

Soils and Civilizations: Using a General Education Course to Teach Agricultural Relevance

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Abstract

The enrollment of students to the major scientific disciplines related to agriculture has been on the decline over the past decades. While it is unclear why enrollments change, few would argue that these same disciplines have not been proactive in raising the awareness and importance of environmental disciplines towards sustainable development and the survival and stability of civilizations. Today, most students are unaware of current food production and food security issues and the career opportunities associated with our majors that are hidden inside the “College of Agriculture.” We developed a general education course that addresses relevant food security issues and outlines the sciences contained within agriculture and future opportunities for feeding future generations. The objectives of this paper were to determine how our general education course changes student perception of population, food security and civilization stability and the relationship these concepts have with environmental sustainability. We evaluated student survey responses from two semesters (n=435) of our course. Fifty-two percent of students did not know a major in soil science existed, while 56% responded that they would like to take another course in that discipline. Ninety-nine percent indicated that knowledge of soil science was important in understanding food security, with 43% indicating that their opinion of these issues changed since the beginning of the semester. The food security knowledge and expertise contained within the Agriculture College is seen by students as highly relevant to their future and suggests more forthright marketing through general education courses of our expertise and career opportunities related to these disciplines should be explored further.

Introduction

Climate change, population growth, food security and sustainable intensification are all examples of the buzz words that drive the public discourse shaping our perceptions about the role agriculture and the environment will play in future generations. While roughly 12% of the world’s population does not get enough to eat, most health issues in developed countries revolve around obesity and overconsumption. Population growth is occurring in areas with less productive soils that are degraded or rapidly degrading due to unsustainable agricultural practices (Bindraben, et al., 2012). Agriculture can be a source or a sink in regards to greenhouse gases (GHG) and currently produces as much as 13% of GHG emissions (FAO, 2009; FAO, 2011; FAO, WFP and IFAD 2012; Follett, et al.; 2011).

Since 1960 when our population surpassed 3 billion people, more than 4 billion new faces have populated our planet with an increase of nearly 80 million each year. Malthus (1793) warns us about how populations crash when food production does not grow at the same rate as population. By the time our current college graduates arrive at mid-career—in just 20 years—there will be another two billion persons to clothe and feed. This represents a range of problems that will require the best minds to research and solve these pressing issues. Unfortunately, most of the current young generation has a low awareness and inaccurate perceptions with regards to the importance of agriculture (Terry and Lawver, 1995, Gonzalez, 2006). This has mainly been attributed to urbanization and lack of exposure to food production activities. Farm and rural populations have declined, with less than 5% of the U.S. population now living on farms and less than 2% of the labor force working in agriculture

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(Dimitri, et al., 2005), resulting in less contact by young people with agriculture. Gonzalez (2006) found most high school students either have misconceptions about agriculture or lack knowledge about agricultural fields of study and employment opportunities.

While the National Academy of Sciences reported significant increases in the number of U.S. college graduates in agricultural and natural resources disciplines from 1987 to 2007, most of the increases were in natural resources conservation, research and animal science fields of study (2009). Several studies have also shown that the enrollment of students to disciplines related to soil and earth sciences has been on the decline since the early 1990's and 2000's (Hartemink, 2008; Collins, 2008). Unfortunately, agricultural scientists and Land Grant Universities have generally adopted a "Field of Dreams" approach to marketing our disciplines whereby we do little to entice students to explore the relevancy of our scientific disciplines to food security and civilization sustainability. In 2010, the Soil Science Society of America conducted a survey to further investigate the trends in soil science education and training (Havlin et al., 2010). One of the concerns that prompted the study was the fact that there was declining academic course offering and enrollment to soil science education programs at land grant universities, a concern also raised by Collins (2008). Havlin et al. (2010) recommended promoting soil science during earlier stages of education and opening general soil science courses up to the wider college student population as part of "general education science credits."

The National Academy of Sciences book, "Transforming Agricultural Education for a Changing World," presented an imperative to change agricultural education (National Academy of Sciences, 2009). The national research priority agenda for 2011-2015 put forth by the American Association for Agricultural Education supports this view (Doerfert, 2011). While many approaches are needed, this paper addresses one ongoing development of a curriculum to increase knowledge of agriculture and soil science by changing fundamental perceptions about agriculture that would appeal to a broader student population. The "Soils and Civilizations" curriculum presented in this paper blends soil science and agriculture with respect to history and civilization and has success at the University of Tennessee (UT) by increasing the number of degrees pursued within the "College of Agriculture." This class is populated by a variety of students with undeclared majors to upperclassmen in engineering and nursing.

The course fills a general education requirement at UT and has evolved and grown over the nine years of its offering to over 200 students each semester. Several

approaches are used in the course and data is being collected to begin to assess the impact this course has on attitudes about agriculture and soil science. Each semester several students change majors and become students in the College of Agriculture and Natural Resources as a result of taking this course.

The course addresses some of the most important intersections of agriculture and society, including:

1. Distribution of both population and food production and their impact on food security
2. Environmental degradation and its impact on food production
3. Historical analysis of the relationship between civilization success or failure and soil conservation
4. The potential impact of climate change on food production
5. An analysis of climate change as a contemporary example of the "tragedy of the commons" (Hardin, 1968; Ostrom, 1990)

These topics provide a dynamic and cross-disciplinary subject matter that draws students into the material with issues that they can relate to on a personal level. At the outset, few students think there are environmental issues that could impact their livelihood but by semester's end there has been some movement on the educational continuum. That combined with the tragic collapse of civilizations provides a dramatic background for learning about soil science, agriculture, history and geography. For example the disappearance of the Anasazi, Sumerians and Nubians provides a rich backdrop for learning about agricultural practices and the impacts of drought, deforestation and salinization.

The objective of this approach is to:

1. Educate the student populace about agriculture
2. Make knowledge of agriculture more accessible to non-agriculture students by juxtaposing contemporary food security issues with historical collapses
3. Show the importance of agriculture in addressing today's pressing issues, such as food security and climate change
4. Show the relationship between agriculture and natural resource conservation to the rise and fall of civilizations
5. Entice students to learn more about agriculture and soil science with follow-up courses and possible pursuit of a major or career in agriculture and soil science.

Materials and Methods

The course "Soils and Civilizations" was developed nine years ago at the University of Tennessee and has been taught 14 times. The class in spring 2013 had 188 students with 233 registered for Fall 2013. For

the past five years enrollment has been capped by the seating capacity of the chosen classroom; in 2013 this course is held in the largest lecture hall on campus. The approach involves presenting interesting historical stories combined with science, problems and solutions and engaging and challenging students.

There is no way to precisely measure the impact of a curriculum on students, as ideas and concepts can be presented and discussed that students may not grasp until later in their academic career. However, this paper is an attempt to quantify more immediate change in perception and attitude. During the 2012 fall semester a survey was conducted at the end of the course to characterize attitudes towards agriculture, climate change and soil science and to determine if the course had an impact on their opinions. The survey response rate was 62% (84 of 135 students). Tables 1 and 2 list the survey questions given to students at the end of the fall 2012 semester and the overall response of the students to the questions based on a Likert scale of importance (Table 1) and scale of agreement to several statements (Table 2). For the spring 2013 semester, surveys were conducted at the beginning and end of the semester to capture the actual change in student perceptions to various topics within the period of the course and to gauge how significant this course is towards enhancing perceptions about the importance of soils and agriculture to development and food security. Questions were modified and student responses are compared between the beginning and end of the semester for scale of importance questions (Table 3) and scale of agreement statements (Table 4).

Results and Discussion

Thirteen percent of respondents in the fall 2012 survey indicated they were freshmen, 34% sophomores, 27% juniors and 26% seniors, with 56% male and 44% female. Based on the responses to the survey in Tables 1 and 2, we are able to make several noteworthy observations. Most of the students signified recognition of the connection between soils, agriculture and food security with 99% of respondents indicating that the class was somewhat or extremely important for understanding why soil is important to food security. Sixty-eight percent indicated it was extremely important for them to understand food security. Seventy-six percent indicated it was extremely important to understand soil resources to avoid environmental catastrophe. Forty percent of survey respondents agreed that their understanding of the topics covered in this course changed since the beginning of this class, while an additional 43% strongly agreed that their understanding of the topics covered in this course changed since the beginning of this class.

Response to the survey also suggests that this course could have an impact on students actually considering a career in soil science. While 52% indicated that soil science was an unknown discipline to them before the course, the survey shows a change in awareness with 56% agreeing or strongly agreeing that they would like to take another class in soil science. Interestingly, 13% agreed that if they had taken the course earlier in their academic career, they might have changed their major to soil science, while an additional 5% strongly agreed they might have changed their major.

The spring semester began with 193 students registered and 181 completed the course. During this

**Table 1. Student Responses at the End of 2012 Fall Semester
Using a Likert Scale Based on Questions/Statements Asked with Answers on a Scale of Importance**

#	Questions/Statements	Mean	SD	Scale of Importance									
				Extremely		Somewhat		No Opinion		Not Very		Not At All	
				# of 5's	% of 5's	# of 4's	% of 4's	# of 3's	% of 3's	# of 2's	% of 2's	# of 1's	% of 1's
1	The topics covered in this course	4.4	0.59	40	48%	42	50%	1	1%	1	1%	0	0%
2	This class is important for understanding why soil is important to food security	4.7	0.49	60	71%	23	27%	1	1%	0	0%	0	0%
3	It is important to understand intrinsic soil productivity and its link to sustainability	4.5	0.59	44	52%	36	43%	4	5%	0	0%	0	0%
4	How important would it be for you to take a student travel course to further understand food security?	3.4	1.10	14	17%	30	36%	22	26%	14	17%	4	5%
5	How important is it to understand the downfall of the Maya	4.0	0.75	17	20%	51	61%	13	15%	2	2%	1	1%
6	How important is it to understand the downfall of the Greenland Norse?	3.8	0.78	14	17%	49	58%	15	18%	6	7%	0	0%
7	How important is it to understand the role of energy in our lifestyle?	4.8	0.45	66	79%	17	20%	1	1%	0	0%	0	0%
8	How important were the oral readings in lecture?	3.4	1.02	5	6%	45	54%	14	17%	16	19%	4	5%
9	How important is it to you to understand food security?	4.6	0.70	57	68%	20	24%	4	5%	2	2%	0	0%
10	If you were forced to emigrate, how important would it be to evaluate the soils before hand?	4.3	0.82	43	51%	26	31%	13	15%	2	2%	0	0%
11	Understanding soil resources to avoid environmental catastrophe?	4.8	0.46	64	76%	19	23%	1	1%	0	0%	0	0%

Table 2: Responses at the End of 2012 Fall Semester to Statements Based on a Scale of Agreement

#	Statements	Mean	SD	Scale of Agreement									
				Strongly Agree		Agree		No Opinion		Disagree		Strongly Disagree	
				# of 5's	% of 5's	# of 4's	% of 4's	# of 3's	% of 3's	# of 2's	% of 2's	# of 1's	% of 1's
12	This class has changed my understanding of how we feed ourselves	4.0	0.84	22	26%	45	54%	12	14%	4	5%	1	1%
13	Climate Change is a fact	4.6	0.60	56	67%	23	27%	5	6%	0	0%	0	0%
14	We collectively need to understand the effects of humans on our changing climate	4.6	0.60	57	68%	24	29%	2	2%	1	1%	0	0%
15	The information provided in this course is important for all UT students	4.1	0.96	32	38%	39	46%	7	8%	3	4%	3	4%
16	My understanding of the topics covered in this course has changed since the beginning of this class	4.2	0.85	36	43%	34	40%	11	13%	2	2%	1	1%
17	This class has taught me that understanding population growth is important to understanding our future	4.4	0.72	46	55%	29	35%	8	10%	1	1%	0	0%
18	If I had taken this course earlier in my academic career, I might have changed my major to soil science	2.5	1.09	4	5%	11	13%	24	29%	29	35%	16	19%
19	I would like to take another course in soil science	3.6	1.04	17	20%	30	36%	25	30%	9	11%	3	4%
20	The oral readings in class wasted limited class time	2.5	0.98	2	2%	9	11%	32	38%	25	30%	14	17%
21	If I knew I could make a living as a soil scientist I would become one	2.7	1.14	5	6%	15	18%	27	32%	22	26%	15	18%
22	There is more fiction than fact in this course	1.8	1.01	3	4%	3	4%	8	10%	28	33%	42	50%
23	The Bushmen are an example of a sustainable civilization	3.5	1.19	19	23%	30	36%	14	17%	17	20%	4	5%
24	We—the Americans—are an example of a sustainable civilization	2.0	1.11	1	1%	11	13%	12	14%	23	27%	36	43%
25	Global Warming is a fact and due to human activity	3.7	1.04	20	24%	35	42%	20	24%	5	6%	4	5%
26	Soil science was an unknown discipline to me until I took this course!	3.2	1.45	22	26%	22	26%	6	7%	22	26%	12	14%

Table 3: Comparison of the Mean Responses to Survey Questions at the Start and End of 2013 Spring Semester to Questions Based on the Scale of Importance Shown in Table 1

#	Questions	Beginning Survey Mean	Ending Survey Mean	Difference
1	How important were the topics covered in this course to you?	4.0	4.2	0.21
2	How important is a course on soils for understanding food security?	4.5	4.8	0.28
3	How important is it to understand intrinsic soil productivity and its link to sustainability?	4.1	4.6	0.42
4	How important would it be for you to take a student travel course to further understand food security?	3.3	3.3	-0.02
5	How important is it to understand the downfall of the Maya?	3.6	3.7	0.10
6	How important is it to understand the downfall of the Greenland Norse?	3.5	3.6	0.11
7	How important is it to understand the role of energy in our lifestyle?	4.6	4.8	0.17
8	How important is it to understand the role of agriculture in climate change?	4.5	4.7	0.17
9	How important is it to you to understand food security?	4.2	4.6	0.42
10	If you were forced to emigrate, how important would it be to evaluate the soils beforehand?	3.8	4.4	0.59
11	Understanding soil resources to avoid environmental catastrophe?	4.5	4.8	0.32

Table 4: Comparison of the Mean Responses to Survey Statements at the Start and End of 2013 Spring Semester to Statements Based on the Scale of Agreement Shown in Table 2

#	Statements	Beginning Survey Mean	Ending Survey Mean	Difference
12	I understand how we feed ourselves	3.9	4.2	0.28
13	Climate Change is a fact	4.1	4.8	0.75
14	We collectively need to understand the effects of humans on our changing climate	4.6	4.6	-0.01
15	The information provided in this course is important for all UT students	3.6	4.3	0.78
16	I have good understanding of sustainable agriculture.	3.0	4.1	1.12
17	I think population growth is important to understanding our future.	4.2	4.5	0.35
18	I would like to take another course in soil science	3.3	3.6	0.34
19	I would like to take more agriculture related classes.	3.7	3.8	0.11
20	If I knew I could make a living as a soil scientist I would become one	2.7	2.8	0.06
21	I believe technology can solve all of our problems	2.5	2.6	0.10
22	The Bushmen are an example of a sustainable civilization	3.1	3.9	0.83
23	We—the Americans—are an example of a sustainable civilization	3.0	2.9	-0.09
24	Global Warming is a fact and due to human activity	3.4	3.8	0.32
25	Soil science is an unknown discipline to me	3.4	2.3	-1.10
26	Today more countries have programs on fighting obesity than hunger	3.1	3.4	0.22
27	Climate change is a new phenomenon	2.3	1.8	-0.45
28	Sustainable energy use is an issue that should be addressed	4.2	4.5	0.27
29	Soils have little impact on food security	1.7	1.6	-0.17
30	“Civilizations” are “sustainable”	3.0	2.8	-0.17
31	I think that all students should be required to take a class in agriculture or soil science	3.3	3.9	0.59
32	I think that government has an important role in protecting natural resources	3.8	4.3	0.47

session, 175 students took the survey at the beginning of the semester and 176 students completed the survey at the end. Twenty-nine percent of respondents taking the spring 2013 survey indicated they were freshmen, 21% sophomores, 26% juniors and 23% seniors, with 60% male and 40% female. Forty-six percent indicated they grew up in the suburbs, 16% in the city, 25% in rural areas and 13% on farm. The most significant change in responses by students to survey statements at the end of the course was an increase in the mean from 2.9, where 3 was “No opinion” to 4.1, with 4, being “Agree” in response to the statement, “I have a good understanding of sustainable agriculture.” Another notable change was an increase in the mean from 3.2 to 3.8 in response to the statement, “I think that all students should be required to take a class in agriculture or soil science” and from 3.5 to 4.3 in response to the statement that “The information provided in this course is important for all UT students.” By the end of the course students indicated that the !Kung Bushmen were an example of a sustainable civilization (Figure 1) and our US civilization is similar to most civilizations studied that have disappeared. While the news politicizes climate change issues, students found climate change to be a fact.

But perhaps more importantly for those of us employed within the Land Grant University System, the survey results suggested that students gained a better understanding of food production and how population growth can cause civilization demise. Student perceptions moved toward the understanding that few of our current civilizations are truly sustainable with sustainable energy use as just one issue that needs to be addressed.

Summary

Based on the responses of this survey, there is a strong indication that this course has an influence/impact on the attitudes of students towards soil, agriculture and their relation to food security and sustainability. Registration for the fall 2013 semester increased 17% to a total of 233 students. Surveys will be used to continue measurements and other methods will be explored to quantify the impact of this course on enrollment to soil science courses. We think an introductory class is necessary to explain agriculture’s role in civilization, subsequent civilization stability and solving global agricultural and food security problems. Quite simply, this course outlines the mission of the Land Grant Universities, a mission that can only be completed if we strive to enlist the best minds to work in agricultural sciences. Our future may depend on our success at marketing our disciplines to future generations and this course is a tool to do so.

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