Report of The University of Vermont's Activities and Goals for Watershed Management in St. Lucia

January 2004

Mackenzie Dean
Charles Kerchner
Cay Townsend
Katrina Van Dis

Focus of Project

Traditionally, people have assumed that the contributions of ecosystems to human well-being, such as the provision of clean drinking water from forested watersheds, are free services. However, in a market economy, a landowner forced to choose between clearing forest to grow cash crops or preserving forests to provide clean drinking water to downstream neighbors invariably goes with the former. We are beginning to understand that there is a responsibility of society to pay an incentive to landowners in watersheds to protect valuable water sources. The government of St. Lucia is currently exploring the creation of incentives that would spur farmers to improve environmental conditions and provide drinking water cost effectively. The solution, in creating market mechanisms to pay for watershed protection, requires a synergistic relationship between the suppliers and beneficiaries of ecosystem services.

From January 2nd-16th, 2005, a team from The University of Vermont (UVM), comprised of students and professors, worked with stakeholders in St. Lucia to improve watershed management. In the past, there has been limited means for compensating land owners in upper watersheds for protecting water sources, but St. Lucia is now considering a market-based approach to the provision of water. Our research in St. Lucia focused on identifying potential market mechanisms to pay for the protection of ecosystem services. In our approach, we used different methods to project ways in which the downstream beneficiaries could compensate upstream landowners for improving land use practices.

Problem

There is an increasing demand for drinking water in St. Lucia, as the domestic population grows by 1.2% a year and tourism has increased 84% from 1990 to 2000 (Conservation International, 2002). As the demand for water increases, St. Lucia searches for ways to create sustainable mechanisms for the cost-effective provision of water quality and quantity. While efforts have been made to meet the growing demand of water, progress in many regions of the island has been inhibited by degradation of watersheds due to the banana industry. Since 1950, bananas have been the main agricultural product providing livelihood to thousands of small scale farmers. Bananas were preferred by farmers over other crops, because they could be planted for small scale production and provided an income to farmers continuously through the year. Economic opportunities lead to banana farms spreading throughout the island at an astonishing rate. Between the periods of

1950-1965, the banana industry exports grew by an annual 142 percent. An influx in international aid, from the Development Division of the British government and United States Agency for International Development (USAID), between the late 1970's and early 1980's also spurred banana production, leading to exports that exceeded 130 thousand tones by 1990. (Reynolds, 2003) Along with the economic benefits provided by the banana industry, though, came serious environmental degradation.

While the banana industry rapidly grew so did the rate of deforestation on the island. The rising number of banana farms lead to massive clearing of forest on steep slopes. The deforestation rate reached 2% per year from 1977-1982 (SLUMAFFE, no date), which resulted in excess runoff and a decrease in water quality. The increase in soil erosion from the banana boom accompanied by deforestation has exacerbated the problems of water supply. As supply for water is falling, due to poor watershed management and demand is increasing from population and tourism growth, water treatment facilities are struggling with a cost effective approach to providing water.

The Water and Sewerage Company (WASCO), in St. Lucia, supplies an average of 6.2 million gallons daily between the wet and dry season while the demand reaches up to 8 million gallons a day (Shanta King, 2004). In the dry season, lack of fresh water leads to a rationing of water in many communities while in the wet season, increased turbidity, siltation, and excess waterflow requires that WASCO shut off some of their systems.

We decided to study the Marquis watershed in St. Lucia which has had problems with watershed degradation, resulting in inadequate water quality and quantity. This is a pilot project that will use the Marquis watershed and water treatment facility, Hill 20, as a model for designing market mechanisms that are both beneficial to WASCO and the landowners. While we are using the Marquis watershed as a pilot project, our overall goal is to use the assessment as a model of sustainable land use management, which can be applied to other watersheds on the island.

Hill 20 is located in Babonneau, St. Lucia and is a water treatment plant that provides water directly to 10,000 habitants in Babonneau and surrounding communities. (Cox, 2004) The water treatment plant receives water from both the Talvan and Marquis catchments. Within the two catchments there are two pumping stations and several gravity fed aqueducts located in the watershed. The Talvan catchment alone provides up to half of the water to Hill 20. This catchment has heavy agricultural activity which includes banana cultivation on riverbanks, steep slopes and unstable soils. The unsustainable land use has directly contributed to poor water quality at Hill 20. Studies have revealed that the water from the Talvan catchment is high in turbidity, nitrate, and fecal colliform levels. (Cox, 2004) Although there is less agricultural production than before, due to decline in the banana industry, recent urban development in the area will undoubtedly add to contamination of water to Hill 20.

The high levels of chemicals from banana farms and silt from heavy rainfall requires that Hill 20 take extra steps to treat the polluted water, and at times shut down the facility. There are two ways that the water treatment facility to can deal with the increase in

demand for water and high levels of pollutants. The traditional way is to invest in infrastructure and chemicals to accommodate the escalating levels of contamination and turbidity, and to develop new catchments to supplement water supply during the dry season.

The traditional approach to dealing with increasing degradation to water sources has several shortcomings. First, the traditional approach is short-term; adding more chemicals and presumably building larger settling tanks, due to excess turbidity, will be sufficient as long as the level of pollutants does not increase. With a growing population in the area, ever-increasing infrastructure is inevitable. Secondly, we know that investment in chemicals and infrastructure is costly. WASCO's production costs are not covered by their current rates, so additional costs to the treatment process will only add to their deficit. Thirdly, the approach does not provide incentive for land owners to implement proper land use practices. Even if there are a few land owners that practice good watershed management techniques, there is currently no form of compensation for protecting these water sources. Lastly, costs to expand infrastructure and treat excess turbidity is import intensive. This will contribute to St. Lucia's balance of trade deficit. Another solution to this problem, which is cost effective for WASCO and beneficial to the landowners, is to create incentives that encourage watershed conservation. This method is a more sustainable approach to watershed management.

There are a few examples that demonstrate how providing incentives for farmers to protect watersheds is more efficient. The watershed management approach used by New York City, in the United States is one such example. Similar to St. Lucia, New York City relies on surface water to supply the population with drinking water.
In 1989, the Environmental Protection Agency (EPA) said that all above ground water sources must have a filtration system-- unless they could change farmer's landuse activity within the watershed "that may have an adverse impact on microbiological quality of the source water". (Daily, 2002) Threats of diseases such as *Giardia* and *Cryptosporidium* forced the EPA to order New York City to build a filtration plant that would have cost $6- $8 billion. The policy makers opted for another strategy to avoid paying for a costly facility: they decided to let nature do the purifying for them.

The New York watershed project cost $1.5 billion in payments for conservation education and programs that paid farmers to improve farming practices. This strategy saved the state a projected $4.5-$6.5 billion. The watershed management strategy aimed to reduce the levels of sediment, fecal bacteria, phosphorus, nitrate and other waterborne diseases. (Daily, 2002) While they paid farmers to enforce buffer zones, there were also farmers that volunteered to work with planners to incorporate better farming practices. The project was beneficial in promoting conservation awareness by converting residents to become stewards of the environment.

New York decided to implement a less costly watershed protection plan rather than build a costly filtration plant. It proved successful in improving water quality, being cost effective for the treatment plant and creating incentive to landowners in the upper watershed. Many other initiatives throughout the world have come as a result of the New

York watershed management strategy. In Costa Rica, charging consumers a few cents more for water created a fund to pay farmers to protect a forest reserve (Daily, 2002). St. Lucia could experience similar economic and environmental benefits from adopting such an approach in the Marquis watershed and other regions on the island.

The Talvan catchment has seen a decrease in banana production that will most likely improve water quality. The problem lies in the fact that while water quality may improve, the agricultural sector has been hard hit and is looking for ways to increase the vitality of the sector. In addition, the potential threat that another boom with an agricultural commodity will again reduce water quality means a proactive approach to addressing the problem is essential. Our research focused on tackling both of these issues in a holistic manner. We are looking for ways to improve water quality in the Marquis watershed that are more cost effective for WASCO, and beneficial to the upper watershed farmers.

Goals and Objectives

Our goals while in St. Lucia were to scope out the current water quality issues in the Marquis Watershed, establish project partners, and begin collecting data that would enable us to make an assessment of land use and cost effectiveness of water provision. The future goal is to add value to current efforts in identifying market-based approaches to providing incentives for watershed protection.

The main objectives while in St. Lucia were achieved. We feel that we have a comprehensive understanding of the economic issues facing WASCO, environmental conditions of the watershed, and need for establishing agricultural markets. We identified three main project partners with whom we will be collaborating to accomplish our present and future goals. The three main project partners are the Ministry of Agriculture, Forestry, and Fisheries (MAFF), WASCO, and The Caribbean Natural Resources Institute (CANARI). We also began collecting data from WASCO and the Ministries that will help us initiate our analysis of water treatment costs and watershed degradation.

Objectives

We have established concrete objectives to achieve our goal of making an assessment of land use and cost effectiveness of water provision. Successfully implementing the assessment will enable us to identify the appropriate market-based incentives. The objectives will be done in separate time frames with different individuals contributing to various aspects of the project.

Future projects that could be useful for both St. Lucia and UVM students are outlined below. (Please note that these are suggestions of potential projects and are subject to change according to the needs of the Ministries).

Land Use

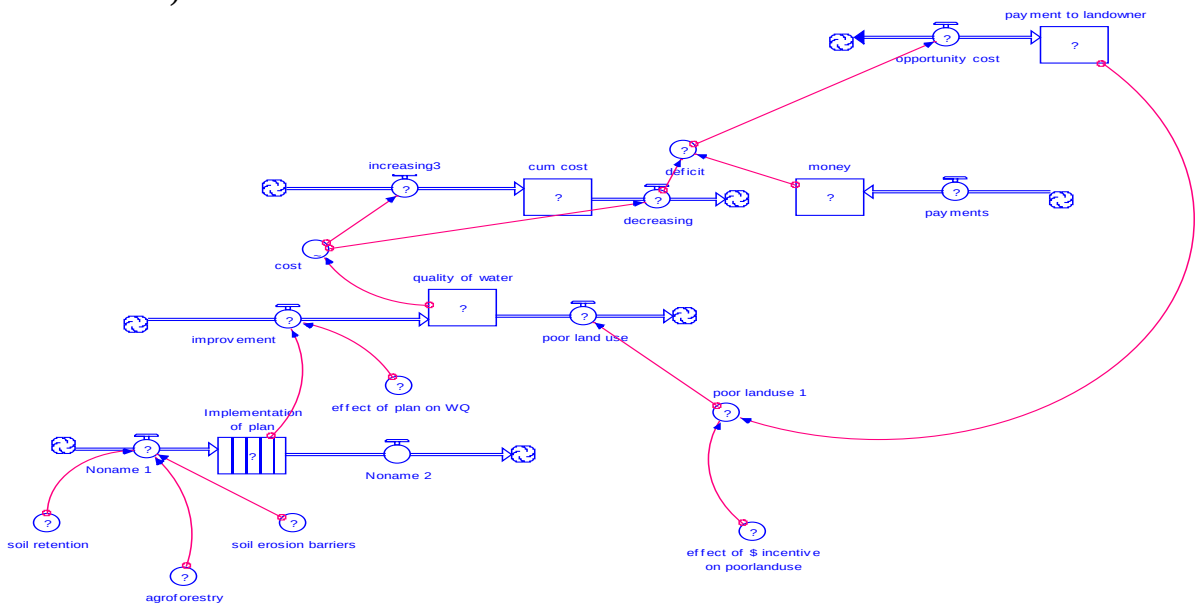
One way that CANARI and MAFF felt that we could add value to the current initiatives in the Marquis watershed is by comparing how social, economic, and environmental

factors contribute to water quality and quantity. The two catchments in the Marquis watershed have significantly different levels of water quality. Comparing the Marquis and Talvan catchments would be valuable in understanding how land use affects pollutant levels at Hill 20. Charles Kerchner, graduate student in the Department of Community Development and Applied Economics, will use GIS to make an assessment of land use in the Marquis catchment. An aerial photo of the watershed that is at a scale of 1:25,000 will be ortho-rectified in ERDAS Imagine and then digitized using ArcGIS9.

The focus of the GIS study will be to determine how the land compatibility assessment between the Marquis and Talvan catchments can provide quantifiable information on the relationship between land use and ecosystem services. There will be some similar aspects incorporated in the assessment that Dr. Cox used in the Talvan catchment study, so that a valid comparison can be made. Determining how land use patterns affect water quality and quantity is essential to identifying a payment mechanism that encourages sustainable land use practices. The GIS assessment will also locate priority areas to implement sustainable agriculture methods.

Modeling the Marquis watershed

In an effort to make a simulation model of the Marquis watershed, we will use the STELLA software program. This model will provide different scenarios of watershed management. Running a simulation model will show how the different variables of watershed management are interdependent. The model will help clarify the synergies between cost, water quality, and land use and help us make decisions that inform our actions. Designing the various scenarios will help stakeholders decide which approach to watershed management is most appropriate for the respective area. Like the GIS assessment, the STELLA simulation for the Marquis watershed will be a model that can be applied to other watersheds in St. Lucia, in order to guide the decision process. (see model below)



Water Testing with Schools
The GIS assessment and STELLA model will require water tests to be performed for both catchments in order to understand the specific water characteristics that are affected by land use. The water tests are also an effective way to promote community education of watershed management with local schools. Students can administer relatively simple and inexpensive water quality tests at river sources near their schools. This is critical to reinforce important watershed management concepts while at the same time providing important information for project research.

Grant Funding
Identifying grants that will fund research and projects in St. Lucia is important to accomplishing stated objectives. Grants will be coordinated with the project partners so that the goals and objectives of the project add value to current efforts.

Knowledge of Water Treatment
To gain more knowledge of water treatment systems, future groups will research different watershed management approaches on and off the island. Before coming to St. Lucia, the students will do a literature review on similar water treatment projects in other locations. Once on-island they will arrange to visit the Talvan and Marquis watersheds and Hill 20 as well as Roseau Dam, Thomazo watershed, various gravity pits, John Compton Dam, and water intakes in the southern region of the island.

The students will also do a literature review of all the ecosystem services and categorize them according to their rivalness and excludability. The categorization of goods by their characteristics, rival and excludable, will determine whether the ecosystem service is a "pure public good", a "pure market good" or in another category. This will determine the appropriate market mechanism to pay for the protection of that service.

Cost Analysis
The UVM students working on the project will contact the Water and Sewage Company (WASCO) and the Ministry of Agriculture in St. Lucia. From these two entities they will obtain information regarding the cost of water treatment during different time periods as well as the costs of planting riparian zones. After the information is obtained the students will be able to carry out a cost analysis on the treatment of water versus land rehabilitation along the riverbanks. This cost analysis could declare whether the economic benefit will be positive or negative for WASCO. If it is negative, beneficiaries need to be found in order to help pay the cost for converting land to protect water sources. If the benefit is positive for WASCO, beneficiaries can still be found in order to reduce the cost to WASCO.

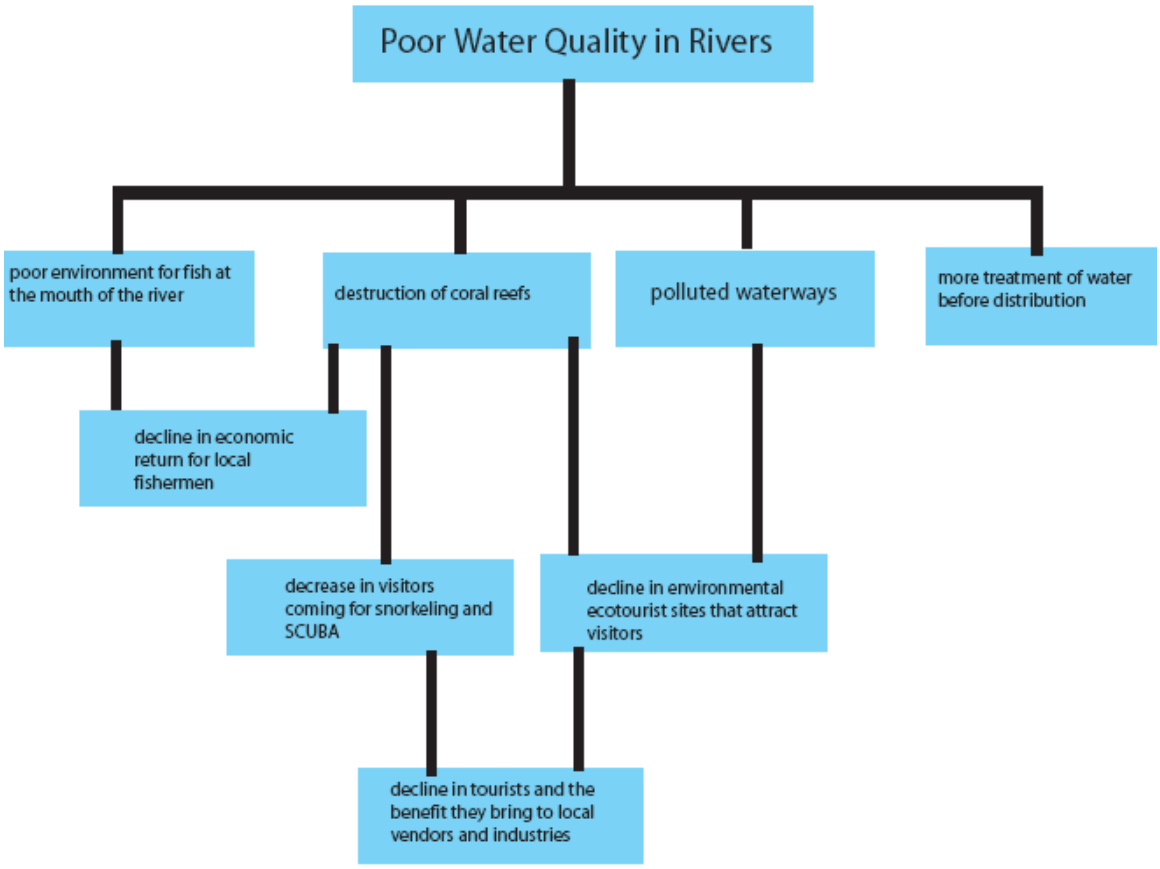
Improved watershed management provides numerous benefits in addition to water supply, such as decreasing erosion and siltation in the ocean. On a relatively small island the fragile ecosystem affects the tourism, scuba diving, fishing, and hotel industry. If

these industries understand the value of watershed protection to increasing their revenue, they could contribute to payments to upstream providers.

Finding Beneficiaries

Beneficiaries are the people either downstream or elsewhere that will profit from having cleaner water. Many people or groups do not realize they are benefiting from the ecosystem service of clean water, and therefore have no interest in paying for the service. The students will perform surveys and inquiries to find out exactly who is profiting from the ecosystem services and if they understand the benefits they receive from good land use practices. For example interviewing dive shops to understand their perception of watershed protection and the costs that siltation loads have on business revenue. Creating a tourism survey that uses contingent valuation methods, to see how much more tourists are willing to pay for an aqua colored ocean, is also relevant to the cost analysis. If the industries that rely on tourism know that they are profiting from cleaner water systems it can create an incentive for the beneficiaries to aid in the cost of land rehabilitation.

The diagram below demonstrates how poor water quality affects various downstream beneficiaries. Watershed degradation can have a lasting impact on business revenue with the tourism and fishing industry.



Other Market Mechanisms
We have focused mainly on finding ways that downstream beneficiaries can pay upstream providers to protect the watershed. It is important to note that we do not assume that all opportunity costs to land owners can or will be completely covered by payment mechanisms from WASCO and other beneficiaries. There are other forms of incentives that encourage sustainable agriculture and provide economic opportunities. Agroforestry in the watershed that follow recommendations from MAFF, for appropriate land use regimes, is also vital to the long-term sustainability of the project. *(For more detail refer to Findings and Results)* Our initial research is focusing on water supply because drinking water is a market good. Having one main beneficiary (WASCO) should reduce the transaction cost of creating a market for the provision of water supply. This is just one of several different analyses that should be done to identify market mechanisms. Other incentive packages include tax incentives, certification schemes, and sustainable agriculture alternatives (as mentioned earlier in the report).

Partnerships for the Actual Project
Once all the information is gathered, organized, and communicated the students can form partnerships with groups working in the watershed. Partnerships can be formed with the Talvan Watershed Catchment Group, Forestry Department, Landowners and schools. The Talvan Watershed Catchment Group has already been working to plant more vegetation on the riverbanks. They will benefit from our research by identifying the value of the service the TWCG is providing. We will also need to form partnerships with landowners in order to determine the opportunity costs associated with converting their land to a riparian buffer. For this partnership we must establish a benefit for them, economic or otherwise, that will persuade them to re-establish their part of the riverbank. A partnership with schools may be formed in order to teach the students about water quality. By teaching the students how to test the water they can use their own knowledge to express the importance of proper land use practices, as well as provide vital information of water quality necessary for the GIS and STELLA assessment.

Literature Review
Before visiting St. Lucia we did an extensive literature review that focused on water quality issues in St. Lucia and in other regions throughout the world. Our objectives for the literature review were to determine the problem, stakeholders who were involved, possible solutions, and steps we would be taking to solve the problem. The articles covered topics such as runoff, soil and water quality, evapotranspiration, market mechanisms, interviewing techniques, buffer zones, agroforestry, and other watershed related issues. The main topic covered for the literature review was focusing on the myriad of market mechanisms that compensate land owners for practicing sustainable agriculture. At the end of this report is a list of references.

Methodology

We researched and evaluated the current economic, environmental and social conditions of the Talvan watershed. We conducted formal and informal meetings with key stakeholders involved with the International Institute for Environment and Development (IIED) project titled *Who Pays for Water?* This project is a study implemented by the Caribbean Natural Resource Institute (CANARI) in collaboration with IIED and is focused on using market and incentive-based approaches to watershed protection and the relevance of these approaches to achieving more effective watershed management and improved livelihoods.

The Ministry of Agriculture, Forestry and Fisheries (MAFF), the Water and Sewerage Company (WASCO), and the Talvan Watershed Catchment Group (TWCG) are the key stakeholders who we interviewed. They provided us with an understanding of the problems, potential solutions and framework for our continual and future project. We chose these groups because they each have a critical role in implementing a successful project. CANARI in collaboration with MAFF has the responsibility of administering the project. A partnership with WASCO is essential to determine the cost effectiveness of water treatment and to implement a payment strategy to compensate TWCG to restore riparian buffers. The confidence of the TWCG in the project goals is crucial to the sustainability, if any new land use initiatives are created. If the TWCG does not believe in proposed solutions, the project goals can not be accomplished.

Interviews

The Chief Planning Officer of MAFF, Christopher Cox, was an integral part of our group and the key contact for us prior to traveling to St. Lucia. In addition to his expertise we interviewed other stakeholders including Shanta King, WASCO; Alexander Lucien, Talvan Watershed Catchment member and WASCO employee; Deborah Bushell, Water Resource Management Unit; and Addams Toussanint, MAFF. .

We gained invaluable information from each interview we conducted. We were able to take the information collected from the interviews to help us identify our project objectives. Through formal and informal interviews we were also able to establish project partners with institutions and individuals that we will be working with on future activities. (Note: Each interview has been documented)

Findings

The most important finding made in St. Lucia is the general consensus between WASCO, MAFF, and the TWCG that they would all benefit from improved land use practices. WASCO understands that if there was improved land use it would decrease their costs of water treatment. TWCG and MAFF also understand that an important economic and environmental application of agroforestry would be an appropriate land management scheme. The perception of how good land use practices in watersheds affect the sustainability of the environment, economy, and agricultural sector is critical in allowing us to implement a project strategy.

It was determined, after researching the Talvan catchment, that farmers need to be exposed to successful agroforestry practices. Although knowledge of diversifying crops appears to be wide spread between both the TWCG and MAFF, there has been limited visual exposure to farmers who practice these techniques. Visual exposure is vital to gain the confidence of landowners to invest in proper land use methods.

In order to establish value-added commodities and an international market, there was discussion of exposing local farmers and members of MAFF to demonstrative plots outside of St. Lucia. A trip to another region in Latin America or the Caribbean would be viewed as extremely beneficial to farmers, so they could see how the benefits and practicality of agroforestry offers opportunities for income generation.

Another limiting factor, we acknowledged, is barriers that prevent access to global markets. Reliability and consistency of agricultural markets in St. Lucia was a concern to many in the TWCG. The consensus was there was simply not the infrastructure and established buyers of agricultural products that could be relied on. There was too much risk involved in planting new crops, such as cocoa, if they didn't know there was a ready buyer. Diversifying their markets as well as their crops would be advantageous to the agricultural sector.

While the dominant economic doctrine favors specialization according to comparative advantage, St. Lucia has learned from experience that investment in one crop has severe consequences. When the agriculture sector produces one main commodity it leaves itself vulnerable to the market price determined by the international demand. As more farmers plant one commodity such as bananas it increases supply, which will effectively decrease the market price. Also, when there is a change in trade policies, as such with the banana industry in St. Lucia, the price for the commodity may decrease and farmers will be left with limited alternative sources for income generation.

Biodiversity is also a reason for crop diversification. When there is not a diversified farm then the plants are unable to combat diseases. St. Lucia has already experienced a failure in the banana industry due to diseases spread from of mono-cropping. In the 1920's St. Lucia began planting a banana variety called Gros Michel. While the Gros Michel banana had excellent taste, bunches that weighed over a hundred pounds, and size that compared to the plantain, a disease called Panama wiped out the crop, eventually terminating that period of the banana industry in 1925. (Reynolds, 54) If farms have biodiversity it will help prevent lose of crops due to infectious diseases.

Conservation International identified St. Lucia as one of 37 countries that is listed as a biodiversity hotspot. (Tourism & Biodiversity, UNDP, 2002) The criteria for a biodiversity hotspot include two indicators, the amount of endemic flora and fauna as well as the level of pressure from environmental degradation on these species. Agroforestry can contribute to preserving the endemic flora and fauna, preventing soil erosion, increasing evapotranspiration, and revitalizing the soil with increasing biomass. The diversification of a farm is important for good watershed management and creating a sustainable income generation component.

A consistent international and local market must be created for fruits and other agricultural products if the agricultural sector wants to increase production. There appeared to be several opportunities for value-added processing of fruits that could be sold as juices to hotels and restaurants on the island.

It seems that St. Lucia already has access to some established international markets. An example of an export market is World's Finest Chocolate located in Soufriere. The business is a cocoa plantation that has established a ready market for export. Securing an international agricultural market, such as what World's Finest Chocolate has done, is important to gain the confidence of farmers to invest in agroforestry. An interview with the plantation owner of The World's Finest Chocolate was identified as a priority for the next group visit.

The other area of concentration will be an economic assessment of Hill 20. Dr. Farley will be in communication with Denis Pantin to determine what area of focus is most appropriate for the Marquis watershed. Current efforts of determining a cost assessment are already underway with the assistance of WASCO. These efforts are to determine what payment should be made for opportunity costs associated with land use in the Talvan catchment. If we know the costs of meeting water demand through traditional means of expanding infrastructure and investing in chemicals, then we have a benchmark that can be used to assess the costs of improving watershed management. It is also important to note that conventional approaches are import intensive and likely to rise, while watershed management approaches are import substituting and may be more stable.

In general terms, the economic perspective will be looking at payment schemes and market mechanisms that are most appropriate for watersheds in St. Lucia. These have to do with categorizing ecosystem services, for their degree of excludability and rivalness, to determine what market mechanism is most appropriate. (See below for work timeline)

Watershed and Economic timeline

Date	Things	Person responsible	Details
Jan- March.	Lit. review	Charles	
Jan. 20th- Feb. 7th	Obtain GIS data	Christopher Cox	
Feb. 14th-Feb. 28th	Contact Denis P	Josh F.	
Feb.14th- Feb. 28th	Contact WASCO	Charles	Contact for Data
Jan.- May	Work on GIS of Marquis	Charles	Provide results of assessment May 15th
Feb. 15- May 15th	Economic analysis	Josh/Charles	
Feb. 1st- Feb. 15th	Locate grant funding for summer study of D.R. & St. Lucia	Charles	

Feb. 1st- Feb.15	Contact Thomas/SODIN	Charles	
Feb. 15st – Feb. 30th	Complete thesis proposal	Charles	
April 1st- April 25th	Design water sampling approach with schools	Charles/ Christopher Cox/ SODIN	
May 23- August 1	Visit to D.R and St. Lucia	Charles	

References

Barrow, Devon, d'Auvergne, Crispin, & James, Anita. (2001) *St. Lucia country paper on National Climate Change Issues.* October 27, 2004. http://www.cpacc.org/download/Stlucia_issue_paper.pdf>

CANARI. 2003. Building institutions for sustainable development: the role of participatory processes. CANARI Policy Brief No.3: 4pp. October 2004. www.canari.org

CANARI. 2004. Markets for Watershed Protection Services: Challenges and Opportunities.CANARI Policy Brief No. 4: 4pp. October 2004. <www.canari.org>

CANARI. 2002. Participatory forest management in the Caribbean: impacts and potentials. CANARI Policy Brief No. 1: 4pp. October 2004. <http://www.canari.org>

Cox, Christopher. 2004. *A Hydrologic Assessment and Watershed Management Plan for the Talvan Water Catchment.* CANARI Report. November 2004.

Cox, Christopher. 2004. *Perspective on Land Management and Soil and Water Conservation in St. Lucia.* Retrieved October 27. www.slumaff.org

Cooper, Mary. "Water Quality Abstract." The CQ Researcher Volume 10, Number 41.

Daily, Gretchen & Ellison, Katherine. 2002. *The New Economy of Nature: The Quest to make Conservation Profitable.* Washington, DC: Island Press, Shearwater Books.

Geoghegan, T. 2002. Incentives for watershed management in St. Lucia: results of a brief diagnostic. CANARI Technical Report No. 317:20 pp. October 2004. <www.canari.org>

Geoghegan, T., Krishnarayan, V., Pantin, D. and Bass, S. 2003. *Incentives for watershed management in the Caribbean: diagnostic studies in Grenada, Jamaica, St. Lucia and Trinidad*. The Caribbean Natural Resources Institute, Laventille, Trinidad and International Institute for Environment and Development, London (unpublished draft). October 2004. <www.iied.org>

Institute for Environment and Development (IIED). 2002. *Silver Bullet or Fool's Gold: A global review of markets for forests environmental services and impacts on the poor.* December 9, 2004. http://www.iied.org/docs/flu/psf/psf_silvbullet.pdf

Kenward, Nicole & Mees, Chris. (2000). Impact *and Amelioration of Sediment and Agrochemical Pollution of Caribbean Costal Waters: DFID Natural Resource*

Systems Programme. October 27, 2004. http://www.mragtd.com/r7668FinalReport.pdf.>

King, Shanta. Personal Communication, January 13, 2004. Castries, St. Lucia.

Rochester Ranger District. "Steps 5-6 Synthesis and Recommendations." Upper White River Watershed Assessment Part 1 December 2000; 98-103.

Reynolds, Anderson. 2003. *The Struggle for Survival: an historical, political, and socioeconomic perspective of St. Lucia.*. View Fort, St. Lucia; Jako Books Publication.

SLUMAFFE, no date. Forest Biodiversity. Available on-line at http://www.slubiodiv.org/Biodiversity_Project/Information/Biodiversity_Papers/Forest_Biodiversity/forest_biodiversity.html

Struening, Elmer and Marcia Guttentag. 1975 "Interviewing in Evaluation Research" Handbook of Evaluation Research. Beverly Hills; Sage Publications. Pp 355-395.

United Nations Environment Programme, Conservation International. "Tourism and Biodiversity." CD-ROM.

Virgo, Keith and Sitlijng, Jyotsna. 2003. *Measuring the Impact of Watershed Management Projects.* Waterlines, V 22, no. 1.