waste

Figure 28: Prevention Mechanisms

Appendix L: Critical Incident Chart and Timeline

Table 12: Critical Incidents

Time Period	United States	Hawaii
Middle Ages	Streets in cities were covered with household waste, human and animal excrement, and stagnant water.	Tahitians canoed to Hawaiian Islands and settle. They lived off of the land, and waste was not a part of their vocabulary.
19th Century	Public health became a primary driver for a sanitation movement. Linkages discovered between infectious diseases (e.g., Cholera) and poor sanitation.	Westerners began to travel to Hawaiian islands. Whaling becomes a big industry. Missionaries move to the islands and introduced systems of trade and new religions.
20th century	Legislation is put into place to get waste off the streets and municipalities began providing collection services.	Tourism increased and Hawaii became a state in 1959.
1970	Environmental protection from waste disposal became an important issue, technical standards increased, focusing mostly on leachate and gas control from landfills.	Hawaii builds first sanitary landfill. Other landfills were started and abandoned.
1984	The U.S. Environmental Protection Agency instituted the Resource Conservation and Recovery Act, which provided increased regulations on landfills and greater environmental protection.	County closes 4 landfills due to new RCRA regulations and opens one large, central landfill.
1984-2011	Waste generation rates continue to grow exponentially until 2009. First decline in 2009.	Waste generation rates continue to grow. Landfills begin reaching capacity. Limited space available for building more.

Appendix M: Number of Items Coded in Each Category

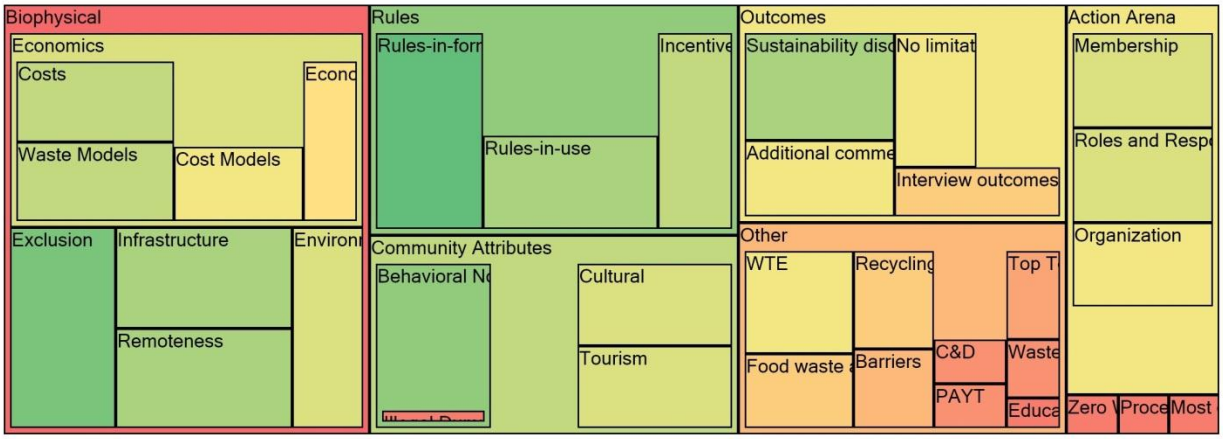


Figure 29: IAD Number of Codes by Category

Appendix N: Dissertation Timeline

Table 13: Dissertation Timeline

Research Activity	Apr '10	May - Jun '10	Aug - Dec '10	Jan – May '11	May – Aug '11	Oct '11
Proposal Defense	X					
Pre-field Work	X	X				
Data Collection		X	X	X		
Interview follow-up			X	X		
Coding, documentation			X	X		
Analysis of Data				X		
Write Dissertation				X	X	
Submit Dissertation					X	
Review Process					X	
Dissertation Defense						X

Appendix O: Glossary of Key Terms

Anaerobic Digestion: A process that breaks down biodegradable material in the absence of oxygen. It can be used for managing green waste and sewage sludge and it also produces renewable energy.

Composting: A humus or soil-like material created from aerobic, microbial decomposition of organic materials such as food scraps, yard trimmings, and manure (EPA, 2011a).

Gasification: A technology that can convert carbonaceous material such as coal, petroleum coke, and other materials into a synthesis gas using high temperature and pressure. Synthesis gas can be used as a fuel source or as a building block for other chemical processes (EPA, 2011d, 2007b).

Incineration: A treatment technology involving destruction of waste by controlled burning at high temperatures (EPA, 2011a).

Landfill: Sanitary landfills are disposal sites for non-hazardous solid wastes spread in layers, compacted to the smallest practical volume, and covered by material applied at the end of each operating day (EPA, 2011a).

Landfill Gas-to-Energy: The natural by-product of the decomposition of solid waste in landfills comprised primarily of carbon dioxide and methane (EPA, 2011e).

Leachate: Water that collects contaminants as it trickles through wastes, pesticides or fertilizers. Leaching may occur in farming areas, feedlots, and landfills, and may result in hazardous substances entering surface water, ground water, or soil (EPA, 2011a).

Methane: Methane (CH_4) is a greenhouse gas that remains in the atmosphere for approximately 9-15 years. Methane is over 20 times more effective in trapping heat in the atmosphere than carbon dioxide (CO_2) over a 100-year period and is emitted from a variety of natural and human-influenced sources. Human-influenced sources include landfills, natural gas and petroleum systems, agricultural activities, coal mining, stationary and mobile combustion, wastewater treatment, and certain industrial process (EPA, 2011b).

MRF: A Materials Recycling Facility for sorting and processing recyclables.

Plasma Arc Gasification: A waste technology that uses an electric arc gasifier and electrical energy to create high temperatures to break down waste into elemental gas and slag (Circeo).

Recycling: Minimizing waste generation by recovering and reprocessing usable products that might otherwise become waste (EPA, 2011a).

Solid Waste: Non-liquid, non-soluble materials ranging from municipal garbage to industrial wastes that contain complex and sometimes hazardous substances. Solid wastes also include sewage sludge, agricultural refuse, demolition wastes, and mining residues. Technically, solid waste also refers to liquids and gases in containers (EPA, 2011a).

Solid Waste Management: Supervised handling of waste materials from their source through recovery processes to disposal (EPA, 2011a).

Waste-to-Energy (WTE): Facility where recovered municipal solid waste is converted into a usable form of energy, usually via combustion (EPA, 2011a).

White Goods: Bulk goods and appliances, such as refrigerators, washing machines, and stoves.

REFERENCES

Allison, E. (2008). The Dark Side of Light: Managing Non-biodegradable Wastes in Bhutan's Rural Areas. *Mountain Research and Development*. 28, 205.

American Society of Civil Engineers [ASCE]. (2011). Report Card for America's Infrastructure. http://apps.asce.org/reportcard/2005/page.cfm?id=33.

Andersson, K. P. & Ostrom, E. (2008). Analyzing decentralized resource regimes from a polycentric perspective. *Policy Sciences*. 41: 71-93.

Arrow, et. al. (1995). Economic Growth, Carrying Capacity, and the Environment. *Science*. 268.

Badiru, A. B. (2010). "The Many Languages of Sustainability. *Industrial Engineer*. 42(11): 30-34.

Bai, R. & Sutanto, M. (2002). The practice and challenges of solid waste management in Singapore. *Waste Management*. 22, 557-67.

Begum, R. A. et al. (2007). Factors and values of willingness to pay for improved construction waste management – a perspective of Malaysian contractors. *Waste Management*. 27, 1902-1909.

Boer, T., Pastor, M., Sadd, J.L. et al. (1997). Is there environmental racism? The demographics of hazardous waste in Los Angeles County. *Social Science Quarterly*. 78, 4, p. 793-810.

Bonevac, D. (2010). Is Sustainability Sustainable? *Academic Questions*. 23(1): 84-101.

Bortoleto, A. P. & K. Hanaki (2007). Report: Citizen participation as a part of integrated solid waste management: Porto Alegre case. *Waste Management & Research*. 25(3): 276-282.

Bovea, M. D. & J. C. Powell (2006). Alternative scenarios to meet the demands of sustainable waste management. *Journal of Environmental Management*. 79(2): 115-132.

Broadman, G. et al. (2010). Complaint for Declaratory and Injunctive Relief. United States District Court Eastern District of Washington. Retrieved January, 2011, from http://www.gorgefriends.org/downloads/hawaii.garbage.complaint.pdf

Brown., D. Bernadette, O., Moles, R. (2005). A comparative analysis of the application of sustainability metric tools using Tipperary Town, Ireland, as a case study. *Management of Environmental Quality.* 16, 1, p. 37.

Chambers, B., Chapman, R. E., & Cross, R. T. (1995). Integrated Waste Disposal Strategy for the Orkney Islands—A Case Study. *Water Science Technology*. 32, 9: 159-168.

Cheuk, W., K. V. Lo, et al. (2003). Benefits of Sustainable Waste Management in the Vegetable Greenhouse Industry. *Journal of Environmental Science & Health, Part B -- Pesticides, Food Contaminants, & Agricultural Wastes*. 38(6): 855.

Chirico, J. (2009). There is No Such Thing as Away: An Analysis of Sustainable Solid Waste Management Technologies. *Atlanta Georgia: Program in Science, Technology, and Innovation Policy, Georgia Institute of Technology.*

Chung, S. & Lo, C. W. (2007). The roles of grassroots local government in sustainable waste management in China. *International Journal of Sustainable Development & World Ecology*. 14, 133-144.

County of Maui [MM]. (2007, 2008). Solid Waste Management Committee Meeting Minutes. *County of Maui*.

Daly, H. (1995). On Wilfred Beckerman's Critique of Sustainable Development. *Environmental Values*. 4, 49-55.

Daniels, G. and Friedman, S. (1999). Spatial inequality and the distribution of industrial toxic releases: Evidence from the 1990 TRI. *Social Science Quarterly*. 80, 2, p. 244-53.

Dawson, T. (2007). Maui Narrowly Avoids Landfill Crisis After Waste Volume Jumps Unexpectedly. *Environment Hawaii*. 18, 1, 6.

Dang, I., Cohen, R. R. H., Urynowicz, M. A., Poudyal, J. N. (2009). Report:Searching for a way to sustainability: technical and policy analyses of solid waste issues in Kathmandu. *Waste Management & Research*. 27, 295-301.

Dewulf, J. & Van Langenhove, H. (2005). Integrating industrial ecology principles into a set of environmental sustainability indicators for technology assessment. *Resources, Conservation and Recycling.* 43, 419-432.

Diaz, L.F. (2007). Resource and Environmental Management in Islands. *Waste Management*. 27, 325-326.

Dietz, T., Ostrom, E., Stern, P. (2003). The Struggle to Govern the Commons. *Science.* 302, 1907.

Dinis, M. A. P. (2009). A Concise Review on Some Frequently used solid waste management technologies and their effects into the environment and human health. *Revista da Faculdade de Ciências da Saúde.* 6, 320-330.

Dodds, R., S. R. Graci, et al. (2010). Does the tourist care? A comparison of tourists in Koh Phi Phi, Thailand and Gili Trawangan, Indonesia. *Journal of Sustainable Tourism*. 18(2): 207-222.

Economist. (2009). Talking Rubbish: A Special Report on Waste. Retrieved October, 2009 from http://www.economist.com/specialreports/displaystory.cfm?story_id=13135349

Englande, A. J., & Guang, J. (2006). Application of biotechnology in waste management for sustainable development. *Management of Environmental Quality*. 17(4), 467.

Environment Hawaii. (2006). Big Island, Big Trash. *Environment Hawaii.* 17, 3, 2.

Eshet, T. Ayalon, O. & Shechter, M. (2005). A critical review of economic valuation studies of externalities from incineration and landfilling. *Waste Management*. 23, 487.

Faber, D. R., Krieg, E. J. (2002). Unequal exposure to ecological hazards: environmental injustices in the commonwealth of Massachusetts. *Environmental Health Perspectives*. 110, 2, p. 249-57.

Forsyth, T. (2006). Cooperative environmental governance and waste-to-energy technologies in Asia. *International Journal of Technology Management and Sustainable Development.* 5, 209.

Georges, N. M. (2006). Solid waste as an indicator of sustainable development in Tortola, British Virgin Islands. *Sustainable Development.* 14(2): 126-138.

Gershman, Brickner & Bratton [GBB]. (2009). Integrated Solid Waste Management Plan. *GBB Solid Waste Management Consultants.*

Goven, J. & Langer, E.R. (2009). The potential of public engagement in sustainable waste management: Designing the future for biosolids in New Zealand. *Journal of Environmental Management.* 90, 921-930.

Gunawardana, E. et al. (2009). Influence of biological pre-treatment of municipal solid waste on landfill behaviour in Sri Lanka. *Waste Management & Research*. 27, 5: 456.

Hamilton, C. (2008). Maui County should take advantage of technology, advisory panel member says. *Maui News.*

Hammer, G. (2003). Solid waste treatment and disposal: effects on public health and environmental safety. *Biotechnology Advances*. 22, 71-79.

Hawaii Clean Energy Initiative [HCEI]. (2011). Retrieved October, 2011 from http://www.hawaiicleanenergyinitiative.org/

Hawaii Department of Health [HDOH]. (2010). Solid and Hazardous Waste Branch. Retrieved April, 2010 from http://hawaii.gov/health/environmental/waste/index.html

Hazel, J. & Wilson, G. (2000). Institutional sustainability: 'communty' and waste management in Zimbabwe. *Futures.* 32, 301-316.

Hernandez, M. G. & Martin-Cejas, R. R. (2005). Incentives Towards Sustainable Management of the Municipal Solid Waste on Islands. *Sustainable Development*. 13: 13-24.

Hockman, E. M. & Morris, C. M. (1998). Progress towards Environmental Justice: A Five-year perspective of Toxicity, Race, and Poverty in Michigan, 1990-1995. *Journal of Environmental Planning and Management*. 41, 2, p. 157-76.

Holling, C.S. (1992). Cross-Scale Morphology, Geometry, and Dynamics of Ecosystems. *Ecological Monographs*. 62, 447-502.

Holling, C.S. & Gunderson, L. H. (2002). *Resilience and Adaptive Cycles* as published in Panarchy: Understanding Transformations in Human and Natural Systems. Island Press: Washington D.C.

Hung, M., Ma, H. & Yang, W. (2007). A novel sustainable decision making model for municipal solid waste management. *Waste Management*. 27, 209-219.

Imperial, M. T., Yandle, T. (2005). Taking Institutions Serioulsy: Using the IAD Framework to Analyze Fisheries Policy. *Society and Natural Resource*s. 18, 493-509.

Interviewees [INT]. (2010). Interview Data Collection by Jennifer Chirico. Hawaii.

Janiskee, B. (2010). *The Great Pacific Garbage Patch Brings Blight to the Beach at Hawaii's Kalaupapa National Historical Park*. National Park Traveler.

Jayaraman, V. B., R. Sinha, et al. (2005). Waste and consumer education for society about the 3R's and 5P's holds the key to sustainable waste management. *Waste: The Social Context*. 288-293

Jenkins, R. R., Kopits, E., and Simpson, D. (2009). Policy Monitor—The Evolution of Solid and Hazardous Waste Regulation in the United States. *Review of Environmental Economics and Policy*. 3, 1: 104-120.

Jin, J., Wang, Z., Ran, S. (2006). Comparison of contingent valuation and choice experiment in solid waste management programs in Macao. *Ecological Economics*. 57, 430-441.

Johnson, H., Wilson, W. (2000). Institutional sustainability: 'community' and waste management in Zimbabwe. *Futures*. 32, 301-316.

Jones, B.D. (2003). Bounded Rationality and Political Science: Lessons from Public Administration and Public Policy. *Journal of Public Administration Research and Theory*. 13, 4, 395-412.

Joseph, K. (2006). Stakeholder participation for sustainable waste management. *Habitat International.* 30(4): 863-871.

Juniper. (2005). *Mechanical Biological Treatment: A Guide for Decision Makers, Processes, Policies, and Markets.* Juniper Consultancy Services.

Kane, H. K. (1997). *Ancient Hawaii.* Captain Cook, Hawaii: The Kawainui Press.

Kaosol, T. (2009). Sustainable Solutions for Municipal Solid Waste Management in Thailand. *Proceedings of World Academy of Science: Engineering & Technology*. 60: 665-670.

Khan, S. & Faisal, M.N. (2008). An analytic network process model for municipal solid waste disposal options. *Waste Management*. **28**(9): 1500-1508.

Kijak, R. & Moy, D. (2004). A Decision Support Framework for Sustainable Waste Management. *Journal of Industrial Ecology.* 8(3): 33-50.

Kim, G. S., Chang, Y. J., Kelleher, D. (2008). Unit pricing of municipal solid waste and illegal dumping: an empirical analysis of Korean experience. *Environmental Economics and Policy Studies* 9(3): 167-176.

Kinnaman, T. C. (2009). The economics of municipal solid waste management. *Waste Management*. 29(10): 2615-2617.

Kirkeb, J. T. et al. (2006). Environmental assessment of solid waste systems and technologies. *Waste Management Research.* 24, 33-15.

Klang, A, Vikman, P, Brattebo, H. (2006). Systems analysis as support for decision making towards sustainable municipal waste management. *Waste Management Research*. 24, 323-331.

Koontz, T.M. (2005). We Finished the Plan, So Now What? Impacts of Collaborative Stakeholder Participation on Land Use Policy. *Policy Studies*. 33, 3: 459-81.

Kooten & Bulten. (2000). The ecological footprint: useful science or politics? *Ecological Economics*. 32.

Knowles, C. L. (2005). Social factors that influence the sustainability of waste reduction and recovery from small community, enterprise, and industry experiences in southern Chile. *Waste: The Social Context*. 355-364.

Lang, J. C. (2005). Zero landfill, zero waste: the greening of industry in Singapore. *International Journal of Environment and Sustainable Development*. 4, 3, 331.

Leach, M. A., Bauen, A., Lucas, N. (1997). A systems approach to materials flow in sustainable cities. A case study of paper. *Journal of Environmental Planning and Management.* 40, 6, 705-723.

Lee, W. (1997). *Institutional analysis of tourism development in Phang Nga, Thailand*. Dissertation: University of Rhode Island.

Leopold, A. (1949). *Thinking Like a Mountain as published in A Sand County Almanac*. Oxford University Press: New York.

Ley, E., Macauley, M., & Salant, S. (2002). Spatially and intertemporally efficient waste management: the costs of interstate trade restrictions. *Journal of Environmental Economics and Management*. 43, 188-218.

Ley, E., Macauley, M., & Salant, S. (2002). Restricting the Trash Trade. *The American Economic Review. 90, 2, 243.*

Lind, I. (2009). Torn plastic wrapping on bales of Honolulu trash waiting to be shipped to Oregon signal problems. Retrieved April 2009 from www.iLind.net.

Lu, L. et al. (2006). MSW management for waste minimization in Taiwan: The last two decades. *Waste Management*. 26, 661-7.

Marchettini, N. Ridolfi, R., & Rustici, M. (2007). An environmental analysis for comparing waste management options and strategies. *Waste Management.* 27, 562-571.

Marschke, M. & Sinclair, A. J. (2009). Learning for sustainability: Participatory resource management in Cambodian fishing villiages. *Journal of Environmental Management*. 90, 206-216.

Martens, J. (2005). Development of a modular e-learning based distance education study programme to implement sustainable waste management approaches in developing countries. *Waste: The Social Context*. 464-467.

Mazzanti, M. (2008). Is waste generation de-linking from economic growth? Empirical evidence for Europe. *Applied Economics Letters*, 15(4), 287-291.

Mazzanti, M., Montini, A., & Zoboli, R. (2009). Municipal waste generation and the EKC hypothesis new evidence exploiting province-based panel data. *Applied Economics Letters*, 16(7), 719-725.

Mazzanti, M., & Zoboli, R. (2009). Municipal Waste Kuznets Curves: Evidence on Socio-Economic Drivers and Policy Effectiveness from the EU. *Environmental & Resource Economics*, 44(2), 203-230.

McDonough, W. & Braumgart, M. (2002). *Cradle to Cradle*. North Point Press: New York.

McDougall, F. R., E. J. Wilson, et al. (2001). Euro-trash: searching Europe for a more sustainable approach to waste management. *Resources, Conservation & Recycling*. 31(4): 327.

Miles, M. B., Huberman, A. M. (1994). *Qualitative Data Analysis.* Thousand Oaks: Sage Publications, Inc.

Minciardi, R. et al. (2008). Multi-objective optimizationof solid waste flows: Environmentally sustainable strategies for municipalities. *Waste Management.* 28, 2202-2212.

Mohan, R., J. Spiby, et al. (2006). Sustainable waste management in the UK: the public health role. *Public Health (Elsevier).* 120(10): 908-914.

Morrissey, A. (2005). Indicators for sustainable waste management. *Waste: The Social Context.* 488-496.

Morrissey, A. J. and J. Browne (2004). Waste management models and their application to sustainable waste management. *Waste Management.* 24(3): 297.

Ngoc, U. N. and H. Schnitzer (2009). Sustainable solutions for solid waste management in Southeast Asian countries. *Waste Management* 29(6): 1982-1995.

Norton, B. (2005). *Sustainability: A Philosophy of Adaptive Ecosystem Management.* Chicago: University of Chicago Press.

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. *Science.* 325, 410, p. 419.

Ostrom, E. (2008). The challenge of common-pool resources. Environment. 50, 4. 1-20.

Ostrom, E. (2007). Institutional Rational Choice: An Assessment of the Institutional Analysis and Development Framework. As published in Sabatier, P. A. *Theories of the Policy Process Second Ed.*. Boulder. Westview Press.

Ostrom, E. Janssen, M., Anderies, J. M. (2007). Going beyond panaceas. *Proceedings of the National Academies of Sciences.* 104, 39: 15176-15178.

Ostrom, E. (2005). *Understanding Institutional Diversity*. Princeton University Press: Princeton.

Ostrom, E. (1999). Institutional Rational Choice: An Assessment of the Institutional Analysis and Development Framework. As published in Sabatier, P. A. *Theories of the Policy Process*. Boulder. Westview Press.

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. New York: Cambridge University Press.

Ostrom, E., Gardner, R. Walker, J. (1994) *Rules, Games, and Common-Pool Resources*. Ann Arbor: University of Michigan Press.

Parrot, L., J. Sotamenou, et al. (2009). Municipal solid waste management in Africa: Strategies and livelihoods in Yaounde, Cameroon. *Waste Management* 29(2): 986-995.

Pasang, H., G. A. Moore, et al. (2007). Neighborhood-based waste management: A solution for solid waste problems in Jakarta, Indonesia. *Waste Management.* 27(12): 1924-1938.

Petts, J. (2000). Municipal waste management: Inequities and the role of deliberation. *Risk Analysis*, 20(6), 821-832.

Petts, J. (2004). Barriers to participation and deliberation in risk decisions: evidence from waste management. *Journal of Risk Research*. 7(2), 115-133.

Pollock, P. H. & Vittas, M.E. (1995). Who Bears the Burdens of Environmental Pollution? Race, Ethnicity, and Environmental Equity in Florida. *Social Science Quarterly*. 76, 2, p. 294-310.

Ramjeawon, B. (2008). Site selection of sanitary landfills on the small island of Mauritius using the analytical hierarchy process multi-criteria method. *Waste Management and Research*. 26, 5: 439.

Ray, C. (2005). The Next Best Thing. *Civil Engineering*. 58-63.

Ringquist, E. J. (1997). Equity and the distribution of environmental risk: the case of TRI facilities. *Social Science Quarterly*. 78, 4, p. 811-29.

Roussat, N. Dujet, C. Mehu, J. (2009). Choosing a sustainable demolition waste management strategy using multicriteria decision analysis. *Waste Management.* 29, 12-20.

Sabatier, P. Weible, C. (2007). The Advocacy Coalition Framework: Innovations and Clarifications. As published in Sabatier, P. A. *Theories of the Policy Process Second Ed.*. Boulder. Westview Press.

Saeed, M. O. Hassan, M. N., Mujeebu, M. A. (2009). Assessment of municipal solid waste generation and recyclable materials potential in Kuala Lumpur, Malaysia. *Waste Management.* 29, 2209-2213.

Seidman, Irving. (2006). *Interviewing as Qualitative Research*. Teachers College Press, New York.

Sergio, B. R. (1996). Sustainability Indicators for a Waste Management Approach. *Instituo Brasileiro de Administracao Municpal.*

Shekdar, A. V. (2009). Sustainable solid waste management: An integrated approach for Asian countries. *Waste Management.* 29(4): 1438-1448.

Smith, W. J. (2008). The place of rural, remote and least-wealthy small islands in international waste development: the nexus of geography—technology sustainability in Chuuk State, Federated States of Micronesia. *The Geographical Journal*. 174: 251-268.

Soderberg, H., & Kain, J. (2006). Assessments of Sustainable Waste Management Alternatives: How to Support Complex Knowledge Management. *Journal of Environmental Planning and Management*. 49, 1, 1-39.

Solow, R. M. (1992). Sustainability – An Economists Perspective. *Research & Exploration*, 8(1), 3-6.

State of Hawaii. (2011). Sunshine Law. Retrieved May, 2011 from http://www.state.hi.us/oip/sunshinelaw.html.

State of Hawaii. (2011). State of Hawaii DOE Illegal Dumping Notice. Retrieved August 2011 from http://hawaii.gov/health/environmental/waste/sw/pdf/illdump2011.pdf.

State of Hawaii. (2007). Annual Visitor Research Report. *Hawai'i. Department of Business, Economic Development and Tourism. Research and Economic Analysis Division*. Retrieved January, 2011 from www.hawaii.gov.

Tammemagi, H. (1999). The Waste Crisis: Landfills, Incinerators, and the Search for a Sustainable Future. Oxford Press: New York.

Troschinetz, A. M. and J. R. Mihelcic (2009). Sustainable recycling of municipal solid waste in developing countries. *Waste Management*. 29(2): 915-923.

United Nations. (2009). Sustainable Development Topics. UN Department of Economic and Social Affairs: Division for Sustainable Development. Retrieved January, 2009 from http://www.un.org/esa/dsd/susdevtopics/sdt_index.shtml

United Nations. (1992). United Nations Conference on Environment & Development, AGENDA 21. Retrieved January, 2010 from http://www.cuttingthroughthematrix.com/articles/Agenda21.pdf

United Nations. (1987). Our Common Future: Report on the World Commission on Environment and Development. Retrieved April, 2010 from http://www.un-documents.net/ocf-02.htm#I

U.S. Census. (2010). State and County Quick Facts. *U.S. Census*. Retrieved March, 2010 from http://factfinder.census.gov/servlet/SAFFPopulation?_event=Search&_name=&_state=04000US15&_county=&_cityTown=&_zip=&_sse=on&_lang=en&pctxt=fph

U.S. Census. (2011). State and Local Government Finances by Level of Government and by State. *US Census*. Retrieved May 2011 from http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=04000US15&-ds_name=EC0700A1&-NAICS2007=56&-_lang=en

U.S. EPA. (2011a). Terms of Environment: Glossary, Abbreviations, and Acronyms. *US EPA*. Retrieved April, 2011 from http://www.epa.gov/OCEPAterms/aterms.html

U.S. EPA. (2011b). Methane. *US EPA*. Retrieved January, 2011 from http://www.epa.gov/methane/.

U.S. EPA. (2011c). Environmental Justice. *US EPA*. Retrieved January, 2011 from http://www.epa.gov/environmentaljustice/.

U.S. EPA. (2011d). Gasification. *US EPA*. Retrieved January, 2011 from http://www.epa.gov/osw/hazard/wastetypes/wasteid/gas.htm.

U.S. EPA. (2011e). Landfill Methane Outreach Program. *US EPA*. Retrieved January, 2011 from http://www.epa.gov/lmop/index.htm

U.S. EPA. (2011f). Wastes, Resource Conservation, Reduce, Reuse, Recycle, Composting. *US EPA*. Retrieved January, 2011 from http://www.epa.gov/osw/conserve/rrr/composting/

U.S. EPA. (2011g). Regulations Governing Treatment, Storage, and Disposal Facilities. RCRA, Subtitle 6, Chapter 3. *US EPA*. Retrieved January, 2011 from http://www.epa.gov/osw/inforesources/pubs/orientat/rom35.pdf

U.S. EPA. (2007a). Basic Facts: Municipal Solid Waste (MSW). United States Environmental Protection Agency. *US EPA*. Retrieved February, 2007 from http://www.epa.gov/msw/facts.htm.

U.S. EPA. (2007b). Municipal Waste in the United States: 2007 Facts and Figures. *US EPA*. Retrieved February, 2007 from http://www.epa.gov/waste/nonhaz/municipal/pubs/msw07-rpt.pdf

Vucetich, A., Nelson, M. (2010). Sustainability: Virtuous or Vulgar? *BioScience.* 60, 7. 539-544.

Vidanaarachchi, C. K., Yuen, S. T., Pilapitiya, S. (2006). Municipal solid waste management in the Southern Provience of Sri Lanka: Problems, issues, and challenges. *Waste Management*. 26: 920-30.

Wallis, A. M., A. R. Kelly, et al. (2010). Assessing sustainability: a technical fix or a means of social learning? *International Journal of Sustainable Development & World Ecology*. 17(1): 67-75.

Waste News. (2005). Largest Landfills. *Waste News.* 11, 13, 14-16.

Waste to Wealth (2011). The Concepts of Extended Producer Responsibility and Product Stewardship. Retrieved March, 2011 from http://www.ilsr.org/recycling/epr/index.html.

World Bank (2009). Pacific Islands Development in 3D: Key Findings and Policy Advice. *The International Bank for Reconstruction and Development.*

Yin, R. K. (2003). *Case Study Research: Design and Methods*. Thousand Oaks: Sage Publications.

Yousif, D. F. & S. Scott (2007). Governing solid waste management in Mazatenango, Guatemala. *International Development Planning Review.* 29(4): 433-450.

Zotos, G., A. Karagiannidis, et al. (2009). Developing a holistic strategy for integrated waste management within municipal planning: Challenges, policies, solutions and perspectives for Hellenic municipalities in the zero-waste, low-cost direction. *Waste Management* 29(5, Sp. Iss. SI): 1686-1692.