Consortium on Law and Values in Health, Environment & the Life Sciences

2013-14 Student Proposal Cover Page

Applicant Information				
Applicant name:	Suhyun Jung		Email:	Jungx219@umn.edu
Project title:	What is the Optimal Price of Carbon to Compensate Farmers' Profit Loss from Conservation?			
Department:	Applied Economics	College:	College of Food, Agricultural and Natural Resource Sciences	
Degree program:	PhD	Faculty advisor name & email:	Stephen Polasky, polasky@umn.edu	☐ NA
Dept. Head:	Francis Homans	Dept. Head's email:	fhomans@umn.edu	
Dean:	Brian Buhr	Dean's email:	bbuhr@umn.edu	

How did you hear about this funding opportunity?
☐ VIP email ☒ The Brief ☐ Advisor ☐ Dept. email/newsletter ☐ OVPR website ☐ Other

Funding

Total amount of funding requested: **$6,292**

Executive summary (maximum 200 words)

In this study, I construct the first globally consistent production cost data set and use it to estimate farmers' lost agricultural profits that result from conservation planning. In addition, I link these lost profit measures to biophysical data of global carbon sequestration to estimate the price of carbon that would incentivize farmers to not produce agricultural crops on their land. This study fills the gap in the literature where researchers predominantly focus on valuing the benefits of ecosystem services and not considering costs that are associated with farmers' profit (welfare) loss resulting from land conservation. Through this research project, I will be able to help inform conservation planning decisions such as United Nation's program on Reducing Emissions from Deforestation and Forest Degradation (UN-REDD) by full consideration of tradeoffs between agricultural production and carbon sequestration, two of the most widely discussed ecosystem services. I plan to use requested funds to develop a framework for the globally consistent production cost data set, collect data, evaluate the tradeoff, and write a publishable paper. Additionally, I will use some of the requested funds to present the methods and results at professional meetings to get feedback and improve them.

Approvals

Check all appropriate approvals required for your proposal. Approvals must be obtained prior to receipt of funding. If you have applied for approval but have not yet received it, indicate that below.

IRB ☐ Yes ☐ No ☒ NA ☐ Application pending

Other ☐ Yes ☐ No ☒ NA ☐ Application pending Specify:

Checklist

☒ The proposal is 1000 words or less excluding budget, biographies, references and citations.

☒ The proposal includes a work plan with a specific timeline using months or quarters to identify work to be done and completion dates.

☒ The proposal includes a 1-2 paragraph biography of the applicant and all co-investigators.

☒ The budget form is complete including the funds sought for this project, other pending applications for this project, and the amount/source of matching or other funds.

☒ The applicant's faculty advisor is copied on the application email. Professional students w/o advisors check NA.

☒ All necessary approvals are pending or received.

What is the Optimal Price of Carbon to Compensate Farmers' Profit Loss from Conservation?

Suhyun Jung

Consortium on Law and Values in Health, Environment and the Life Sciences
(Student Proposal)

April 21, 2014

I. Project Description

Backgrounds

Ecosystems generate a range of goods and services of value to people ("ecosystem services") but conserving ecosystems and these services often comes at a cost. To date, researchers have predominately focused on valuing the benefits of ecosystem services that come from environmental conservation efforts. A complete analysis of conservation planning decisions, however, requires consideration of costs as well as benefits. For example, one cost of conservation includes the opportunity costs of taking land out of crop; farmers forgo the profits from agricultural production that can be generated if the land was not in conservation. Previously, the lack of globally consistent production cost data has prevented environmental studies from considering this important opportunity cost of environmental conservation despite its direct relevancy to the welfare of the local people.

In this study, I plan to construct the first globally consistent production cost data set and use it to estimate farmers' lost agricultural profits that result from conservation planning. In addition, I link these lost profit measures to biophysical data of global carbon sequestration to estimate the price of carbon that would incentivize farmers to not produce agricultural crops on their land.

Overall Significance

The information on the profit loss of farmers and incentive-compatible price of carbon using the global-scale economic rent data set will help inform conservation planning decisions such as United Nation's program on Reducing Emissions from Deforestation and Forest Degradation (UN-REDD). The methodology in this paper also improves on the current method, developed by Naidoo and Iwamura (2007), of calculating lost farmer profits. Specifically, Naidoo and Iwamura's (2007) method of calculating profit from agricultural production equals total revenue and does not include production cost. Using the revenue maximization as farmers' objective does not correctly reflect farmers' production decisions and thus their impact on the environment, which can be misleading if the information is used for conservation decisions.

In order to determine agricultural returns per hectare, we need unit price of crops, per hectare yield, and per hectare production cost for different crops. Globally consistent data on prices and yields exist to construct revenue from production of major agricultural crops. However, currently there is no globally consistent data set of production costs. The *Commodity*

Costs and Returns Estimation Handbook by AAEA (2000) and the *Sustainability and Production Costs in the Global Farming Sector* by the European Commission (2012) provide methodologies and possible data sources but do not provide complete comparable global crop production cost data. While good production cost data exist for some individual countries (e.g., production cost data in the US published by the US Department of Agriculture), uniform cost data across all countries does not exist.

This study contributes to conservation planning decisions for sustainable development by providing data for the complete analysis of lost profits in agricultural production. The global agricultural production cost data set developed through this study, coupled with currently available global carbon sequestration data set (Ruesch and Gibbs 2008; West et al. 2010), will enable full consideration of tradeoffs between agricultural production and carbon sequestration, two of the most widely discussed ecosystem services. This study is the first to construct a globally consistent agricultural production cost data set to evaluate the tradeoff between agricultural production and carbon sequestration. The development of this data set coupled with the analysis will show how estimates of agricultural return per hectare around the globe can be combined with other biophysical datasets such as land use and land cover or biodiversity to evaluate the tradeoffs among these other services. By doing so, it will stimulate interdisciplinary projects between social scientists, e.g., economists, and natural scientists, e.g., ecologists or conservation biologists.

Methods

I calculate globally consistent production costs for all countries by piecing together data on particular components of cost from a number of existing global data sets. To build a uniform global data set on agricultural production cost I use data in FAOSTAT compiled by the Food and Agriculture Organization (FAO), the International Labor Organization (ILO), the World Bank, the National Bureau of Economic Research (NBER), Economic Research Service (ERS) of the United States Department of Agriculture (USDA), International Seed Federation (ISF), and several other country and sub-national statistics. Data for individual countries often has significant variability and may be subject to a high degree of error. Therefore, I group countries into 19 geographic regions, defined by FAO (FAOSTAT 2011), to try to increase the reliability of the calculated cost numbers.

The data set on production costs includes the costs of major inputs: fertilizer, labor, machinery, and seed. I define production costs on a per hectare basis as the amount of each input required per hectare times the unit price of the input. Many pieces of data are not available by country but are available in certain countries. When this is the case, I use detailed information from the US but build in an adjustment to account for differences in prices and yields. I use fertilizer input and corresponding yield data from Mueller et al. (2012). Mueller et al. (2012) divided the world into 100 climate bins using precipitation and growing degree-day characteristics.

I combine these data sets on production costs, yields, and prices with the amount of carbon sequestration in different countries obtained from existing literature to estimate the tradeoff value between agricultural production and carbon sequestration. The value of per hectare agricultural profit is calculated using the constructed globally-consistent agricultural production cost data set along with prices and yields data sets as described above. Then, I compare the value of per hectare profit to the amount of carbon sequestration from Global

Biomass Carbon Map (Ruesch and Gibbs 2008; West et al. 2010) to determine the incentive-compatible price of carbon for farmers to compensate for their land in conservation across the globe. The average value of per hectare agricultural profit ($/ha) will be divided by the amount of carbon sequestration (ton/ha) in each country and geographic region to calculate the price of carbon that needs to be compensated for farmers.

II. Timeline

Jan 2014 – May 2014	Download global-scale FAO, ILO, and NBER data sets and USDA ERS data set to make them consistent by normalizing them to 2010 US dollars and aggregating at 19 geographic region
June 2014	**Literature review on aggregating regional and national level data to a globally-consistent data set to apply them for the crop-specific data at the regional scale**
July 2014	**Data validation using the literature on production cost estimates**
	Aggregate above-, below-ground carbon, and soil organic carbon global data sets and merge them with the global agricultural production cost data set
August 2014	**Evaluation of tradeoffs between agricultural profit and carbon sequestration and determine incentive-compatible carbon prices across the globe**
	Complete first draft of research paper
September 2014 – December 2014	Circulation of the paper and discussion within the department of Applied Economics and Institute on the Environment
January 2015 – May 2015	**Paper presentation at profession meetings**
June 2015	**Financial report to the Consortium**

Note: The bold-typed timeline indicates work to be done as a result of the support from the Consortium.

III. Biography

Suhyun Jung is a PhD candidate in the department of Applied Economics at the University of Minnesota. His research interest lies in the fields of environmental, resource, ecological, and development economics and spatial econometrics. His doctoral research focuses on environmental effects of regulating producers' deforestation decisions and resulting tradeoffs among ecosystem services. His other research extends further to the valuation of ecosystem services, modeling land use and land cover change and their impacts on ecosystem services, and the modeling of spatial spillover effects. He holds a B.S. degree in Economics from Korea University, and an M.S. degree in Agricultural Economics from the University of Tennessee. He is currently an interdisciplinary doctoral fellow at the Institute on the Environment and his research is supported by the graduate school's Interdisciplinary Doctoral Fellowship. He enjoys running along the lakes and spinning when he is not working in the office.

References

AAEA. 2000. Commodity Costs and Returns Estimation Handbook. AAEA Task Force on Commodity Costs and Returns.

European Commission 2012. Sustainability and Production Costs in the Global Farming Sector: Comparative Analysis and Methodologies. JRC Scientific and Policy Reports.

FAOSTAT. 2011. Country Groups and List of All Countries in Each Group. http://faostat.fao.org/site/371/DesktopDefault.aspx?PageID=371

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Naidoo, R. and T. Iwamura. 2007. Global-scale Mapping of Economic Benefits from Agricultural Lands: Implications for Conservation Priorities. Biological Conservation 140: 40-9.

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West, P.C., H.K. Gibbs, C. Monfreda, J. Wagner, C.C. Barford, S.R. Carpenter, J.A. Foley. 2010. Trading Carbon for Food: Global Comparison of Carbon Stocks vs. Crop Yields on Agricultural Land. Proceedings of the National Academy of Sciences 107: 19645-19648.

Consortium on Law and Values in Health, Environment the Life Sciences

Budget for Student Proposals

Project Title: **What is the Optimal Price of Carbon to Compensate Farmers' Profit Loss from Conservation?**

		Instructions: Provide justification along with costs.	**Requested funding**	**Matching/other funding**	
	Category	**Description & justification**	**Amount**	**Amount**	**Source**
1	Your stipend	*Hourly wage rate ($20.13) × 248hours = $4,992**	$4,992		
2	Speaker honoraria	___ speakers x $ _____ honorarium			
3	Supplies & Services	Identify and explain use.			
4	Equipment	Identify and explain use.			
5	Travel	Airfare to Boston, MA for the ASSA conference in January or other professional meetings (at most $500), lodging at the location ($500), transportation, meals, and registration fee ($300): Total estimated at $1,300 **	$1,300		
		Subtotal research expenses (2-6)	**$1,300**	**$0**	
	TOTAL BUDGET		$6,292	$0	

* **Stipend**: I am requesting funding for my stipend between June 2, 2014 and August 8, 2014 for 10 weeks (25 hours/week) based on the departmental rate of wages for research assistants. I have no funding for the summer, 2014, and I will be working on literature review, data construction and validation, evaluation of tradeoffs, and writing a paper during the summer period.

** **Travel costs:** I've submitted an abstract of this proposal on April 15, 2014 to the American Economic Association (AEA) meeting, which is the biggest conference in the Economics field. It will be held in Boston, MA from January 3, 2015 to January 5, 2015. Even if I am not selected to present my paper at this conference, I will continue to apply for other conferences to present this paper and use the funding for it. I am requesting this funding as a part of my proposal because I can significantly improve my paper by presenting and getting feedback from people in my field. The specific amount is based on my previous experience at other cities, and they are less than the university's recommended amount found at http://travel.umn.edu