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Managing Costa Rica's Waste

Recommendations
for a Municipal
Solid Waste
Management Plan



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Managing Costa Rica's Waste: Recommendations for a Municipal Solid Waste Management Plan

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Abstract

In May 2010, Costa Rica passed the “Law for the Integrated Management of Residues,” which stated that lawmakers would pass specific decrees to improve solid waste management. We worked with GTZ and CYMA to provide recommendations for these decrees. We researched international programs and conducted a focus group and interviews with key stakeholders in order to determine feasible Market-Based Instruments to improve waste management. To this end, we recommend that Costa Rica gradually implement Eco-labeling, Pay-As-You-Throw, and Deposit-Refund.

Acknowledgements

We could not have completed this project without the contributions of the German Technical Cooperative (GTZ). We are particularly indebted to our sponsor, Dr. Sergio Musmanni, for the many hours he spent meeting with us, providing us with valuable background, empirical data, and expert contacts within the related fields.

Furthermore, this project could not have succeeded without the participation of a variety of people from the government and private sectors. We held a workshop and several follow-up interviews with them in order to determine the feasibility of our outcomes. Participants included: Marcos Adamson, Silvia Chaves, José Antonio Cordero, Rolando Castro Córdoba, Luis Diego Jimenez, Rafael Díaz Porras, and Carlos Picado Rojas. They represented the following organizations: Universidad de Costa Rica (UCR); Universidad Nacional (UNA); Centro Internacional de Política Económica para el Desarrollo Sostenible (CINPE); Centro de Derecho Ambiental y de los Recursos Naturales (CEDARENA); Instituto Nacional de Biodiversidad (INBio); Comisión Nacional de Prevención de Riesgos y Atención de Emergencias (CNE); and Florex, a company that sell green cleaning products.

Their important contributions in the form of their knowledge and advice on waste management played an invaluable role in the formulation of our recommendations.

Finally, we would like to thank our advisors, professors Stanley Selkow, Jennifer Rudolph, and Ingrid Shockey. Their constant advice, support, and editorial feedback was immensely helpful to us throughout the course of this project.

Executive Summary

Costa Rica is well known for its rich biodiversity, environmentally conscious citizens, and numerous national parks, which has resulted in a \$1.9 billion a year ecotourism industry (Fallas, 2007). However, the resultant rapid economic development and urbanization has contributed to a waste management problem, as the infrastructure for municipal solid waste management (MSWM) in Costa Rica has not advanced accordingly. Over sixty percent of the 2,400 tons of waste produced daily is put into open dumps while fifteen percent is put into sanitary landfills, less than ten percent is recycled, and about 250 tons is dumped illegally in rivers and streets (Frankie, 2004). Such improper management of toxic residues can negatively impact the environment and public health, causing mutations in species and diseases such as cancer in humans (Modern Marvels, 2004). Furthermore, plastics deposited in the streets can block the drainage system, exacerbating urban flooding (Karley, 2009). Costa Rica, a country economically dependent on ecotourism, should be concerned about these environmental and health problems associated with improper waste management (Costa Rica, 2010; Ministerio Federal de Cooperación Económica y Desarrollo, 2008).

In May 2010, the Costa Rican government passed the “Ley para la Gestión Integral de Residuos,” or the “Law for an Integrated Management of Residues” to outline the need for an integrated MSWM system. The objective of the law is to provide the necessary legislation to regulate and organize a comprehensive national plan for the management of solid waste. Originally, the law only contained general guidelines for improvements of the MSWM plan in Costa Rica. The lawmakers stated that they would pass decrees in the future to specifically identify the approaches and methods that Costa Rica will use to improve its MSWM system (Law for an Integrated Management of Residues, 2010). Our focus for this project was on Chapter III of the law, which focuses on the utilization of economic incentives (Law for the Integrated Management of Residues, 2010; Sergio Musmanni, personal communication, Sept 20, 2010). We considered market-based instruments, or MBIs, to address this issue. MBIs are economic tools that use markets to modify people’s behavior to achieve specific goals. Particularly, we wanted to utilize MBIs in order to improve MSWM in Costa Rica.

The goal for our project was to design recommendations for a municipal solid waste management plan. We provided these recommendations to aid in the formulation of the decrees

as provided by the aforementioned law. In order to accomplish this goal, we set out the following objectives:

- To research the MSWM policies, legislation, and infrastructure of other countries, with emphasis on business, social, legal, and environmental aspects;
- To highlight tools which facilitate the development of processes, products, and services for an integrated MSWM system;
- To consult with Costa Rican stakeholders and experts in order to consider other aspects that could be limiting factors, such as local practices and legal constraints; and
- To evaluate the complexity, costs, and benefits of these tools.

To achieve these objectives, we examined the successes and failures of MBIs and solid waste management in other countries, conducted a focus group, and held several interviews with experts in Costa Rica. The purpose of the case studies was to gain background knowledge on existing MBIs and how different countries employed them successfully in order to determine which ones could be applicable to Costa Rica. The purpose of the focus group and interviews was to consult with local experts about which of our identified MBIs would be most feasible, as well as to identify the advantages and obstacles associated with each.

We examined successes and failures of market-based instruments and solid waste management plans in Brazil, Germany, and Taiwan in order to identify strategies that could be successful in Costa Rica. Brazil, for example, tried to implement a series of MBIs at the national and local levels. However, there was a lack of connection between the goals of the two levels of government as well as between the funding and goals of the incentives, both of which contributed to the failure of the program. This study showed us ways to determine the feasibility of a proposed MBI. Germany, on the other hand, used a series of national laws regarding household recycling and industrial responsibility to gradually limit their use of landfills and achieve a near one hundred percent recycling rate. The programs in Germany that we determined could work within Costa Rica included eco-labeling and requiring Producers to Collect Recyclables (PCR). However, these overall accomplishments took a national effort and several decades to achieve, so it is important that Costa Rica recognize that waste management improvement is gradual. Finally, Taiwan used MBIs that encouraged household composting and waste reduction, providing a source of funding for environmental programs and decreasing the

average national waste output. Specific programs that could be feasible in Costa Rica included Pay-As-You-Throw (PAYT) and a tax on plastic bags. Overall, these case studies provided us with an understanding of legal frameworks and economic factors that can affect waste management programs, as well as an initial list of instruments to consider for Costa Rica (*Municipal Solid Waste Management*, 2006; Chang, 2008; da Motta, 1996; Huber, 1998; Lu, 2005; Ministério do Meio Ambiente, 2008; Mühle, 2010; National Renewable Energy Laboratory, 1995; Nature Conservancy, 2005; Programa CYMA, 2007; Taipei City Government, 2010; Taiwan EPA, 2005; Vehlow, 2009, Zhang, 2010).

We conducted a focus group and interviews in order to determine which instruments would be feasible for implementation in Costa Rica. The participants, including experts from non-government organizations, government agencies, universities, and the business sector, helped us determine that the most feasible programs from our list were PAYT, eco-labeling, and deposit-refund. These programs all have significant potential to modify how people dispose of their waste and how much they recycle. We further analyzed these three MBIs to determine advantages, obstacles, and methods of overcoming these obstacles.

We determined that eco-labeling, deposit-refund, and PAYT all have the potential to significantly improve the solid waste management system in Costa Rica. In eco-labeling, a designated certification entity awards an eco-label to companies that have met certain environmental standards which they can then place on their products. This label creates product differentiation for consumers, increases environmental awareness, and provides a form of advertising for the producers. In deposit-refund, the government places a fee on a recyclable product when it is purchased, which the consumer can then retrieve by recycling the product. Deposit-refund places an economic value on the material, resulting in increased recycling and decreased littering. In PAYT, municipalities charge residents per bag of disposed solid waste, while collecting recyclables for free. By charging residents for how much they throw away, PAYT provides a powerful economic incentive that directly encourages people to reduce waste while also generating revenue.

Despite the advantages of these programs, there are a number of potential obstacles to their successful implementation. However, our research provided some possible ways to overcome these obstacles. For example, eco-labeling relies on consumer willingness to pay more for products that are produced using environmentally-friendly materials and practices. To encourage

consumers to buy these products, the government can carry out an education campaign describing the importance of the eco-label and how such products have a smaller environmental impact. Deposit-refund requires consumer participation through recycling and infrastructure for the collection and reprocessing of all of the targeted recyclable materials, which is something that is currently lacking in Costa Rica. By first expanding the country's recycling infrastructure and testing the program with one type of material, the government can determine how much to charge for the deposit and where to place the recycling centers to maximize participation. PAYT requires individuals to be willing to pay for their trash and the municipalities to be able to collect separated waste, which most municipalities are currently unable to do. The government can overcome these obstacles by helping municipalities expand their ability to collect separated materials, finding the right price for waste disposal to increase participation, and educating the public about the significance of the program and how it will run. Such measures will ensure that these programs are successful and reach their greatest potential for improving waste management.

We recommend that Costa Rica implement eco-labeling because of its reliance on market forces rather than government enforcement, and because of its ability to differentiate between products. We recommend that Costa Rica also implement deposit-refund, but that it begins the program with only one material. Once the country has more recycling infrastructure in place, we recommend that it expand the program to the whole country and other materials such as plastics, glass, and aluminum. We also recommend that Costa Rica implement PAYT for its ability to reduce waste generation and increase recycling rates. However, we suggest that municipalities first expand their ability to collect separated waste to maximize PAYT's potential. To ensure that these programs run well and have the support of the public, the government must educate the public about the problems associated with improper waste management and how these programs will address these issues, create concrete plans to allocate the revenue from the programs and be transparent with its use of funds, and expand the municipalities' capacity to collect and process reusable waste.

We have considered a wide range of possibilities on how to implement the law for "The Integrated Management of Residues" and suggested the most feasible options from our findings. However, our conclusions are simply a step towards improving the MSWM system in Costa Rica. We advise that the respective government ministries conduct further in-depth cost-benefit

analyses of these programs to ensure that they are organized and run well. Due to time constraints and the nature of our project, we were unable to determine exact methods of implementation or to provide a full cost-benefit analysis with regards to budgeting. Although the usefulness and necessity of these programs are not in question, further review is necessary to ensure that they are implemented successfully. After our report is presented to GTZ, the organization may choose to incorporate these into their own recommendations to the policy-makers drafting decrees.

Authorship Page

All team members contributed to determining the organization and content of each chapter. All team members also contributed to writing and editing the chapters. However, the appendices were written by separate team members, but edited and reviewed by all. The primary authors of each section are:

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Chapter 1 – Introduction

Costa Rica is a country with stunning rainforests, beaches, volcanoes, and cloud forests. Its vast biodiversity includes over 500,000 species, representing nearly four percent of the total species worldwide, within a country that covers only 0.03% of the world's surface (National Biodiversity Institute, 2010). This astonishing range of biodiversity, protected within an extensive national park system, has contributed to a thriving ecotourism industry, which from 2002 to 2006 grew more than 6.6% annually and generated over \$1.9 billion per year (Fallas, 2007). Despite the resultant image of being an environmentally aware country, Costa Rica is riddled with a municipal solid waste management (MSWM) problem (Cozta Rica, 2010). The country has been unable to develop its infrastructure and policies to properly handle the increased load of waste resulting from rapid economic growth and urbanization. Roughly 2400 tons of waste is generated daily and an estimated 250 tons is dumped illegally into streets and rivers (Frankie, 2004). There is also only a single digit recycling rate, while most of the waste in Costa Rica is dumped into open dumps and unregulated sanitary landfills, many of which do not meet regulations. Since 2008, the Costa Rican government has recognized the MSWM problem and has shown interest in finding a solution through legislation (Ministerio Federal de Cooperación Económica y Desarrollo, 2008).

In May 2010, the government of Costa Rica passed a law for the “Integrated Management of Residues” (Integrated Management of Residues, 2010). The law provided guidelines to address the problems in the current MSWM system in Costa Rica. As stated in the law, lawmakers will pass specific decrees within the next several months in order to achieve these general goals. However, in order for the national law to succeed, municipalities, residents, and businesses will have to support the law at the ground level. The German Technical Cooperation (GTZ), a German organization created to promote sustainable development, and Programa Competitividad y Medio Ambiente (CYMA), a government environmental agency in Costa Rica, entered into a seven-year partnership in 2005 in order to improve MSWM within Costa Rica (Deutsche Gesellschaft für Technische Zusammenarbeit, 2005). Our goal, and one mission of both GTZ and CYMA, is to advise the government in the formulation of decrees for the new waste management law.

While other countries have made significant progress in MSWM, Costa Rica has only recently begun to improve their waste management program (Magera, 2006; Ministerio Federal de Cooperación Económica y Desarrollo, 2008). Moderate developments in Costa Rica include programs for trading of recyclable materials, the creation of recycling centers, and the full separation of reusable materials in some areas. In order to improve MSWM, the governments of other countries often utilized market-based instruments (MBIs), which are economic incentives that modify behavior to achieve environmental goals and raise revenue for environmental programs. Countries such as Germany, Taiwan, and Ecuador have utilized MBIs to this end. Furthermore, there have been extensive studies of MBIs in the past fifteen years with one focus being how they can be applied to municipal solid waste (MSW) management (Andersen, 2000; Chang, 2008; Huber, 1998; Lu, 2005; Southgate, 1995).

Despite many recent developments, the MSWM system in Costa Rica has significant room for improvement. Although other countries have experienced success in MSWM through MBIs and there have been extensive studies on the use of these instruments, this knowledge has not yet been fully applied to Costa Rica. To address this issue, we gathered information about MBIs from case studies and other research and analyzed the feasibility of the implementation of these MBIs in Costa Rica. We considered the availability of resources and infrastructure in Costa Rica as well as the feasibility of these MBIs economically, socially, and environmentally.

The goal for our project was to propose to GTZ and CYMA potential methods for improving the municipal solid waste management system in Costa Rica, which will inform policymakers as they draft decrees. Our objectives were:

- To research the MSWM infrastructure of Germany, Brazil, and Taiwan, with emphasis on business, social, legal, and environmental aspects
- To highlight tools which facilitate the development of processes, products, and services for an integrated MSWM system
- To consult with Costa Rican stakeholders in order to consider other aspects that could be limiting factors, such as local practices and legal constraints
- To evaluate the complexity, costs, and benefits of these tools

Policymakers can then use our report while formulating decrees to improve the MSWM system in Costa Rica. By proposing these improvements, we can reduce the negative environmental, health, and social impacts associated with waste production, management, and disposal.

Chapter 2 – Background

In May 2010, the Costa Rican government passed the “Ley para la Gestión Integral de Residuos” or the “Law for an Integrated Management of Residues” to outline the need for an integrated municipal solid waste management (MSWM) system. The objective of the law is to provide the necessary legislation to regulate and organize a comprehensive national plan for the management of solid waste. Originally, the law only contained general guidelines for improvements to the MSWM system in Costa Rica. The lawmakers stated that they would pass decrees in the future to specifically identify the approaches and methods that Costa Rica will use to improve its MSWM system (Law for an Integrated Management of Residues, 2010).

The German Technical Cooperation (GTZ) is a German non-governmental organization operating in developing countries such as Costa Rica, with a goal of assisting with sustainable development. In 2005, GTZ began a seven year partnership with the Programa Competitividad y Medio Ambiente (CYMA), a Costa Rican government organization that monitors environmental protection, economy, and health. The mission of the CYMA is to support industrial development in certain regions and promote integrated MSWM in Costa Rica. The integrated MSWM plan consists of a set of legal, financial and administrative actions to organize the management process from the generation to final disposal of waste. GTZ and CYMA remain partnered to assess on the current MSW situation, including the current regional and national collection programs, in order to advise policy-makers on potential decrees (Deutsche Gesellschaft für Technische Zusammenarbeit, 2005; GTZ, n.d.; Ministerio Federal de Cooperación Económica y Desarrollo, 2008).

2.1 Waste Disposal and Management Practices

Before we discuss the MSWM problem in Costa Rica, we must first provide some general background of waste disposal and management practices. A result from the production of waste is the need to manage its disposal. MSWM plans ensure a large-scale effective waste disposal system. Solid waste management is “the systematic administration of activities that provide for the collection, source separation, storage, transportation, transfer, processing, treatment, and disposal of solid waste” (Nemerow, 2009, p. 179). Policies to reduce waste through the reuse of products, and the recycling and composting of inorganic and organic materials are vital to MSWM. The three phases after solid waste production are typically collection, separation, and

transportation (Nemerow, 2009). Finally, remaining waste must be disposed, commonly into open dumps or landfills. In the follow section we examine these steps to understand the fundamental infrastructure that underlies conventional waste management theories.

2.1.1 Reduce, Reuse, Recycle

Reduction, a method in which producers reduce solid waste output, is one way to decrease the amount of solid waste requiring disposal. To this end, individuals can purchase reusable products with limited packaging or choose to repair and reuse items that might otherwise go to landfills. Education campaigns and government-created economic incentives are the typical methods of turning consumer trends away from products that produce excessive waste (Tammemagi, n.d; EPA, 2010).

While individuals can reduce waste production through the reuse of items, they can also give materials to municipalities to be recycled. The US EPA (2010) states “recycling is a method that turns materials that would otherwise be waste into valuable resources.” Paper, steel, aluminum, glass, copper, zinc, and plastics are commonly recycled materials. Consumers recycle for a variety of reasons, including environmental concerns, government legislation, and economic incentives. In general, successful recycling programs include minimal inconvenience to the consumer, incentives for participation, and methods of educating the public of the environmental impacts of waste disposal. Recycling systems require infrastructure, including a place for consumers to put their recyclables, collectors to transport the materials, and a place to convert the recyclables to usable materials for manufacture (Kimball, 1992; Neal, 1987; Nemerow, 2009).

Just as recycling allows for the reuse of inorganic waste, composting allows for the reuse of organic materials, which comprised sixty percent of the MSWM in Costa Rican landfills in 2005 (Magera, 2006). Composting is a procedure through which organic waste is decomposed to produce a material that can fertilize and condition land or be used as pig feed (Chang, 2008; Taipei City Government, 2010). Thus, instead of placing organic waste in landfills that often lack space, composting converts organic materials into a useful product (EPA, 2010).

2.1.2 Collection, Separation, and Transportation

The first step in a MSWM plan is the collection of solid waste from consumers. In the collection process, waste producers bring their waste to collection centers or municipal waste

trucks collect waste from homes and businesses. Government run transfer stations serve to make collection systems more efficient by offering a location for transfer of waste from local collection trucks to large disposal vehicles. The large collection trucks then compact the waste to allow more waste per truck. Reusable materials can also be separated from other waste at the transfer stations (Neal, 1987).

Depending on the materials and methods of extraction, separation of waste can take place before, during, or after the collection process. Source separation is “the segregation of various materials from the waste stream” (Nemerow, 2009, p. 179). Individuals can separate waste by sorting recyclable and compostable materials from non-reusable materials. Another opportunity for waste separation is at transfer stations, where large-scale separation processes can occur, such as magnetic separation to remove ferrous materials (Nemerow, 2009; Sudhir, 1997).

While the use of transfer stations and the separation of MSW can improve the efficiency of transportation of waste, there are still environmental and economic costs associated with transportation. A fleet of garbage vehicles requires significant investment to purchase the fleet and then to dispose of them at the end of their useful life. Additionally, they require fuel and maintenance, which is costly for government waste management agencies. Fuel economy is typically poor, increasing the costs of fueling and the amount of toxic emissions, which have negative impacts on both the environment and public health (Consultantes Río Colorado, 2010; Nemerow, 2009). Thus by reducing the amount of the transportation of waste, municipalities can reduce monetary costs and harmful emissions.

2.1.3 Disposal Options

After reduction, recycling, and composting have minimized the overall waste stream, some waste must still be treated or disposed. While waste can be treated or disposed in a variety of ways, the most common form of disposal in Costa Rica is open dumps. In this process, people and municipalities bring waste to a designated area where it simply sits above ground. This can negatively impact public health and sanitation as well as the environment, resulting in such effects as air pollution and water contamination (EPA, 2010; Yousuf, 2009).

Landfills are another common waste disposal method in which waste is dumped into the ground and covered with soil, providing an environment conducive to decomposition. Sanitary landfills are the second most common form of disposal in Costa Rica and often contain a

membrane underneath the waste to catch the runoff leachate, a liquid solution resulting from the accumulated waste and rainwater. Sanitary landfills should prevent leachate contamination of groundwater in order to protect the environment and public health. The design of landfills must take into consideration factors such as climate, geology, soils, and topography (Nemerow, 2009; EPA, 2010). It is possible to convert open dumps into sanitary landfills, although it is generally expensive (see Appendix A).

2.2 Current Costa Rican Infrastructure

Currently, the MSWM plan in Costa Rica is governed by outdated legislation from the Ministry of Health. Most waste is sent to open dumps and sanitary landfills, while little is recycled. Although roughly ninety percent of the waste in Costa Rica is collected, rural areas are often left off the collection routes (Magera, 2006). Also, funding is an issue for the MSWM program as municipalities spend most of their funds on landfill costs (Sergio Musmanni, personal communication, September 20, 2010).

Perhaps the most immediately pressing issue is the lack of governmental funding and infrastructure for further development of MSWM in Costa Rica. Currently, almost all of the funding for MSWM is spent on landfill disposal fees, leaving few funds remaining for development of alternative MSWM methods. Furthermore, there is a lack of infrastructure for recyclable materials. Although a strong collection program is in place, there are few domestic recycling centers. As a result, recyclable materials, such as aluminum and steel, are sent to be processed internationally, most notably to China. The few domestic recycling centers in Costa Rica have a monopoly on recyclable materials, and thus have total control over the quality of materials accepted and the price for those materials (Sergio Musmanni, personal communication, October 27, 2010).

Another issue for the improvement of MSWM in Costa Rica is the lack of enforcement on both the national and municipal level. In Costa Rica, the national government creates a law and the municipalities are responsible for developing a system of management and enforcement. However, municipalities are not sanctioned by the national government if they choose not to enact and enforce the laws in their region. Although this has not been a common occurrence in Costa Rica, the municipalities may not facilitate the new waste management law, rendering it largely ineffective. Furthermore, municipalities often lack the resources to regulate sanctions at

the local level. One example is a \$200 fine for illegal dumping of waste into streets that is rarely enforced (Law for the Integrated Management of Residues, 2010; Sergio Musmanni, personal communication, October 27, 2010).

In 2008, Costa Rica implemented a national assessment plan for MSWM called the Plan De Residuos Sólidos (PRESOL), with a goal of providing initiatives for governmental and private entities to develop an improved MSWM strategy. The creators of PRESOL completed an initial assessment and defined thirty-one initiatives such as optimizing the collection system, regulating dangerous residues, and creating social awareness for MSWM plans (See Appendix B for a list of the initiatives). Unfortunately, PRESOL received no legal support and was unsuccessful at implementing these initiatives. The success of PRESOL was the completion of an initial assessment and definition of initiatives (Ministerio Federal de Cooperación Económica y Desarrollo, 2008).

Costa Rica currently generates 2,475 tons of waste per day, which is equivalent to 0.55 kg per capita. According to a study completed by Magera (2006), in 2005 Costa Rica put approximately seventy-five percent of its waste into landfills and open dumps, and only recycled eight percent of the total waste. Also, only five sanitary landfills meet environmental and health standards. This fact has contributed to the public's confusion between open dumps and sanitary landfills, resulting in public opposition against the creation of new sanitary landfills to replace open dumps or old landfills that should be decommissioned. Approximately ninety percent of the waste is organic, paper, cardboard, or plastic (See Figure 1 below), and Costa Rica could improve its recycling program as many materials have low recycling rates (See Figure 2 below). Particularly, note that the recycling rate is below fifty percent for all materials except aluminum. Many sorting facilities are manual, diminishing efficiency. Some local waste management programs provided housing to workers in return for them collecting waste and recyclables at the landfills. However, this practice had limited contribution to the recycling process due to the absence of a professional storage facility for the collected materials and a lack of organization of the workforce. Furthermore, MSWM programs are concentrated in urban areas and generally neglect rural areas (Magera, 2006; Ministerio Federal de Cooperación Económica y Desarrollo, 2008; Sergio Musmanni, personal communication, September 20, 2010).

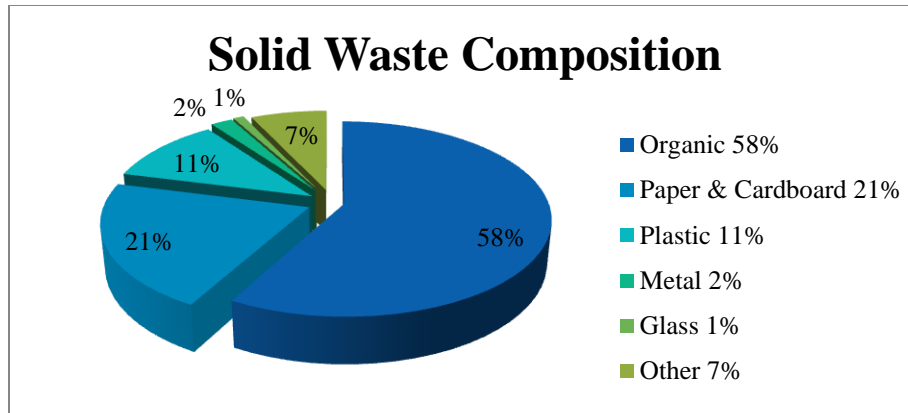


Figure 1: Graphical Representation of Costa Rica’s Solid Waste Composition

Material	Recycling Rate
Aluminum	75%
Paper & Cardboard	39%
Plastic	15%
Metal	35%
Glass	44%

Figure 2: Recycling Rates for Materials in Costa Rica

Although the collection of MSW in Costa Rica is generally strong, the management, separation, disposal, and recycling practices often require significant improvement. However, several communities are making considerable enhancements to their MSWM systems. For example, in Nosara, residents are asked to separate metal, glass, aluminum, and plastic from their trash. Consumers pay \$2.20 per month for collection services that occur twice weekly (City of Nosara, 2005). The municipality of Desamparados created a flyer to educate consumers on the separation or recyclable materials before collection (Municipalidad de Desamparados, n.d) (See Appendix C). In Atenas, there is a recycling center for those who want to recycle metals, plastics, paper, and electronics. This recycling center also offers jobs to the disabled, thus creating opportunities and building a positive atmosphere (Mills, 2010). Additionally, the pamphlet “MERSI,” a section within the magazine *Industria*, provides a place for people to publish their offers and demands for recyclable materials in order to facilitate trade, although generally there are more offers than demands (CNP+L, 2009). Despite all of these successes, Costa Rica still only has a single digit recycling rate, a large amount of illegal dumping, and a large amount of organic waste being disposed of in landfills.

2.3 Market-Based Instruments

We studied market-based instruments (MBIs) as methods of addressing the problems in waste management. MBIs are economic incentives created to modify behavior in order to achieve environmental, economic, or management goals. Our focus for this project was Chapter III of “Law for an Integrated Management of Residues” which strongly considers the utilization of economic incentives (See Appendix D for the complete text of Chapter III of the law). MBIs have not been utilized for MSWM in Costa Rica, which represents a significant area for study and improvement. In other Latin American countries, rapid urbanization and development created environmentally harmful practices, leading countries such as Brazil, Bolivia and Ecuador to implement MBIs to achieve environmental goals (Andersen, 2000; Huber, 2010; Law for the Integrated Management of Residues, 2010; Sergio Musmanni, personal communication, Sept 20, 2010).

Even with a lack of initial funding and governmental enforcement, MBIs can be excellent tools for raising revenue for environmental programs and creating economic incentives for environmental change. They are generally less expensive than other management options, since the government can rely on the private sector to optimize costs with respect to MBIs. In addition, they can be effectively utilized by governments with few resources. Furthermore, MBIs promote environmental change through economic incentives, as consumers who make the decision to use environmentally harmful products or practices are generally the ones confronted with the economic incentive to change their methods (Huber, 2010; The Nature Conservancy, 2005).

Historically, MBIs have been implemented to create revenue for Environmental Protection Agencies (EPAs). Generally, governments impose fees for environmentally destructive behavior and earmark the money for EPAs. For example, taxes on materials that are impossible to recycle or compost force companies to rethink their strategies and minimize their negative environmental impacts because there are economic incentives to do so. Then, the EPAs can use the money to fund other environmental projects, such as the creation of MSWM infrastructure and programs. Through the utilization of MBIs, governments can raise revenue to fund environmental programs (Huber, 2010).

In countries such as Ecuador, Brazil, and Venezuela, governments implement MBIs primarily for generating revenue, and therefore these programs often exhibit a disconnection

between the target of the fee and the purpose of the raised money. Ecuador provides an example of such a division, where residents pay a small solid waste fee based on electricity usage. This fee encourages residents of Ecuador to decrease negative environmental impacts through energy use reduction, but does not directly encourage any change of behavior regarding MSW disposal. Programs that exhibit this lack of connection between where the fee is imposed and what type of project it is supposed to be funding are generally less effective than programs that directly correlate the fee with the objective. On the other hand, people who produce more electricity tend to be wealthier and produce more trash, thus there is an indirect connection between the amount each citizen pays and trash they produce. The policy also puts the electricity companies, who have the power to cut electricity, in charge of enforcement of the payments to the MSWM fund. Thus the government does not have to spend resources on enforcement because the private sector assists. MBIs created solely for revenue generation can still be effective in these situations (Huber 2010; Southgate, 1995).

The effectiveness of MBIs is that they can be implemented to encourage change. In relation to the improvement of MSWM, fees can be imposed by volume of materials disposed in landfills, a program known as Pay-As-You-Throw (PAYT). This program encourages people and businesses to adjust their behavior and reduce waste through recycling, reduction, and composting. After the implementation of PAYT in Taiwan, recycling and composting increased, while landfill disposal decreased. Programs such as PAYT also create revenue for the government to fund other MSWM plans such as social awareness programs, monetary incentives to recycle and compost, and the creation of infrastructure. For example, from 2002 to 2005, the government of Taiwan was able to expand the recycling program even while the gross national product (GNP) decreased. This success was possible because of the behavioral changes that PAYT brought about and the funding that it was able to produce (Chang, 2008; Huber, 2010).

Although many MBIs are effective with minimal effort, governments must proceed with caution when creating them. MBIs that force residents to pay a fee for MSW disposal may result in an increase in illegal dumping into streets and rivers. In this case, the MBI that was supposed to reduce landfill disposal created another problem instead; this represents a perverse effect on the problem. When deciding what types of MBIs to implement, governments must take into account many factors. The average income level and the local level of poverty can influence an MBI's efficacy. The national government must consider the level of enforcement reasonable to

expect at the municipal level, as instruments are typically enforced at this level, and a lack of communication between the national and municipal governments can be a fatal flaw. Also, new MBIs must not conflict with current legislation, as this can create potential loopholes and inefficacy. Consideration of social implications, such as whether or not residents are willing to respond to MBIs, is of vital importance as well; they should be kept modest to avoid straining the available resources of both the government and the public. MBIs require participation from stakeholders, leadership from municipalities, and reliance on the market. MBIs that adopt these policies and consider the social, environmental, and economic consequences, both direct and indirect, are likely to be successful (Andersen, 2000; Huber, 2010). Appendix E contains information regarding common constraints to MSWM.

2.4 Education

Education is a key aspect in implementing MSWM programs. The strategy that a government will use to improve solid waste management is directly related to the level of education and motivation of the general public. In general, if people are motivated and educated about a waste management program, they will be more willing to support the program and help it be more successful. Thus, if the general public is uneducated about waste management, the government may choose to initiate education programs in order to be able to implement successful MSWM programs (Chakraborty, 2005; Chang, 2008).

Other countries have educated the public in order to achieve environmental goals in MSWM. In Taiwan, the government initiated several educational programs before successfully implementing MBIs to improve its MSWM system. They reinforced administrative propaganda for the composting program, set up several recycling sites, and advertised recycling to the public. After education, Taiwan had success with its other programs; however, it should be noted that in 2005, Taiwan had a \$60 million budget for educational programs. The success of these educational programs resulted in the continued success of their new waste management system (Chang, 2008; Lu, 2005).

Bangladesh used different tactics to implement educational programs for MSWM improvement in Dhaka. An NGO introduced a manual for teachers to educate children. They chose schools to implement the waste education, where teachers would provide an eight course module that focused on “learning by doing.” There was also an emphasis on community

programs which actively tried to solve waste related problems, educating the people who completed the community service as well as those who observed the service. After the program, community awareness rose by about thirty percent. Unfortunately, the manual was not as successful as it might have been because it was only a co-curricular course and thus did not reach as many people as a mandatory program would have (Chakraborty, 2005).

Germany also implemented several successful public education plans. The region of Bad Tölz applied a system of waste avoidance, composting, and waste-to-energy processes in response to a lack of landfill space in the 1980's. The waste avoidance plan was largely implemented through a public education campaign. This campaign distributed materials on the importance of "smart" shopping and composting of organic household waste. The city of Duisburg implemented a similar waste avoidance program, distributing information packets about how to limit household waste output. These packets also explained how the new Packaging Ordinance law would work, its purpose, and the importance of contributing to the program in order to maximize its effectiveness. These two cities' public education programs both contributed significantly to their MSWM systems. Their programs demonstrate how public education can be used to encourage people to modify their waste habits and to inform them of how to contribute to larger waste management programs (National Renewable Energy Laboratory, 1995).

Education can be an important aspect of creating a successful MSWM program, especially in the earlier stages of development. Taiwan, Bangladesh, and Germany are several examples of countries that successfully educated the public. It is important to note that depending on the country and current level of education, different programs will have varied levels of success. While our focus is on MBIs, we will also consider educational programs to supplement them, as such programs can improve the efficacy of a waste management system.

2.5 International Case Studies

Case studies of MSWM strategies in other countries can provide useful information for Costa Rica, regarding the successes and failures of waste management programs. Analyzing which programs succeeded or failed internationally helped us determine which programs are likely to work in this country. We researched and analyzed several case studies to determine possible benefits and obstacles of implementing MBIs in Costa Rica. We examined Germany for its

strong recycling rate, Brazil for its attempts at environmental improvement, and Taiwan for its strategies of MSWM programs to determine some of the most effective management policies available to Costa Rica.

2.5.1 Germany

Germany has an effective MSWM plan, utilizing legislation and social responsibility to achieve an almost perfect recycling rate, in which nearly all recyclable materials are recycled. The German government passed many laws over the past two decades regarding waste management. Some of these implemented laws are:

- the “Act for Promoting Closed Substance Cycle Waste Management and Ensuring Environmentally Compatible Waste Disposal” from the early 1990s that requires all residents to separate their recyclables;
- the “Ordinance of Packing,” or “Ordenanza de Empaque” (ODE), which was passed in 1986 and set up a system that required producers to recollect their packaging materials;
- the “Ordinance on the Avoidance and Recovery of Packaging Wastes” in 1998 that aimed to maximize the use of reusable and recyclable beverage containers; and
- the “Technical Instructions on Municipal Solid Waste” that since 2005 has drastically limited the amount and type of material that is permitted in landfills.

Through legislation, the German government set achievable goals and drove the country towards better waste management. Due to the passage of these laws as well as others, Germany has in place an effective system of reuse, recovery, recycling, and incineration, resulting in little need for landfill disposal. In 2007, more than sixty percent of the total municipal solid waste was recycled, about thirty percent was treated with various “Energy from Waste” or incineration methods, and only about one percent was put in landfills (Mühle, 2010; Zhang, 2010).

The German government has been successful in implementing a gradual plan to improve its MSWM program. Figure 3 (below) shows the decrease in land-filling and complimentary increase in recycling and incineration over the ten year period from 1997 to 2007. Vehlou (2009) states that from 1980 to 2010, Germany produced between 500 and 600 kg of MSW per capita annually, which is similar to the 572 kg per capita produced in the UK and the 652 kg for the EU as a whole in 2007. However, within this timeframe, the 562 landfills in 1990 dropped to 333 in 2000. To compensate for the decrease in landfill use, the number of incinerator plants

increased from forty-eight to seventy-two between 1990 and 2007, resulting in a twenty-two petajoule increase in power output from MSW incineration. Incineration increased significantly in 2004 in response to the upcoming “Technical Instructions” that would limit landfill use the following year. In general, the decrease in landfill use and increase in incinerator use occurred with the passage of each new law. Germany was successful at improving its MSWM system through focused legislation, but the process was very gradual (*Municipal Solid Waste Management*, 2006; Mühle, 2010; Vehlow, 2009).

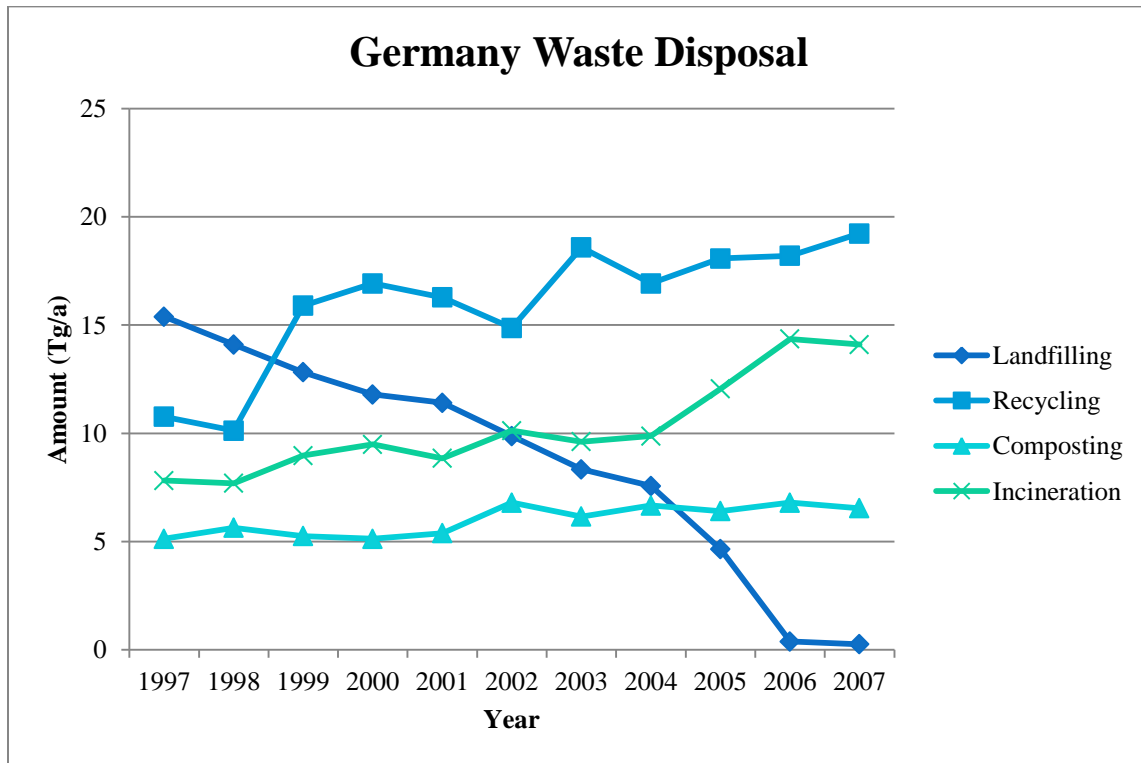


Figure 3: Graphical Representation of Germany’s Waste Disposal Techniques

One law that contributed to the increased efficacy of Germany’s waste management plan is the Green Point initiative, which is also called the Ordinance of Packing (ODE). Its purpose was to implement a system that required manufacturers to accept the return and to reuse their packaging materials waste outside of the main MSWM system. The law provided for the establishment of Producer Responsibility Organizations (PRO), whose purpose would be to undertake the responsibility of recycling programs imposed upon the companies. The companies would pay the PROs to collect and recycle their waste for them, thus streamlining the process. The ODE established collection quotas that were initially set to sixty percent for glass and

twenty percent to forty percent for all other materials in 1993. The quotas went up to ninety percent for glass and eighty percent for all other materials in 1995. If a company met the collection quotas set forth in the law, they would then be allowed to place the Green Point seal on their products, a technique called eco-labeling. This drive to increase the recycling of packaging materials was a result of the population requesting a greener alternative to incineration. The law also embodies the concept that “whoever pollutes should pay,” placing responsibility for recycling on the manufacturers (National Renewable Energy Laboratory, 1995; Programa CYMA, 2007).

Germany also utilizes a colored bin system of four bins to separate paper materials; organics; recyclable packaging materials, such as glass and aluminum; and residual waste at the residential level. In this system, each recyclable material is assigned its own colored bin. This system simplifies the recycling process by allowing individuals to separate the different recyclables themselves, thus eliminating a step in the recycling process. When municipalities collect the recyclables, it is clear which material is in each bin. The colored bin system also utilizes the sense of social responsibility present in Germany, as not separating waste into the colored bins is seen as socially unacceptable. Through the colored bin system, Germany recycles nearly all of its recyclable material. In 2006, one hundred percent of glass, ninety-nine percent of paper, one hundred percent of organics, and seventy-eight percent of packing materials were recycled (Mühle, 2010).

Germany’s plan to deal with solid waste has been extremely effective and it could serve as an example for creating a successful MSWM plan in Costa Rica. Over the course of several decades, they passed numerous focused laws that successfully pushed the country towards maximizing recycling and incineration and minimizing landfill disposal. As it was in Germany, the transition to an extremely efficient and successful MSWM system in Costa Rica will likely have to take place over many years. Specific initiatives such as the colored bin system, the Packaging Ordinance, and eco-labeling were successful in Germany. The municipalities followed national laws, residents had a sense of social responsibility for MSWM, and the government had a significant amount of initial funding. The strength of connection between the levels of government in Germany is different from that of Costa Rica, meaning that some programs that were successful in Germany may be less so here (CIA, 2010). Nevertheless, the

German MSWM plan is a near ideal example to refer to when analyzing the long term goals for MSWM in Costa Rica.

2.5.2 Brazil

While Germany was successful in improving its MSWM system, Brazil was ineffective at implementing MBIs for environmental improvement. We studied Brazil in hopes of understanding what mistakes governments can make when attempting to implement MBIs, as well as how to avoid such mishaps.

During the 1970s, Brazil faced several environmental problems as a result of “rapid urban industrialization and mechanization of agriculture” (Huber, 1998). In order to define the objectives, priorities, guidelines, instruments, and duties of environmental policies, the National Environmental Policy was passed in 1973. The Brazilian Institute of Environmental and Renewable Natural Resources (IBAMA) was created in 1989 in an attempt to integrate the federal agencies that addressed environmental issues. Despite the creation of IBAMA, there was still a gap between the federal and state agencies. For example, as a result of the immediate deforestation problem in Brazil, the focus of IBAMA was the proper management of Brazil’s forests. However, the state environmental agencies were focusing on local problems such as pollution and water quality. This lack of connection between the focuses of the national and regional environmental agencies resulted in less successful programs at both levels of government (da Motta, 1996; Huber, 1998; Ministério do Meio Ambiente, 2008).

Regional EPAs lacked the funds to implement the proper programs to improve environmental issues. Federal agencies determined the budget of regional EPAs, which were typically not enough to function successfully. Regional EPAs tried to implement a fine system to create income, but fines could be contested in the regional courts, making them an unreliable income. Also, regional EPAs could attempt to implement license fees, but the revenue from this method was not significant. The weak connections between federal and regional EPAs resulted in financial and political weakness. In 1988, Brazil had many severe environmental problems, such as untreated sewage, agricultural runoff, and a lack of sanitary landfills. Solutions to these problems were extremely expensive as were the health costs associated with diseases that result from these environmental problems (Huber, 1998).

The government of Brazil attempted to introduce MBIs to improve environmental management. Throughout the 1970s, 1980s, and early 1990s, the government began implementing deforestation, preservation, resource exploitation, and sewage taxes. The revenue was used to address environmental problems. Unfortunately, these taxes were created with the sole purpose of raising revenue rather than addressing the negative environmental impacts, thus limiting their efficacy. Although Brazil had difficulties addressing environmental issues, Brazil earmarked roughly 540 million US dollars for environmental purposes in 1993. With this revenue, the government was more able to make a positive environmental impact (da Motta, 1996; Huber, 1998).

However, despite the often lacking connection between revenue creation and behavioral change, Brazil has had recent success with MBIs, particularly when the private sector backed government policy. For example, in 2005, soybean farmers in the Amazon were required to put eighty percent of their land into preserves. This law was often unenforced in remote regions until Cargill, a major soybean distributor, declared that they would only buy soy from farmers and companies which were in compliance with the law (The Nature Conservancy, 2005). In this way, Cargill gained government support as a distributor, and the government gained Cargill's private sector support in enforcing its laws. Thus in this case, legal action was not enough to obtain environmental success until the government received assistance from the private sector. When legislation is backed by the private sector, it tends to be more effective as it has a stronger economic drive.

From the case study of Brazil, we found several obstacles to the implementation of MBIs that may affect Costa Rica. There should be a strong relationship between federal and regional EPAs. In Brazil, the federal EPA was distracted by the deforestation problem and could not assist regional EPAs with local problems. Also, a lack of funds for regional EPAs was a clear problem. The government in Brazil attempted to raise revenue through a fee system, but it was largely unsuccessful since fines were contested in court. For an MBI to raise revenue, municipalities must be able to regulate and enforce it. With a reasonable budget garnered from MBIs, regional EPAs would more likely be effective. However, the purpose of MBIs is not only to create revenue, but also to provide economic incentives to promote positive environmental changes. Programs that do not include these incentives are less likely to be successful.

2.5.3 Taiwan

Taiwan has been successful in implanting MBIs to improve MSWM. While Taiwan and Costa Rica have many differences, both the Taiwanese and Costa Rican governments are searching for ways to improve their waste management systems. To this end, Taiwan utilized a combination of education, incentives, and command-and-control techniques to integrate its waste management system. Through their MSWM improvement strategy (See Appendix F for full strategy), the Taiwanese government developed clever economic incentives to achieve their environmental goals and create revenue for municipalities (Lu, 2005).

In Taipei, the government implemented the Pay-As-You-Throw (PAYT) system. The government charged collection and treatment fees by forcing citizens of Taipei to buy special trash bags. Strict regulations were put in place for those who attempted to counterfeit the bags. Residents paid \$0.13 per liter of solid waste collected, while recycling was collected for free. The PAYT program gave Taipei citizens an economic reason to recycle. In five years, Taipei decreased annual solid waste production from 8.35 million tons to 7.51 million tons, representing a decrease of nearly ten percent (Chang, 2008; Lu, 2005).

Taiwan also employed a program to reduce the usage and disposal of environmentally harmful plastic materials. The plan gradually prohibited certain target groups from using and disposing of plastics. The program restricted the use of plastic bags made of environmentally harmful material and limited the thickness of plastic shopping bags. Consumers were also required to pay extra for plastic shopping bags. As a result, plastic waste decreased from 150 tons per year to 120 tons per year from 2003 to 2005 (Chang, 2008; Lu, 2005).

Roughly twenty-five percent of MSW in Taiwan is food and garden waste. To address this issue, Taiwan started Total Recycling for Kitchen Garbage (TKG) (Taipei City Government, 2010). The focus of TKG was to take food waste from residential areas, restaurants, and hotels, separate it from non-food waste, and use it as pig food and fertilizer. The program gave incentives for residents to separate food waste from recyclable and other solid waste. Around sixty-eight percent of the organic waste is used as pig feed, while thirty-two percent is composted. The amount of food waste that goes to landfills has decreased as food waste that is utilized for pig feed or fertilizer has more than doubled from 2003 to 2005 (Chang, 2008; Lu, 2005).

The Taiwan Environment Protection Agency (EPA) also passed the Resource Recycling and Reuse Act in 2005. The act requires producers of fluorescent lamps, foam plastics, dry batteries, aseptic containers, LCDs, cathode ray tubes, and printed circuit boards to be responsible for the recovery of their produced goods, thus making it very progressive in terms of recycling. A recycling fund management program has also been put into operation, in which manufacturers or importers of certain items must pay a fee that goes into the Taiwan EPA's recycling funds. The recycling fund supplements the budget that the EPA uses specifically to subsidize the collection and recycling of materials. Furthermore, the local government of Taipei issued the "Waste Disposal Act," which requires residents to recycle twelve types of waste items. If they do not, they must pay a fine and waste-collection crews may refuse to collect their waste. The fines are paid to the government to fund MSWM programs (Chang, 2008; Lu, 2005; Taiwan EPA, 2005).

Although the country still produces millions of tons of waste each year, Taiwan reduced its MSW per capita from 1.14 kilograms to 0.81 kilograms between 1997 and 2002 (Lu, 2005). Furthermore, even though plastic waste has decreased, plastics are now the largest percentage of waste going into landfills. Reducing the use of plastic bags has been difficult because of their heavy use in Taiwanese culture, such as carrying take-out food in plastic bags. This dilemma shows that the EPA must continue to study what kind of policies the Taiwanese society will accept and support, and that the Taiwanese government must create more concrete objectives for businesses and residents of Taiwan. Although there are still obstacles to overcome, Taiwan has succeeded in its attempt to reduce waste (Chang, 2008).

The successes of solid waste management in Taiwan relates to Costa Rica since they are the results of policy changes. First, the government implemented education programs by promoting recycling and the "waste not, want not" attitude towards reduction. Then, the government gave the people of Taiwan incentives to recycle, compost, and reduce the usage of plastics, a plan that Costa Rica could potentially emulate. The Taiwanese government identified the key problems and formed policies to address these problems, mainly by creating incentives. They implemented and enforced the policies, analyzing the results and considering the social aspects. In addition to enforcing policies that improved waste management in Taiwan, the government created policies, such as PAYT and the Waste Disposal Act, which would create revenue for local MSW programs. The programs resulted in residents producing less waste, thus reducing the waste-related costs for municipalities. The increased revenue and reduced costs allowed the

government of Taiwan to expand its recycling program, despite the aforementioned decreases in the GNP (Lu, 2005).

The Taiwanese government had a definitive methodology for MSWM; it was a key reason for Taiwan's success, and could potentially work in Costa Rica. However, many of the programs passed in Taiwan require strong government enforcement, which Costa Rica may lack due to the significant divisions between the national and municipal governments. Appropriation of funds and the divisions of tasks between the national and municipal governments is often unclear in Costa Rica (Lu, 2005; Sergio Musmanni, personal communication, October 27, 2010). PAYT, composting Kitchen Garbage, and creating recycling incentives are all ideas that could potentially be implemented in Costa Rica, as well as the simple philosophy of creating clever economic incentives to achieve environmental goals and create revenue for municipalities.

2.6 Conclusions Drawn from Our Research

Through the passage of the May 2010 waste management law, the Costa Rican government sought to improve its MSWM system. One method of improving MSWM is through MBIs, which have been studied and implemented in other countries such as Germany, Taiwan, Brazil, and Ecuador. MBIs were effective at raising revenues in countries such as Taiwan and Ecuador. Through legislation and market incentives, Germany and Taiwan also improved their management systems.

Germany provided examples of comprehensive recycling programs to minimize dependence on landfills. It improved MSWM through legislation that increased the efficiency of recycling and incineration. Germany also used policies that forced manufacturers to accept responsibility for their products and materials through eco-labeling. This can require follow-up and enforcement, and thus may not be feasible as an initial program in Costa Rica because of its limited ability to enforce such laws. However, more wide-spread implementation of a colored bin system or some other method of separation could be effective in Costa Rica, though it would require an initial investment. In Germany, social responsibility was vital to the success of the colored bin system and eco-labeling. Municipalities in Costa Rica, such as Desamparados and Nosara, have begun educational campaigns in order to achieve this sense of responsibility (*Municipal Solid Waste Management*, 2006; City of Nosara, 2005; Mühle, 2010; Municipalidad de Desamparados, n.d.).

Brazil highlighted several obstacles for the implementation of MBIs, from which we inferred how Costa Rica might employ MBIs more successfully. A lack of correlation between the subject of the taxes and revenue use often weakened instruments in Brazil. Although these instruments could still raise revenue, they did not provide an economic incentive for people to modify behavior relevant to the purpose of the MBI. A strong relationship between the federal and regional governments is also typically important, which could be an obstacle in Costa Rica. However, since the municipalities would be the ones to develop and enforce the specifics of these MBIs, this connection is less necessary. Most important is that both the federal and municipal governments have the same overall goals: in this case, the improvement of MSWM (Andersen, 2000; Huber, 1998; Sergio Musmanni, personal communication, October 27, 2010).

Taiwan demonstrated that a variety of government programs such as PAYT and TKG can inform and encourage the public to minimize waste production and disposal. However, Taiwan's plastic bag programs also demonstrated that it is important to consider what management programs will be socially and culturally acceptable in Costa Rica. Also, the Taiwanese government relied on a strong list of legislation to achieve its goals. Although a modified step-by-step methodology has potential for success in Costa Rica, it is important to note that many of the programs passed in Taiwan required strong enforcement by the government, which Costa Rica may lack due to the divisions between the national and municipal governments (Chang, 2008; CIA, 2010; Lu, 2005; Sergio Musmanni, personal communication, October 27, 2010).

Clearly, stakeholder participation is integral to determining which policies have the greatest potential for success in Costa Rica because of the numerous legal, environmental, and social aspects involved. Based on knowledge of MBIs, Costa Rica's current infrastructure, and international case studies, we created a list of possible initiatives worthy of further investigation for implementation in Costa Rica. A detailed list is available in Appendix G.

Chapter 3 – Methodology

The goal for our project in Costa Rica was to design recommendations for a municipal solid waste management plan. We provided these recommendations in a report to aid in the formulation of decrees as provided by the “Law for the Integrated Management of Residues.” In order to accomplish this goal within the four month timeframe for both the initial and on-site research, we set out the following objectives:

- To research the MSWM policies, legislation, and infrastructure of other countries, with emphasis on business, social, legal, and environmental aspects;
- To highlight tools which facilitate the development of processes, products, and services for an integrated MSWM system;
- To consult with Costa Rican stakeholders and experts in order to consider other aspects that could be limiting factors, such as local practices and legal constraints; and
- To evaluate the complexity, costs, and benefits of these tools.

From our research, we created a list of possible tools to improve MSWM in Costa Rica. After interacting with stakeholders to determine which of the tools would be most successful, we provided an evaluation of each of these programs. We aimed to develop a system that would be beneficial to Costa Rica, with regards to the natural environment, the social structure, and the public health.

3.1 International Case Studies and Costa Rica

We both examined international MSWM programs and studied current management practices in Costa Rica with a focus on the economic, social, legal, and environmental aspects. We sought to find countries that have had successful waste management systems and to determine what instruments and tools led to their success. To identify possible obstacles, we analyzed countries that have not had success in environmental management and determined the reasons for their failure. Through our study of the current Costa Rican MSWM plan as well as the successes and failures of the plans in other countries, we gained insight into what programs could work in Costa Rica.

In order to understand how to create a successful MSWM plan in Costa Rica, we analyzed several other countries that have implemented successful MSWM programs. We chose Germany and Taiwan because these two countries have implemented effective waste management

programs. We analyzed the strategies they used to achieve environmental goals, including legislation, education, and market-based instruments. We determined the disposal methods that they used, the relevant government regulations, and the resultant social implications. We then highlighted the instruments that we could possibly utilize to improve MSWM in Costa Rica.

Next, we analyzed the waste management plan of Brazil. We chose Brazil because it utilized a variety of MBIs, but was unsuccessful in its attempts at environmental management. Through our study of Brazil, we determined obstacles present in the implementation of MBIs, which helped us predict possible reasons for failure for the implementation of MBIs in Costa Rica.

In order to understand MSWM in Costa Rica, we first analyzed waste management in general. We then focused on the system in Costa Rica in order to understand what waste is produced, the effectiveness of the existing MSWM plan, and the disposal methods of solid waste. We utilized sources from GTZ and studied waste management in several municipalities, including Nosara, Atenas, and Desamporados, to determine regional MSWM initiatives. Through this research, we identified areas in which Costa Rica could improve its waste management system.

3.2 Highlighting Management Tools

We searched for management tools that could achieve environmental goals in Costa Rica. Through our research and analysis of other countries, we assembled a list of possible instruments that could improve MSWM in Costa Rica. We developed a comprehensive list of MBIs through research and collaboration with experts from the local universities as well as other organizations. We aimed to create a complete list of MBIs so that we could have a variety of programs to further analyze and possibly recommend.

From our research, we concluded that MBIs are a realistic and logical method to address the concerns expressed in the law. In this project, we were particularly concerned with Chapter III of the law, which highlights economic strategies to improve waste management. Command and Control (CAC) is another method of achieving environmental goals through economic instruments; however, CAC methods require strong enforcement. Since Costa Rica is a small country with a decentralized government, achieving this level of enforcement is not feasible. Educational programs can incite people to be environmentally motivated, but the economic focus of Chapter III precluded us from focusing only on educational programs. Thus, we chose to

consider educational programs as a supplement to MBIs, as an informed public makes MBIs more effective.

MBIs are flexible and generate revenue. Thus, with little initial investment, a government can implement MBIs to generate funding to direct to other programs. Also, MBIs can incentivize change by providing people with economic reasons to alter their behavior. Furthermore, experts have extensively analyzed MBIs, providing an abundance of prior research that could be applied to Costa Rica. These advantages make MBIs powerful instruments for creating environmental change.

We then analyzed the feasibility of different MBIs in Costa Rica. Through discussion with GTZ, we analyzed the amount of government funding available for their implementation and enforcement. Also, we determined the degree of cooperation between the municipalities and the national government. An effective working relationship between the different levels of government is vital for the successful implementation of any MSWM program. We also identified weaknesses from our international case studies in order to determine possible obstacles for the implementation of MBIs in Costa Rica.

We identified the environmental issues that the “Law for Integrated Management of Residues” and PRESOL address, and analyzed the effectiveness of existing policies in Costa Rica. We read the formal legislation to understand the problem and ensure that our recommendations were addressing the issues, and we determined which problems the government deemed most relevant to ensure that our efforts were focused towards these concerns.

3.3 Interacting with Stakeholders

After we identified management tools, we determined key information to gather from stakeholders in Costa Rica, identified by GTZ. Because the recommendations we gathered targeted Costa Rican policy-makers, we determined including the general public in feasibility studies to be impractical. Any reasonably sized sample would fail to be representative of the interests of the entire public. A sample of convenience would consist of residents of San José, who would not have the same concerns as residents of other municipalities. Instead, we identified potential key stakeholders as experts in the field of waste management, members of

the government, personnel of relevant NGOs, and members of the business sector in order to gain a broad prospective of the waste management issue in Costa Rica.

We conducted a workshop, or focus group, following METAplan procedures, with information for discussion recorded by participants anonymously on boards at the front of the conference room (See Appendix H for a list of participants in the focus group and follow-up meetings). Open discussion is encouraged, but since it will not be used in the report, participants do not feel the need to censor their comments. Instead, the collected information posted on the boards is what will inform our project. Our sponsor suggested this method as it is common for conducting workshops in Costa Rica. We provided the participants with a list and explanations of our proposed initiatives, asking them to pick those they felt would be most effective in Costa Rica. Discussion was to determine the financial, legal, and social feasibility of our different proposals. For a list of questions and discussion points utilized at the workshop, please see Appendix I.

3.4 Evaluation of Tools

Our group analyzed the instruments that stakeholders considered most appropriate, considering the implications of those instruments deemed most feasible. Discussion with stakeholders during the workshop garnered insight as to the types of incentives most likely to succeed in Costa Rica.

From this input and the background information we had gathered earlier, we analyzed general economic costs, environmental and social benefits, and potential drawbacks for those instruments deemed to be most feasible in Costa Rica. In particular, we studied the cost effectiveness of these instruments, determining whether sufficient funding for programs exists as well as whether they would generate revenue to fund related waste management programs. We highlighted the benefits of the programs, including the effects on the environment, on the consciousness and pride of the public, and on public health. We also examined potential drawbacks, such as whether waste fees might encourage illegal dumping or might require more enforcement than is available.

3.5 Conclusion

Our final goal was to create a report to inform policy-makers as they write decrees for the “Law for the Integrated Management of Residues.” In addition to our preliminary research, our

examination of MSWM plans and MBIs in several countries provided us with the necessary information to determine the policies suitable for implementation in Costa Rica. Through interviews with stakeholders and further analysis, we determined the feasibility of our policies. We hoped to create positive environmental change in Costa Rica through the formulation of these policies.

Chapter 4 – Results and Analysis

After conducting extensive background and on-site research, we identified several instruments that could improve solid waste management in Costa Rica. Our initial research resulted in an understanding of basic strategies for waste management. We determined that the Costa Rican government should focus on the general strategies of MBIs and public education in order to implement the waste management law. Then we conducted a focus group and interviews to determine the feasibility of our proposed MBIs. From this on-site research, we learned that stakeholders thought Pay-As-You-Throw, deposit-refund, eco-labeling and requiring producers to collect their recyclables would be the most feasible programs for implementation in Costa Rica. We then conducted further analysis of these three programs in order to make more complete and informed recommendations to our sponsor.

4.1 Basic Strategies and Research Results

Based on our background research as well as our studies of the levels of success of waste management programs in other countries, we determined education and market-based instruments (MBIs) to be the categories of programs that are most feasible in Costa Rica. We also encountered command and control (CAC) techniques in our research, but because such programs require extra funding for enforcement and the law focuses on the use of markets, we did not consider CAC in our recommendations (Law for the Integrated Management of Residues, 2010). When used together, MBIs and education would likely achieve the most positive results in Costa Rica because of their ability to modify behavior and their comparably small enforcement and resource requirements.

MBIs will be the main economic tools for implementing the law. Compared to CAC, MBIs are much more versatile and tend to require less enforcement and subsequent funding. They utilize markets to encourage, rather than force, behavioral changes. For example, in PAYT, the government charges individuals based on the number of bags of waste they throw out or based on the volume or weight of the waste. In this way, the public is given an incentive to reduce their waste output: if they dispose of less waste, they will be charged less money. MBIs also have the potential to raise revenue, such as through the fees collected for waste disposal. This money can then be used to fund other related programs. Funds from MBIs such as PAYT can pay for educational campaigns that would inform the public of why waste management is

important and how they can further reduce their waste (Andersen, 2000; Huber, 1998; MassDEP, 2010).

In this way, educational methods are an important supplement to economic programs because they encourage change from the ground up. Many educational programs often begin in schools or after-school programs and teach children about how they can contribute to proper waste management. Children will then often share this knowledge with their parents, thus increasing the program's reach. Other forms of education are public education campaigns containing billboards and advertisements. Appealing to the national pride and environmental consciousness of the people can result in higher participation in the above programs. Funding for these programs could be supplied through government agencies such as the Ministry of Education or the Ministry of Tourism or through funds from MBIs (Chakraborty, 2005; Chang, 2008; Lu, 2005).

Based on our background research, we garnered a solid understanding of the varied methods of waste management. In Taiwan, PAYT was effective at reducing waste and generating revenue; it also helped increase funding for environmental and waste management programs even as the country's GNP was decreasing. A bin system, deposit-refund, eco-labeling, and a variety of other recycling programs in Germany resulted in near one hundred percent recycling rates for all recyclable materials. Germany's eco-labeling program also fed into a program that required producers to collect their packaging materials. In Ecuador, a surcharge on electricity provided funding for waste management, with the connection being that those who utilize more electricity are more likely to produce more waste. Brazil also implemented a series of MBIs that were unsuccessful, but that highlighted potential obstacles to be aware of in Costa Rica. From the successes and failures evident in these international case studies, we were able to develop a list of several programs that could serve to address the objectives of the law. (See Appendix G for a list of these programs). It was then important to discuss our recommendations with stakeholders in Costa Rica, as only they could give us input regarding how well these programs would work within the context of the country (*Municipal Solid Waste Management*, 2006; Chang, 2008; da Motta, 1996; Huber, 1998; Lu, 2005; Ministério do Meio Ambiente, 2008; Mühle, 2010; National Renewable Energy Laboratory, 1995; Nature Conservancy, 2005; Programa CYMA, 2007; Taipei City Government, 2010; Taiwan EPA, 2005; Vehlow, 2009, Zhang, 2010).

4.2 Determination of Feasibility through Stakeholder Interaction

Based on our interactions with stakeholders in meetings, and primarily through our focus group, we were able to determine those programs that are most feasible in Costa Rica. We found the programs Pay-As-You-Throw (PAYT), deposit-refund, eco-labeling and requiring producers to collect their recyclables (PCR) to be the most feasible, whereas a surcharge on electricity, landfill-tipping fees, utilizing markets as recycling centers, and a harmful materials tax were not as feasible (See Appendix J for results of this workshop).

PAYT was determined to be one of the most potentially effective programs at the focus group (See Appendix I for the rating system and detailed results). Experts who were unable to attend the focus group corroborated this determination during the meetings we had with them. Through the workshop, we determined that the main advantage of PAYT is its ability to reduce waste generation through a monetary incentive. However, the logistics of running the program and the possibility of illegal dumping are obstacles to its successful implementation. These can likely be overcome through either bar-coding or color-coding the bags and enforcing sanctions against illegal dumping.

The focus group determined PCR to be another program likely to have success in Costa Rica. Its advantages include requiring the companies to become more socially responsible by managing their waste and giving them a way to improve their public image. However, the main obstacles are the considerable amount of organization required to implement the program as well as the additional costs of recycling, which could have a negative economic impact on the companies. To surmount these problems, the attendees suggested promoting a recognition system for voluntary collection, thus providing companies who participate in the program with a form of advertising and possibly increasing their sales.

Eco-labeling was also determined to be another feasible and potentially effective program. The attendees determined that its advantages include allowing consumers to identify products manufactured by environmentally-friendly companies and providing producers with the ability to advertise their products. However, its main obstacles are the cost of implementing and running an eco-label certification system as well as a lack of experience with such a program in Costa Rica. To overcome these problems, the focus group recommended creating a national quality system to support and partially fund the initiative and providing the public with information on the significance of the eco-label.

The focus group rated deposit-refund as another feasible program that would likely be effective at increasing recycling. It was highly rated for its lower environmental impact because of its encouragement of recycling and its effect of increasing the amount of cheap recyclable bottles that can then be reused in production. Despite these advantages, obstacles to its implementation are the costs of transporting and treating the bottles as well as the logistics of setting up recycling centers. To address these issues, the focus group recommended making the program mandatory in order to maximize participation and stabilize the market value of the recycled material.

The focus group found the following programs to be impractical in Costa Rica at the moment: an electricity surcharge, landfill tipping fees, recycling centers at markets, and a harmful materials tax. These MBIs have the potential for improving waste management, but they were discarded because their impacts were minimal or because their associated obstacles and costs were too great. For example, we discarded the electricity surcharge, since Costa Ricans are wary to pay additional taxes, because in the past the government has not always used funds for their original goals. Landfill tipping fees would also not provide enough incentive to decrease waste because they are directed through the municipality before reaching the landfill, resulting in a lack of connection between the money and its use. Using markets as recycling centers is not specific enough as to the targeted recyclable material or how to process it, but it can be used as part of another program such as deposit-refund. Lastly, a harmful materials tax would mainly affect producers of specialty products such as electronics and therefore would not have a significant impact on overall waste management.

4.3 Further Analysis

Having determined those programs that are most potentially feasible, we then conducted further analysis regarding potential costs and benefits. This analysis was based off our research on Costa Rica's current infrastructure in conjunction with numbers provided from international case studies. However, we must first note that requiring producers to collect their recyclables is not included in this section. This is because we do not believe PCR is feasible for Costa Rica in conjunction with DR. These two programs focus on recycling many of the same materials such as plastic or glass bottles, and such an overlap would lead to major inefficiencies. Furthermore, PCR would require a significant invest from the participating companies and more organization

to set up than DR, thus making DR the more feasible choice of these two programs. Although PCR could have many benefits, the overlaps with other recycling programs and the considerable cost to companies make it unfeasible at this time.

4.3.1 Eco-labeling

Eco-labeling is a program where the government certifies a company to place an eco-label on its products if the company meets certain specified environmental standards. The advantage of eco-labeling is that it relies on market forces rather than enforcement from municipalities to encourage the use of environmentally friendly products. Eco-labeling can be one of the programs that requires the least resources to implement because the only expenses involved are the formulation of the criteria and the certification of companies. To help offset these costs, municipalities can require companies to pay a fee for a consultation that determines whether the company has met the requirements to use the label. Eco-labeling helps differentiate products so that consumers can choose to only buy products that meet high environmental standards. Therefore, the program doubles as an MBI and an educational tool by reminding consumers that it is important to consider environmental impacts when purchasing products. In addition to this educational component, eco-labeling provides companies with a way to advertise their products by demonstrating their conformance to the environmental standards, thus serving as an incentive for participation. This was notably the case in Germany with the Green Point initiative, in which producers received the Green Point seal if they took the responsibility to collect their recyclables. This helped their sales rise as consumers prioritized the consumption of green products (National Renewable Energy Laboratory, 1995; Programa CYMA, 2007).

Because Costa Rica has had little experience with eco-labeling, the public largely does not understand the relevance of the eco-labeling program. To overcome this obstacle, the government must educate consumers in conjunction with implementing eco-labeling so they will understand the significance of the program, and therefore be willing to buy eco-labeled products even if they are more expensive. Fortunately, our research indicates that there is a precedent for this program in Costa Rica. The cleaning products company Florex has pledged itself to use environmentally-friendly practices and materials, and it advertises this commitment. An eco-labeling system would educate consumers as to why they should be willing to pay more for these types of products. Florex is a prime example of a company who would benefit greatly from such

a system. Although the success of Florex suggests that consumers are willing to pay extra for eco-friendly products, we were still unable to determine to what extent consumers would be willing to participate in this program. Therefore, we must still consider the extra expense of eco-friendly products as well as the lack of information for consumers as potential obstacles to the implementation of eco-labeling (Distribuidora Florex Centroamericana, S.A, 2010).

In order for eco-labeling to be successful, there must be a standardized method for determining which companies are certified to use the eco-label. To develop these standards, the government will need to create a certification entity, determine which products can use the label, define criteria for each product category, and set up a process for companies to apply to use the label. The certification entity would have to be a capable, national organization such as Inteco, the National Institute for Technical Norms, that could regulate and certify companies (Inteco, 2009). One option for implementing the program that the focus group suggested was different levels of certification. For example, the eco-label program could have five levels of certification, with five indicating that the company has met the most stringent environmental standards. The certification level would be displayed on the eco-label of the company's products to show the consumer what standards the company has met to minimize its environmental impact. For companies to be able to place the label on their products, all of their products must meet the requirement for the specific level of certification. Another option is the use of different categories to determine the level of a company's certification. These categories might include the company's energy and resource consumption, waste generation, and pollution. This would help ensure that manufacturers try to minimize their environmental impact at every step in the product's production (National Renewable Energy Laboratory, 1995; Programa CYMA, 2007).

The European Union has successfully implemented an eco-labeling system that overcame many of the obstacles mentioned above. The European Commission went through an extensive review process to create a specific set of criteria for nearly every product category, excluding only food, drink, pharmaceutical products and medical devices. This means that manufacturers of almost all product types can apply to use the eco-label if they meet the defined criteria. For companies to receive the right to use the eco-label, they must apply to the Competent Body of their country, which is the Commission's local representative for the program. They must pay a one-time application fee of between 200 and 1200 Euros as well as an annual fee of no more than 1500 Euros. Although the EU eco-label program has experienced some minor problems with

low awareness of the label and an initially low rate of use by industry, the use of the label has skyrocketed from fifty-three awarded licenses in 2000 to 1003 licenses in 2009, thus demonstrating its usefulness as an MBI. If Costa Rica were to implement a similar system, it would have a high chance of succeeding (European Commission, 2007; European Commission, 2008; European Commission, 2010; European Parliament Council, 2009).

4.3.2 Deposit-Refund

Deposit-refund (DR) is a program in which consumers pay a small additional fee when they purchase recyclable products, such as plastic bottles or aluminum cans, and only receive a refund for this fee when they recycle the material. The advantage of DR is that it provides an economic incentive for consumers to recycle by placing a value on recyclable materials. Because it encourages recycling, the program can also help reduce littering and the amount of recyclables thrown into landfills. Additionally, the program can encourage companies to use recycled materials over virgin materials because the large amounts of recycled bottles resulting from increased recycling are typically cheaper. Although there are initial costs to create the infrastructure to handle the return of bottles and cans, companies save money over time by using the recycled materials (*Municipal Solid Waste Management*, 2006; Vehlow, 2009, Zhang, 2010).

However, there are logistical and transitional challenges associated with implementing DR. The government must determine a reasonable deposit value; if it were too high, it would discourage people from buying the products; if it were too low, people might not bother to recycle. The government must also identify locations where consumers can easily return the recyclable materials. For example, grocery stores are often used as recycling centers in countries such as the USA because they are centrally located and are visited by consumers on a routine basis. Although grocery stores may initially oppose this transition due to space and personnel requirements, they may be more willing to participate if the refund can be exchanged for store credit, thus increasing business. Finding the ideal price for the deposit and the best location for the recycling centers are vital for encouraging participation in the program (Rafael Díaz Porras, personal communication, November 4, 2010).

Furthermore, Costa Rica's infrastructure is not yet up to the task of dealing with the increase in recycled materials. DR usually focuses on glass, plastic, and aluminum containers and would create a large increase in the amount of these recycled materials. Unfortunately, Costa Rica does

not have enough capacity to properly collect, sort, and reprocess these materials. For example, there is only one glass processing plant in the entire country, and it is not even able to manage the current amount of materials sent there (Sergio Musmanni, personal communication, December 3, 2010). DR would further exacerbate this problem by producing more recycled glass bottles that the facility could not handle. Some types of recycled materials such as steel are even sent out of country because there is no domestic facility to process it (Sergio Musmanni, personal communication, October 27, 2010). Although sending the recycled materials to foreign markets is an option, Costa Rica will need to expand its ability to reprocess recycled glass, aluminum, and plastic bottles for DR to be truly successful.

4.3.3 Pay-As-You-Throw

Pay-As-You-Throw (PAYT) is a program in which residents pay a fee to municipalities per bag or volume of disposed waste, while recyclables are collected for free. The advantage of PAYT is that it offers a direct monetary incentive for consumers to reduce waste while raising revenue for other solid waste management programs. These funds could be used for a variety of programs, such as increasing the municipal collection capacity of recyclable materials, enforcing sanctions for illegal dumping, or even initiating composting programs. In addition to raising revenue, PAYT can help municipalities by decreasing the average waste output, thus lowering the collection costs. It is also a very flexible program because it can incorporate the disposal or recycling of different types of waste, such as electronic, organic, and recyclable materials. It is this combination of advantages that makes PAYT such a powerful program. This is clearly demonstrated by its success in Taiwan, where it contributed to a reduction of annual solid waste output from 8.35 million tons to 7.51 million tons over the course of five years (Chang, 2008; Lu, 2005).

Despite these benefits, there are a number of logistical and management obstacles to implementing PAYT in Costa Rica. First, municipalities must have the infrastructure to be able to offer the free collection of recyclables. This option will encourage people to recycle because separating recyclables from their solid waste will decrease their waste output and thus how much they pay. Unfortunately, the Programa CYMA (2010) survey revealed that a mere 13.5% of Costa Ricans said that their municipality collects separated waste. However, 54.7% of Costa Ricans said that they usually separate their waste for recycling, thus demonstrating that a large

percentage of the public is ready to adopt a free collection service for recyclables (Programa CYMA, 2010). This separate collection ability is vital for PAYT to work well, and until municipalities ensure that they have the proper infrastructure, the program will not reach its full potential.

Residents must also be willing to contribute to the program by separating their recyclables and paying for disposal of their waste. The Programa CYMA survey (2010) revealed that 62.9% of Costa Ricans would be willing to pay extra for trash collection. To harness this willingness and ensure social acceptance of PAYT, the government should undertake a public education campaign, describing exactly how the funds will be used and why PAYT is an effective program. The government should also set aside a separate fund dedicated to the money raised from PAYT, thus making it easier for citizens to see how the money is allocated and used. Such an education campaign and proper money management will ensure that Costa Ricans support the government's use of the funds (Jose Antonio Cordero, personal communication, November 9, 2010; Sergio Musmanni, personal communication, December 3, 2010).

Another problem with PAYT is the potential of illegal dumping. Residents may not be willing to pay extra to throw away their trash, and may instead choose to dump their waste illegally into rivers or streets. To address this problem, municipalities must determine a fee that is small enough to not encourage this activity, while still being large enough to encourage people to decrease their waste output and raise revenue. They should also provide a more direct deterrent by strengthening sanctions on illegal dumping. Since there is already a standard fee for municipal solid waste management, the PAYT program should be a comparable or cheaper expense for those who produce relatively little waste, such as people in poverty. Municipalities could use the revenue raised from PAYT to enforce the current \$200 fee for illegal dumping, which would quickly discourage people from attempting to circumvent the system. In addition, two effective methods of enforcement utilized internationally that could also work in Costa Rica are to place either cameras or signs at common dumping areas to discourage this illegal activity (Chang, 2008; Lu, 2005). For an example of a municipality that has overcome these obstacles, see the Malden, MA, USA case study (Appendix K).

4.4 Project Limitations

We were able to acquire a significant amount of information regarding the current state of MSWM in other countries, which techniques worked there, and which techniques could work in Costa Rica. From this background, we were able to determine those programs that would be most successful in Costa Rica. Interactions with stakeholders allowed us to test the validity of our findings so that we could make the most feasible recommendations to our sponsors. However, despite the complexities of our studies and the multi-step nature of our approach, there were still limitations to our findings.

Although we were able to successfully determine that the programs PAYT, deposit-refund, and eco-labeling can be implemented in Costa Rica, it is important to remember that there were several limitations to our project. Due to time constraints and a lack of information in the field, we were unable to conduct a full cost-benefit analysis of each program using current figures from industry and government. We were able to determine the overall feasibility as well as a general time frame for implementation of the programs, but were not able to provide budgeting recommendations or an enumerated timeline. Although we completed extensive background research on MSWM practices and MBIs, it is also important to note that we are not experts in the fields of either waste management or economics. While we have a strong understanding of how these processes work, we must base much of our determination of feasibility on international success and stakeholder interaction. In addition, we could not fully analyze every MBI because of the sheer number of MBIs that have been implemented. For these reasons, the programs that we have recommended are not novel ones that we created specifically for this project, but are instead tried-and-true practices, modified to fit within the Costa Rican context.

Overall, the findings we provided within this report should be taken within the context of our project. We were given a four month timeframe, with approximately seven weeks on site. We are outsiders to Costa Rican culture, and therefore do not understand all of the nuances of societal acceptance of government programs. Because this project is for Costa Rica as a whole, it would have been practically impossible to conduct a full representative survey of the entire population, and we therefore had to rely on the opinions of a select number of experts in business, economics, and the government in order to garner an understanding of the cultural context in Costa Rica. Our findings are based off our own prior research and the input of these experts.

Chapter 5 – Conclusions and Recommendations

The law for the “Integrated Management of Residues” is a piece of landmark legislation that seeks to improve municipal solid waste management in Costa Rica. The legislation gives lawmakers and government ministries the ability to pass decrees in the future that set specific restrictions and limits on different materials and waste management. It also seeks to utilize market instruments and economic incentives to modify waste generation and improve the management of solid waste. This utilization of market-based instruments, or MBIs, is a key strategy to improve waste management. MBIs are economic incentives created to modify behavior, often to achieve environmental goals.

Costa Rica currently produces over 2,400 tons of solid waste every day, of which approximately 250 tons is dumped into streets and rivers. Most of the waste is disposed of in open dumps and sanitary landfills, but many sanitary landfills do not meet government regulations and there is only a single digit recycling rate. There are many environmental issues and health problems associated with improper solid waste management. For example, water runoff from open dumps and improperly disposed hazardous materials can contaminate ground water and cause diseases, including cancer. Additionally, plastics can obstruct drainage systems, sometimes exacerbating urban flooding. Furthermore, the dumping of waste into rivers can contaminate and kill marine life. Costa Rica should try to improve its MSWM system in order to prevent these various environmental and health problems (Costa Rica, 2010; Frankie, 2004; Karley, 2009; Magera, 2006; Ministerio Federal de Cooperación Económica y Desarrollo, 2008; Modern Marvels, 2004).

It was our goal to recommend methods to improve solid waste management in Costa Rica through the utilization of MBIs. To this end, we held a workshop with qualified Costa Rican stakeholders in order to determine the feasibility of an assortment of MBIs (See Appendices I and J). Originally, we presented nine MBIs to our stakeholders and discussed advantages, disadvantages, and obstacles with respect to industrial and household waste (See Appendix G for a list of our MBIs). We determined that eco-labeling, deposit-refund, and Pay-As-You-Throw are the most suitable MBIs for implementation in Costa Rica. We conducted further analysis of these three programs to determine feasibility and likelihood of success.

5.1 Recommended Programs

We recommend that the Costa Rican government implement eco-labeling, deposit-refund, and Pay-As-You-Throw in order to improve the management of solid waste. These programs have the greatest potential to reduce waste generation, increase recycling rates, and promote proper waste management. For each program, we will briefly discuss key advantages and obstacles as well as our recommendations. A more detailed analysis of each program can be found in sections 4.2 and 4.3.

Eco-labeling is a program in which the government awards companies that meet certain environmental standards a label to place on all of the products they sell. The primary advantage of eco-labeling is that it relies primarily on market forces rather than governmental enforcement, which reduces the amount of resources required to implement the program. Eco-labeling creates product differentiation, which allows consumers to choose to buy only products that have earned the eco-label. Furthermore, the program doubles as an MBI and an educational and awareness tool by reminding consumers that it is important to consider environmental impacts when purchasing products, which is ideal for Costa Rica. To implement eco-labeling, it is necessary to have either a third party entity or municipality consultant agency to determine certification criteria and identify which companies meet these criteria. Inteco, a private national institute for technical norms monitored by the government, is a qualified candidate that might be the likely choice for this task. We also recommend that the criteria include how a company manages solid waste, such as recycling and composting rates as well as the management of toxic residues. Furthermore, we recommend that there be three to five levels of certification that can be placed on the eco-labels to show the consumers what standards the company has achieved.

Deposit-refund (DR) is a program in which consumers pay a small fee when they purchase a recyclable product, such as plastic bottles or aluminum cans, and are only refunded this fee when they recycle it. The advantage of DR is that it provides an economic incentive for consumers to recycle and decreases littering by placing a value on the recyclable material. However, the Costa Rican infrastructure is not yet sufficient to treat all recyclable materials throughout the entire country. Thus, we recommend that Costa Rica first improve its recycling capacity, and then implement DR only for one recyclable product as a test run to determine how best to run the program. A natural choice might be plastic bottles, as plastics are twenty percent of the total waste in Costa Rica, yet only fifteen percent of the total plastics are recycled. Additionally,

implementing DR for plastic bottles is relatively easy and has been done in other countries (Magera 2006). We also recommend that the government determine ideal locations for people to return the bottles and redeem the fee. A likely choice is grocery stores and supermarkets, as they experience significant consumer traffic.

Pay-As-You-Throw (PAYT) is a program in which residents pay the municipality a certain amount per bag or by volume of solid waste, while recyclables are collected for free. The advantage of PAYT is that it provides a direct economic incentive to encourage consumers to reduce waste. The program creates revenue from the selling of the bags as well as a decrease in the costs associated with the amount of waste sent to landfills. This revenue can be used to fund other solid waste management programs such as improving municipality collection, incorporating composting into PAYT, or enforcing sanctions on illegal dumping. In Costa Rica, the two biggest obstacles to implementing PAYT are public resistance to pay additional fees to the government and a lack of infrastructure for the municipalities. Since in the past, the government has not always delegated funding to programs that it promised it would, we recommend that the government create concrete objectives for which to use the funds, inform the public of these objectives, and then only use the funds for these purposes. Before PAYT can be implemented, we also recommend that every municipality have the infrastructure to collect recyclables. It is vital that the program be nationwide and that every municipality be prepared to implement it. We believe that PAYT is the MBI with the greatest potential to reduce waste generation and increase recycling, and we recommend that the preparation for its implementation be the primary goal of Costa Rica.

5.2 Concluding Remarks

Our goal was to determine which MBIs would be most likely to improve solid waste management in Costa Rica in accordance with “Integrated Management of Residues” law passed in May 2010. We determined that eco-labeling, deposit-refund, and Pay-As-You-Throw are the three most suitable programs and we recommend them for Costa Rica. The government should first instate eco-labeling because it requires relatively few resources and relies on market forces rather than municipality enforcement. Deposit-refund is another promising MBI that should also be implemented once adequate infrastructure to fully treat recyclable products is in place. PAYT is the most powerful MBI for decreasing waste generation and increasing recycling rates, but

municipalities must first develop their infrastructure to collect separated materials and educate their constituents about PAYT and the destination of the generated funds. We recommend that the government take priority in preparing to implement PAYT in the future. There are some obstacles associated with the implementation of these programs, specifically DR and PAYT, and we recommend that future projects examine these obstacles and search for solutions to ensure their success.

An improved and more efficient waste management system will have numerous benefits on Costa Rican society as a whole: it will minimize collection costs for the government by decreasing the amount of waste produced, help individual households by providing a better and easier way to properly dispose of waste, help companies by encouraging them to maximize their efficient use of disposable materials to increase income, and prevent associated health and environmental problems. Each step the country takes towards reducing and recycling waste diminishes the negative economic, social, monetary, environmental, and public health effects of improper waste management. This improvement in solid waste management is an important goal for Costa Rica as it continuously strives to modernize and grow its economy. It will also prove instrumental as it seeks to improve its image as an environmentally friendly nation and to preserve its natural wonders and stunning biodiversity for future generations to admire.

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Appendices

Appendix A: Transformation of an Open Dump into a Sanitary Landfill

Bangladesh provides an excellent case study as to how a transformation of an open dump into a sanitary landfill might take place. In 2005, the country undertook a project to transform a fifteen year old open dump into a sanitary landfill; the dump, called Matuail, was in the capital city Dhaka. The project began in July 2005 and was completed in October 2007, costing seven million USD. The Dhaka City Corporation, with the technical assistance of the Japan International Cooperation Agency (JICA), oversaw this project. Key steps included implementing a semi-aerobic waste stabilization process, which consisted of installing a pipe network below the solid wastes to collect the leachate, as well as supplying oxygen through perforated pipes to accelerate the stabilization of solid waste through aerobic decomposition. The sanitary landfill improvement decreases the risk of fire, odor, and disease vectors through proper ventilation, the disposal of waste in layers, and a top layer composed of mature decomposed waste that is more than three years old and 30-50 cm thick. Additionally, sanitary landfills are less permeable to rainwater, thereby producing much less leachate than an open dump (Yousuf, 2009).

Appendix B: PRESOL Initiatives

This appendix contains a list of each of the thirty-one initiatives from PRESOL. These initiatives fall under the following categories: Technical; Legal and Administrative; Institutional and Organizational; Education and Awareness; and Economic. Initiatives included innovative technology for waste recovery, separation of waste, proper management of hazardous wastes, regulations for industrial solid waste and large quantities of waste, active participation of the private sector in waste management protocols, promotion of public awareness, and economic instruments, among others (Programa CYMA, 2008).

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Appendix C: Desamparados Flyer

This Appendix contains a flyer distributed in Desamparados. It shows collection dates for waste and recyclable materials in various districts of the municipality (Municipalidad de Desamparados, n.d.).

Servicio de Recolección de Residuos Valorizables • Calendario 2010

Enero

L	M	Mi	J	V
				1
4	5	6	7	8
11	12	13	14	15
18	19	20	21	22
25	26	27	28	29

Febrero

L	M	Mi	J	V
1	2	3	4	5
8	9	10	11	12
15	16	17	18	19
22	23	24	25	26

Marzo

L	M	Mi	J	V
1	2	3	4	5
8	9	10	11	12
15	16	17	18	19
22	23	24	25	26
29	30	31		

Abril

L	M	Mi	J	V
			1	2
5	6	7	8	9
12	13	14	15	16
19	20	21	22	23
26	27	28	29	30

Mayo

L	M	Mi	J	V
3	4	5	6	7
10	11	12	13	14
17	18	19	20	21
24	25	26	27	28
31				

Junio

L	M	Mi	J	V
	1	2	3	4
7	8	9	10	11
14	15	16	17	18
21	22	23	24	25
28	29	30		

Julio

L	M	Mi	J	V
			1	2
5	6	7	8	9
12	13	14	15	16
19	20	21	22	23
26	27	28	29	30

Agosto

L	M	Mi	J	V
2	3	4	5	6
9	10	11	12	13
16	17	18	19	20
23	24	25	26	27
30	31			

Septiembre

L	M	Mi	J	V
		1	2	3
6	7	8	9	10
13	14	15	16	17
20	21	22	23	24
27	28	29	30	

Octubre

L	M	Mi	J	V
				1
4	5	6	7	8
11	12	13	14	15
18	19	20	21	22
25	26	27	28	29

Noviembre

L	M	Mi	J	V
1	2	3	4	5
8	9	10	11	12
15	16	17	18	19
22	23	24	25	26
29	30			

Diciembre


L	M	Mi	J	V
		1	2	3
6	7	8	9	10
13	14	15	16	17
20	21	22	23	24
27	28	29	30	31

Municipalidad de Desamparados
 Distrito 2° -San Miguel.

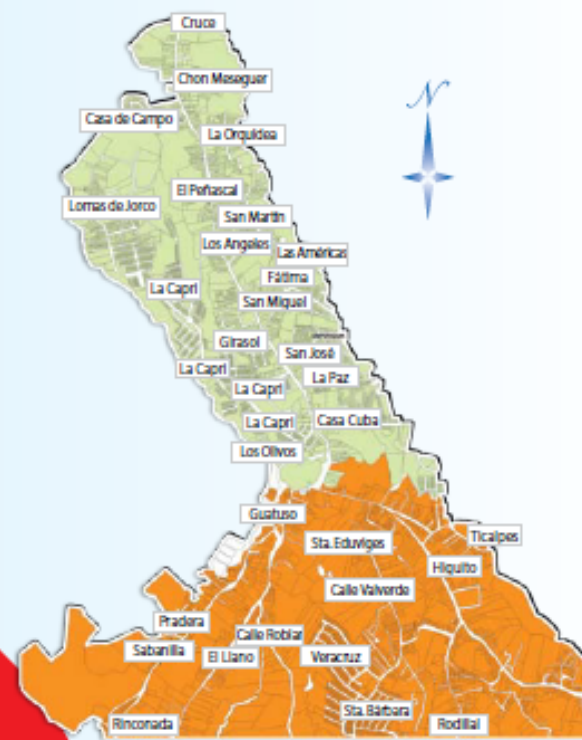
Por favor, verifique según el lugar donde Usted vive, cuál ruta corresponde a su sector. El mapa en esta página le ayudará:

- San Antonio:** Río Damas, La Constanza, Huetares, Villa Karen.
- San Antonio:** Pazoleta, Calle Trejos, Calle Seltral, Colegio, El Solar, Calle Choruca.
- San Miguel:** Cruce, Chon Mesaguar, Casa de Campo, La Orquídea, Lomas de Jorco, El Peñascol, San Martín, Los Ángeles, Las Américas, Fátima, San Miguel, La Capri, San José, Emperador, La Paz, Las Palmas, Casa Cuba, Los Olivos, Valladolid.
- San Miguel:** El Llano, Sabanillas, Higuito, Calle Valverde, Jerusalén, Veracruz, Santa Bárbara, Rodillal.
- Apoyo de Rutas.

Lunes
Miércoles
Miércoles
Jueves
Viernes



Todos los materiales deben empaquetarse en una bolsa plástica transparente



Appendix D: Chapter III of the Law for the Integrated Management of Residues

This Appendix shows the original Spanish text of Chapter III of the “Law for the Integrated Management of Residues,” containing Articles 20, 21, 22, and 23 (Law for the Integrated Management of Residues, 2010).

Asimismo, todos los centros educativos públicos y privados del país deberán establecer e implementar planes de manejo integral de residuos que se generen en sus instalaciones, como una forma de enseñar a los educandos en forma práctica sobre la gestión integral de residuos.

CAPÍTULO III

PROMOCIÓN PARA LA GESTIÓN INTEGRAL DE RESIDUOS

ARTÍCULO 20.- Fomento para la gestión integral de residuos

El Ministerio de Salud, en coordinación con otras instituciones públicas y los sectores involucrados, promoverá en el Reglamento de esta Ley las herramientas legales, políticas, económicas, los instrumentos de mercado o de comunicación, así como los incentivos no fiscales u otros, para el fomento de la prevención de la contaminación, la aplicación de la producción más limpia, la reutilización y la valorización de residuos, para promover las tecnologías menos contaminantes en el tratamiento y la disposición final de estos.

En el establecimiento de estas herramientas se fomentará la creación, el desarrollo y el fortalecimiento de las micro y pequeñas empresas, las cooperativas, las organizaciones de mujeres y otras formas de organización social que coadyuven al cumplimiento de la política, el Plan Nacional, el plan municipal respectivo y los objetivos de esta Ley.

ARTÍCULO 21.- Incentivos a generadores

El Estado incentivará y apoyará a las pequeñas y medianas empresas nacionales que sean generadoras de residuos, con el fin de que se adapten a los cambios tecnológicos, los nuevos requisitos y los plazos que esta Ley establece, incluida la eventual sustitución de materiales, componentes o equipos.

Título II: Herramientas para la Gestión Integral de Residuos

ARTÍCULO 22.- Medidas especiales

El Ministerio de Salud, en coordinación con el Ministerio de Ambiente, Energía y Telecomunicaciones, podrá adoptar, vía reglamento o decreto ejecutivo, medidas para lo siguiente:

- a) Promover la importación, fabricación y comercialización de productos que favorezcan la gestión integral de residuos.
- b) Prohibir la importación de materiales cuya valorización o gestión integral sea limitada o inexistente en el país.
- c) Restringir o prohibir, en coordinación con los sectores y de acuerdo con las metas que se fijan al efecto, la importación, fabricación y comercialización de productos que dificulten el cumplimiento de las políticas nacionales para la gestión integral de residuos.
- d) Crear sistemas de depósito, devolución y retorno para los residuos de difícil valorización que no estén sujetos a un programa de manejo.
- e) Promover las estructuras de comercialización de residuos valorizables y de los productos de ellos obtenidos.
- f) Solicitar al productor o importador de un determinado producto, ante la duda razonable de que este pueda ocasionar daños a la salud y al ambiente, que utilice el análisis de ciclo de vida u otro instrumento de evaluación del riesgo, de conformidad con los estándares y requisitos que se establezcan vía reglamento. El propósito de esta medida es la observancia del principio precautorio, la autorización o no del ingreso de estos productos, su fabricación o comercialización en el país, así como la definición de los términos, los límites y las condiciones en que estas actividades podrán llevarse a cabo, en caso de ser autorizadas.
- g) Promover estructuras socialmente justas y ambientalmente adecuadas de comercialización de residuos valorizables y de los productos de ellos obtenidos, con la finalidad de evitar prácticas monopolísticas.

- h) Coordinar con las autoridades del Ministerio de Seguridad Pública, el Organismo de Investigación Judicial y las municipalidades la regulación de la comercialización de materiales valorizables. Se podrá restringir este tipo de actividad cuando esta promueva actos ilícitos contra bienes de dominio público o dedicado a un servicio público.
- i) Prohibir o limitar temporalmente la exportación de residuos cuando tengan valor estratégico para el país.

El Ministerio de Salud queda autorizado para coordinar con otros ministerios o entes públicos, vía reglamento o decreto ejecutivo, las medidas especiales necesarias para el cumplimiento de esta Ley.

ARTÍCULO 23.- Participación ciudadana

El Ministerio de Salud y las municipalidades, en el marco de sus competencias, promoverán la participación de todas las personas en forma activa, consciente, informada y organizada en la gestión integral de residuos. Para ello deberán:

- a) Convocar, fomentar y apoyar la conformación, consolidación y operación de grupos intersectoriales interesados en participar en el diseño e instrumentación de políticas y programas correspondientes.
- b) Apoyar a los grupos sociales organizados en la realización de programas, proyectos y otras iniciativas sociales para la gestión integral de residuos.
- c) Fomentar la aplicación de la presente Ley, mediante la realización de acciones conjuntas con la comunidad para la gestión integral de residuos, con énfasis en la valorización de los materiales contenidos en ellos. Para tal fin, podrán establecer convenios de cooperación con comunidades urbanas y rurales, instituciones académicas, micro y pequeñas empresas, cooperativas y otras formas de organización social, de la gestión integral de residuos.
- d) Fomentar y garantizar la participación ciudadana en el control y la fiscalización del cumplimiento de esta Ley, de la política y el Plan Nacional, así como de otros programas y proyectos en la materia.

Appendix E: Potential Constraints to Municipal Solid Waste Management

This appendix contains information regarding the many factors that can influence MSWM, which must be considered in developing a plan for waste management in Costa Rica. For example, we hope to remedy the obstacle of lack of policy and financing through the use of MBIs (Huber, 1998).

Title	Description
Government policy	Presence of regulations, enforcement of laws, and use of incentive schemes
Government finances	Cost of operations, budget allocation to MSWM, stability/reliability of funds
Waste characterization	Assessment of generation and recovery rates, and composition of waste stream
Waste collection and segregation	Presence and efficiency of formal or informal collection and separation by scavengers, the municipality, or private contractors
Household education	Extent of knowledge of waste management methods and understanding linkages between human behavior, waste handling, and health/ sanitation/environment within households
Household economics	Individuals' income influencing waste handling behavior (reuse, recycling, illegal dumping), presence of waste collection / disposal fees, and willingness to pay by residents
MSWM administration	Presence and effectiveness of private and/or public management of waste (collection, recovery, disposal)
MSWM personnel education	Extent of trained laborers and skilled professionals in MSWM positions
MSWM plan	Presence and effectiveness of an integrative, comprehensive, long-term MSWM strategy
Local recycled material market	Existence and profitability of market systems relying on recycled-material throughput, involvement of small businesses, middlemen, and large industries/exporters
Technological and human resources	Availability and effective use of technology and/or human workforce and the safety considerations of each

Appendix F: Taiwanese Programs

This appendix contains the key steps in the methodology of Taiwan while attempting to develop a national plan for MSWM. Taiwan utilized a variety of techniques, including education, market-based instruments, and command-and-control (Lu, 2005).

1. The setting up of numerous recycling sites and the promotion of the concept of recycling to the public (environmental education).
2. Restrictions on the use of disposable dishes, and encouragement of the public to develop the habit of “waste not, want not” to promote waste reduction and recycling (environmental education).
3. Collecting recycling fees from businesses and applying them to call attention to recycling work (EPR).
4. Mandating that waste-collection crews of the local government perform waste recycling and reduction work (C&C).
5. Mandating public participation in recycling and refusing to collect waste from those who do not cooperate in sorting and recycling (C&C).
6. Setting up restrictions on the use of plastic bags (C&C).
7. Implementation of kitchen-waste recycling (C&C).
8. Introduction of a volume-based collection fee system (economic incentive).

Appendix G: List of Potential MBIs

This appendix contains information on the programs we provided for discussion at our focus group and meetings. This is the handout provided to participants in the meetings, as background knowledge in case any participant was unaware of a particular program. In addition to this handout, we also briefly explained the programs and answered any questions that may have been raised.

Economic Incentives to Improve Residue Management in Costa Rica

MBIs

- ▶ Economic incentives to encourage environmental change
- ▶ Common objectives of MBIs
 - Create economic costs for environmental damages
 - Raise Revenue

Pay As You Throw (PAYT)

- ▶ Municipalities charge a fee to collect residues
 - Charge by bag or volume
- ▶ There is no charge to pick up reusable materials
- ▶ Incentive to reduce, reuse, and recycle

Electricity Surcharge

- ▶ Tax placed on electricity bills
 - Raise revenue for solid residue management programs
- ▶ Tax is progressive
 - People generate more electricity generally:
 - Are wealthier
 - Produce more residue

Deposit-Refund

- ▶ There is a small fee on plastic bottles
- ▶ People only get the fee back if they recycle

Eco-Labeling

- ▶ Label environmentally friendly products
 - Example: companies who properly deposit toxic residues
- ▶ Consumers can choose to only buy these products
- ▶ Encourages companies to achieve standards
 - Want to receive label

Producers Collect Recyclables

- ▶ Target producers of reusable materials
- ▶ Producers required to collect materials after use by consumers

Markets as Recycling Centers

- ▶ Supermarkets are centers for recycling
- ▶ People bring recyclables to market
- ▶ Municipalities then collect the recyclables

Education Programs

- ▶ Education programs in schools
 - Teach children
- ▶ Advertisements
 - Educate the general public
- ▶ Requires funding
 - Ministry of Education

Community Service

- ▶ Volunteers
 - Gather residues in rivers, streets
- ▶ Method of education

Landfill Tipping Fees

- ▶ Fee to dispose residues at landfills
- ▶ Cost is transferred to residents and businesses who produce the residues

Harmful Material Tax

- ▶ Require manufacturers of harmful materials to pay a tax
- ▶ Encourages reducing production of harmful materials

Appendix H: A List of Attendees to the Workshop and Follow-up Meetings

This appendix contains a list of attendees to the workshop and follow-up meetings. These individuals represent experts in business, economics, and the environment. They came from the following organizations: Universidad de Costa Rica (UCR); Universidad Nacional (UNA); Centro Internacional de Política Económica para el Desarrollo Sostenible (CINPE); Centro de Derecho Ambiental y de los Recursos Naturales (CEDARENA); Instituto Nacional de Biodiversidad (INBio); Comisión Nacional de Prevención de Riesgos y Atención de Emergencias (CNE); and Florex, a company that sells green cleaning products. Individual participants included:

- Rafael Díaz Porras,
- José Antonio Cordero,
- Rolando Castro Córdoba,
- Luis Diego Jimenez,
- Silvia Chaves,
- Marcos Adamson, and
- Carlos Picado Rojas.

Appendix I: Discussion Points for the Workshop and Follow-up Meetings

This appendix contains a schedule of the workshop, including its set-up and organization, as well as the discussion points for both the workshop and the follow-up meetings.

Schedule of the Workshop:

Obtain permission to reference a list of participants in our report

Introduction of purpose and participants

- We will start off by letting Dr. Musmanni introduce our team.
- We will then introduce ourselves, our project, and the purpose of the focus group.
- See below for the introduction.

Brief PowerPoint presentation, describing the programs to be studied

- It will list how each program works along with the pros and cons.
- A handout with these programs was also provided. This can be found in appendix H.

Dr. Musmanni describes how Metaplan will work

Attendees chose their top three programs on board 1, tally up choices

They post their choices for pros and cons on board 2, discuss choices

Reconvene, start discussion about final program options and fill out board 3

Set-Up of the Boards:

- Board 1 will list all the main programs to be ranked.
 - Each person will rank their top three choices from the both household perspective and the industrial perspective with a colored card. (Green for their top choice; yellow for their second; and red for their third)
 - This means that each person will have two first, two second, and two third choices.
 - Once they are ranked, we will assign each first choice three points, each second choice two points, and each third choice one point and add them up to determine the top picks.
 - This will allow us to quickly focus in on the most feasible programs. For example:

Board 1 – Ranking			
Programs	Rank 3	Rank 2	Rank 1
PAYT			
Electricity Surcharge			
Deposit-Refund			
Eco-labeling			
Producers Collect Recyclables			
Markets as Recycling Centers			
Landfill Tipping Fees			
Harmful Materials Tax			

- Board 2 will be for discussion of associated advantages, obstacle, and ways to overcome obstacles (in green, red, and blue, respectively) for the top three to five programs from the previous board.
 - It will be composed of two parts, one on each side of the board.
 - One will represent the household perspective and the other will represent the industrial perspective.
 - Each person will post one comment for each category before discussion takes place.
 - Once the board is filled out, the group will be able to discuss their comments, and give each other feedback, and expand on the cards posted.
 - For Example:

Board 2			
Programs	Advantages	Obstacles	Overcoming obstacles
Eco-labeling			
Deposit-refund			
PAYT			

- On the third board, we will list all of the MBIs with their prior rankings totaled, in order to confirm the most feasible MBIs.
 - We will add together the household and industrial points, in order to determine the overall best programs.
 - We will then discuss this ranking in order to determine whether participants agree with this order based on the entire discussion.
 - This is the time for final comments and explanations.

Board 3		
Programs	Feasible in Costa Rica	Not Feasible in Costa Rica
PAYT		
Electricity Surcharge		
Deposit-Refund		
Eco-labeling		
Producers Collect Recyclables		
Markets as Recycling Centers		
Landfill Tipping Fees		
Harmful Materials Tax		
PAYT		
Electricity Surcharge		

Introductory Statement:

Welcome to our workshop. Thank you all for coming, we greatly appreciate your time. We are Dhia Ben-Haddej, Alyce Buchenan, Alex Owen, and George Shakan. We are students from Worcester Polytechnic Institute in Worcester, MA, USA. We are here in San Jose for seven weeks working on our Interactive Qualifying Project, or IQP. It is a project that is an important part of the curriculum at our school. We decided to do our project here with our sponsor GTZ on municipal solid waste management. **(Give time for everyone to introduce themselves.)**

Ecotourism, a \$1.9 billion per year industry, has helped lead Costa Rica to fast economic growth. This growth is fueled in part by its green image, which stems from its protected national parks and the environmentally conscious people. However, its municipal solid waste (MSW) infrastructure has not been able to maintain the same level of development and the country is riddled with a waste management problem. Roughly 2400 tons of waste is generated daily and an estimated 250 tons is dumped illegally into rivers. There is also only a single digit recycling rate, while most of the waste in Costa Rica is dumped into open dumps and unregulated sanitary landfills, many of which do not meet regulations.

In May of 2010, the Costa Rican government passed a law for the “Integrated Management of Residues.” The law stated that specific government ministries would pass decrees in the future that would provide the specifics for how the law would be implemented. Our goal is to create a report that will aid in the formulation of these decrees that will hopefully improve the MSWM system in Costa Rica.

Our focus is on using market-based instruments to improve the MSWM system in Costa Rica. Market-based instruments, or MBIs, are economic incentives created to modify behavior in order to achieve environmental goals. Our goal for this conference is to determine which MBIs are most likely to be successful in Costa Rica.

We extensively studied the use of MBIs to improve solid waste management. We analyzed other countries such as Germany, Brazil, Ecuador, Bangladesh, and Taiwan as well as studies about MBIs in general in order to understand solid waste management and market-based instruments. From these studies, we composed a list of programs that we would like to further examine. Now we will present these programs.

Appendix J: Notes of Results and Discussion from the Workshop and Follow-up Meetings

This appendix contains detailed notes from our workshop, including discussion of ranking and feasibility of the provided programs.

Thursday, November 18, 2010

- **Board 1 discussion**
 - Industrial perspective

Board 1 – Ranking (Industrial = I)			
Programs	Rank 3	Rank 2	Rank 1
PAYT		I	
Electricity Surcharge			
Deposit-Refund		I	
Eco-labeling	I		I
Producers Collect Recyclables	I, I	I	
Markets as Recycling Centers			
Landfill Tipping Fees			I
Harmful Materials Tax			I

- Reason for choosing PCR
 - Industrial sector produces a lot of trash
 - Good way to encourage them to reduce waste disposal
- Reason for choosing eco-labeling
 - Lets companies “show off” their green practices
- Analysis
 - One person is on action side (PCR), one person in on information side (eco-labeling)

- Household perspective

Board 1 – Ranking (Household = HH)			
Programs	Rank 3	Rank 2	Rank 1
PAYT	HH, HH		
Electricity Surcharge		HH	
Deposit-Refund	HH	HH	
Eco-labeling		HH	HH
Producers Collect Recyclables			
Markets as Recycling Centers			HH
Landfill Tipping Fees			HH
Harmful Materials Tax			

- Reason for PAYT
 - Good way for raising money
- Reason for MRC
 - Easy and convenient since you go there a lot
- Reason for landfill tipping fees

- Makes people take collective action
 - Reason for eco-labeling
 - Could work for industrial supplies
- Total scores:

Board 1 – Ranking (Totals)			
Programs	Rank 3	Rank 2	Rank 1
PAYT	HH, HH	I	
Electricity Surcharge		HH	
Deposit-Refund	HH	I, HH	
Eco-labeling	I	HH	I, HH
Producers Collect Recyclables	I, I	I	
Markets as Recycling Centers			HH
Landfill Tipping Fees			I, HH
Harmful Materials Tax			I

- **Board 2 discussion**

- Industrial perspective

Industry	advantages	obstacles	Overcoming obstacles
PAYT	Effective; will reduce waste generation	How much?; how to charge industries?; promotion of alternative routes of disposal	Way of collecting; create a mechanism to charge large generators individually
Producers collect recyclables	Image improvement; social responsibility action; decrease amount; already mandatory by law	Increased investment (economic impact); only for certain waste	Why do it? Benefit?; what to do with toxic product?; promote recognition system for voluntary collection
Eco-labeling	Market/product differentiation; increased process; growing number of informed customers	Costs of having a valid/recognized system in place; new suppliers, new materials; lack of experience on EL in CR	Access to information; national quality system helps and supports the initiative; generate a technical norm on eco-labeling
Deposit-refund	Lower costs of product; lower environmental impact (external), better image; reduces littering	Logistics + warehousing + treatment costs; recycling center (collecting); affects prices	To make it mandatory

- Discussion of deposit-refund

- Recyclable bottles are cheaper
- Once more materials in markets, can be more attractive (to industry?)
- Cost of disposal could affect product
- If mandatory, levels cost of materials
- More complicated – people want “quick and dirty” answer
- Hard to organize logistics, treatment
- Discussion of MRC
 - They would complain
 - Say “that’s not our core business”
 - In US, appealing to customers for ease of recycling
 - In US, combine DR and MRC – get ticket for cash
 - Ex: if you use MRC and have a recycling company in community, it’s a mutual relationship
- Household perspective

Household	Advantages	Obstacles	Overcoming obstacles
PAYT	Less amount; promotes reducing	Logistic for collection; identity free riders, household participating; how to charge household?	“barcoding” in houses from the same neighborhood; program bags or stickers with amount/price
Deposit-refund	(same as industry)	(same as industry)	(same as industry)
Eco-labeling	(same as industry)	(same as industry)	(same as industry)
Electricity surcharge	Easy metric; links affluence with residue generation; bring resources for recycling initiatives; easy to collect	Money goes to government; not always fair; not very popular	Collecting system; education and [sic] sensibilization

- Discussion of PAYT
 - Can color code program bags
 - People can go dump bags elsewhere to avoid being charged (illegal dumping)
 - Barcoding and program bags only help people who use program
 - Can introduce sanction for dumping illegally
- Discussion of eco-labeling
 - For household, more appeal of better product
 - For industry, appeal of advertising green products

- **Board 3 discussion**

MBIs	Thoughts
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PAYT (8)	
Producers collect recyclables (8)	
Deposit-refund (7)	
Eco-labeling(7)	
Electricity surcharge (2)	It is something to evaluate
Landfill tipping fees (2)	
Markets as recycling centers (1)	
Harmful materials tax (1)	Although is a low score, in some cases is critical

- Possible additional MBIs
 - Certification and recognition system for companies that voluntarily do “green” practices, along with awards
 - High [sic] valorization potential
 - Energy from waste
- Harmful materials tax discussion
 - Is important
 - Industry might not care about it
 - Industry doesn’t always consider harmful materials to be harmful
 - Low score, but very good to consider
- PAYT discussion
 - Start by providing general info about harmful materials
 - Next, people can decide if they are able to adjust disposal methods yet
 - Cost for municipality is lower because cost of sending to a landfill is lower
 - Will eventually generate revenue
 - People who are good at reducing waste will pay very little
 - Aim is to lower amount of waste sent to landfill
- Thought: if some smaller companies don’t produce enough recyclable waste, they might not try hard to recycle – if 25, 50, or 100 companies have someone else pay them for their recyclables and then use it for manufacture, it could work
- Thought: can use biogas from landfilling for trash truck fleet, electricity production
 - Puts value on taking action
 - Must have 20,000 tons of compost per year to produce a usable amount of biogas
- Thought: usefulness of public private partnerships
- Thought: a few years ago, a university did a study on residues in different regions
 - Use of sugarcane residues
 - Palm oil residues
- Discussion of certification/recognition system
 - If a company meets a mark, the government could reduce their taxes

- Government wouldn't like idea of reducing taxes

Appendix K: PAYT in Malden, Massachusetts, USA

The city of Malden in Massachusetts, USA is a perfect example of a municipality that has implemented a highly successful PAYT program. Initiated in 2008, it requires all households to dispose of their waste in city-approved bags. These bags are ordered and paid for by local retailers from the manufacturer Waste Zero. People then purchase the bags and the retailers send the profit to the city, which puts the money in the General Fund. The price for a thirty-three gallon bag is \$2 and the price for a fifteen gallon bag is \$1, resulting in the average household spending less than \$200 annually on bags. The city picks up the bags and separated recyclables once a week, but does not collect non-PAYT bags. Repeat offenders can be fined a minimum of \$50. The city also increased its illegal dumping fine to \$300, but has fortunately not seen an increase in illegal dumping. To increase participation in the program, the city carried out an outreach program including press releases, TV announcements, and information pamphlets delivered to homes. The program has proven to be extremely successful, with \$2.5 million in savings for the city, a compliance rate of over ninety-eight percent, a recycling rate up seventy-four percent, and solid waste tonnage down forty-nine percent, all within the first year. These astounding numbers demonstrate PAYT's effectiveness as an MBI and the kind of improvement in MSWM that it could bring about if implemented in Costa Rica (MassDEP, 2010).