

## SOAR Project Proposal—Summer 2018

**Project Title** Socio-Economic Analysis of Satellite Observations to Predict Cholera

**Student** Nathaniel Rhoads  
Class of 2019  
Economics Major

**Project Start** May 27, 10 weeks

**Professor** Dr. Sonia Aziz, Ph. D.  
Associate Professor  
Economics

### Description/Rationale

Widespread pathogen contaminated drinking water threatens the health millions of Bangladeshi's who lack resources for mitigation, and imparts significant economic burden due to the cost of water borne diarrheal illness (Smith, Lingas, & Rahman, 2000). Water sources without high levels of pathogen contamination are scarce, affecting people's health and productivity (Aziz et al, 2015). Cholera is a particularly prevalent water borne illness in Bangladesh, with an estimated 300,000 reported cases per year (Qadri et al, 2015), and remains an endemic threat to public health across the globe due to the nature of *vibrio cholera*, the disease causing pathogen (Colwell RR, et. al, 1985, Enserink M, 2010, Harris JB, Larocque RC, Charles RC, Mazumder RN, Khan AI, Bardhan PK, 2010).

Nathaniel Rhoads's work will focus on categorizing and integrating primary and secondary data (collected under the aegis of a National Aeronautics and Space administration grant) and will analyze factors affecting the private value households place on averting cholera using protective expenditures or actions in context of early warning systems based on satellite observations that predict risk of cholera outbreak. Two observations motivate economic analysis for determining the value of prediction of cholera several months in advance: (i) changing climatic conditions and recurrent natural disasters increasingly place the at risk population vulnerable to disease outbreak and (ii) estimated values of damages from an impending outbreak of cholera is likely to act as an attractive incentive for policymakers to negotiate with governing institutions for preemptive actions such as better water and sanitation facilities or access to safe drinking water.

Due to lack of resources, awareness and clean water access, the use of contaminated water in Bangladesh persists. In addition to health consequences, water contamination leads to economic repercussions. Filtration methods and clean water wells exist in Bangladesh; however, the alterations, on a large scale, are subject to heavy resource constraints. Household members, typically women, must make the decision whether or not the benefits of clean water are worth the opportunity costs associated with obtaining it. Research to determine estimations for the demand for clean water in Bangladesh could be central in modifying policy decisions centering on the country's water distribution. From a health management and planning perspective, the data and analyses outlined above are important.

## **Roles and Responsibilities:**

### Faculty Responsibilities:

- Guide comprehensive literature review.
- Share and critique research in progress.
- Meet regularly with the student.
- Guide design of theoretical and empirical framework
- Collaboratively identify appropriate tools of analysis
- Ensure adherence to project timeline
- Guide student to produce a paper/outcome with potential presentations at conferences

### Student Responsibilities:

- Read and review articles important to the field
- Examine emerging schools of thought in development economics
- Data Overview: Look at primary and secondary data for synthesis
- Data Analysis: Analyze available data and draw conclusions
- Collaboratively identify appropriate tools of analysis
- Meet regularly with the SOAR advisor
- Produce a paper/presentation with the goal of scholarly presentation

## **Describe how the student will be engaged in discipline-appropriate scholarly research.**

A substantial portion of the research process will consist of literature review, and examination of state of the art, emerging paradigms in development economics. In particular, the work will examine emerging schools of thought in development economics spearheaded by Esther Dufflo and Abhijit Banerjee. In spite of the paucity of literature on socio-economic valuation of cholera in particular, past explorations of societal loss due to general water-borne illness is well documented in the economics literature, and will be critical in guiding efforts in estimating economic valuation of cholera avoidance. This information will serve as a theoretical framework to evaluate the household and economic value of satellite prediction of cholera outbreak.

## **Describe how the work of the student will contribute to the discipline and opportunities the student will have to share his or her work with other students, faculty, and the community.**

I believe that the novelty of the work proposed is a valuable contribution to the literature in the field. In addition to academic expectations, I hope that the work we complete during this project will contribute to increasing awareness and understanding of water quality issues in low income areas of Bangladesh. We will be working with principal investigators at the National Aeronautics and Space Administration (NASA) and researchers at the International Center for Diarrheal Disease Research in Bangladesh (ICDDR, B) on data analysis to estimate WTP for avoiding cholera pathogens in drinking water using satellite observations to track *vibrio cholerae* in the environment. The data gathered through the study could act to inform future policy regarding water quality. Through participation in SOAR, we will also have the opportunity to

present Nathaniel's research at Moravian College Scholar's Day, which will provide us with a platform to share his research experiences and results with others at the college.

<i>Week</i>	<i>Tasks</i>
<b>1</b>	Literature Review
<b>2</b>	
<b>3</b>	
<b>4</b>	Data Overview - Synthesize and integrate secondary and primary data
<b>5</b>	
<b>6</b>	Data Analysis
<b>7</b>	
<b>8</b>	Write-up
<b>9</b>	
<b>10</b>	

## **Student Statement of Purpose**

Title: Socio-Economic Analysis of Satellite Observations to Predict Cholera

Student: Nathaniel Rhoads, Class of 2019

Major: Economics

On Campus Housing Requested for (May 27, 2018 through August 1, 2018)

Professor: Dr. Sonia Aziz, Ph. D.

### **Student Rationale**

My primary purpose of participating in a SOAR project is to work further on non-market applications of economic theory. Prior to taking several economics classes here at Moravian College, I thought that the best application for economic theory was in the world of markets and finance. After taking several courses, including Dr. Aziz's Environmental Economics class, I was exposed to applications of economic theory that I had not previously thought of. While I have learned these applications in a classroom, being able to apply them to real-world research would be greatly beneficial to me. I also feel that participating in this research would expose me to other non-market applications of economic theory, perhaps giving me a potential specific field I would like to explore further in graduate studies.

As well as working further on non-market applications of economic theory, I hope to challenge myself during this project. There are many instances in my classes where we discuss potential applications of economic theory, but that is when I struggle sometimes. The theory comes easily to me, but applications are sometimes harder to see. I often try to work through it and end up understanding the topic, but the normal class time is not enough to solidify my understanding. The length of time provided for the SOAR project provides me time to work through applications of economic theory in depth. This time duration also allows me to fully understand any topics I may not fully comprehend.

During this research, I also hope to apply some mathematical analysis to economic data. I chose a minor in mathematics not only because I enjoy pure mathematics, but also because the extent to which math pervades economic theory fascinates me. By working on this project, I also hope to find further instances of math in economic analysis.

I am already familiar with Dr. Aziz's work in Bangladesh, as she has referenced it several times in classes I have taken with her. Even though I was exposed only to an overview of her work, I was immediately interested in the research. Throughout this project, I hope to gain a further understanding of Dr. Aziz's work and see what goes into academic research.

### **Expected Outcomes**

It is my hope that working on this project will reinforce my aspirations for graduate work in economics with a focus on its non-market applications. I hope to gain experience in the research process as well as contribute valuable academic research regarding the valuation of clean water in Bangladesh and its welfare effects. SOAR would give me the educational experience outside of the classroom that I need to further my studies and provide me the opportunity to contribute to the field of environmental economics. Though working on this project, I will have the opportunity to develop an economic theoretical framework to test in conjunction with econometric models, giving me experience from the planning stages of a research project through the results and potential implications of the study.

Attached is a list of potential references for beginning my research on the topics of valuation of non-market, environmental goods, willingness to pay in developing countries, research methods, and water studies in Bangladesh.

#### References:

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- Murty, M. N., Gulati, S. C., & Banerjee, A. (2003). Welfare Gains from Urban-Air Pollution Abatement in the Indian Subcontinent. *Institute of Economic Growth*, 1-36.
- Pattanayak, S. K., Yang J. C., Whittington, D., & Bal Kumar, K. C. (2005). Coping with Unreliable Public Water Supplies: Averting Expenditures by Households in Kathmandu, Nepal. *Water Resources Research*, 41(2), 1-11.
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- Smith, V. K. (1997). Time and the Valuation of Environmental Resources. *Resources for the Future*, 1-29.

## **SOAR Expense Proposal- Summer 2018**

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### **Budget Items**

Student Travel: Airfare to Bangladesh - \$1000

### **Explanation**

Nathaniel Rhoads will be traveling to Bangladesh to work with NASA and ICDDR, B to gain research experience and access data essential to SOAR work.

The estimated cost of the airfare is \$1,800 but we are requesting \$1000 per the standard cap. There are numerous other expenses (eg. accommodation) but we are using the remaining funds from the NASA project to defray these expenses.