

SIMPLE-G in the Classroom

An interdisciplinary approach is fundamental to addressing the global sustainability issues facing the world today. Yet this is often missing in current graduate programs. Applied economists are given a good foundation in economic theory and quantitative methods, but typically lack exposure to the bio-physical scientists who study the underlying mechanisms governing sustainability. Conversely, climate scientists, agronomists, engineers and others working on these problems from a physical perspective, are rarely exposed to economic models and don't see where their work might fit into a more comprehensive analysis of sustainability policies. In this paper, we discuss experiences and opportunities for bridging this gap using the SIMPLE-G framework – both in a graduate course as well as in a short course run by the Center for Global Trade Analysis at Purdue University and how it has been incorporated in other universities.

This effort to bridge economics with other disciplines in the context of global sustainability analysis began with the introduction of a new graduate course at Purdue University, entitled: “AGEC 528: Global Change and the Challenges of Sustainably Feeding a Growing Planet”. AGEC 528 gives students the tools to address sustainability and food system questions utilizing a stripped-down, minimalist partial equilibrium framework, SIMPLE: a Simplified International Model of Prices Land use and the Environment. The SIMPLE model is implemented in the GEMPACK software suite and, during the first half of the semester, students complete five lab assignments which introduce the basic ideas behind supply, demand and international trade in the context of the evolving global food system and associated environmental impacts. During this time students also define a project which they will undertake, building on these tools. This year the course is introducing SIMPLE-G, the gridded version of SIMPLE, for use by more advanced students in the class.

Table 1. Topics Covered in the Course

Planetary Boundaries and the Food System	Population Growth and Global Food Demand
Yield Growth and Yield Gaps	Post-Harvest Losses and Food Waste
Total Factor Productivity Growth	Linking Biodiversity and Agricultural Production
Potential for Cropland Expansion	Environmental Impacts of Agriculture: Water Quality
Water Availability: Constraints and Opportunities	Environmental Impacts of Agriculture: Greenhouse Gas Emissions
Globalization	Climate Change as a Factor Influencing Global Agriculture
Consumer Preferences for Food	Nutrition and Food Security

The course meets twice a week with weekly guest lectures from experts on the specific topic being covered that week. The weekly topics (Table 1) present a new dimension between food systems, the environment, and sustainability.

For PhD level students in applied economics, there are additional assignments that aim to dive deeper into the theoretical framework and allow for more detailed analysis. Finally, student complete a research project that serves as a capstone for the course and give students the opportunity to develop their own research through the final project.

These projects offer excellent examples of how students from both economic and non-economic disciplines are able to utilize this material to address their own research and reach their own learning goals. This present will review two examples of student projects that evolved into dissertations and eventually peer-reviewed publications. The first of these explores the role of food waste in global food security and environmental sustainability (Lopez Barrera and Hertel 2020), which develops the relationship between changes in per capita income and the share of food wasted and how these trends might be characterized in the future. The second project focuses on the impact of heat stress on agricultural labor capacity (Lima et al. 2020; Hertel and de Lima 2020) which addresses impacts of climate change (i.e., temperature and humidity) on agricultural labor capacity.

The course overall has been well received by students both within the economics discipline and especially by students from other departments. Below are a couple of quotes from students about their experience in the course and what they gained from it.

“I am not an economics person. I believed more in production to solve the world’s food problem. Taking this class changed that view. It exposed me to the deprivations I would suffer from if I do not pay attention to economic activities that directly impact my immediate environment as well as the world view too. I got exposed to many challenges that exist in agricultural productivity and the multidisciplinary approach to solving them. I got more interested in world trade and learned to foresee the implications of my activities and decisions on the poor and rich at the national, continental, and world level.” (Agronomy)

“AGEC 528 in essence changed my career from financial management to agricultural economics. I was impressed by the multidisciplinary design of the course. Frankly, it was my first experience with multidisciplinary course. Sitting in this class was a great chance to look at the big picture of a critical challenge, which is feeding the world in 2050. Speakers from different disciplines were sharing their views and articles relating to this issue. It was really informative how tradeoffs appear between different disciplines like economics and environment.” (Agricultural Economics)

SIMPLE-G has also been featured in the suite of courses offered through GTAP-U (<https://www.gtap.agecon.purdue.edu/events/gtap-u/index.aspx>). Because it shares the same basic theory and software implementation as the GTAP model, but focuses on a single sector, and because it offers a resolution more familiar to physical scientists (0.5 arc minute grid cells), it is a natural point of entry for scientists seeking to engage with the GTAP community. This short course has a similar instructional design to the standard GTAP short course. It builds on the lab materials from AGECE 528, with participants completing a four-week online set of modules before coming to campus for in-person instruction. The on-site portion of the course is one week in duration. The first 2.5 days are devoted to lectures and labs designed to build skills in spatial analysis, implementation of SIMPLE-G and utilization of the 'mini-model' for deep dives into key results. This is followed by 2 days of project work in which participants replicate an existing SIMPLE-G study, critique it and extend the analysis in some meaningful direction. The course concludes with project presentations by the course participants. The SIMPLE-G course has been offered twice to date and has contributed to material which will appear in the forthcoming 'SIMPLE-G book'.

In order to better understand how the SIMPLE-G material has been utilized in the classroom by students, we conducted a survey of students and professors that have had experience with the material. There were three different surveys that were distributed to different pools of participants. The first survey was among the students that were currently in AGE 528 or had taken the course in the last two years. We asked them for some basic information about their name and program and if they would be willing to sit down for an interview with Elizabeth Fraysse. Then, we asked them to fill out the following questions:

1. What made you decide to take this course? What motivated you to pursue an interdisciplinary course that combines economics with other disciplines? If an advisor recommend this course to you please list their name and department
2. Could you please describe, how you saw this course fitting into your future research and what elements you have used in your research after this course? Please give examples where possible.
3. What elements of non-economic disciplines were discussed during this course that you had not considered using before?
4. Please describe your experience in the course, what challenges did you face in this course?
5. Do you think interdisciplinary courses can contribute to addressing real-world problem and challenges.
 - a. Strongly agree, agree, neutral, disagree, strongly disagree
6. Interactions and discussions with other students from different disciplines enhanced your learning experience.
 - a. Strongly agree, agree, neutral, disagree, strongly disagree
7. What skills and knowledge did you gain from this interdisciplinary course that you think are transferable to other disciplines and fields? (Multiple selection)
 - a. Programming
 - b. Statistical analysis
 - c. Economic modeling
 - d. Understanding of economic theories
 - e. Data analysis
 - f. Interdisciplinary thinking
 - g. Policy analysis
 - h. Communication
 - i. Critical thinking
 - j. Teamwork
8. On a scale of 1-10 please rate your perceived level of economic background: (1 being none and 10 being strong economic background)
 - a. Before this course?
 - b. After this course?

The next survey was among the participants in the SIMPLE-G short course. We asked them for some basic information about their name and job title and if they would be willing to sit down for an interview with Elizabeth Fraysse. Then, we asked them to fill out the following questions:

1. What made you decide to participate in the SIMPLE-G short course?
2. Before starting this course, how did you see this course fitting into your future research or career objectives?
3. After this course, how do you see what you learned during this course to be utilized in your future or ongoing research?
4. Please describe your experience in the course, what challenges did you face in this course? Were there any topics that you had not considered incorporating in your research or had limited experience that you were exposed to more during this course?
5. How did the interactions and discussions with other students from different disciplines, careers, and research backgrounds enhance your learning experience?
6. If you utilized the online material, did you find it useful and aid you in your experience in the course? Is there anything you would like to be expanded upon?

This paper will present results from a survey on how the from AGE 528 and the SIMPLE-G short course has been utilized by both economics and non-economics disciplines to address their own student and participant goals, as well as overall course impacts. The survey will take place over the course of the Spring of 2023 and will target both current and previous students, as well as instructors that have adapted this course material at other institutions. The aim of the survey is to better gain insight into:

This course provides stepping stones for both economics and non-economics students to engage with GTAP materials and models. By presenting this paper at the conference, we hope to encourage other members of the GTAP community to use this interdisciplinary material in their own research or in their own courses.