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# Exploring the Feasibility of Economic Incentives for Reforestation in the Fond D'Or Watershed, St. Lucia

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EXPLORING THE FEASIBILITY OF ECONOMIC INCENTIVES FOR  
REFORESTATION IN THE FOND D'OR WATERSHED, ST. LUCIA

A Thesis Presented

by

Amanda Richardson

to

The Faculty of the Graduate College

of

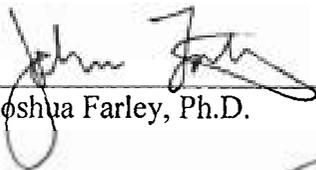
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In Partial Fulfillment of the Requirements  
for the Degree of Master of Science  
Specializing in Community Development and Applied Economics

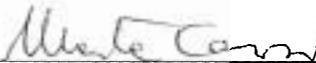
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Accepted by the Faculty of the Graduate College, The University of Vermont, in partial fulfillment of the requirements for the degree of Master of Science, specializing in Community Development and Applied Economics.

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## ABSTRACT

This thesis examines the feasibility of economic incentives for reforestation, with improved water quality being one potential benefit, in the Fond D'or watershed of Saint Lucia. Population growth, economic development, and the onset of climate change have decreased the environmental quality in Small Island Developing State (SIDS) while increasing risk to the islands' water security. The unique topography and geology of Caribbean island nations contribute to the challenges of managing freshwater resources. The governments of SIDS often lack the human and financial resources to provide potable water for their citizens, as well as to monitor and enforce environmental regulations limiting land use in watersheds. Therefore, a new approach to watershed management in Saint Lucia is imperative for the provision of valuable ecosystem services at the local, regional, and global scales. Payments for ecosystem services (PES) are a promising approach to the protection and maintenance of public ecosystem services where there is little incentive for private landowners to provide them.

The first article explores household willingness-to-pay (WTP) for reforestation in Fond D'or watershed. The contingent valuation method was used to obtain residents' WTP for a hypothetical scenario in which an increase in water users' fees are used to fund a program where farmers in the upper watershed are compensated for taking land near water sources out of agricultural production for reforestation. The findings from 294 household surveys provide a description of the state of water quality and quantity in the Fond D'or, domestic water uses and sources, as well as attitudes and opinions about current water service. Bivariate analyses were performed to identify underlying factors that influence WTP, revealing that increased WTP is not a result of higher education and income. Rather, residence in a particular community group likely influences opinions about water, ultimately shaping WTP. Lastly, I discuss WTP in terms of its potential contribution to a PES scheme in Saint Lucia; WTP by local beneficiaries represents one potential funding source for PES mechanisms as well as public support for environmental improvement programs.

The second article describes a methodological approach to constructing a PES scheme in the Fond D'or watershed. Of the five environmental policy approaches—*prescription, penalties, property rights, persuasion, and payments*—payment is likely to be the most feasible method to influence private land management decisions for the provision of ecosystem services for the public good. This article draws upon existing PES schemes for hydrological services around the globe to provide key lessons for expanding the use of the instrument to Saint Lucia. I apply these lessons to the social, political, and institutional context of Saint Lucia, identifying opportunities for and challenges to developing local or regional payment schemes for ecosystem services in the Fond D'or watershed. I outline the steps to constructing a PES and recommend further research to Saint Lucian policymakers.

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## LIST OF ACRONYMS

<b>CEDERENA</b>	Ecological Foundation for the Development of Renewable Natural Resources
<b>CEHI</b>	Caribbean Environmental Health Institute
<b>CVM</b>	Contingent Valuation Method
<b>EC</b>	Eastern Caribbean Dollar
<b>ESPH</b>	Heredia Public Service Enterprise
<b>GDP</b>	Gross Domestic Product
<b>GEF</b>	Global Environment Facility
<b>GOSL</b>	Government of Saint Lucia
<b>ICDP</b>	Integrated Conservation and Development Project
<b>IWCAM</b>	Integrated Watershed and Coastal Areas Management
<b>MA</b>	Millenium Ecosystem Assessment
<b>MAFF</b>	Ministry of Agriculture, Forestry, and Fisheries
<b>NGO</b>	Non-Governmental Organization
<b>NYC</b>	New York City
<b>PES</b>	Payments for Ecosystem Services
<b>PSA</b>	<i>Pagos por Servicios Ambientales</i>
<b>SIDS</b>	Small Island Developing States
<b>UNEP</b>	United Nations Environmental Program
<b>UNDP</b>	United Nations Development Program

<b>UVM</b>	University of Vermont
<b>WASA</b>	Water and Sewage Authority
<b>WASCO</b>	Water and Sewage Company, Inc
<b>WHO</b>	World Health Organization
<b>WRI</b>	World Resources Institute
<b>WTP</b>	Willingness-to-Pay
<b>WTA</b>	Willingness-to-Accept

## **CHAPTER 1: COMPREHENSIVE LITERATURE REVIEW**

### **1.1 Introduction**

The term “ecosystem services” is a new expression for an old idea (Brauman, Daily, Duarte, & Mooney, 2007). Stocks of natural capital—both biotic and abiotic—yield valuable flows of goods and services; ecosystem services are those ecosystem functions that are of value to humans (Daly & Farley, 2004).

Ecosystem structure provides, most perceptibly, raw materials available for conversion into market goods. Less concrete are the services delivered through ecosystem processes: flood control, waste absorption, nutrient cycling, water and air purification, etc. Many of these ecosystem services are purely non-rival and non-excludable (a.k.a. public goods)—rival meaning that the consumption of the service by one party prevents its consumption by others and excludable meaning that the service can be owned and the owner can prevent others from using the service (Daly & Farley, 2004). Public goods generally fall outside the realm of the market economy, so while these services sustain human health and well-being, resource extraction for economic production is rewarded in the marketplace over the conservation of the ecosystem structure that provides them. Rising populations, unsustainable rates of consumption and continued neglect have increased the scarcity of ecosystem services around the globe.

Conserving or enhancing ecosystem services requires forgoing alternative values and land uses, such as timber extraction or agricultural production (Pagiola,

Bishop, & Landell-Mills, 2002). As a result, ecosystem services, particularly those public in nature, are not given appropriate consideration in policy decisions. This occurs because public goods remain outside the realm of the market, lack an economic value, and are unaccounted for in policy and management decisions (Costanza et al., 1997; Kumar, 2005; Naidoo & Ricketts, 2006).

Public ecosystem services often result from private management decisions. Generally, private landowners will not provide sufficient quantities of public goods acting in their own self-interest and, oftentimes, government intervention by way of subsidies, taxes, regulation, modification of property rights, or direct provision is necessary to manage pure public goods. Given this quandary, conservation practitioners seek to provide incentives for landowners who would otherwise destroy ecosystems and species, to preserve them. These conservation approaches range from direct to indirect depending on the conservation objectives and types of interventions (Figure 1.1) (Ferraro & Kiss, 2002).

Potential Investments for Biodiversity Conservation		
Investment	(Least direct)	Examples
Support for the use/marketing of extracted biological products		Logging, nontimber forest product extraction, and hunting
Subsidies for reduced-impact land and resource use		Sustainable agriculture on already cultivated lands, "alternative income generation"
Support for the use and or marketing of biodiversity within relatively intact		Eco-tourism, sport hunting, bioprospecting, wild honey production
Payment for other environmental services (generating biodiversity conservation as a side benefit)		Watershed protection, carbon sequestration
Payment for conservation land or "retirement" of biodiversity use rights		Easement, "nonlogging" concessions
Performance-based payment for biodiversity conservation		(Most direct)

Ferraro & Kiss (2002)

**Figure 1.1: Conservation investments in biodiversity ranging from indirect to direct**

Direct approaches, like conservation easements or performance-based payments, address the issue that individuals seek what is in their best interest by aligning incentives to conserve with society as a whole (Ferraro & Simpson, 2001; Pagiola et al., 2005). This approach recognizes the trade-offs associated with conservation and seek to bridge conflicting interests by means of compensation (Wunder, 2007). Direct approaches may be more successful in achieving conservation goals than indirect approaches because they offer comprehensible links between well-being, individual behavior, and ecosystem conservation (Ferraro, 2001). This approach may also be more efficient than command-and-control measures, particularly in

developing countries where the governments lack the human and economic resources to enforce rules regarding the use of a resource.

### **1.1.1 Payments for Ecosystem Services**

Payments for ecosystem, or environmental, services (PES) are an innovative method of using economic incentives to promote land management activities on private land for the provision of public ecosystem services. This type of intervention is less direct than conservation easements but more direct than eco-tourism or Integrated Conservation and Development Projects (ICDPs) (Figure 1.2), which have been described as "conservation by distraction" (Ferraro & Kiss, 2002). PES mechanisms directly address the incentive to convert or degrade natural ecosystems by paying the landowner *at least* as much as he/she would have received from converting the habitat to some other land use. Countries in parts of Latin America and the Caribbean, as well as North America and Europe, are using this approach for environmental protection and improvement.

PES for hydrological services is a common application of the PES tool. Ecosystems normally deliver multiple benefits simultaneously (McMichael et al., 2005) and watersheds, in particular, provide well-recognized services like water quality, water table regulation, aquatic habitat protection, and soil contaminant control (Landell-Mills & Porras, 2002; Scherr et al., 2004). For this reason, many national parks and protected areas were initially created for watershed protection (Scherr et al., 2004).

Almost 30 percent of the world's largest cities depend on forested watersheds for their water supply (Scherr, White, Khare, Inbar, & Molnar, 2004). As water demand

is expected to double, even triple, in the next 50 years, especially in developing countries, the prospect for increased demand and increased payment for watershed services is vast (Scherr et al., 2004). Many countries have already arrived at watershed PES arrangements for specific services that are strategic at the local (e.g. downstream agricultural users), regional (e.g. urban water supply) or national (e.g. hydropower plant) scale (Robertson & Wunder, 2005).

The opportunities are great but there are trade-offs associated with watershed PES development (Pagiola et al., 2002). While landowners in the upper watershed maintain forests on their land and provide clean water to downstream users, they are foregoing benefits from harvesting timber, grazing livestock, or cultivating crops. If the land is denuded, reforestation requires limiting land use in the upper watershed, which results in lost revenue for the landowners. There also exist issues surrounding the equitable distribution of benefits. In a watershed, the benefits accrue disproportionately to downstream water users. In light of these trade-offs between conservation, productivity and equity, institutions must be developed so that all parties benefit (Pagiola et al., 2002).

While many nations have implemented successful PES schemes, most widely known is Costa Rica's successful *pagos por servicios ambientales* (PSA or Payments for Environmental Services) program. The Costa Rican government implemented this nation-wide program in 1996 to compensate landowners for maintaining forests on their lands or for reforesting degraded lands, thereby supporting livelihoods while promoting conservation. The national PSA program is primarily funded through a tax

on fuel sales and Global Environment Facility (GEF) grants, whereas several local or regional watershed PES schemes are funded through water users' fees. Similarly, a watershed scheme in Quito, Ecuador relies on voluntary payments by water users to supply FONAG, its water fund (Echavarría, 2002; Landell-Mills & Porras, 2002); New York City water users' compensate upstream rural agricultural communities for management practices that provide clean drinking water (Landell-Mills & Porras, 2002). Brazil allocates revenues from a sales tax to support the integrated management of the Rio Ribeira de Iguape Watershed in São Paulo (May, Neto, Denardin, & Loureiro, 2002; Rosa, Kandel, & Dimas, 2003); Mexico and Bolivia have created similar arrangements for watershed protection financed through a combination of private and public funds.

The case can be made that the need for PES schemes is greatest in developing countries (Scherr et al., 2004). However, these countries generally face challenges in establishing PES mechanisms due to a low degree of governance and limited institutional developments (Kumar, 2005). Other issues plaguing the establishment of PES in developing nations are uncertain or inequitable land tenure, lack of experience enforcing legal contracts and limited opportunities for non-agricultural investment and employment (Ferraro & Kiss, 2002).

### **1.1.2 Ecosystem Valuation**

Ecosystem managers, concerned by the loss of global ecosystems in the last 50 to 60 years, do not have all the information regarding the value of ecosystem services to contribute to decisions regarding how to efficiently allocate scarce resource dollars to

ecosystem management or conservation (Kumar, 2005; Naidoo & Ricketts, 2006). Economic valuation of ecosystems provides a tool for comparing the varied costs and benefits connected with ecosystems, yielding an expression of their value in an easily understandable metric (Pagiola, von Ritter, & Bishop, 2004). Valuation studies have the potential to increase knowledge of the value of ecosystems and the importance of protecting ecosystem services to strengthen the case for conservation issues (Edwards & Abivardi, 1998; Pagiola et al., 2004).

Ecosystem valuation can inform the application of economic incentives for ecosystem service provision. Accurate economic data, such as the costs and benefits of water provision, can contribute to a better understanding of the positions and motivations of service providers and beneficiaries. PES design can incorporate this data, although numerous PES schemes around the world have failed to do this.

In a world of finite resources, it is necessary to assess the benefits of protecting and enhancing environmental resources against the benefits of forgone alternatives in order to understand how to best allocate scarce resources (Bateman & Willis, 1999). The Contingent Valuation Method (CVM) is a valuation method for understanding people's preferences for public environmental goods, much like market research is employed to understand consumer's preferences for private, marketed goods (Bateman & Willis, 1999; O'Doherty, 1996). CVM involves directly asking people, through a survey or questionnaire, how much they would be willing to pay for a hypothetical scenario presented in the questionnaire. CVM is dependent upon respondents

considering the scenario to be realistic (Whittington, 1996). In this way, CVM can contribute valuable information to environmental decision-making.

While a useful tool in some cases, CVM has its share of shortcomings. Among them is the fundamental difference in the way that people value market goods and public environmental goods (Diamond & Hausman, 1994; Gowdy, 1997; O'Doherty, 1996); people's inexperience with valuing public environmental goods (Bateman & Willis, 1999; O'Doherty, 1996); and people's aversion to placing a dollar value on nature (Gowdy, 1997; Vatn & Bromley, 1994). Also, human perception of the value of an ecosystem may not reflect the actual biotic contribution (Gowdy, 1997; Vatn & Bromley, 1994); and people's value of an environmental good may not adjust according to the scale of the scenario, known as *scale bias*, (i.e. one whale saved vs. a herd of whales saved)(Arrow et al., 2001; Gowdy, 1997). In addition, CVM is susceptible to numerous sources of bias and error relating to the payment vehicle, strategic behavior, and respondents' lack of awareness on the subject (Bateman, Langford, & Rasbah, 1999; Bateman & Willis, 1999; Gowdy, 1997; O'Doherty, 1996).

Despite its criticisms, CVM has been defended by proponents as a solution to "environmental managerialism" because it offers the public a voice in public policy decisions, engaging them in a structured dialogue with experts and decision-makers (Blore, 1996). Active participation by the respondents is a primary facet of CVM, which is a hypothetical direct-valuation technique (O'Doherty, 1996). When some proposed policy change will produce an environmental effect, those benefiting or suffering from the change are asked directly, via survey or questionnaire, their

willingness-to-pay (WTP) to prevent environmental degradation or improve environmental quality. Therefore, the *process* of CVM, rather than simply the results, is valuable to decision-makers.

CVM focuses on forecasted behavior before the environmental change occurs, rather than other methods that measure behavior after the change. This can be of use to policy makers who will be evaluating the costs and benefits of various alternatives that will cause changes in welfare (O'Doherty, 1996). Public attitudes to risk are at the core of many environmental issues and risk is built into the framework of CVM (Blore, 1996). CVM may be one way of exploring the limits to risk acceptance of those that ultimately pay and the results are essentially a useful expression of attitudes towards public goods or a proposed policy (Diamond & Hausman, 1994). Again, the process of CVM is a valuable contribution in and of itself.

CVM has proved to be an appropriate tool yielding results that contribute to understanding public health and public service issues, particularly water services, in rural parts of developing nations, with poor, illiterate populations (Casey, Kahn, & Rivas, 2005; Mbata, 2006; Onwujekwe, Chima, Shu, Nwagbo, & Okonkwo, 2001; Shultz & Soliz, 2007; Whittington, Briscoe, Mu, & Barron, 1990).

## **1.2 Site Description**

Small Island Developing States (SIDS) share a unique set of sustainable development challenges due to their small size, topography, and relative isolation (Reynolds, DeSisto, Murray, & Kolodinsky, 2007; Tompkins et al., 2005). One

significant challenge that SIDS face is the management of water resources—*access* to freshwater resources being of primary concern (Cosgrove & Rijsberman, no date). A complex interface between natural factors, a low degree of governance resulting in weak water policies, and limited institutional developments, contributes to declining quality and quantity of freshwater in many SIDS (Kumar, 2005).

Freshwater resources are a critical national issue on the Caribbean island of Saint Lucia where water scarcity in rural areas during the dry season has reached critical capacity (Ministry of Physical Development Environment and Housing, 2004; Ministry of Planning Development Environment and Housing, 2001). Population growth, internal migration, and infrastructure development are all factors contributing to rising water demand on the island. Without groundwater reserves, Saint Lucia is completely dependent on rainfall for freshwater supplies. However, due to its steep topography and volcanic terrain, rain events cause high levels of run-off, sedimentation, erosion, gully formation, and landslides. A lack of natural catchments for water collection and storage for treated water compounds the challenge for the government to supply freshwater to communities.

Saint Lucia's unreliable water supply can be attributed not only to geologic and topographic constraints but also to institutional weaknesses in Saint Lucia's water sector. Poor financial performance, operational efficiency, and low capital investment are currently overwhelming the water sector (Financial Private Sector and Infrastructure Department & Caribbean Country Management Unit, 2001). These natural and institutional factors interact with human activities at the watershed-level,

further exacerbating environmental quality and water quality for downstream water users.

To help Caribbean SIDS effectively address their environment and management challenges the United Nations Development Program (UNDP), United Nations Environmental Program (UNEP), along with the Caribbean Environmental Health Institute (CEHI) have initiated an Integrated Watershed and Coastal Areas Management (IWCAM) program funded through GEF. IWCAM provides a framework for countries to better address the environmental challenges that they face through an integrated approach to the management of watersheds and coastal areas on the national and regional level (UNDP-GEF IWCAM, 2005). The Fond D'or watershed is the site of the IWCAM program in Saint Lucia. The primary goal of the Saint Lucian pilot project is to improve water quality in the streams and rivers in the Fond D'or watershed, contributing to the sustainability of the island and the general health and well-being of the population.

The use of economic incentives for reforestation and/or forest protection as part of the IWCAM project is one approach to achieving the protection and potential improvement of environmental quality within the Fond D'or watershed. Forested watersheds deliver an array of ecosystem services simultaneously while beneficiaries at the local, regional, and global scales enjoy these services. For example, water filtration (quality), water flow regulation (quantity), micro-climate control, soil stabilization, maintenance of aquatic habitats, carbon sequestration, biodiversity and scenic beauty

are but a few among many watershed ecosystem services (Daily, 1997; Pagiola, Bishop, & Landell-Mills, 2002).

IWCAM managers in Saint Lucia are interested to understand the importance of natural ecosystems within the Fond D'or watershed in terms of their ability to provide important ecosystem services that influence the water quality for downstream beneficiaries. Ecosystem valuation is a tool that can highlight the importance of these natural ecosystems and weigh the benefits of preserving them against the total economic, environmental, and social effects of converting the forested slopes of the watershed to agricultural activities. By using CVM to understand the motivations of service buyers, there is the potential to bolster the case for using economic incentives, or a PES mechanism, to promote conservation within the watershed.

### **1.3 Goals, Objectives, and Methods**

Ecosystem goods and services are those ecosystem processes that contribute to human health and well-being. Many of these goods and services are public goods and lack a market value. Because of this, the conversion of ecosystem structure into raw materials for economic production is rewarded in the marketplace over conservation of the ecosystem structure. Rising populations, unsustainable rates of consumption and continued neglect have increased the scarcity of ecosystem services around the globe.

Ecosystem valuation provides a tool to understand and estimate the economic value of those goods and services that lack market values. The results of valuation have the potential to increase our knowledge of the value of ecosystems and the importance

of protecting ecosystem services to strengthen the case for conservation issues. CVM is a direct-valuation technique that estimates people's preferences, or demand, for public environmental goods. CVM can also be used to estimate people's contributions to campaigns to restore or protect these goods.

As recognition of the state of global ecosystem services has increased, so has the use of economic incentives to protect or restore ecosystems on private land for public benefit. PES mechanisms directly address the incentive for private landowners to convert or degrade natural ecosystems by paying the landowner *at least* as much as he/she would have received from converting the habitat to some other land use. This technique is being used in both developing and industrialized nations around the world to protect and enhance natural ecosystems. Most widely recognized is Costa Rica's national PSA program.

Ecosystem valuation can inform the application of economic incentives for ecosystem service provision. Accurate economic data, such as the costs and benefits of water provision, can contribute to a better understanding of the positions and motivations of service providers and beneficiaries.

The goal of this research is to inform the design of a PES mechanism for reforestation in the Fond D'or watershed of Saint Lucia. The following chapters describe an original application of CVM in the Fond D'or watershed and a framework for designing a PES mechanism in the context of Saint Lucia based on a synthesis of existing PES literature.

In Chapter 2, I conduct an economic valuation of the household demand for reforestation in the Fond D'or watershed using survey data collected using the CVM. While researchers typically use CVM to estimate non-use values of ecosystems or estimate the damage to natural ecosystems, the household surveys in the Fond D'or watershed estimated WTP in order to understand the potential household contribution to an economic incentive program for reforestation. This research is the first of its kind in the Fond D'or watershed; it will contribute to public policy discussions by providing a measure of public demand, as well as information regarding public attitudes and support to assess the feasibility of using PES as a tool for the IWCAM project.

In Chapter 3, I present payments for reforestation as a policy option for integrated watershed management in Saint Lucia to improve water quality in the Fond D'or watershed. While PES is widely used in South America and the Caribbean, the tool has not yet been used in Saint Lucia. Drawing upon lessons from existing PES mechanisms around the globe, I present a methodological approach to designing a payment mechanism, discussing the elements of the approach in the institutional and political context of Saint Lucia. Throughout the paper, I explore some of the opportunities and challenges associated with developing a watershed PES scheme and conclude with recommendations for the policy makers of Saint Lucia.

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## **CHAPTER 2: WILLINGNESS-TO-PAY FOR REFORESTATION IN THE FOND D'OR WATERSHED, SAINT LUCIA**

### **2.1 Introduction**

The benefits provided by natural ecosystems are both widely recognized and poorly understood (Daily, 1997). Those benefits come in the form of ecosystem goods and services, which are the ecosystem functions that are of use to humans (Daly & Farley, 2004). Ecosystem structure provides, most perceptibly, raw materials that are converted into market goods. Less concrete are the services delivered through ecosystem processes: flood control, waste absorption, nutrient cycling, water, and air purification. These services sustain human health and well-being but because they are not market goods, conservation of ecosystem structure for the provision of services is not rewarded in the marketplace while economic production is. Because ecosystem services are delivered spatially as well as temporarily, they are difficult to quantify and measure. There are trade-offs associated with conserving or enhancing ecosystem services: protecting ecosystem structure means forgone alternative values and land uses, such as timber extraction or agricultural production (Pagiola, Bishop, & Landell-Mills, 2002).

Ecosystem managers, concerned by the loss of global ecosystems in the last 50 to 60 years, do not have all the information regarding the value of ecosystem services to contribute to decisions regarding how to efficiently allocate scarce resource dollars to ecosystem management or conservation (Kumar, 2005; Naidoo & Ricketts, 2006).

Economic valuation of ecosystems provides a tool for comparing the varied costs and benefits connected with ecosystems, yielding an expression of their value in an easily understandable metric (Pagiola, von Ritter, & Bishop, 2004). Valuation studies have the potential to increase knowledge of the value of ecosystems and the importance of protecting ecosystem services to strengthen the case for conservation issues (Edwards & Abivardi, 1998; Pagiola et al., 2004).

Ecosystem valuation can inform the application of economic incentives for ecosystem service provision. Payments for ecosystem, or environmental, services (PES) are an innovative method of using economic incentives to promote land management activities on private land for the public ecosystem services they provide. PES mechanisms directly address the incentive to convert or degrade natural ecosystems by paying the landowner *at least* as much as he/she would have received from converting the habitat to some other land use. Countries in parts of Latin America and the Caribbean, as well as North America and Europe, are using this approach for environmental protection and improvement.

PES for hydrological services is a common application of this tool. Almost 30 percent of the world's largest cities depend on forested watersheds for their water supply (Scherr, White, Khare, Inbar, & Molnar, 2004). As water demand is expected to double, even triple, in the next 50 years, especially in developing countries, the prospect for increased demand and increased payment for watershed services is vast (Scherr et al., 2004). Many countries have already arrived at watershed PES arrangements for specific services that are strategic at the local (e.g. downstream

agricultural users), regional (e.g. urban water supply) or national (e.g. hydropower plant) scale (Robertson & Wunder, 2005).

While many nations have implemented successful PES schemes, most widely known is Costa Rica's successful *pagos por servicios ambientales* (PSA or Payments for Environmental Services) program. The Costa Rican government implemented this nation-wide program in 1996 to compensate landowners for maintaining forests on their lands or for reforesting degraded lands, thereby supporting livelihoods while promoting conservation. The national PSA program is primarily funded through a tax on fuel sales and Global Environment Facility (GEF) grants, whereas several local and regional watershed PES schemes are funded through water users' fees. Similarly, Ecuador relies on voluntary payments by water users to supply FONAG, its water fund (Echavarria, 2002; Landell-Mills & Porras, 2002); New York City water users' compensate upstream rural agricultural communities for management practices that provide clean drinking water (Landell-Mills & Porras, 2002). Brazil allocates revenues from a sales tax to support the integrated management of the Rio Ribeira de Iguape Watershed in São Paulo (May, Neto, Denardin, & Loureiro, 2002; Rosa, Kandel, & Dimas, 2003); Mexico and Bolivia have created similar arrangements for watershed protection financed through a combination of private and public funds.

Small Island Developing States (SIDS) share a unique set of sustainable development challenges due to their small size, topography, and relative isolation (Reynolds, DeSisto, Murray, & Kolodinsky, 2007; Tompkins et al., 2005). One significant challenge that SIDS face is the management of water resources—*access* to

freshwater resources being of primary concern (Cosgrove & Rijsberman, no date). A complex interface between natural factors, a low degree of governance resulting in weak water policies, and limited institutional developments, contributes to declining quality and quantity of freshwater in many SIDS (Kumar, 2005).

Freshwater resources are a critical national issue on the Caribbean island of Saint Lucia where water scarcity in rural areas during the dry season has reached critical capacity (Ministry of Physical Development Environment and Housing, 2004; Ministry of Planning Development Environment and Housing, 2001). Population growth, internal migration, and infrastructure development are all factors contributing to rising water demand on the island. Without groundwater reserves, Saint Lucia is completely dependent on rainfall for freshwater supplies. However, due to its steep topography and volcanic terrain, rain events cause high levels of run-off, sedimentation, erosion, gully formation, and landslides. A lack of natural catchments for water collection and storage for treated water compounds the challenge for the government to supply freshwater to communities.

Saint Lucia's unreliable water supply can be attributed not only to geologic and topographic constraints but also to institutional weaknesses in Saint Lucia's water sector. Poor financial performance, operational efficiency, and low capital investment are currently overwhelming the water sector (Financial Private Sector and Infrastructure Department & Caribbean Country Management Unit, 2001). These natural and institutional factors interact with human activities at the watershed-level,

further exacerbating environmental quality, thereby affecting water quality for downstream water users.

To help Caribbean SIDS effectively address their environment and management challenges the United Nations Development Program (UNDP), United Nations Environmental Program (UNEP), along with the Caribbean Environmental Health Institute (CEHI) have initiated an Integrated Watershed and Coastal Areas Management (IWCAM) program funded through GEF. IWCAM provides a framework for countries to better address the environmental challenges that they face through an integrated approach to the management of watersheds and coastal areas on the national and regional level (UNDP-GEF IWCAM, 2005). The Fond D'or watershed is the site of the IWCAM program in Saint Lucia. The primary goal of the Saint Lucian pilot project is to improve water quality in the streams and rivers in the Fond D'or watershed, contributing to the sustainability of the island and the general health and well-being of the population.

The use of economic incentives for reforestation and/or forest protection as part of the IWCAM program is one approach to achieving the protection and potential improvement of environmental quality within the Fond D'or watershed. Forested watersheds deliver an array of ecosystem services simultaneously while beneficiaries at the local, regional, and global scales enjoy these services. For example, water filtration (quality), water flow regulation (quantity), micro-climate control, soil stabilization, maintenance of aquatic habitats, carbon sequestration, biodiversity and scenic beauty

are but a few among many watershed ecosystem services (Daily, 1997; Pagiola et al., 2002).

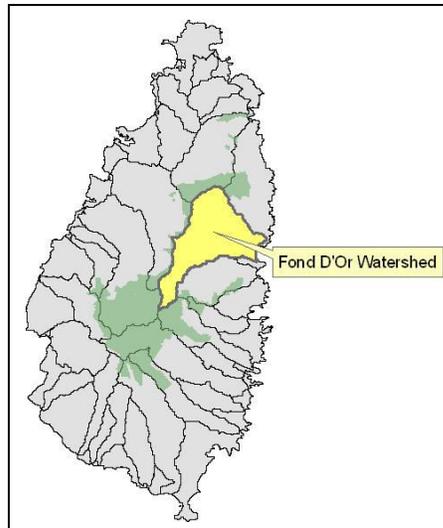
IWCAM managers in Saint Lucia are interested to understand the importance of natural ecosystems within the Fond D'or watershed in terms of their ability to provide important ecosystem services that influence the water quality for downstream beneficiaries. Ecosystem valuation is a tool that can highlight the importance of these natural ecosystems and weigh the benefits of preserving them against the total economic, environmental, and social effects of converting the forested slopes of the watershed to agricultural activities. This type of valuation has the potential to bolster the case for using economic incentives, or a PES mechanism, to promote conservation within the watershed.

The goal of this research is to conduct an economic valuation of the household demand for reforestation in the Fond D'or watershed to contribute to assessing the feasibility of implementing a PES scheme. Households are direct consumers of water; therefore, residents within the Fond D'or watershed are one of the many groups of beneficiaries of watershed ecosystem services. For groups of beneficiaries of various ecosystem services delivered by the Fond D'or watershed, willingness-to-pay (WTP) to ensure service provision is the principal measure of demand. Supply-side valuation studies (opportunity cost) have been done more than WTP studies, meaning that the buyers thus know more about the sellers than *vice versa* (Wunder, 2005). Increasing awareness about the buyers among ecosystem service providers could potentially improve the prospects for participation in a PES scheme.

This research is the first of its kind in the Fond D’or watershed; it will contribute to public policy discussions by providing a measure of public demand, as well as information regarding public attitudes and support to assess the feasibility of using PES as a tool for the IWCAM project.

## **2.2 Site Description**

The Fond D’or watershed (Figure 2.1) is located in the Dennery District on the eastern side of Saint Lucia, one of the Lesser Antilles islands located in the Caribbean Sea. The Fond D’or watershed is one of the largest watersheds in Saint Lucia and is the widest watershed at 3.6 miles across (IWCAM, 2008). The Fond D’or River is the main body of water within the watershed; the river empties into the Atlantic Ocean at the central part of the island’s eastern coastline. The 2001 national census reports that the upper watershed contains roughly 36 settlements, consisting of 3,000 households and a population of 10,000 (Saint Lucia Government Statistics Department, 2001).



**Figure 2. 1: The Fond D'or watershed, Saint Lucia**

The Water and Sewage Company, Inc (WASCO) currently provides drinking water and sewage services for which residents pay a monthly fee based on household water usage. Although wholly state-owned at this time, WASCO was established in 1999 as an effort to shift to a private-sector, market-based approach to water provision (Geoghegan, Krishnarayan, Pantin, & Bass, 2003). WASCO's government-owned predecessor, the Water and Sewage Authority (WASA), charged low rates and operated at a loss. In 2000, shortly after it was established, WASCO instituted rate increases—the first in over a decade—and now manages to cover its operating expenses as well as infrastructure improvements while continuing to repay WASA's debt. The World Bank contributed to the transition from a publicly-owned utility to a privately-operated company “under a well-functioning regulatory framework” through a Water Sector Reform Technical Assistance project (Sustainable Development Department &

Caribbean Country Management Unit, 2007). Despite these efforts, WASCO's current income does not cover the costs of water production and protection and current operations continue to be plagued by a legacy of low rates and inadequate infrastructure (Geoghegan et al., 2003).

The current state of the water sector is detrimental not only to the health and welfare of Saint Lucia's citizens, but also to the island's economic development, which is strongly linked to the island's competitive edge as a tourism destination. Agribusiness, formerly Saint Lucia's primary component of Gross Domestic Product (GDP) has declined from 15% in 1990 to 5% in 2003, and tourism subsequently assumed the role as principal contributor to the island's economy (Sustainable Development Department & Caribbean Country Management Unit, 2007). The water and sanitation sector has emerged as a key limiting factor in realizing the island's tourism development potential; access to basic services by developers and hoteliers is hindering their interest in investing in the island.

Efforts to reform the water sector are currently underway; one proposed water policy advocates that water users' fees cover all costs of production, storage, treatment, and delivery, including the costs associated with "protecting forests, watersheds and other ecosystems required to regulate and maintain water quality" (Geoghegan et al., 2003). Additionally, the Water Supply Infrastructure Improvement project, a short-term investment program funded by the World Bank, is currently carrying out "critical works" to alleviate water shortages in the north of the country (Sustainable Development Department & Caribbean Country Management Unit, 2007). This project

is expected to improve the water supply infrastructure in the north of the island, thereby facilitating new developments in the tourism industry and improving the quality of life of roughly 100,000 people. Residential customers also hope to benefit because of this project by increasing coverage to households currently without water services.

Despite the targeted efforts to make over Saint Lucia's struggling institutions and water infrastructure, water quality issues related to upstream land use of the ecosystems that provide water regulation services have not been addressed. Water quality in the Fond D'or watershed, for instance, is a serious concern and is largely attributed to upstream human activities (Geoghegan et al., 2003). Conversion of steep forested land for agriculture and grazing causes an influx of sediment in the water, while the use of agrochemicals for banana production pollutes the water. The use of sub-standard septic systems, pit latrines, and the river for bathing and washing along with unregulated development along riverbanks contributes to a decline in water quality. While Saint Lucia has a low prevalence of waterborne diseases overall (safewateronline.com, 2008), recent testing of surface water in the watershed reveals high fecal coliform counts (IWCAM, 2008).

### **2.3 Methods**

PES schemes are fundamentally an exchange between the beneficiaries of ecosystem service(s) and the providers of the service(s) to ensure continued service provision. Therefore, PES design requires that we identify the providers and beneficiaries of an ecosystem service, or bundle of services, and consider them in a

variety of potential arrangements. Accurate economic data, such as the costs and benefits of water provision, can contribute to a better understanding of the positions and motivations of service providers and beneficiaries. PES design can incorporate this data, although numerous PES schemes around the world have failed to do this.

University of Vermont undergraduate students enrolled in a service-learning course titled *Sustainable Development in Island Economies: Saint Lucia* developed a survey to understand household WTP for reforestation with water quality improvement being one potential benefit. The goal of the survey was to elicit attitudes towards reforestation and to obtain a dollar estimate of WTP for a reforestation program using the Contingent Valuation Method (CVM); the resulting metric will contribute to assessing the household contribution to financing of a PES scheme in the Fond D'or watershed.

### **1.3.1 Contingent Valuation Method (CVM)**

In a world of finite resources, it is necessary to assess the benefits of protecting and enhancing environmental resources against the benefits of forgone alternatives in order to understand how to best allocate scarce resources (Bateman & Willis, 1999). CVM is a method for understanding people's preferences for public environmental goods, much like market research is employed to understand consumer's preferences for private, marketed goods (Bateman & Willis, 1999; O'Doherty, 1996). In this way, CVM can contribute valuable information to environmental decision-making. CVM involves directly asking people, through a survey or questionnaire, how much they would be willing to pay for a hypothetical scenario presented in the questionnaire.

CVM is dependent upon respondents considering the scenario to be realistic (Whittington, 1996).

While a useful tool in some cases, CVM has its share of shortcomings. Among them is the fundamental difference in the way that people value market goods and public environmental goods (Diamond & Hausman, 1994; Gowdy, 1997; O'Doherty, 1996); people's inexperience with valuing public environmental goods (Bateman & Willis, 1999; O'Doherty, 1996); and people's aversion to placing a dollar value on nature (Gowdy, 1997; Vatn & Bromley, 1994). Also, human perception of the value of an ecosystem may not reflect the actual biotic contribution (Gowdy, 1997; Vatn & Bromley, 1994); and people's value of an environmental good may not adjust according to the scale of the scenario, known as *scale bias*, (i.e. one whale saved vs. a herd of whales saved)(Arrow et al., 2001; Gowdy, 1997). In addition, CVM is susceptible to numerous sources of bias and error relating to the payment vehicle, strategic behavior, and lack of awareness on the subject (Bateman, Langford, & Rasbah, 1999; Bateman & Willis, 1999; Gowdy, 1997; O'Doherty, 1996).

Despite its criticisms, CVM has been defended by proponents as a solution to "environmental managerialism" because it offers the public a voice in public policy decisions, engaging them in a structured dialogue with experts and decision-makers (Blore, 1996). Active participation by the respondents is a primary facet of CVM, which is a hypothetical direct-valuation technique (O'Doherty, 1996). When some proposed policy change will produce an environmental effect, those benefiting or suffering from the change are asked directly, via survey or questionnaire, their WTP to

prevent environmental degradation or improve environmental quality. Therefore, the *process* of CVM, rather than simply the results, is valuable to decision-makers.

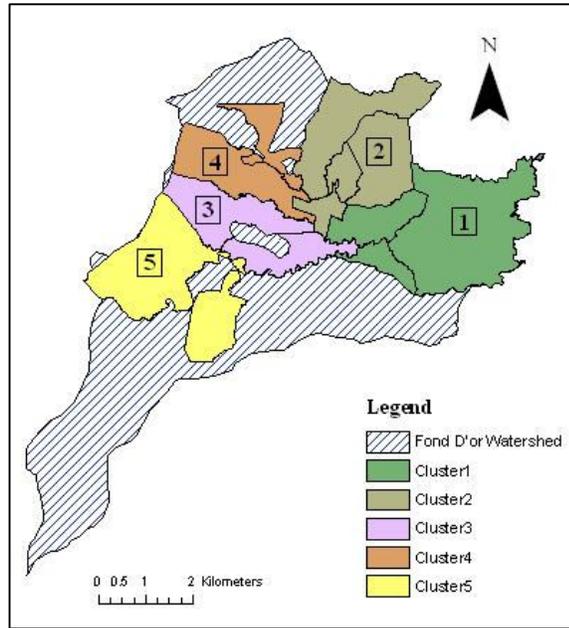
CVM focuses on forecasted behavior before the environmental change occurs, rather than other methods that measure behavior after the change. This can be of use to policy makers who will be evaluating the costs and benefits of various alternatives that will cause changes in welfare (O'Doherty, 1996). Public attitudes to risk are at the core of many environmental issues and risk is built into the framework of CVM (Blore, 1996). CVM may be one way of exploring the limits to risk acceptance of those that ultimately pay and the results are essentially a useful expression of attitudes towards public goods or a proposed policy (Diamond & Hausman, 1994). Again, the process of CVM is a valuable contribution in and of itself.

While researchers typically use CVM to estimate non-use values of ecosystems or estimate the damage to natural ecosystems, the household surveys in the Fond D'or watershed estimated WTP in order to understand the potential household contribution to an economic incentive program for reforestation. Asking people to contribute to program development is *not* estimating non-use values (Blore, 1996). In this case, we did not use CMV to estimate the monetary value of water quality or the upland ecosystem structure that provides the services that affect water quality. Therefore, this CVM application was not susceptible to the myriad of aforementioned criticisms of the typical use of CVM.

## **2.4 Survey Methods and Descriptive Findings**

We developed the household surveys utilizing CVM in the fall of 2007 at the University of Vermont. The surveys underwent several rounds of revisions after careful review by survey experts at UVM as well as by IWCAM project partners in Saint Lucia.

We paired UVM students from the service-learning course with volunteers from the Ministry of Agriculture, Forestry, and Fisheries of Saint Lucia and provided training in proper survey administration technique. The survey teams delivered the surveys to five community groups in the Fond D'or watershed (Figure 2.1, Table 2.1) in January 2008. Surveys lasted an average of 10 to 15 minutes and included both closed-form and open-ended questions related to their domestic water source(s) and uses, water availability and WTP an additional amount on their monthly water bill to support reforestation efforts in the watershed. In addition, we asked respondents about their satisfaction with the quality and quantity of the drinking water they received, as well as their opinions on the status of drinking water in the valley, and if the cost of their water service was fair for the quality and quantity of water they received. Survey administrator teams collected demographic information at the end of the interview.



**Figure 2 2: Location of community groups in the Fond D'or watershed**

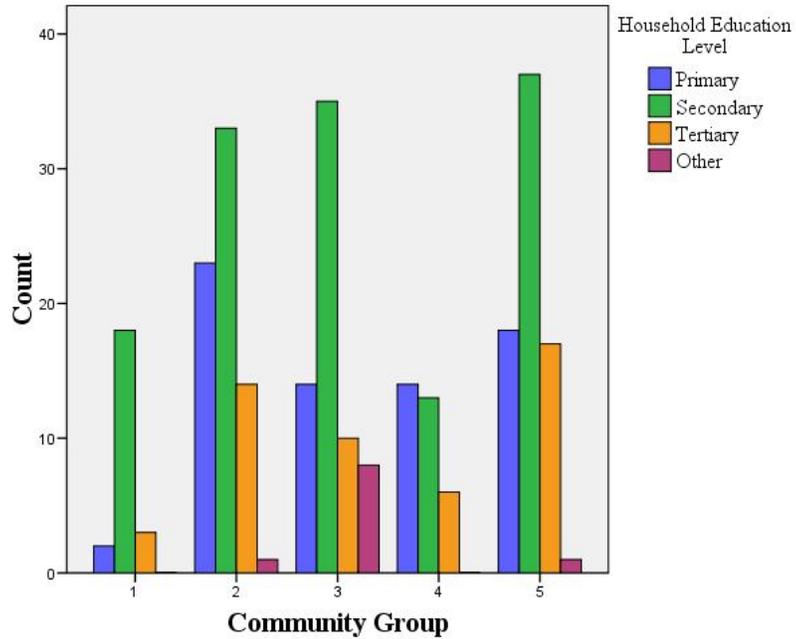
**Table 2.1: Communities by group in the Fond D'or watershed**

<b>Group</b>	<b>Communities</b>	<b>N</b>
1	La Caye, Lumiere, LaPelle	31
2	AuxLyon, Gadette, LaRessources, Despinoz	76
3	Deniere Riviere, Belmont	70
4	RichFond, Grande Ravine	41
5	Grande Riviere, Mornpanache, Debonaire, Thomazo	76

We collected 294 surveys for a 95% confidence level. Sixty-seven percent of respondents were female, with a mean age of 44 years. Because we conducted the surveys during the workweek between the hours of 10:00 a.m and 3:00 p.m, the majority of the people encountered during that period were women working in the home, which explains the high percentage of female respondents. We also encountered

a high number of retirees and elderly due to the time of day in which survey delivery occurred.

The mean family size was 4; this number is higher than the mean family size of 3 recorded in the most recent national census (St. Lucia Government Statistics Department, 2001). The majority of survey respondents reported a monthly income of less than EC \$1000 (\$375 US) which is consistent with the 2001 Saint Lucian national average of EC \$927 per month. Half of the respondents' households contain at least one person who had completed a secondary education; 19% of households contain at least one person who had some college education but no degree. Figure 2.3 displays the highest education level attained by a member of a household by community group. Fifty-eight percent of households listed three or more domestic uses of water (i.e. shower, flush toilet, washing machine, and/or garden). Thirty-two percent of respondents reported that at least one member of their household is employed in an agricultural occupation.



**Figure 2. 3: Household education levels by community group**

### **Water Sources and Uses**

In order to obtain a list of household water sources, we asked respondents whether they use one or more of the following water supplies in their home: piped water from WASCO, rainwater collected in storage tanks, water obtained from a river, creek, or stream, bottled water, or another source. Other sources of water that we recorded were public water taps (not available in every community) and trucks that deliver water from public taps, springs, or the river. Several respondents mentioned that they acquire water from a neighbor or family member; we were unable to determine the reason for this, however, we assume that those households are not connected to WASCO services.

We asked respondents to indicate their main water sources for the following uses: cooking, cleaning, bathing, drinking, laundry, garden (if applicable), or other household

water uses. Respondents named WASCO as the main water supply for each of the activities listed. However, due to the infrequent supply of piped WASCO water, we found that respondents generally rely on a combination of sources to meet their water needs. For cooking, cleaning, bathing, and laundry the proportion of respondents using solely WASCO water is roughly 60%; those using a combination of WASCO and collected rainwater is 30%; the remaining 10% of respondents use some other combination of rainwater, springwater, or purchase bottled water. Households with kitchen gardens rely mainly on natural precipitation; however, 75% of respondents indicate that they use WASCO water on their gardens occasionally. Only 21% of residents rely solely on WASCO water for their drinking water, while 30% purchase bottle water in addition to WASCO water; 14% use a combination of WASCO water and collected rainwater. Fourteen percent of respondents drink only bottled water and 23% use a combination of rainwater, springwater, or purchase bottled water. Two percent of respondents indicated that they boil and/or filter tap water prior to consumption.

### **Water Quality**

When we asked their opinion on whether there is a problem with drinking water in the valley, the overwhelming majority of respondents (92%) stated that there is a problem. When we asked them to identify the cause of the problem, 28% remarked on the generally poor quality of the water; 25% attributed the problem to management (WASCO or the government); 19% attributed the problem to faulty water infrastructure such as pipes or water tanks; respondents also mentioned weather and seasonal

shortages as possible causes. When we asked who should be responsible for addressing problems with drinking water in the valley, the majority (85%) responded that the government and/or WASCO should be responsible for addressing the problem.

We asked respondents to rate their satisfaction with the quality of the water they receive from WASCO and 22% responded that they are either *highly satisfied* or *satisfied*. Thirty-five percent reported that the quality of water they receive is suitable for household needs and 13% believe that the cost of WASCO service is fair for the quality that they receive. We asked respondents to describe the quality of the water from the tap; common responses were “dirty,” “brown” in color, “silty,” or having “sediment” due to a lack of a “filtration system.” Many also reported that the water is particularly dirty during and after rain events. Descriptions of a “bad taste,” “funny smell,” worms, and algae in the water were common. Equally common were reports of a bitter taste of food due to over-chlorination. One respondent said that the “purity of the water is doubtful” because he/she is aware of the environmental conditions near the water intake. Another respondent went as far as to say, “[the water] is not fit for consumption.”

### **Water Quantity**

When asked to rate their satisfaction with the quantity of the water they receive from WASCO, 26% of respondents indicated that they are *highly satisfied* or *satisfied*. When asked whether the amount of water they receive is sufficient for their household needs, 36% responded “yes” and 33% believe that the cost of WASCO service is fair for the water quantity they receive.

Respondent satisfaction levels indicate that water quantity is less of a problem than water quality in some communities. While we were unable to conclude the cause of this disparity, a reasonable assumption is that the placement of each community in the watershed (Figure 2.2) and the condition of the water infrastructure in a particular community each plays a role in varying water quantity. Some communities, or groups of dwellings, are located on slopes in the upper watershed, whereas others are positioned on the flats of the mid-to-lower watershed. Several respondents mentioned that they do not have a problem with quantity because they live in a flat area where the water pipes converge. Some respondents in the upper watershed mentioned that even though they live within sight of the WASCO water tank, they do not receive water frequently.

To support our assumption that the condition of water infrastructure varies by community, one community reported having water meters recently installed and the community members had observed the meter needles spinning sporadically. Residents of this community group reported that their water charges increased following the installation of the meters while their usage had not altered. Although anecdotal, this suggests that the condition of the water infrastructure and WASCO's management presence may vary in each community.

When we asked respondents to describe the quantity of water, we frequently heard comments on the timing of water availability, that it is "not reliable", "not regular", that it comes for "five minutes and is gone" or is only available "late at night" between the hours of "11 p.m. and 5 a.m." or "9 p.m. and 5 a.m." Descriptions of water

availability varied; some respondents stated that they did not receive water for days’ at a time; others reported going weeks without water in the tap. Respondents commented that the amount of water typically received is “not enough to do house chores” and that the stream of water coming from the tap is only a “trickle” so it takes “half an hour to fill a bucket.” Other respondents said that there is not enough water to use their sinks and/or flush toilets, or to have a “good shower.”

When asked if there are certain times of year when they do not have enough water, 89% of respondents said “yes.” Because Saint Lucia relies solely on rainfall for freshwater supplies, we expected water shortages occur primarily during the dry season. However, 41% reported shortages during the rainy season and 32% reported shortages during the dry season. Based on descriptions of water quality collected, it is common knowledge in the communities that WASCO shuts off the water pipes during monsoon season to prevent mud from running through the pipes. Due to a lack of water during the dry season and lack of water service during the rainy season, 27% of respondents reported shortages year-round. Table 2.2 summarizes respondents’ opinions on water quality, quantity, and seasonal shortages.

**Table2.1: Summary of respondents' opinions on water quality, quantity, and water shortages**

Water supply sufficient	Water quality suitable	Satisfaction		Water Shortage		
		Quality	Quantity	Rainy Season	Dry Season	Year Round
35%	35%	22%	33%	41%	32%	27%

### **Willingness-to-pay for reforestation**

We presented the WTP question to respondents in a double-dichotomous question format. The scenario read to respondents went:

“Healthy forests provide many public benefits; forests provide consistent water supply, flood and drought control and wildlife habitat. A program is being considered for forest re-growth in the Fond D’or watershed. In this program, several acres of land would be [taken out of agriculture production and] reforested upstream to protect a clean source of water for future use. I would like to remind you that this program does not currently exist; we are gathering this information to be used in developing programs for water service improvement.”

After reading the scenario, we asked respondents “Would you be willing to pay an additional amount on your monthly water bill to support a program that reforests land upstream to protect a water source?” to which they answered “yes” or “no”. If a respondent answered “yes”, we took them through a series of bids levels that increased by an amount of EC \$1.50, which is 10% of the EC \$15 (\$5.72 US) reported to be WASCO's minimum monthly charge (IWCAM, 2008). The bid levels were EC \$1.50, 3.00, 4.50, 6.00, 7.50, 9.00, 10.50, 12.00, 13.50, and 15.00. Respondents answered “yes” or “no” to each bid level; their maximum WTP was taken to be the amount to which they answered “no.” If a respondent said they were willing to pay the highest bid level of EC \$15, we asked if they would be WTP *more* than \$15.00 EC. If they

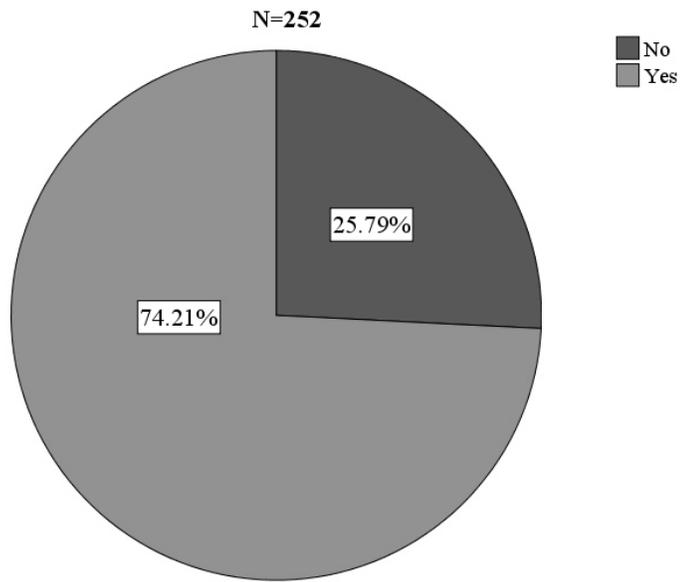
responded “yes,” we elicited an exact value of maximum WTP through an open-ended question.

While the majority of respondents believe that WASCO or the government should be responsible for addressing water problems in the valley, 74% of respondents indicated that they are willing to pay an extra amount on their monthly water bill to support a watershed reforestation program (Figure 2.4). We calculated the mean WTP per household for the hypothetical reforestation scenario to be EC \$4.88<sup>1</sup> per month (\$1.84 US). Figure 2.5 summarizes respondents’ WTP for the hypothetical reforestation program presented to them in the survey. In addition to WTP, 94% of respondents think that farmers should be compensated for participating in a program that requires them to take land out of production for reforestation.

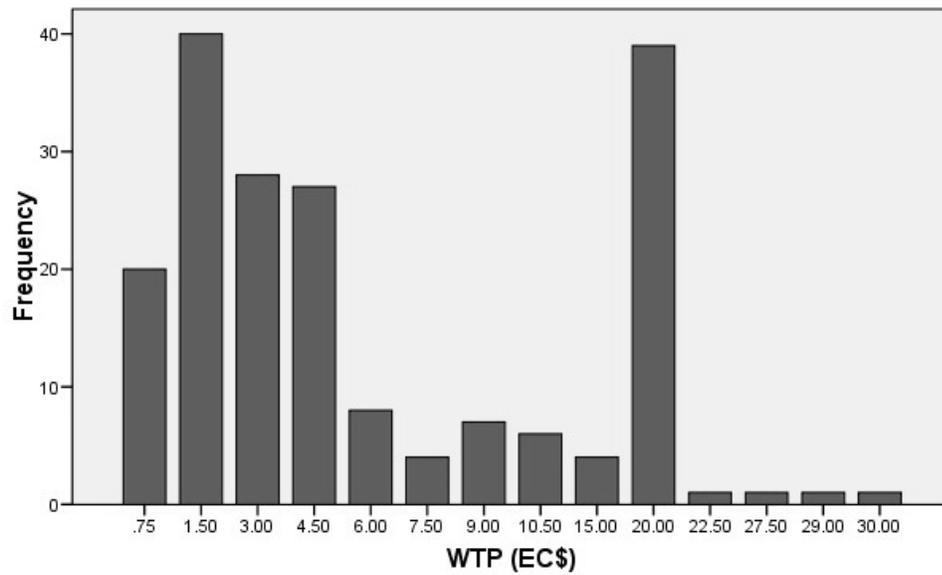
Seventy-one percent of respondents reported that they pay their monthly water bill to WASCO. Of the 29% that do not currently pay their water bill, many explained in responses to follow-up questions that they ceased paying their bill because they felt they should not pay for something that they do not receive. Respondents also commented that water fees continue to rise while the number of days a week or month that they receive water continues to fall. While we had previously been told that EC \$15 is the minimum monthly water charge, the survey revealed that water charges range broadly from EC \$7 to EC \$350 per month with a mean of EC \$32.52 (\$12.46 US).

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<sup>1</sup> One U.S. dollar is equal to \$2.65 Eastern Caribbean (EC) dollars.



**Figure 2. 4: Percent of respondents willing to pay extra to support a reforestation program**



**Figure 2.5: Amount respondents are willing to pay (per month) to support a hypothetical reforestation program**

## **2.5 Analysis of Survey Data**

I performed statistical analyses to understand more fully the willingness of residents of the Fond D'or watershed to pay for reforestation of the watershed with improved water quality being one of many potential environmental benefits, based on their economic, demographic, and opinion/attitudinal profile. I believe that the survey responses provide an indication of residents' support for environmental programs that seek to improve the condition of the watershed, particularly in terms of its ability to provide a consistent flow of clean water. Such information might be of value to the IWCAM program as well as to Saint Lucian policy makers when considering a course of action to address pressing environmental and social issues. The survey responses also provide a monetary estimate of household WTP for reforestation that can be considered a potential financing source for environmental improvement programs in the Fond D'or watershed.

## **2.6 Results**

I performed bivariate analyses on household water sources, water uses, and satisfaction with current water services. The bivariate analysis of the binary WTP variable yielded only two significant variables: water suitable for household needs ( $p=.028$ ,  $\chi^2=4.842$ ) and whether a respondent resides in community group 3 ( $p=.026$ ,  $\chi^2=4.958$ ). These results suggest that a respondent's WTP is a factor of their opinions regarding the suitability of the water they receive from WASCO and residence specific to community group 3. While literature suggests that WTP is a product of demographic

characteristics including age, gender, and socioeconomic factors—higher education and income levels will lead to increased WTP—we cannot confidently assert that education ( $p=.264$ ,  $\chi^2=3.976$ ) or income ( $p=.199$ ,  $\chi^2=15.834$ ) are factors influencing WTP among the residents of the Fond D’or watershed.

Bivariate analyses of the binary community group variables reveal that residence in a particular community group significantly influences several attitudinal/opinion variables. Residents in community group 1 are more satisfied with their water quality than other community groups ( $p=.006$ ,  $\chi^2=7.426$ ), while residents in community group 2 ( $p=.010$ ,  $\chi^2=6.714$ ) and community group 3 ( $p=.001$ ,  $\chi^2=10.586$ ) are more satisfied with their water quantity than other community groups. More residents in community group 1 believe that the water is suitable for their household needs ( $p=.002$ ,  $\chi^2=9.241$ ), while more residents in community group 2 ( $p=.004$ ,  $\chi^2=8.258$ ) believe that the water *is not* suitable for their needs. Lastly, a higher proportion of residents in community group 3 pay their monthly water bill ( $p=.000$ ,  $\chi^2=15.400$ ) than do residents of other community groups, while a significantly smaller proportion (54%) of residents in community group 5 pay their bill ( $p=.001$ ,  $\chi^2=10.770$ ).

For the 47 respondents willing-to-pay the highest bid amount of EC \$15 (\$5.68 US), or more than EC \$15, residence in community group 3 was the prominent factor ( $p=.039$ ,  $\chi^2=4.273$ ). A higher proportion of those 47 respondents reside in community group 3 than in other community groups. For the respondents residing within community group 3, significant characteristics are education ( $p=.000$ ,  $\chi^2=17.850$ ), satisfaction with water quantity ( $p=.001$ ,  $\chi^2=10.586$ ), and whether or not they pay their

WASCO water bill ( $p=.000$ ,  $\chi^2=15.400$ ). While the overall education level of residents in community group 3 is consistent with that of other community groups (Figure 2.2), a higher number of residents in community group 3 reported having an education “other” than a primary, secondary, or tertiary education. Twelve percent of respondents in community group 3 had “other” education compared with less than 2% in the other four community groups. Ninety percent of residents in community group 3 pay their monthly water bill compared to 50% in community group 1, 71% in community group 2, 75% in community group 4, and 54% in community group 5 ( $p=.001$ ,  $\chi^2=10.770$ ). These results suggest that a more education and regular payment of the water bill by the residents of community group 3 may play a factor in their higher WTP.

## **2.7 Discussion and Limitations**

The analysis of survey data presented here suggests that WTP by residents in the Fond D’or watershed is a factor of their attitudes and opinions about current water quality and quantity rather than demographic variables such as ability-to-pay. Water quality and quantity appear to vary by location in the watershed with water infrastructure and WASCO management presence. Therefore, residence in a particular community group likely influences opinions on water quality and quantity.

Residents of the communities of group 3 are willing-to-pay the highest bid level of EC \$15 or higher, more than residents from other community groups. While education was not determined to be an influential factor of overall WTP, education is a significant characteristic of community group 3: residents of community group 3 have a

larger proportion of non-traditional education than other community groups. While I cannot conclusively attribute the higher level of WTP to the higher rate of non-traditional education, it is certainly a defining characteristic of the community group. A failure in the survey instrument's ability to precisely capture a respondent's WTP beyond the highest bid level could also explain the high proportion of residents in community group 3 that was willing-to-pay EC \$15 or more. The open-ended question after the last bid levels left room for error.

I was unable to perform further statistical analysis due an incomplete data set. The data was collected as part of a project for an undergraduate-level service-learning course and while students were given training in proper survey administration techniques, for many it was their first experience in a foreign country or working in the field in a foreign country. Inconsistencies in data collection resulted in large amounts of missing data. While the process of service learning was the primary goal of the course, the data collected as a result contains valuable information. This research, being exploratory in nature, provides insight into the current condition of drinking water in the Fond D'or watershed and residents' attitudes towards potential environmental improvement programs. Anecdotal evidence from the surveys reveals that the condition of drinking water is a highly controversial issue in the communities and, overall, residents have an unfavorable view of WASCO. Despite negative feelings towards WASCO and the general belief that WASCO or the government should be responsible for addressing the current water situation, the majority of respondents are willing-to-pay to support reforestation programs. When interpreting the WTP estimate, it is

important to remember that self-reported WTP often differs from revealed, or actual, WTP (Verhoef & Franses, 2002). By responding that they are WTP, respondents are not committing to an actual payment. Due to the inability of many respondents to detach the hypothetical reforestation scenario from the need for water infrastructure improvement, the mean WTP calculated is not an exact estimate for reforestation efforts. Additionally, as it is unclear whether there is a penalty for residents who do not pay their water bill, it is not possible to predict whether an increase in water users' fees will cause more people to cease paying their bill.

Studies have repeatedly revealed that stated WTP significantly exceeds revealed WTP (Goldar & Misra, 2001; Kealy, Dovidio, & Rockel, 1988; Loomis, Brown, Lucero, & Peterson, 1996; Neill, Cummings, Ganderton, Harrison, & McGuckin, 1994; Reynolds, 2007). While the disparity between stated WTP and revealed WTP varies depending on the commodity being valued and the study design, 50% is a common over-estimate. Adjusting for this differential, the potential annual contribution from an increase in water users' fees is approximately EC \$1,000,000 or \$400,000 US.

To compare this figure to one of the costs of water treatment in Saint Lucia, a previous UVM study conducted in the Talvan watershed of Saint Lucia in 2007 estimated that the annual cost of using PAX-18, a chemical that increases the settling rate of sediment, plus labor costs, is \$27,891 US (adjusted from 2006 USD) or EC \$73,074 (Alkire, Kerchner, Sadoff, & Skaskiw, 2007). Sedimentation has other costs as well; the cleaning of silt-laden screens at water treatment facilities results in the loss of approximately 120,000 gallons of treated water per week (Alkire et al., 2007). If

treatment costs are similar in the Fond D'or watershed, these figures demonstrates that improved upstream land management practices in conjunction with reforestation could significantly reduce sedimentation and downstream wastewater treatment costs of using PAX-18, as well as a decrease in the loss of treated water. Reduced siltation in the pipes would also potentially decrease the number of days in the rainy season in which water treatment facilities shut down, positively impacting water availability for residents. The current cost of wastewater treatment is 7% of the potential annual contribution from an increase in water users' fees; this shows that a minimal investment of these funds would see a large decrease in the costs of wastewater treatment and treated water losses.

### **2.8.1 Sources of Error**

In addition to limitations associated with self-reported WTP, the survey was susceptible to various sources of error including information-based error, respondent-based error, and researcher-based error. Information-based error pertains to how the information was provided by the administrator and how it was received by the respondent and the potential for error to occur during the exchange (O'Doherty, 1996). How the information was provided and how it was received determines if the answers given reflect what the researcher seeks and, ultimately, establishes the accuracy of the data. The amount of information provided in the hypothetical WTP scenario was paramount to the scenario being believable, but also presented a risk in that lengthy descriptions tend to result in respondent tedium and faulty responses (Bateman & Willis, 1999; O'Doherty, 1996).

What type of information provided—whether “positive” or “negative” information (this is entirely subjective) — determines how the information is received and then used in the valuation process. We provided “positive” slanting information about forest ecosystem services in the hypothetical scenario because the target population’s level of knowledge about ecosystems and the services they provide was unknown. In this case, we used the CVM scenario as an educational tool to increase awareness about ecosystem services in addition to being a tool to elicit WTP. In an effort to be concise, we withheld information about economic impacts of removing agricultural activities from the watershed and necessary alterations to current water infrastructure.

Another possible source of respondent-based error is strategic behavior. Strategic behavior depends on the perceived payment obligation and probability of good provision (O'Doherty, 1996). People may over- or underestimate in hopes of securing good provision, or enjoying continued provision, at a low price. The strategic underestimation of WTP in the hopes of gaining a public-funded benefit for which the respondent truly has a higher WTP than stated is known as ‘free-riding’ (Bateman et al., 1999). The majority of respondent ‘free-riders’ will give a small undervaluation while a few anti-free-riders will give large overvaluations (O'Doherty, 1996). It is possible to counteract strategic behavior by telling the respondent that the sample size is smaller than it really is so that the respondent feels that his/her response will have a great effect and also by telling the respondent that the provision of the good is dependent on revealed WTP (O'Doherty, 1996). We do not perceive strategic behavior to be a threat

to the validity of the survey findings presented here. The payment vehicle utilized in hypothetical scenario was that of an additional fee tacked on to water users' fees. Since the collection of water fees currently occurs and the majority of the respondents pay their water bill, the opportunity to free ride was limited.

Another source of respondent-based error arises from inexperience with valuing public goods. Household survey respondents oftentimes seemed confused by the increasing dollar bid amounts in the second level of the double-dichotomous WTP questions. It appears that respondents felt that by indicating that they were willing to pay some amount, they had "agreed" to one amount and the agreement was reneged when they were asked to pay another, higher amount. To address this, we told respondents prior to beginning the bidding process that they would be presented with a series of dollar amounts and they were to indicate when the amount was beyond their means or inclination to pay. Some respondents were not WTP because they felt like the government should provide water services or that they already pay a fee to WASCO, so they should not have to pay any additional amount.

It is also possible that respondents' preferences were simply a reaction to the foreign survey administrators. Respondents are able to sense what the survey administrator "wants" and may say that they are willing-to-pay more for a good than they really are (Bateman & Willis, 1999). We introduced the survey as a means to gather information about water; the fact that foreign researchers were conducting the surveys could have been interpreted as outside assistance to an assumed problem. If respondents thought that by participating in the survey their problems might be

addressed, they might be more likely to tell the administrator what they think they want to hear. Appropriate control for this in face-to-face interactions is to offer “irrelevant” information rather than zero information (Bateman & Willis, 1999). Dichotomous questions are also better than open-ended questions to lessen this effect (O’Doherty, 1996). These effects on the household survey were likely minimized because the survey consisted mostly of dichotomous questions and provided relatively neutral information. Additionally, UVM student researchers were accompanied in the field by local Saint Lucian residents who provided important cultural and language services; the presence of Saint Lucian assistants may have also mitigated the effects of the foreign researchers on survey responses.

Scale bias was not a concern for this application of CVM. We did not ask respondents to differentiate their WTP for different levels of water purity or forest protection. The scenario was vague in regards to the amount of forest necessary to maintain or improve water quality and as a result, we did not ask respondents to value 1 hectare of forest versus 100 hectares; they were simply asked their WTP to contribute to an overall reforestation program.

Lastly, because many of the respondents view WASCO with skepticism and mistrust, the payment vehicle proposed in the hypothetical scenario may have affected their WTP. The scenario postured that the hypothetical reforestation program would be funded by affixing an additional amount on the monthly water utility bill. Survey administrators stressed that that an additional fee would not go to WASCO, but rather to the farmers to fund reforestation efforts near water sources. Despite this clarification,

it may have been difficult for respondents to agree to such a proposition, especially if they do not currently pay their water bill or have strong opinions regarding WASCO and its operations. This demonstrates that respondents do not value a change in environmental service provision in isolation of the wider policy context; the true measure of value includes attitudes towards the payment vehicle as part of the wider policy context (O'Doherty, 1996).

### **2.8.2 CVM and PES**

One of the goals of the CVM survey in the Fond D'or watershed was to estimate WTP in order to conduct a valuation of the demand for reforestation with the goal of improved water quality. These findings illustrate household demand for environmental improvements that may increase water quality: 74% of households are willing-to-pay to receive the potential benefits of reforestation. In addition, valuation can be used to identify potential financing sources for conservation interventions, to secure sufficient funds at any given time as well as to make financing self-sustaining into the future. This research estimates the potential PES financing source offered by household contributions at EC \$1,000,000 or \$400,000 US annually.

Household WTP, or household demand, is one piece of information needed to understand how to apply economic incentives properly. However, finding the necessary WTP within less affluent communities oftentimes poses a significant challenge; the ability of poor downstream users to pay for upstream environmental service protection is usually low (Robertson & Wunder, 2005). Supply-side valuation is another piece critical to PES, perhaps even more so than demand-side valuation (Pagiola et al., 2004).

For farmers or landowners, the foregone benefits of alternative land uses—opportunity costs—estimate the supply side of providing ecosystem services, particularly water filtration services, by protecting existing forests or targeting areas for reforestation. Agricultural land use in the Fond D’or watershed consists mostly of banana and other fruit tree plantations and root crops like yam and dasheen. According to recent national data compiled by the Saint Lucia Ministry of Agriculture, the annual opportunity cost per acre of yams and dasheen is EC \$32,418 (\$12,142 US). Conducting supply-side and demand-side valuation will help set an appropriate payment level so that the payment exceeds the benefit from the next best alternative land use (or behavior won’t change) and less than the value to downstream users (or they won’t pay).

### **2.8.3 CVM as an Educational Tool**

Diamond (1994) indicates that people may not be aware of their preferences for public environmental goods prior to being queried. Thus, respondents will actually form preferences during the valuation process. In this way CVM is an important educational tool, helping people define and understand their attitudes and preferences towards the environment (Vatn & Bromley, 1994). We selected the information provided in the CVM scenario of the household survey as a tool to communicate the benefits provided by natural ecosystems. This effort towards public education is important for policy considerations where public welfare could be affected.

## **2.8 Conclusions and Recommendations**

The results of the contingent valuation survey in the Fond D'or watershed reveal a high demand (WTP) for environmental improvements at the household level. Seventy-four percent of residents in the Fond D'or watershed are willing-to-pay for these improvements; an average WTP of EC \$4.88 per household per month was calculated, amounting to EC \$1,000,000 or \$400,000 US annually. Household WTP represents one possible funding source for financing a PES mechanism in the watershed. While valuation helps to build a case for a payment mechanism, final prices agreed upon will reflect the costs and benefits to the stakeholders.

There does not appear to be a major problem with scale bias, hypothetical bias, or strategic behavior with this application of CVM. However, it is not possible to predict whether individuals, if asked, would pay the amount they indicated in the survey. Since most of the residents pay their monthly water bill to WASCO and indicate support for the hypothetical increase in users' fees, it seems that if WASCO were to institute a flat rate increase for all water users for environmental improvement efforts, there would likely be public support. This is important for public policy makers and the managers of the IWCAM project as they evaluate the costs and benefits of various alternatives that will affect residents in the watershed. However, due to the varying condition of water infrastructure within the communities, infrastructure improvement is a necessary part of such a program and concerted efforts on behalf of WASCO may improve their image and reputation within the communities, which may ultimately increase support for reforestation of the watershed.

To better assess the feasibility of a PES scheme in the Fond D'or watershed, I recommend future research to quantify the biophysical nature of ecosystem services in the watershed. For water quality, this means understanding the source(s), nature, and flow of the service as well as the land use thought to deliver the desired services. Next, I recommend that further valuation studies be conducted to understand the costs of service provision. This will entail inquiring into landowners, or service providers', willingness-to-accept (WTA) compensation and attitudes towards participation in a program, as well as the opportunity costs of taking land out of production for reforestation. Calculating the opportunity costs of participation and WTA is a critical piece to assessing the feasibility of a PES mechanism. We estimated the opportunity cost for agricultural land in root crops, but further estimation of opportunity costs of other agricultural land uses is needed. While household WTP represents one potential financing mechanism for a PES scheme, other potential mechanisms should also be explored. This includes other private payment mechanisms through tourism, hydroelectric or water bottling operations, and public payment mechanisms.

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**CHAPTER 3: A METHODOLOGICAL APPROACH TO CONSTRUCTING  
PAYMENTS FOR ECOSYSTEM SERVICES IN THE FOND D'OR  
WATERSHED, SAINT LUCIA**

**3.1 Introduction**

A key conclusion of the Millenium Ecosystem Assessment (MA) is that global ecosystems—forests, coral reefs, wetlands, and other ecosystems—have been severely degraded and, without intervention, will further deteriorate. This conclusion has serious implications to humans who benefit from ecosystem goods and services, which are the ecosystem functions that are of importance to our well-being and survival (Daly & Farley, 2004). Most of us recognize that ecosystems provide raw materials that fuel economic production of the goods that we purchase in the marketplace. Less recognizable are the services delivered through ecosystem processes such as flood control, waste absorption, nutrient cycling, water, and air purification, etc. Many of these services are public goods and, therefore, lie outside the realm of the economic marketplace. This means that markets generally reward resource extraction for economic production while failing to reward the conservation of ecosystem structure for the provision of public ecosystem services. Rising populations, unsustainable rates of consumption, and continued neglect have increased the scarcity of ecosystem services around the globe.

In response to these market failures, governments often step in on behalf of the public to provide ecosystem services through various policy approaches. These policy

approaches can be condensed into the “5 P’s”: *prescription*, *penalties*, *persuasion*, *property rights*, and *payment* (Salzman, 2005). While each policy approach has an application for specific services, and socio-political contexts, *payment* is a promising option for developing nations where prescription via regulatory command-and-control measures have failed, in part, because the governments lack the human and economic resources to enforce rules regarding the use of a resource.

The regulation of the hydrological cycle for the provision of potable water is a common application of the payment policy option, commonly known as payments for ecosystem services (PES). These instruments provide incentives for private landowners to provide ecosystem services through the protection of ecosystem structure, thereby making conservation a more attractive option. We can see examples of successful applications of this tool for drinking water provision in parts of the developing world, particularly in Latin America and the Caribbean, as well as in the developed world. Drinking water for some of the world’s largest cities is currently being provided through PES or PES-like mechanisms, demonstrating that investing in natural capital makes economic and policy sense (Salzman, 2005).

Small Island Developing States (SIDS) share a unique set of sustainable development challenges due to their small size, topography, and relative isolation (Reynolds, DeSisto, Murray, & Kolodinsky, 2007; Tompkins et al., 2005). A significant challenge that SIDS face, is the management of water resources—*access* to freshwater resources being of primary concern (Cosgrove & Rijsberman, no date). Natural factors, a low degree of governance resulting in weak water policies, along

with limited institutional developments, all contribute to declining quality and quantity of freshwater in many SIDS (Kumar, 2005).

Freshwater resources is an important national issue on the Caribbean island of Saint Lucia where water scarcity in rural areas during the dry season has reached critical capacity (Ministry of Physical Development Environment and Housing, 2004; Ministry of Planning Development Environment and Housing, 2001). Population growth, internal migration, and infrastructure development all contribute to rising water demand on the island. Without groundwater reserves, Saint Luica is completely dependent on rainfall for freshwater supplies. However, due to its steep topography and volcanic terrain, rain events cause high levels of run-off, sedimentation, erosion, gully formation, and landslides. A lack of natural catchments for water collection and storage for treated water compounds the challenge for the government to supply freshwater to communities.

Saint Lucia's unreliable water supply can be attributed not only to geologic and topographic constraints but also to institutional weaknesses in Saint Lucia's water sector. Poor financial performance, operational efficiency, and low capital investment are currently overwhelming the water sector (Financial Private Sector and Infrastructure Department & Caribbean Country Management Unit, 2001). These natural and institutional factors interact with human activities at the watershed-level, further exacerbating environmental quality, thereby affecting water quality for downstream water users.

The current state of the water sector is detrimental not only to the health and welfare of Saint Lucia's citizens, but also to the island's economic development, which is strongly linked to its competitive edge as a tourism destination. Agribusiness, formerly Saint Lucia's primary component of Gross Domestic Product (GDP) has declined from 15% in 1990 to 5% in 2003, while tourism has assumed the role as principal contributor to the island's economy (Sustainable Development Department & Caribbean Country Management Unit, 2007). The water and sanitation sector has emerged as a key limiting factor in realizing this development potential; access to basic services by developers and hoteliers is hindering their interest in investing in the island. The future of the Caribbean islands, the health and well-being of their populations, is dependent on a new, integrated approach to watershed management (UNDP-GEF IWCAM, 2005). Prescription has been the traditional approach to solving environmental problems; payments represent a promising new approach.

Successful *prescription* through command-and-control mechanisms is determined by a country's governmental and regulatory infrastructure, along with the nature of the environmental problem (Harrington & Morgenstern, 2004). Many regulatory approaches have failed in past 20 years, particularly in the developing world, because the governments generally lack the resources to mandate and proscribe behaviors, monitor compliance, and penalize those who do not comply. Employing *penalties* is a financial approach to altering behavior by making certain activities more expensive through taxes or fees (Salzman, 2005). As with prescription, a certain level of governmental and institutional capacity is necessary to enforce penalties. Where the

punishable activities are closely linked to livelihoods and the means to pay is not there, penalties will not be an effective or just approach to environmental protection. *Persuasion* is an approach that utilizes information and public education to encourage a certain land ethic; persuasion is, in essence, self-regulation. While public education about ecosystem services is a critical piece of any environmental policy approach, without other economic alternatives, persuasion alone will not be sufficient for influencing landowners to achieve environmental goals. The privatization and allocation of access to a resource through *property rights* is not the appropriate solution for solving the freshwater crisis in the Caribbean. Freshwater is not the “tragedy of the commons” as with an open-access resource where the creation of property rights where they do not exist is a solution. The issue of freshwater in Saint Lucia is one of influencing private land use decisions—in other words, altering existing property rights—for the provision of ecosystem services, which proves to be more difficult.

Of the “5 P’s,” *payment* appears to be an effective and feasible approach to watershed management. Payments provide an incentive to landowners to manage their land in a particular way for the delivery of desired ecosystem goods and services for public benefit. PES mechanisms represent an integrated approach and a potential solution to the unique environmental problems that concern SIDS.

### **3.2 Goal**

The goal of this paper is to present payments as a policy option for the managers of the Integrated Water and Coastal Areas Management (IWCAM) program

in Saint Lucia to improve water quality in the Fond D'or watershed. I begin by describing the current state of freshwater in the Caribbean and the need for an innovative approach to protecting watershed ecosystem services. I then present a methodological approach to designing a payment mechanism, discussing the elements of the approach in the institutional and political context of Saint Lucia. Throughout the paper, I explore some of the opportunities and challenges associated with developing a watershed PES scheme and conclude with recommendations for the policy makers of Saint Lucia.

### **3.3 Background**

#### **3.3.1 Watershed Ecosystem Services**

John Wesley Powell described a watershed as "that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community" (EPA, 2007). Due to the natural boundaries it creates, the watershed has become an appropriate unit within which to manage water resources and land uses that influence the quality and quantity of those resources.

Watershed services are the benefits that humans derive from the watershed: the plant and animal biodiversity, as well as the goods and services that contribute to human welfare provided by the groups of ecosystems within the watershed (Smith, De Groot, & Bergkamp, 2006). Watersheds provide a variety of ecosystem services—provisioning, regulatory, supporting, and cultural/amenity services—in one setting and

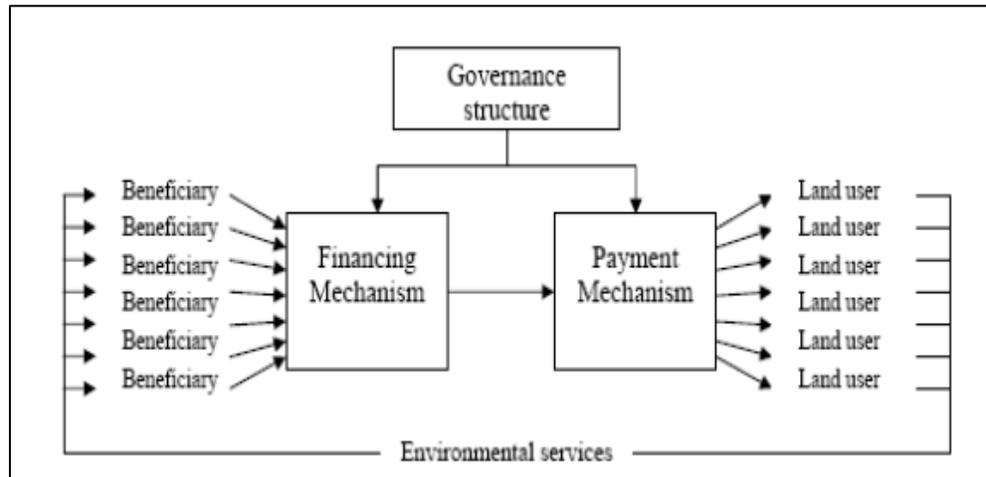
land users upstream determine the flow and quality of ecosystem services available to downstream beneficiaries. By regarding humans as beneficiaries of those ecosystem services there is enormous potential for protecting the ecosystems that provide those services (Brauman, Daily, Duarte, & Mooney, 2007). Through the lens of the ecosystem services framework, we can unite conservation and development by correlating environmental health to human health, security, and material goods necessary for well-being.

Tackling SIDS' current water quality and availability issues at the watershed scale through the ecosystem services framework is a logical approach because so many ecosystem processes are interlinked at the watershed level.

### **3.3.2 Payments for Ecosystem Services**

PES mechanisms are an innovative direct approach to the conservation and improvement of ecosystem service provision. PES mechanisms facilitate a transaction between service buyers (beneficiaries) and sellers (providers) (Figure 3.1) that, theoretically, leads to larger social economic efficiency (Corbera, Brown, & Adger, 2007; Kosoy, Martinez-Tuna, Muradian, & Martinez-Alier, 2005). Particularly in parts of the developing world where livelihoods are closely linked to ecosystem goods and services and regulation through command-and-control conservation measures have proved unsuccessful, PES mechanisms are promising tools for altering land use behaviors that degrade the environment while promoting livelihoods (Kosoy et al., 2005). A payment by downstream beneficiaries can help align land users' incentives

with those of society by making conservation a more attractive option to upstream service providers (Pagiola, Arcenas, & Platais, 2005).



From: Pagiola, 2003.

**Figure 3. 1: Institutions, stakeholders, and the flow of payments in a PES mechanism**

PES is not a ‘silver bullet’ to solving current environmental and social problems; it is an appropriate tool only within a specific context and set of local conditions (Waage, Scherr, Jenkins, & Inbar, 2006). While it is impractical to duplicate a successful PES mechanism and apply it to another context, key lessons can be drawn from established PES programs and provide a set of considerations for designing a PES scheme in another context (Rosa, Kandel, & Dimas, 2003).

Almost thirty percent of the world’s largest cities depend on forested watersheds for their water supply (Scherr, White, Khare, Inbar, & Molnar, 2004). As water demand is expected to double, even triple, in the next fifty years, especially in developing countries, the prospect for increased demand and increased payment for

watershed services is vast (Scherr et al., 2004). Examples of mechanisms based on the principles of PES have emerged from the field in recent years, particularly in Latin America and the Caribbean (Pagiola, von Ritter, & Bishop, 2004). Costa Rica's national *pagos por servicios ambientales*—payment for environmental services or PSA—program is one example that is partially funded through a tax on fuel sales and GEF grants, whereas local or regional watershed PES schemes are funded through water users' fees. Similarly, Ecuador relies on voluntary payments by water users to supply FONAG, its water fund (Echavarría, 2002; Landell-Mills & Porras, 2002); New York City water users' compensate upstream rural agricultural communities for management practices that provide clean drinking water (Landell-Mills & Porras, 2002); Brazil allocates revenues from a sales tax to support the integrated management of the Rio Ribeira de Iguape Watershed in São Paulo (May, Neto, Denardin, & Loureiro, 2002; Rosa et al., 2003). In Mexico's PES for hydrological services program, the state makes payments as incentives to individuals and communities in over-exploited watersheds for forest preservation (Alix-García et al., 2005); and several of Bolivia's PES-type systems for watershed protection have been spearheaded by non-governmental organizations (NGOs) and funded through a combination of fees, taxes, and trusts (Robertson & Wunder, 2005).

In Saint Lucia, the private, but currently state-owned Water and Sewage Company, Inc (WASCO) provides drinking water, for which residents pay a monthly fee. Despite efforts to reform the water sector, WASCO's current income does not cover the costs of water production and protection and current operations continue to be

plagued by a legacy of low rates and inadequate infrastructure (Geoghegan, Krishnarayan, Pantin, & Bass, 2003). A lack of human and financial resources has left the state unable to address these problems effectively. Given the obstacles that governments face in providing ecosystem services for their citizens, other policy mechanisms should be examined, including payment mechanisms (Whitten, Salzman, Shelton, & Proctor, 2003).

### **3.4 Methodological Approach to Establishing PES**

Given the recent emergence of PES schemes for hydrological services around the globe, lessons drawn from these examples have contributed to the generation of a method for determining the feasibility of this approach in a specific context. Here I discuss the approach in terms of the Fond D'or watershed of Saint Lucia.

#### **3.4.1 Identify the ecosystem service and target conservation areas**

Before considering the design of a payment mechanism, we must first classify the desired ecosystem service(s) and the land use best thought to deliver the service(s) in order to prioritize sites for conservation. Biophysical assessments will aid in identifying water sources and measuring the flow and storage capacity. During the assessment, it is important to take into account water sources in relation to the placement of current water infrastructure such as tanks or catchments. Next, identify the land use or uses thought to best enhance or protect the provision of the desired ecosystem services. What degree of change is required to meet the target land use? Will

it require full reforestation of the site or adoption of environmentally friendly agricultural techniques such as agroforestry? Performance-based payments is a method in which landowners are rewarded for the degree of land use adopted, tailoring the payment to reflect the different ecosystem services provided by varying land uses.

Watersheds are recognized contributors of important watershed services, but translating this understanding into action on the ground is difficult (Smith et al., 2006). First, the biophysical links between a specific land use and the ecosystem service outcomes may be unclear, especially in tropical forested watersheds. This has resulted in the emergence of myths regarding the forest-water linkage and policies based on those myths (Robertson & Wunder, 2005). For example, one commonly accepted myth is that forest cover, compared to other vegetative cover, will always increase run-off. In actuality, forest cover usually decreases run-off more than agricultural crops, but trees may increase groundwater recharge. The result is that considerable scientific doubts surround biophysical linkages, and many of them are extremely complex and dependent on site-specific conditions.

One notion at the core of the “traditional” role of forests is the “sponge” effect of the tree roots, leaf litter, and soil (Myers, 1983; Spears, 1982). The hydrological community long believed that trees act like sponges during wet periods, soaking up water and then releasing it during dry periods. This concept came under scrutiny in the early 1980’s and was followed by a heated debate on the hydrological role of forests (Bruijnzeel, 2004). Many of the underlying assumptions about the links between water and forests were debunked during the birth of a new and more “scientific” view of

tropical forest functioning. However, some important patterns generally hold true. The first being that water quality is easier to define, quantify, and measure than water quantity (Forest Trends, The Katoomba Group, & UNEP, 2008). Generally true is that the clearing of tropical forest cover will initially increase annual water yield, with maximum yield being reached at total clearing (Bruijnzeel, 2004; Forest Trends et al., 2008). While water yield increases, a decrease in forest cover can lead to a reduction in rainfall infiltration resulting in strong declines in dry season flows. Another principle is that reforestation and soil conservation efforts can reduce peak flows and stormflows. Because landslides and mass wasting tend to occur more frequently in non-forested areas, it is commonly stated that good plant cover can generally prevent surface erosion and well-developed tree cover may reduce susceptibility for landslides (Bruijnzeel, 2004; Forest Trends et al., 2008; Idol, 2003). The caveat to each of these principles is that local conditions—plant species, soil types, topography, and geology—will determine to what extent these main principles hold true at a specific site.

To understand the biophysical linkages between land use and hydrological functions, a full-scale assessment of hydrologic functions in the Fond D'or watershed may be necessary while a less technical assessment may also suffice. If researchers deem technical assessments necessary, these assessments could be costly or require additional researchers or specialists. Even when the biophysical links are clear, it is still questionable whether or not a particular land use practice will deliver the hypothesized benefits over time (Waage et al., 2006). In spite of this, the dynamic nature of forest ecosystems is not an obstruction to successfully targeting conservation efforts. Rather,

the PES design process can incorporate the variable nature of ecosystem functions for more effective results.

*Additionality* is one of the principles of PES that requires knowledge of land use, before and after program implementation. Additionality is an indicator of the efficacy of a PES scheme by defining a baseline so that the effect of a PES can be measured in relation to that baseline (Wunder, 2005). In theory, a PES should prompt the desired change in land use; the change would not have occurred under a business-as-usual scenario or without the incentive provided in the PES mechanism. Ideally, the payment scheme should target farmers not currently managing their lands in the environmentally-friendly manner assumed to provide the desired ecosystem service because additionally can be easily established (Alpizar, 2008).

Additionality can be difficult to determine because of the complex nature of ecosystems; a change in land management might not yield immediate effects or other ecosystem components could be shaping the processes that are the end goal of a desired land use. If a landowner is managing in a way that provides the desired ecosystem services prior to the implementation of the PES scheme, we cannot establish additionality even though the environmental goals are being met. Since additionality is a requirement for participation in a PES transaction, those landowners would not be rewarded for their efforts to provide the ecosystem services even though they have been providing the services without compensation. The additionality requirement might offer perverse incentives for these landowners to change their land use or management to less-than-ideal practices in order to be eligible for the program. In this case,

additionality seems to be an ill-suited measure of efficacy and social equity in terms of attaining environmental goals. A valid approach to a payment scheme is a combination of payments to farmers to initiate the desired land use and payments to farmers to maintain provision of the service (Alpizar, 2008). Incorporating the dynamic nature of ecosystems into the PES design process is beneficial to determining additionality because natural variation can be built into the baseline measure.

*Conditionality* is another principle of PES that can be more challenging to meet than additionality (Wunder, 2005). The conditionality principle states that the payment is made only if the service is delivered. Determining conditionality requires close monitoring and requires that the payments are truly contingent on service delivery, typically resulting in periodic payments rather than up-front payments or good-faith payments (Robertson & Wunder, 2005). Because ecosystem services are delivered temporally as well as spatially, they can be difficult to quantify and measure; even when it is possible to measure them, services may not be delivered for several years in a tropical reforestation scenario. This business-like aspect of PES has caused some resistance to adoption of PES schemes and the majority of existing payment schemes are determined to be *PES-like* initiatives due to the lack of conditionality (Wunder, 2005).

Performance-based payments assuage some of the challenges associated with additionality and conditionality because the level of payment is determined by land use practices and the costs of implementing a certain land use. With this type of payment scheme, landowners are rewarded for the degree of conservation land use adopted.

Payments for conversion to a land use ideal for providing hydrological services will differ from payments to maintain a land use currently providing the same services because the costs associated with realizing those land uses vary. This practice establishes a direct connection between land use, investment, and payment.

In the Fond D'or watershed, the first step to implementing a payment scheme is to perform land use and hydrological assessments, whether technical or informal. After classifying the desired land use or uses and determining the feasibility of converting parts of the watershed to that land use, we can then prioritize areas for conservation. Priority conservation areas might be those nearest to water sources, particularly degraded portions of the watershed, or land where agricultural practices are having a considerable effect on water quality. The next step is to work with the farmers or landowners of these sites to understand the costs of service provision and their willingness-to-accept (WTA) compensation for removing agriculture or shifting land use near water sources.

### **3.4.2 Estimating the costs of service provision**

Landowners make land use decisions regarding the net benefits of one land use and the net costs of switching to another land use. The costs of ecosystem service provision are the costs associated with implementing the ideal land use (the land use best thought to deliver the desired ecosystem services), known as implementation costs, and opportunity costs, which are the foregone benefits of the alternative land use. Implementation costs will vary depending on the change in land use necessary to

achieve the desired land use—full land use conversion or partial land use conversion. Full land use conversion, will have higher implementation costs if the desired land use is radically different from the original land use and requires proactive measures, such as the tilling of soil or planting of trees in a former slash-and-burn agriculture setting. Afforestation of land previously used for slash-and-burn agriculture will also have high opportunity costs because of the inevitable loss of income from crop production.

In the first step, we investigate the biophysical links between current agricultural land use and water service provision, identify an ideal land use that will improve service delivery, and locate sites for conservation. Before estimating implementation and opportunity costs, we will have an idea of the scale of land use change necessary to achieve the ideal land use. Partial land use change may involve adoption of an agroforestry system or full land use conversion may mean the removal of crops for natural or active reforestation of the site.

Agricultural land use in the Fond D’or watershed consists mostly of banana and other fruit tree plantations and root crops like yam and dasheen. According to recent national data compiled by the Saint Lucia Ministry of Agriculture, the annual opportunity cost per acre of yams and dasheen is EC \$32,418 (\$12,142 US) (Table 3.1). Data on agricultural land under banana production was not available; therefore, the opportunity cost for banana plantations is undetermined.

**Table 3.1: Opportunity cost of agricultural land producing yam and dasheen**

<b>Item/Operation</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Prices</b>	<b>Total Cost</b>
Land Clearing	Man Days	8	50	400
Ploughing	Man Days	15	50	750
Planting Material Preparation	Man Days	2	50	100
Planting	Man Days	8	50	400
Fertilizing	Man Days	6	50	300
Weed Control	Man Days	35	50	1750
Pest and Disease Control	Man Days	4	50	200
Harvesting Days	Man Days	8	50	400
Treating and Storing	Man Days	2	50	100
Transportation	Trips	3	80	240
Fertilizer	Bags	30	90	2700
Lime	Bags	10	30	300
Planting Material	Plants	6969	0.3	2090.7
<b>TOTAL</b>				<b>9730.7</b>
Marketing yields	Lbs.	18150	1.25	22687.5
<b>PROFIT (per acre)</b>				<b>EC \$32,418.2 or \$ 12,141.65 US</b>

While a recent UVM research project sought to understand household support for a PES mechanism in the Fond D'or watershed, farmer, and landowner attitudes towards participation in a PES mechanism and their WTA compensation remains undetermined. This piece of information is critical for determining the feasibility of implementing PES. Participation in a PES is voluntary; as a result, the success of the strategy relies on participation and WTA.

Knowing the opportunity cost for alternative land uses will help determine which groups should be given priority as service sellers in the negotiation of a payment scheme (Smith et al., 2006). Payment schemes in Brazil and Costa Rica reveal that the opportunity cost of livestock farmers exceeds the maximum willingness-to-pay (WTP) of downstream service buyers, whereas the opportunity cost to the agricultural sector is more comparable to potential payments. In this case, there is little economic

justification to involve the livestock farmers in a payment program unless other objectives, such as social equity, take precedence. Comparing the opportunity costs can provide insight into the negotiation of a fair price that will influence behavior of those groups willing to participate (Smith et al., 2006). However, supply-side and demand-side valuation is not always necessary to negotiate a price; any mutually agreed upon price can be the "right price" for the parties (Wunder, 2005).

#### **3.4.2.1 Land Tenure**

The opportunity for farmers to participate in payment programs is limited where land tenure is uncertain. In fact, insecure land tenure is the primary barrier to the implementation of incentives for watershed services in developing nations (Ferraro & Kiss, 2002; Landell-Mills & Porras, 2002). Clearly established property rights, whether through formal or customary law, are the foundation of payment program for watershed services (Smith et al., 2006). Clear property rights, as well as water access and use rights, make it possible to negotiate contracts, monitor, and enforce those contracts (Smith et al., 2006).

The 1973/74 Saint Lucia agricultural census indicated that 70.6% of all landholdings were "owned or held in ownerlike possession" and no less than 92.6% of agricultural land was under such holding, indicating a reasonably stable agricultural sector (OAS, 2005). Landholders who rent were nearly 50% of all in the Dennery district, within which the Fond D'or watershed is located. More recent literature discusses Saint Lucia's "family-land" system, which dominates agricultural land tenure with 52% of the agricultural land area under that form of tenure (GOSL, 2003; Vargas,

2002). Family land is a form of communal ownership among members of a family wherein an undefined number of heirs hold share in the land without physical division of the property among members (GOSL, 2003; Vargas, 2002). Advantages of the family land system are equal access to the land, flexibility in land use, and non-monetary welfare benefits (GOSL, 2003). This system also creates constraints for social mobility and empowerment in rural areas in the case of disputes or where collateral, in the form of land, is necessary to obtain credit. This type of ownership may be an obstacle to conservation or the adoption of best agricultural practices. It presents a challenge to designing a payment program; with a number of legal owners, it may pose difficult to identify a particular party to enter into a contract with. It will also be challenging if the parties do not agree on the future management of the land.

Other recent trends in land tenure in Saint Lucia that may impact the feasibility of a payment program is land speculation that drives up land prices beyond what the productivity of the land justifies, and the continued fragmentation of small parcels (GOSL, 2003). Another phenomenon is distorted land distribution whereby 93% of all farmers control only 24% of the land and 0.17% of farmers—mostly absentee owners—control 50% of land available for cultivation. Working with absentee landowners may pose a challenge, but may be necessary since they own half of the cultivable land.

If there are many landholders with small parcels, a payment program may necessitate a number of them be involved in order to achieve the conservation goals of the targeted areas identified in step one. A high number of service “sellers” will

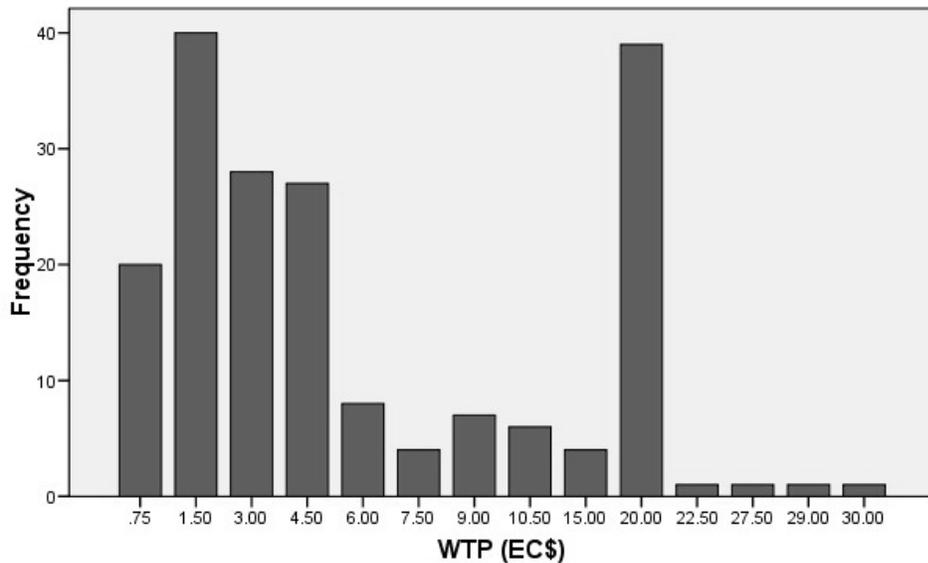
increase transaction costs, reducing the efficiency of the payment transaction. This problem can be reduced by grouping small landholders together into associations or cooperatives where a representative may negotiate on behalf of the group and, in turn, arrange individual contracts with group members (Smith et al., 2006). Sub-contracting such as this will require special care; it can be difficult to monitor compliance from everyone and a contract may be at risk where one member fails to comply.

While it seems that much of land in Saint Lucia is under some type of stable land tenure, each type of land tenure will require a different logistical approach to the payment strategy. Investigating land tenure particular to the farmers in the Fond D'or watershed is an important component of understanding the feasibility of a payment mechanism.

### **3.4.3 Estimating demand for ecosystem services**

In order to establish an incentive mechanism, we must recognize the goods and services provided by the watershed as assets with a price. Demand for those assets can be determined by identifying clear beneficiaries and for each group of beneficiaries, estimating their maximum WTP. Beneficiaries include stakeholders from the public and private sector and the local, regional, and global scale: residents of the watershed, hydropower producers, water bottling companies, farmer or irrigator groups, and the tourism industry to name a few. Once beneficiaries at all scales have been identified, we must determine which group has the greatest incentive to pay for the alteration of landowners' decisions (Pearce & Moran, 1994).

Researchers from the University of Vermont (UVM) used the contingent valuation method (CVM) to investigate household WTP in a study conducted in January 2008. The surveys presented respondents with a hypothetical payment scheme in which an additional fee on a household's monthly water bill be allocated to farmers for reforestation of the upper watershed around water sources; respondent WTP was estimated through a series of dichotomous questions containing increasing payment levels. The results of the survey reveal a positive attitude towards a reforestation program with improved water quality being one potential benefit; 74% of households were willing-to-pay an additional amount on their water bill to support a reforestation program, with mean household WTP estimated at EC \$4.88 (\$1.84 US) per month. Figure 3.1 illustrates the highest amount that households are willing-to-pay.



**Figure 3. 2: Household WTP**

Repeated studies reveal that stated WTP significantly exceeds actual WTP (Goldar & Misra, 2001; Kealy, Dovidio, & Rockel, 1988; Loomis, Brown, Lucero, & Peterson, 1996; Neill, Cummings, Ganderton, Harrison, & McGuckin, 1994; Reynolds, 2007). While the disparity between stated WTP and actual WTP varies depending on the commodity being valued and the study design, 50% is a common over-estimate. After adjusting for this differential, the annual contribution to a conservation payment program through an increase in water users' fees for the approximate 3,000 households (Saint Lucia Government Statistics Department, 2001) in the watershed is roughly EC \$1,000,000 or \$400,000 US. While households represent one potential funding source for a payment mechanism, other sources exist. I discuss alternative arrangements in the financial mechanism section.

The hypothetical scenario in the household survey utilized WASCO as a broker between the buyers (residents) and the sellers (farmers). This type of arrangement is an example of a *monopsony*, where an organization acts as a single buyer on behalf of many buyers, and is common to many watershed PES schemes because it is more efficient when there are many buyers and sellers of the service. In other arrangements, as in the scenario, maximum WTP for each group of beneficiaries must be determined. A price can then be politically negotiated between the buyers and sellers; the price (payments) must be enough to cover the costs of adopting the land use but should be smaller than aggregated WTP (Alpizar, 2008).

#### **3.4.4. Financial mechanism**

A variety of financing options are available to support a payment mechanism, as demonstrated by payment schemes around the world. In Costa Rica, a regional scheme in the Heredia watershed uses a system where water users pay an environmental fee on their water bill to the Heredia Public Service Enterprise (ESPH), a private water utility through public concession. ESPH created PROCUENCAS, a program to administer the transfer of funds directly to landowners to adopt sustainable land management practices (International Institute for Environment and Development, 2007; Smith et al., 2006). Colombia instituted new taxes to fund its PES initiative. Similarly, Costa Rica uses a fuel tax, in addition to international grants and loans, to fund its national program for the provision of four ecosystem services, whereas in Brazil, the state transfers funds collected through a sales tax to the municipalities based on the size and quality of their conservation areas (Wunder, 2005). These examples demonstrate that a variety of arrangements is possible; it is a matter of which arrangement or arrangements are the most feasible and will provide a sustainable source of funding given local conditions in the Fond D'or watershed.

#### **3.4.4.1 Private payment scheme-water users**

The UVM household WTP survey investigated the potential for financing the PES mechanism through an increase in water users' fees and discovered that the majority of residents were willing to pay. The scenario used the government (WASCO) as a broker between the buyers and sellers, collecting fees from water users (buyers); fees imposed by water-based enterprises (e.g. water suppliers, hydroelectric companies) is an approach currently used in New York City, Romania, Costa Rica, and Brazil

(Landell-Mills & Porras, 2002). These schemes are examples of monopsonies. Where transaction costs are high and there are many buyers and sellers, *monosopic* schemes—a single buyer—are common and most efficient (Wunder, 2005). In the case of the multiplicity of services produced by a watershed, there exists the potential for a great number of buyers and sellers and, therefore, high transaction costs. A hydroelectric company, brewery, water bottling company, or tourism operator are examples of potential buyers in a monopsonic scheme for the ecosystem services provided by a watershed. Where transaction costs are high, keeping buyers and sellers to a minimum might be the most appropriate option (Wunder, 2005).

Another approach where there are many buyers is the concept of *pooling demand*. Water users in Quito, Ecuador and outlying areas pay different rates for water depending on whether or not they extract (International Institute for Environment and Development, 2007). This includes farmers, domestic water users, hydroelectric companies, tourism operators, and industrial water users. Others involved are private corporations (a brewery and electricity producer) and the national government (irrigation project). The benefit of pooling demand for services that have a diversity of beneficiaries at different scales is that there are more potential financing sources for conservation interventions, the ability to secure sufficient funds at any given time is increased, as well as the likelihood of making financing self-sustaining into the future.

#### **3.4.4.2 Private payment scheme-tourism**

Revenues from tourism are another source of financing for a payment program. A contingent valuation survey aimed at Saint Lucia tourists conducted by UVM

researchers in January 2008 reveals that the majority of vacationers on the island are willing to contribute to one or more policy measures intended to improve the condition of watersheds and coastlines: 1) exit tax; 2) park entrance fees; and/or 3) a rooms and meals tax. Examples from the Caribbean demonstrate that tourism is a sustainable source of conservation financing. Belize allocates \$3.75 US from an airport departure tax to the Protected Areas Conservation Trust and a 20% commission on cruise ship passenger fees (Belize Tourism Industry Association, 2007); meanwhile, the Turks and Caicos designate 1% of a 9% hotel tax to support the maintenance and protection of the island's protected areas (Spergel, 2001). Fees targeting users of marine resources—boats, yachts, divers—are used to finance protection of the Rhone Marine Park in the British Virgin Islands, Saba Marine Park in The Netherlands Antilles, and Pigeon Island National Historic Park and the Soufriere Marine Management Area, both in Saint Lucia (Geoghegan, 1998). A study in the Turks and Caicos indicated that high fees can be sustained if the marine site is comprised of high quality coral reefs (Lindberg, 2001).

Reinforcing the importance of healthy coastal ecosystems to the tourism industry and to Saint Lucia's economy, a recent study by the World Resources Institute (WRI) found that one-quarter of Saint Lucia's tourists dive or snorkel during their visit; the resulting contribution to the national economy has been estimated at US \$91 million (Burke, Greenhalgh, Prager, & Cooper, 2008). Additionally, WRI estimates that satisfaction derived above what tourists paid is US \$2.3 million. The economic importance of reef ecosystems to the national economy is clear, not only for tourism

but for local resident use—estimated to be between US \$52 and \$109 million. Given SIDS’ unique topography that directly links ridges to reefs, the IWCAM approach is not only essential to alleviating negative impacts to coastal areas from upstream activities, the funds allocated for watershed improvement have a great chance of positively impacting reef ecosystems. Tourism, Saint Lucia’s primary economic activity represents a larger financial contribution to a payment mechanism than do domestic water users, with increased likelihood of being a self-sustaining financing mechanism.

#### **3.4.4.3 Public payment schemes**

The Government of Saint Lucia is also a potential source of funding for a payment mechanism. Such a program could be of interest to the government because potable water is an issue of public importance and has direct impacts on public health and labor productivity (Alpizar, 2008). A recent report by the World Health Organization (WHO) supports this, asserting that the economic return of investing in drinking water and sanitation is 10-fold (Pruss-Ustun, Bos, Gore, & Bartram, 2008). Some of the global benefits of this investment would be health care savings of US \$7 billion for agencies and US \$340 million for individuals; 320 productive days gained each year for people between the ages of 15-59 years, resulting in productivity gains of US \$9.9 billion a year. While these figures are global estimates, they illustrate that the economic returns from investing in drinking water and sanitation are great; individual

countries, such as Saint Lucia, would likely see returns for their own countrywide efforts.

With a government-funded health care program, such as in Saint Lucia, the costs of a PES mechanism could be considered a preventative health measure that will perhaps save money on state health care expenditures and increase labor productivity in the long run. According to WHO, the per capial expenditure on health care by the Government of Saint Lucia was 5.9% of GDP in 2005; total expenditure on health in 2005 was \$397 US; the government assumes 56.2% of the costs while individuals cover the remaining 43.8% (Pruss-Ustun et al., 2008; World Health Organization, 2005). Improvements to water quality may produce positive health benefits, thereby decreasing the government and individual expenditures on health.

A PES scheme might also be more cost-effective than constructing new water treatment facilities and infrastructure, the costs of which would be shouldered by WASCO. The New York City Water Authority implemented a rate increase to help fund several conservation programs—easements, reduced development rights, and other eco-friendly practices— in the Catskill and Delaware watersheds that provide the city with drinking water after determining that this to be more cost-effective than building a water treatment facility. The avoided infrastructure costs would have doubled the cost of water for NYC users; the city avoided \$4-6 billion US in infrastructure and \$300-500 million US in ongoing expenses (Langton, 2006).

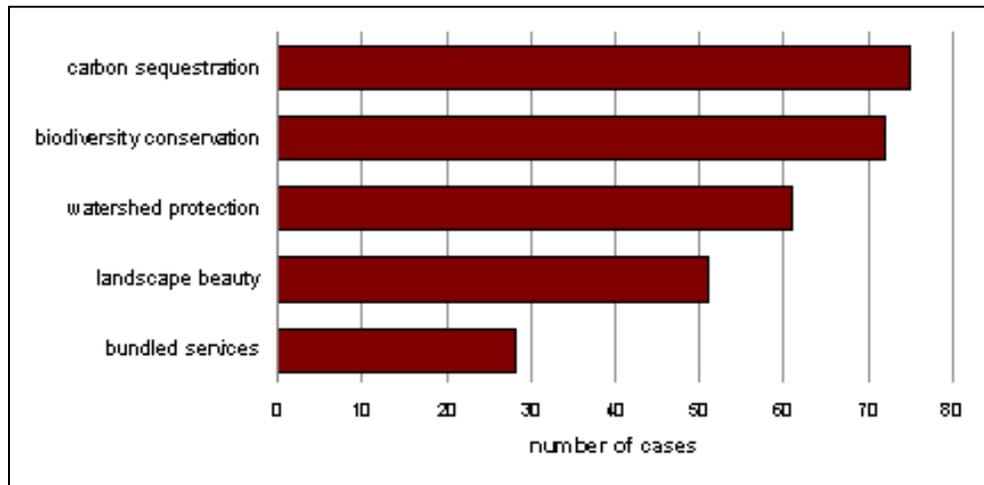
A 2007 UVM study conducted in the Talvan watershed of Saint Lucia estimated that the annual cost of using PAX-18, a chemical that increases the settling rate of

sediment, plus labor costs, is \$27, 891 US (adjusted from 2006 USD) or EC \$73,074 (Alkire, Kerchner, Sadoff, & Skaskiw, 2007). Sedimentation has other costs as well; the cleaning of silt-laden screens at water treatment facilities results in the loss of approximately 120,000 gallons of treated water per week (Alkire et al., 2007). Improved upstream land management practices in conjunction with reforestation could significantly reduce sedimentation and downstream wastewater treatment costs of using PAX-18, as well as a decrease in the loss of treated water. Reduced siltation in the pipes would also decrease the number of days in the rainy season in which water treatment facilities shut down, positively impacting water availability for residents.

#### **3.4.4.4 Bundled services**

Because tropical forested watersheds provide a multiplicity of ecosystem services and beneficiaries at a variety of geographic and temporal scales enjoy the flow of those services, a PES mechanism can facilitate a payment for a *bundle* of services, rather than a singular service. Bundling services is one way to ensure sustainable funding for a PES mechanism. It not only makes long-term fiscal sense for financing a PES mechanism, it reflects the fact that ecosystem services are frequently in joint production so that investment in the production of one service will often result in the simultaneous production of other services (Landell-Mills & Porras, 2002). Figure 3.3 illustrates the number of PES mechanisms in the forest sector for a variety of different ecosystem services, illustrating the opportunities to bundle similar services in a payment program.

Landell-Mills and Porras (2002) reviewed 28 cases of PES programs that provide bundled services; 11 of the cases are located in Latin America and the Caribbean. They found that 50% of the cases involved the bundling of two services with the most common pairing being carbon sequestration potential and biodiversity protection, 18% involved three services, and 29% involved four services. One example is Costa Rica’s national PSA which recognizes four services provided by forests: carbon, biodiversity, watershed protection, and landscape beauty (Landell-Mills & Porras, 2002). Annual payments to private forest owners in Costa Rica's PSA vary according to the activity adopted: reforestation (\$450 US/hectare), sustainable management of forest (\$320 US/hectare), and forest preservation (\$200 US/hectare).



From: Davis, 2008

**Figure 3. 3: PES programs in the forest sector by service.**

If the goal of implementing a payment mechanism in the Fond D’or watershed of Saint Lucia is to ensure that land stewards are compensated for the suite of services they provide, then the bundled approach makes the most sense. To provide a sense of

the value of some of the other ecosystem services provided by the Fond D'or watershed, the World Bank estimates that deforested tropical land used for pasture worth \$200-500 US per acre could be worth \$1,500-\$10,000 US if left in tact and used to offset carbon emissions of industrialized nations (Chomitz, 2007).

Tropical forests have value beyond their carbon sequestration potential: tropical forests most likely contain half of the world's biodiversity (Pearce, 2001). Islands, with a generally high degree of species endemism, play a vital role in supporting global biodiversity. Biodiversity serves different functions within an ecosystem—life support functions, production functions, carrier functions, and information functions (Nunes, Van Den Bergh, & Nijkamp, 2001). Therefore, the value of biodiversity differs depending on the function being valued and the valuation orientation: value of biodiversity to human welfare (anthropocentric) or intrinsic value (biocentric or ecocentric). While the total economic value of biodiversity is boundless, the more meaningful measure is *marginal economic value*, or the value per unit of land area, which may be small (Pearce, 2001). And as stated earlier, coral reef tourism accounts for direct and indirect economic impact totalling US\$ 160–194 million in St. Lucia (Burke et al., 2008). Together these values demonstrate that the ecosystem services provided by the Fond D'or watershed of Saint Lucia have a potentially high value and, therefore, we should consider a payment mechanism for bundled services.

#### **3.4.5 Legal and Institutional Framework**

Scale—institutional, political, and geographic—is an issue critical to PES mechanisms because we must identify and understand the resource flows, beneficiaries,

and the links between them; an institution of equal scale must then oversee the payments. This can be challenging because institutional capacity is generally smaller than a watershed, with the institutions typically residing in cities or towns *within* the watershed. Geographic scale is a challenge because many ecosystem services have beneficiaries at more than one scale—local, regional, and/or global. A spatial map that illustrates resource flows and links to beneficiaries at different scales will help to overcome this challenge. The biophysical scale for water purity is the watershed and while watersheds come in all shapes and sizes, they are generally distinct units of a local or regional extent. The Fond D’or watershed being one of seven major watersheds on Saint Lucia, an island nation 616 square kilometers in size, offers an opportunity for PES because of its limited size and scale.

Environmental problems do not reside within man-made political boundaries, and as a result, the institutional and political scale of a PES must match the scale of resource or conservation efforts (Alpizar, 2008; Salzman, 2005). Institutions, whether formal or informal, are necessary to oversee the payments. The institutions involved establish accountability and transparency for the mechanism; the stakeholders must be confident that the revenues flowing into a PES scheme are managed properly and are going to the anticipated use (Waage et al., 2006). Examples where PES mechanisms are effective or promising all exhibit strong institutional conditions. For developing countries, where governance is low and social and institutional developments are emerging, a functioning legal and institutional system for a payment mechanism may be difficult to realize (Kumar, 2005).

Direct upstream-downstream negotiations are the most straightforward way of negotiating payments for ecosystem services; however, these cases are rare and the use of brokers and intermediaries are common (Smith et al., 2006). At a minimum, the intermediary institution should be capable of reaching arrangements with service providers, monitor contracts, manage and disburse funds, determine whether conditionality has been met, and enforce penalties for violating the rules (Alpizar, 2008). The intermediary will seek to maximize downstream service buyers' demand by identifying sellers who will deliver the greatest improvement at the lowest cost (Smith et al., 2006). The supervisory institution must also consider possible perverse incentives during negotiations with service sellers and create arrangements to mitigate the potential negative effects of such incentives.

Every payment scheme must include measures for compliance and enforcement to ensure that all parties are fulfilling their agreed-to obligations (Smith et al., 2006). The intermediary must conduct monitoring to assess compliance in a way that is neutral and transparent. For a payment scheme to be credible the powers of enforcement must be clearly designated in the legal framework and there must be disincentives for non-complying parties (Smith et al., 2006). In the San Juan de Pimampiro, Ecuador, a national NGO, the Ecological Foundation for the Development of Renewable Natural Resources (CEDERENA), is undertaking a pilot payment program to construct incentives for farmers to conserve forests (Smith et al., 2006). Landowners who violate their contract initially have their payment suspended for a quarter; subsequent violations lead to suspensions and, eventually, exclusion from the program.

If there are a significant number of stakeholders, the transaction costs will be high. High transaction costs limit access to the program by deterring small landholders from becoming involved (Pagiola et al., 2005). In this case, effective intermediaries are necessary to limit the transaction costs for all parties involved (Waage et al., 2006). Effective intermediaries are those that can act as honest brokers, local NGOs or community groups that work locally and are known and trusted by the stakeholders (Smith et al., 2006). Local governments, water utilities or water boards usually have the financial and technical capacity and the legal authority to act as intermediaries (Alpizar, 2008). Relying on established institutions will help keep transaction costs at a minimum. As mentioned earlier, a monopsonic scheme is generally most efficient where there are many buyers and sellers of the service, and is common in PES schemes around the world.

While the author's knowledge of existing Saint Lucian institutions is limited, there are several known groups in the Fond D'or watershed that could potentially serve as intermediaries between the buyers and sellers of the service, oversee the transactions, distribute payments, and monitor and enforce the contract. The IWCAM office (locally known as the Mabouya Valley Development Committee) is a familiar and well-regarded group within the watershed communities. The Mabouya Valley Development Committee has organized a local watershed committee composed of representatives from each community. This watershed committee is currently undertaking a pilot rainwater harvesting project (IWCAM, 2008); this project serves to potentially raise awareness about the group and gain momentum for future watershed protection

projects. The watershed committee representatives are local community members that could serve as monitoring and enforcement agents for the agreement. The members are local and accountable to the public, which will help create a sense of social obligation to adhere to the norms set out in the agreement. Lastly, it is crucial to involve WASCO in the design and implementation of a payment mechanism. Up until now, WASCO has refrained from collaborating with the IWCAM project. Current water infrastructure is in need of improvements and the beneficiaries of a PES scheme will not fully receive the water quality benefits of the PES scheme without properly maintained infrastructure. Most importantly, WASCO has the legal and financial capacity to act as a broker in a payment transaction; monthly collection of water fees is in effect, making WASCO the most logical choice for an intermediary. Evidence from UVM's household WTP survey reveals strong opinions regarding WASCO and a general distrust of WASCO among the communities in the Fond D'or watershed. Public support and trust could be a barrier to success if using WASCO as an intermediary in a payment scheme.

An institutional analysis in the Fond D'or watershed will increase understanding of existing institutional capacity, interest, and influence, while helping negotiators decide which parties need to be involved in the payment scheme and in which roles (Smith et al., 2006). The institutional analysis will identify how institutions link to, and influence, buyers and sellers of watershed services and highlight alterations to the institutional structure needed for a payment scheme to function properly. Negotiators will address gaps in the institutional framework identified during the analysis prior to implementing a payment scheme. This may result in the emergence of new institutions

or groups. In Colombia, downstream water users ascertained that institutions were not able to effectively address their interests in the protection of watershed services; as a result, they created water users' associations to encourage watershed management (Smith et al., 2006). In Costa Rica's national payment scheme for watershed services, participation of a private hydropower company is made possible by a set of institutions that link landowners and consumers; each institution plays a specific role in the structure of the payment scheme (Smith et al., 2006).

### **3.5 Conclusion and Recommendation**

This article submits that payments are a potential policy approach for the IWCAM program in Saint Lucia while acknowledging the site- and context-specific nature of PES and the challenges and limitations associated with this approach. This article outlines the essential steps to creating a payment scheme; the establishment of a successful payment scheme will require that these steps be taken in a logical and consistent manner. Generally, it is the responsibility of the intermediary organizations to coordinate the recommended actions, building upon each step to create an organized scheme. Throughout, managers should remain focused on the creation of incentives that will change the behavior of landowners whose actions affect watershed services. Managers must also engage stakeholders throughout the process, working together to shift priorities, appraise the outcomes, and adapt efforts if needed. Smith et al. (2006) refers to this as a "social learning process."

For the IWCAM program in the Fond D'or watershed of Saint Lucia, best bets for developing a payment mechanism involve developing a local or regional transaction for water quality, utilizing existing institutions with the technical and financial resources and political will to act as intermediaries. This will increase the efficiency of the transaction and legitimacy of the program. We should compare and consider arrangements between different groups of buyers and sellers for their respective transaction and opportunity costs, as well as the likelihood for sustainable financing. We must also investigate other causes of market failure, such as local capacity and willingness to participate, prior to implementation. Stakeholder involvement and environmental awareness are also key components to the process.

The bottom line is that potable water is of importance to human well-being; some even consider access to clean water a human right. While PES programs are promising measures for the provision of hydrological services in the developing world, the reality is that existing market failures, fragmented water utilities, and deteriorating water infrastructure are barriers to implementing successful schemes.

In summary, I recommend the following steps to further examine the feasibility of a payment mechanism in the Fond D'or watershed:

1. Gather biophysical information on water quality and land use impacts on water quality; delineate the ideal land use(s) that have been determined to deliver the ecosystem services of interest.
2. Prioritize sites for conservation; priority should be given to areas that have the potential to provide ecosystem services but are not currently being

managed in a way to provide the ecosystem services of interest. Farmers currently using best practices on their land should also be included to maintain service provision and to avoid perverse incentives.

3. Identify and map beneficiaries spatially to include the local, regional, and global scales. These beneficiaries should include not only beneficiaries of water quality but also those that benefit from a bundle of ecosystem services provided by the watershed. Examine beneficiaries from both the private and public sectors; estimate maximum WTP for each group of beneficiaries.
4. Further examine potential funding mechanisms for a PES for water quality and/or bundled services and the legal, financial and institutional requirements associated with different options. This will include examining international carbon markets, funding through international grants and loans, and private payments from the tourism industry, hydroelectricity producers, or water bottlers. A blend of several mechanisms may be necessary for the scheme to be financially self-sustaining.
5. Identify transaction and opportunity costs, keeping in mind that arrangements that limit transaction costs and arrangements where opportunity costs are not too high are more attractive to participants as well as fiscally feasible.
6. Work with local communities to investigate WTA and identify local capacity constraints to participation in a PES scheme. Education about ecosystem

services and information stressing voluntary participation in the mechanism is essential.

While this paper does not conclude that a payment mechanism in the Fond D'or watershed is or is not feasible at this time, it outlines the steps to be taken in order to reach such a conclusion. It synthesizes critical information regarding PES for consideration by Saint Lucian policymakers. This paper demonstrates that the Fond D'or watershed delivers important ecosystem services to a host of beneficiaries; a payment mechanism is one potential way to mitigate the further loss of important ecosystem services by connecting beneficiaries to service providers, compensating them for their efforts.

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#### 4.0 CONCLUSION

Given the complexity and urgency of today's environmental and social problems, we cannot wait until we have conclusive scientific knowledge to formulate policies to address them. The best course of action is to proceed with current knowledge about natural ecosystems' contribution to human welfare, generating policies that can adapt to increases in knowledge and shifting social and political climates. Science, in this sense, is post-normal. Ecosystem valuation and PES are examples of post-normal science. The goal of these tools is to promote both natural ecosystems and human livelihoods in mutually beneficial arrangement, where stakes are high, using best available knowledge.

The first article, "Willingness-to-Pay for Reforestation in the Fond D'or Watershed, Saint Lucia," illustrates how ecosystem valuation aids in understanding the value of ecosystem services that are not valued in the traditional marketplace. We used the contingent valuation method (CVM) to understand Saint Lucian residents' willingness-to-pay (WTP) for reforestation of the watershed for the protection of critical watershed services, namely water quality. A team of trained survey administrators from University of Vermont and the Ministry of Agriculture, Forestry and Fisheries of Saint Lucia delivered a survey to households in five community groups in the Fond D'or watershed in January 2008. Surveys questions inquired into their domestic water source(s) and uses, water availability and WTP an additional amount on their monthly water bill to support reforestation of the watershed. In addition, we asked respondents about their satisfaction with the quality and quantity of the water they

currently receive, their opinions on the status of drinking water in the valley, and if the cost of their water service is fair for the quality and quantity of water they receive. We also collected demographic information at the end of the interview.

We collected a total 294 surveys for a 95% confidence level. Of the 294 respondents, 74% indicated that they are willing to pay an extra amount on their monthly water bill to support a watershed reforestation program. We calculated the mean WTP per household for the hypothetical reforestation scenario to be EC \$4.88 per month (\$1.84 US). In addition to WTP, 94% of respondents think that compensation should be given to farmers for participating in a program that requires them to take land out of production for reforestation.

Despite evidence from the literature that WTP is a factor of socioeconomic characteristics— higher education and income levels will lead to increased WTP—we cannot confidently assert that education or income are factors influencing WTP among the residents of the Fond D’or watershed. The only variables that are shown to have a significant relationship to WTP are residence in community group 3, and respondent's opinion on whether the tap water they receive is suitable for household needs. Further analysis of the individual community group variables reveals that attitudes and opinions about water quality and quantity are defining characteristics of the community groups.

A high number of residents were willing to pay the highest bid amount of EC \$15 (\$5.68 US), or more. Fourteen of those 47 respondents reside in community group 3. While education was not determined to be an influential factor of overall WTP, education is a significant characteristic of community group 3.

The analysis of survey data presented here suggests that WTP by residents in the Fond D'or watershed is a factor of their attitudes and opinions about current water quality and quantity rather than demographic variables such as ability-to-pay. Water quality and quantity appear to vary by location in the watershed with water infrastructure and WASCO management presence. Therefore, residence in a particular community group likely influences opinions on water quality and quantity.

While researchers typically use CVM to estimate non-use values of ecosystems or estimate the damage to natural ecosystems, we used CVM in the household surveys to estimate the potential household contribution to an economic incentive program for reforestation in the Fond D'or watershed. Estimating beneficiaries' contribution to program development is *not* estimating non-use values. Therefore, this application of CVM was not susceptible to the myriad of criticisms and sources of error embedded in the typical uses of CVM. However, studies have repeatedly demonstrated that stated WTP significantly exceeds revealed WTP, oftentimes by 50%. After adjusting for this differential, the potential annual contribution from an increase in water users' fees is approximately EC \$1,000,000 or \$400,000 US.

CVM can be used as an educational tool, helping people define and understand their attitudes and preferences towards the environment. The hypothetical scenario presented respondents with information regarding the importance of ecosystem services in the watershed for downstream communities, assisting people in forming preferences for public environmental goods for which they may not have had prior

preferences. Increased environmental awareness could potentially raise support for other environmental improvement projects on the island and contribute to the development of a public environmental ethos.

The results of the household survey reveal not only a monetary estimate of WTP, but also a shared attitude towards environmental improvement. The WTP dollar estimate, as well as public support inferred from the survey, can inform policy makers who will be evaluating the costs and benefits of various alternatives that will cause changes in welfare.

Understanding WTP on the part of beneficiaries is only one piece of information necessary to assess the feasibility of implementing a PES mechanism in the Fond D'or watershed. Supply-side valuation to understand the costs of service provision, landowners' willingness-to-accept (WTA) and willingness-to-participate in such a program is perhaps more important than demand-side valuation. Conducting both supply-side and demand-side valuation will help set an appropriate payment level so that the payment exceeds the benefit from the next best alternative land use (or behavior won't change) and less than the value to downstream users (or they won't pay).

Household WTP represents one potential financing mechanism for a PES scheme. However, we should examine other potential financing sources for a PES mechanism for the likelihood that they will be able to secure sufficient funds at any given time as well as to make financing self-sustaining into the future. This includes

private payment mechanisms through tourism, hydroelectric companies, or water bottling operations, as well as public payment mechanisms.

This research, being exploratory in nature, provides insight into the current condition of drinking water in the Fond D'or watershed and residents' attitudes towards potential environmental improvement programs. Anecdotal evidence from the surveys reveals that the condition of drinking water is a highly controversial issue in the communities and, overall, residents have an unfavorable view of WASCO. Despite these negative feelings towards WASCO, and the general opinion that WASCO or the government should be responsible for addressing the current situation, the majority of respondents are WTP. This information can be of use to policy makers who will be evaluating the costs and benefits of various policy alternatives that could cause changes in welfare.

The second article, "A Methodological Approach to Constructing Payments for Ecosystem Services in the Fond D'or Watershed, Saint Lucia," provides an overview of the biophysical, institutional, and political conditions needed for designing a successful watershed PES mechanism. I elaborate on the opportunities and challenges associated with PES in the context of Saint Lucia, drawing upon lessons from watershed PES arrangements around the globe.

I begin by recommending an analysis of the watershed, either technical or informal, to define the biophysical links between land use and water quality. Understanding these links will lead to identification of the land use best thought to deliver the ecosystem services of interest and the degree of land use change required to

meet the environmental goals. After the assessment and identification of ideal land use, we can then identify priority sites for conservation interventions. I discuss the role that the PES principles *additionality* and *conditionality* play in the initial stages of PES design.

Next, I recommend estimating the costs of ecosystem service provision. The costs of ecosystem service provision are the costs associated with implementing the ideal land use, known as implementation costs, and opportunity costs, which are the foregone benefits of the alternative land use. Agricultural land use in the Fond D'or watershed consists mostly of banana and other fruit tree plantations and root crops like yam and dasheen. According to recent national data compiled by the Saint Lucia Ministry of Agriculture, the annual opportunity cost per acre of yams and dasheen is EC \$32,418 (\$12,142 US). In this step, I emphasize the importance of understanding farmer and landowner attitudes towards participation in a PES mechanism and their WTA compensation for taking land out of production; this is critical, as participation in a payment scheme is voluntary. Land tenure in Saint Lucia will also determine whether a PES scheme is feasible. A legal title to the land will determine which landowners are involved in a PES transaction and the logistics of the approach

After investigating the providers of ecosystem services, I turn to the beneficiaries of the ecosystem services provided by a watershed. Beneficiaries include stakeholders from the public and private sector and the local, regional, and global scale. Once we have identified the beneficiaries across all scales, we can determine which group has the greatest incentive to pay for the alteration of landowners' decisions. The

household WTP survey discussed in Chapter 2 focused on residents as one group of beneficiaries and utilized WASCO as a broker in a monopsonic transaction between the buyers (residents) and the sellers (farmers). This is one potential arrangement. We should determine the maximum WTP for each group of beneficiaries; the "price" of the payment results from a political negotiation between the buyers and sellers.

A variety of financing options are available to support a mechanism, as demonstrated by payment schemes around the world. I evaluate the results of the household WTP survey discussed in Chapter 2 in terms of a potential funding source in a private payment mechanism financed by increased water users' fees. Using data from another UVM study, I discuss a private payment mechanism that involves stakeholders from the tourism industry as the buyer(s). Several Caribbean islands, including Saint Lucia, currently fund protected areas and marine management through policy measures aimed at tourists. Given the contribution of reef ecosystems to Saint Lucia's economy, currently estimated at \$91 million US, tourism, Saint Lucia's primary economic activity represents a larger financial contribution to a payment mechanism than do domestic water users, as well as a self-sustaining financing mechanism. Given SIDS' unique topography that directly links ridges to reefs, funds allocated for watershed improvement have a great to chance of positively impacting downstream reef ecosystems.

The Government of Saint Lucia is also a potential source of funding for a public payment mechanism. Such a program could be of interest to the government because potable water is an issue of public importance and has direct impacts on public health

and labor productivity. A recent report by the World Health Organization (WHO) asserts that the global economic return of investing in drinking water and sanitation is 10-fold; this means that individual countries, such as Saint Lucia, would likely see returns for their own countrywide efforts. With a government-funded health care program in Saint Lucia, the costs of a PES mechanism could be also considered a preventative health measure that will perhaps save money on state health care expenditures and increase labor productivity in the long term.

Tropical forested watersheds provide a multiplicity of ecosystem services and beneficiaries at a variety of geographic and temporal scales enjoy the flow of those services; therefore, a PES mechanism can facilitate a payment for a *bundle* of services, rather than a singular service. Bundling services is one way to ensure sustainable funding for a PES mechanism.

Lastly, I discuss the legal and institutional framework necessary for the success of a payment mechanism. Examples where PES mechanisms are effective or promising all exhibit strong institutional conditions. For developing countries, where governance is low and social and institutional developments are emerging, a functioning legal and institutional system may be the limiting factor to implementing a payment mechanism. Institutions, whether formal or informal, must be capable of reaching arrangements with service providers, monitor contracts, manage and disburse funds, determine conditionality, and enforce penalties for violating the rules. Relying on established institutions will help keep transaction costs at a minimum. I recommend an institutional analysis in the Fond D'or watershed to increase understanding of existing institutional

capacity, interest, and influence, while helping negotiators decide which parties need to be involved in the payment scheme and in which roles. The institutional analysis will identify how institutions link to, and influence, buyers and sellers of watershed services and highlight alterations to the institutional structure needed for a payment scheme to function properly.

In Chapter 3, I submit that payments are a potential policy approach for the IWCAM program in Saint Lucia. I acknowledge the site- and context-specific nature of PES and the challenges and limitations associated with this approach. I outline the steps to the creation of a payment scheme and recommend that the managing organization take these steps in a logical and consistent manner. For the IWCAM program in the Fond D'or watershed of Saint Lucia, best bets for developing a payment mechanism involve developing a local or regional transaction for water quality, utilizing existing institutions with the technical and financial resources and political will to act as intermediaries. WASCO has the financial and legal authority to act as an intermediary, as well as a payment collection system currently in place. However, public support and trust could be a barrier to success if using WASCO as an intermediary in a payment scheme.

This thesis reinforces the need for innovative environmental policies in developing nations for both environmental health and human welfare. Small Island Developing States (SIDS) are particularly vulnerable to environmental degradation and serve to benefit greatly from new policy approaches. Given that regulatory approaches have commonly failed to ameliorate negative environmental and social feedback loops,

payments represent a promising intervention. While not a “silver bullet” for solving environmental problems, it is an approach worth considering in the face of such high stakes. The goal of this body of literature is to contribute one piece of research necessary to understand the feasibility of PES in the context of the Fond D’or watershed, Saint Lucia.

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## APPENDIX A: Household WTP Survey

Location: \_\_\_\_\_

Respondent # \_\_\_\_\_

Interviewer initials \_\_\_\_\_

Date: \_\_\_\_\_

We are students at the University of Vermont interested in the condition of water in the Fond D'Or watershed. We are working with the Ministry of Agriculture, Forestry and Fisheries of St. Lucia to research this issue. We are conducting a short survey on the value of water to households within the watershed. Participation is voluntary and your responses will be kept confidential. Do you have a few minutes to answer our questions?

1. a) In your opinion, is there is a problem with drinking water in the Mabouya Valley? (*Circle one*)

1  Yes                      2  No                      3  Do not know (DK)                      4  Refused

*If no, skip to Q#2*

- b) Who or what is causing this problem?

\_\_\_\_\_

2. What type(s) of water supply does your household use (*Check all that apply*):

1  WASCO                      2  Storage tank                      3  Creek/Stream                      4  Bottled

5  Other: \_\_\_\_\_

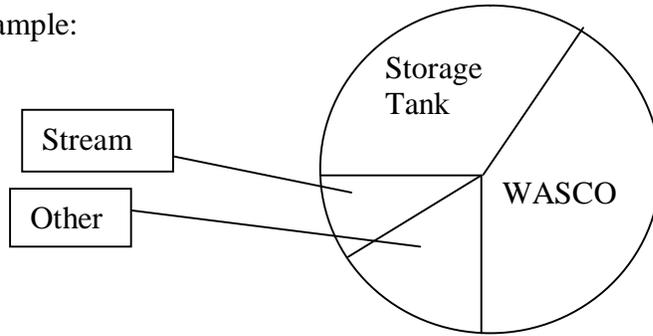
3. a) Do you store WASCO water in drums or tanks?

1  Yes                      2  No                      3  DK)                      4  Refused

- b) If so, how many? \_\_\_\_\_

4. Please sketch your household's water usage from each water source indicated above. Please do one sketch for each activity list below:

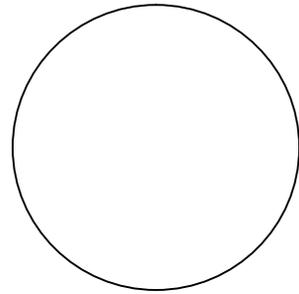
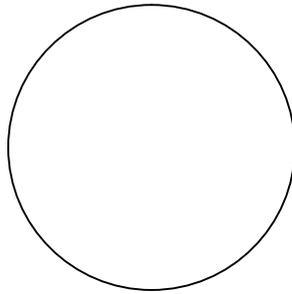
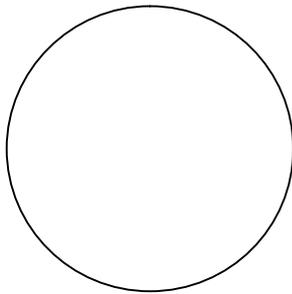
Example:



a) Cooking

b) Cleaning

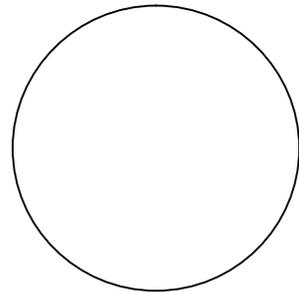
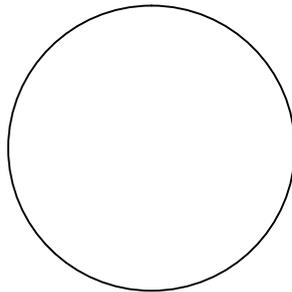
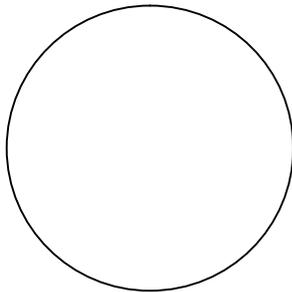
c) Bathing



d) Garden

e) Laundry

f) Drinking



Please answer a few questions about your household's water usage:

	Method				Times/Week	Length of time (min)
Toilet		#	Yes	No	N/A	N/A
	Flush					
	Pit					
Laundry	Machine		Yes	No		
	By hand					
Showers			Yes	No		
	Inside					
	Outside					
Garden	Bucket	Hose	Other			

*If using WASCO water, continue to Q#5.*

*If not using WASCO water, skip to Q #10.*

The next few questions ask about your satisfaction with the quality of water and quantity of water. When we mention quality of water, we are referring to the cleanliness of the water. When we mention quantity of water, we are referring to the amount of water you receive.

5. How would you rate your overall satisfaction with the quality (cleanliness) of the water you receive:

- 1  Very satisfied      2  Satisfied      3  Neither satisfied nor dissatisfied  
 4  Unsatisfied      5  Very unsatisfied      6  DK      7  Refused

Please describe:

---

6. a) Is the quality of water that you receive suitable for your household needs?  
1  Yes                      2  No                      3  DK                      4  Refused

*If no, continue to b. If yes, skip to Q#7*

- b) Please list the uses for which the water is unsuitable:

---

7. How would you rate your overall satisfaction with the quantity (amount) of the water you receive:

- 1  Very satisfied      2  Satisfied                      3  Neither satisfied nor dissatisfied  
4  Unsatisfied      5  Very unsatisfied      6  DK                      7  Refused

Please describe:

---

8. a) Is the water supply sufficient to meet your household needs?

- 1  Yes                      2  No                      3  DK                      4  Refused

- b) Are there certain times of year when you don't have enough water?

- 1  Yes                      2  No                      3  DK                      4  Refused

*If no, skip to Q#9.*

- c) If yes, when \_\_\_\_\_

9. a) In your opinion, is the monthly cost of your water service fair for the amount of water you receive?

- 1  Yes                      2  No                      3  DK                      4  Refused

If no, please explain:

---

- b) In your opinion, is the monthly cost of your water service fair for the cleanliness of the water you receive?

1  Yes                      2  No                      3  DK                      4  Refused

If no, please explain:

---

10. Do you pay water bill every month?

1  Yes                      2  No                      3  Sometimes                      4  DK                      5  Refused

11. On average, how much are you charged for water services a month?

---

12. ***Please consider the following scenario:*** Healthy forests provide many public benefits; forests provide consistent water supply, flood and drought control and wildlife habitat. A program is being considered for forest re-growth in the Fond D' Or watershed. In this program, several acres of land would be reforested upstream to protect a clean source of water for future use. I would like to remind you that this program does not currently exist; we are gathering this information to be used in developing programs for water service improvement.

a) Would you be willing to pay an additional amount on your monthly water bill to support a program that reforests land upstream to protect a water source?

1  Yes                      2  No                      3  DK                      4  Refused

b) If No, please explain

---

---

c) If your water condition improved in the short-term, would you be willing to pay extra on your water bill to support such a program?

1  Yes                      2  No                      3  DK                      4  Refused

*If no, skip to Q #11*

d) Would you be willing to pay \$1.50 EC more on your monthly water bill?

1  Yes                      2  No                      3  DK                      4  Refused

*If yes, continue to c. If no, skip to Q #11.*

e) Would you be willing to pay \$3.00 EC more?

1  Yes                      2  No                      3  DK                      4  Refused

*If yes, continue to d. If no, skip to Q #11.*

f) .....\$4.50 EC more?

1  Yes                      2  No                      3  DK                      4  Refused

*If yes, continue to e. If no, skip to Q #11.*

g) .....\$6.00 EC more?

1  Yes                      2  No                      3  DK                      4  Refused

*If yes, continue to f. If no, skip to Q #11.*

h) .....\$7.50 EC more?

1  Yes                      2  No                      3  DK                      4  Refused

*If yes, continue to g. If no, skip to Q #11.*

i) .....\$9.00 EC more?

1  Yes                      2  No                      3  DK                      4  Refused

*If yes, continue to h. If no, skip to Q #11.*

j) .....\$10. 50 EC more?

1  Yes                      2  No                      3  DK                      4  Refused

*If yes, continue to i. If no, skip to Q #11.*

k) .....\$12.00 EC more?

1  Yes                      2  No                      3  DK                      4  Refused

*If yes, continue to j. If no, skip to Q #11j.*

l) .....\$13.50 EC more?

1  Yes                      2  No                      3  DK                      4  Refused

*If yes, continue to k. If no, skip to Q #11.*

m) .....\$15.00 EC more?

1  Yes                      2  No                      3  DK                      4  Refused

*If yes, continue to l. If no, skip to Q #11.*

n) Would you be willing to pay more than \$15.00 EC?

1  Yes                      2  No                      3  DK                      4  Refused

Please explain: \_\_\_\_\_  
\_\_\_\_\_

13. Do you think landowners should be compensated for participating in a program that would require them to take land out of agricultural production to allow for forest re-growth?

1  Yes                      2  No                      3  DK                      4  Refused

If No, please explain (who should compensate them)?

\_\_\_\_\_

14. Who do you think should be responsible for addressing water problems in this area?

Response: \_\_\_\_\_

**Finally, I have a few questions to ask about your household:**

15. How do you dispose of household wastewater?

Please list:

\_\_\_\_\_

16. How many adults (age 18 and above) live in your household?

\_\_\_\_\_

17. How many children (under age 18) live in your household?

\_\_\_\_\_

18. In what year were you born? \_\_\_\_\_

19. What is the highest level of education that you, or someone in your household, have completed?

1  Primary   2  Secondary   3  Tertiary   4  Other \_\_\_\_\_

20. Who makes decisions regarding finances in your household?

Response:

\_\_\_\_\_

21. a) What is your occupation? \_\_\_\_\_

b) Other occupations in household: \_\_\_\_\_

22. Approximately, what is your average monthly household income (before taxes)?

\_\_\_\_\_

***Use below ranges if necessary:***

- |                                      |                                       |
|--------------------------------------|---------------------------------------|
| 1 <input type="checkbox"/> 0-499     | 8 <input type="checkbox"/> 3500-3999  |
| 2 <input type="checkbox"/> 500-999   | 9 <input type="checkbox"/> 4000-4499  |
| 3 <input type="checkbox"/> 1000-1499 | 10 <input type="checkbox"/> 4500-4999 |
| 4 <input type="checkbox"/> 1500-1999 | 11 <input type="checkbox"/> 5000-5499 |
| 5 <input type="checkbox"/> 2000-2499 | 12 <input type="checkbox"/> 5500-5999 |
| 6 <input type="checkbox"/> 2500-2999 | 13 <input type="checkbox"/> 6000+     |
| 7 <input type="checkbox"/> 3000-3499 |                                       |

20) (*INTERVIEWER DON'T ASK*)

1  Male

2  Female

3  DK

**Thank you for your time today. We appreciate your participation in this research**