

## **Willingness To Pay For Climate Change Mitigation: College Students' Perceptions In Tennessee And Kentucky**

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### **ABSTRACT**

Climate change and its impact on agriculture and rural communities has been a much-discussed topic among scientists, academics and the general public. Existing studies have revealed a disconnect between agricultural stakeholders and the wider climatological community in the U.S., which impacts the process of making informed decisions in response to climate related issues in agriculture. This study evaluates college students' perspectives about global warming and climate change in two agricultural schools located in western Tennessee and western Kentucky, respectively. Data was collected using a Likert scale survey tool and questions ranged from awareness of specific climate change terms, mitigation efforts and the level of concern for such efforts. Ultimately, this study analyzed differences in students' perception of willingness to pay for climate change mitigation efforts as affected by demographics, concern about the impact of climate change on agriculture, and existing knowledge about climate change. Among other variables, the need for more information about climate change had a

**significantly positive impact on the willingness to make a financial contribution to climate change mitigation efforts. This study will potentially enhance existing literature on the future workforces' perceptions for climate change mitigation efforts, which will in turn provide insights for policy recommendations.**

**Keywords:** agriculture, climate change, college students, mitigation, willingness to pay.

## INTRODUCTION

### CLASS and CCE Initiative

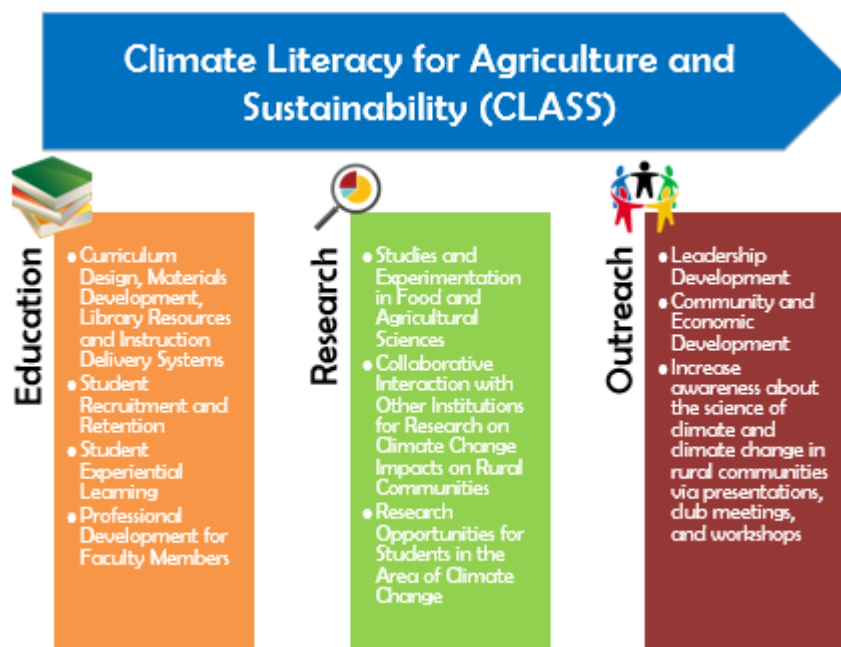
Agriculture in the 21st century is faced with the herculean task of providing for the needs of a growing world population particularly in the event of a changing climate. The U.S agricultural industry is a major player in the world food market providing for a significant share of the global food supply. U.S agriculture export values have varied over the years with a high of \$152 billion in 2014 and \$136.7 billion in 2019 [7]. Commodities such as corn, soybeans and wheat have been staple exports for U.S. farmers for years. Therefore, any significant change in climate that impacts agricultural production in the U.S can have implications for both domestic as well as the global food supply, and corresponding impacts on food security. The existing situation in the U.S regarding climate change understanding and knowledge is that many people with direct or indirect stakes in agriculture do not clearly understand the basics of climates and climate change.

This is an especially acute problem in rural areas of the country, such as the ones in western Tennessee and western Kentucky, where state and local budgets may limit science-education funding, and impedes the process of making informed decisions and preparing the workforce for mitigating risks related to climate change in agriculture. In light of the above, climate change education emerges as a crucial area for K-12 educators, students, college students, as well as agricultural communities.

Climate Literacy for Agriculture and Sustainability (CLASS) is the driving force behind this research conducted at the University of Tennessee at Martin and Murray State University located in western Tennessee and western Kentucky, respectively. This federally funded Climate Change Education (CCE) initiative uses a three-pronged approach using education, research, and outreach to promote awareness in rural communities about climate change (Figure 1). The purpose of the education initiative is to provide curriculum design, material development, library resources, and instruction delivery systems. Other pieces that fall under the education portion include student recruitment and retention, student experiential learning, and professional development for educators with an emphasis on climate change education.

The research approach focuses on developing studies and experiments in food and agricultural sciences, collaborative interaction with other institutions for exploring issues related to climate change impacts on rural communities, and research opportunities for students around the theme of climate change. The outreach component focuses on providing leadership development, community and economic development, and increasing awareness about the science of climate and climate change in rural communities via presentations, club meetings, and workshops. The overarching goal of the CLASS initiative are to incorporate climate change education in the curriculum for

undergraduate and graduate agriculture classes, build capacity in the partnering institutions for both face-to-face and online teaching interfaces for courses in climate change, to encourage undergraduate and graduate-level student involvement in teaching and research related to climate change, and to introduce climate change education to the rural communities by conducting workshops on climate change. The study in-hand explores the research component by using a survey-based approach to evaluate differences in college students' perception of willingness to pay for local or community-based climate change mitigation efforts in western Tennessee and western Kentucky.



**Figure 1. Components of the CLASS initiative**

## LITERATURE REVIEW

Most willingness to pay based studies focus on the maximum amount that a beneficiary would give to receive a product or service. Specific studies among college students examining willingness to pay for climate change mitigation efforts are scarce. The following studies provide a general background related to the topic of people's willingness to pay as it relates to natural resources and the environment as well as efforts to mitigate climate change and global warming.

Carpentier and Vermersch [3] explored whether citizens were willing to pay for bottled water that was higher quality than the water available to them. This survey and study found that there were several factors that made analyzing this particular natural resource difficult. Bottled water and soft drinks were both substitutes for the tap water, and evidence concluded that people who had access to higher quality drinking water were less likely to purchase bottled water than those who had access to lower quality water. Akter and Bennett [1] explored how perception of climate change related to mitigation action.

The study was conducted in Australia and respondents were asked if they would be willing to pay extra on household expenses each month to mitigate climate change effects. If they responded “no”, a follow-up question asked if they would be willing to pay an offered amount if global cooperation could be achieved. Results from the survey showed that only 20% were highly concerned with the impact of climate change in Australia. Most answers indicated a higher willingness to pay among respondents with increasing expectations of temperature increase. Also, willingness to pay increased at a decreasing rate similar to the results found in other surveys.

In another study, Tewari et al. [6] noted that public perception of global warming is a critical factor when analyzing how policies regarding climate and global warming are put in place. This study evaluated how education levels, media, and information can alter public perception on global warming, and how the variations in willingness to pay for climate change mitigation efforts were affected by variables such as income, level of education, and age. Interestingly, higher education levels correlated with a higher concern among the public in regard to the problem of global warming.

Dobbs et al. [4] explored information related to a specialty product that consumers might be willing to pay a premium for if it benefits the economy or environment. However, there might be another way that income levels change the amount that consumers are willing to spend which is through paying premiums. It was found that consumers would be willing to pay premiums for specific products that were labeled as local or environmentally friendly. Li et al. [5] provided data that relates directly to climate change. In this study, it was found that doubling the income leads to a 0.1% change in elasticity for the willingness to pay for climate mitigation. It was also found that another factor that heavily influenced the willingness to pay was the education level of respondents. Boehm et al. [2] collaborated on a study that directly explored how consumers would be willing to pay for climate change mitigation in agriculture based on their knowledge about climate change. This study acknowledged the fact that consumer knowledge of climate could have some effect on the results of willingness to pay.

The results from this survey showed that consumer knowledge barely changed their thoughts or willingness to pay for climate change mitigation efforts. Another interesting element noted in this study was that consumers' willingness to pay was tied to their purchases of agricultural products. Based on previous studies, this article stated that individuals would pay a markup of 30% if apples were labeled for the reduction of carbon emissions and up to 20% more for milk with a similar label. Another aspect explored in this literature review was the risk perception and knowledge of climate change related terminology among respondents. Weiwei et al. [8] discussed public risk perception and willingness to pay for mitigating climate change specifically using smog as an example. This study found that people living near the issue were more likely to be willing to pay up to 0.5% of their income. It was also noted that the more extensive the knowledge of the participants about climate change, the higher their willingness to pay for efforts in pollution reduction.

Based on the studies discussed above, it can be concluded that there are several factors that make agriculture-based willingness to pay projects difficult to test accurately. Moreover, evidence collected from studies on willingness to pay for agriculture-related projects in the context of climate change is differentiated through variations in income, gender, and education.

## Objective and Methods

The overall objective of this study is to evaluate college students' perspectives about climate change in two agricultural universities located in western Tennessee and western Kentucky, respectively. Specifically, this study examined the willingness to pay for climate change mitigation efforts as affected by variables such as age, gender, education, and knowledge about climate change.

A Likert scale survey was designed to gather data from college students and a logistic regression procedure was used in SAS to examine the willingness to pay for climate change mitigation efforts. Survey questions captured the concern about earth's climate and long-term weather patterns, concern about agriculture in one's region as affected by a changing climate, and the concern that agriculture globally may be affected by a changing climate. The question capturing the willingness to pay component of the study asked if the participants would be prepared to make a financial contribution for local/community-based projects that may help mitigate the effect of climate change to some extent.

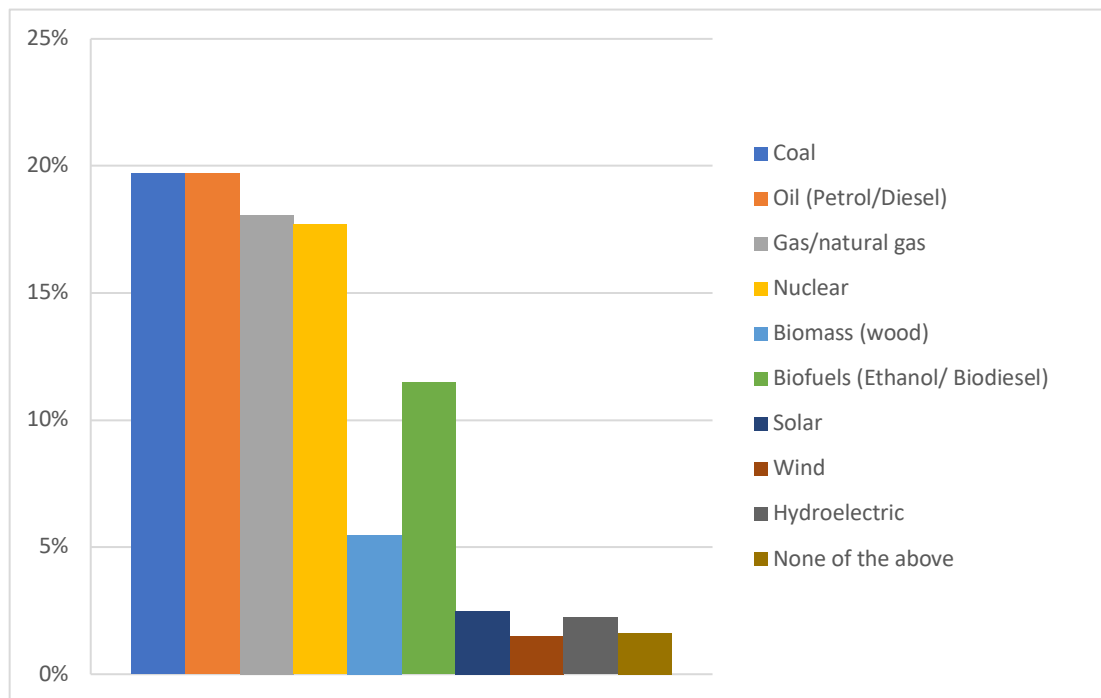
Surveys were administered to students in agriculture at the University of Tennessee at Martin and Murray State University and 230 responses were obtained of which 118 responses were complete for the variables of interest for the logistic regression model. The survey was administered via an email link from Questionpro.com. The protocol for the survey was reviewed and approved by the University of Tennessee at Martin Institutional Review Board Committee (2019-724-E05-4005). Demographic information collected included: gender and if the student was a resident of west Tennessee/west Kentucky. A description of the chosen survey questions corresponding to the abbreviated terms as used in the logistic regression analysis are provided below in Table 1.

**Table 1. Description of individual level variables employed to estimate the model**

Variable	Description
<b>Wtp</b>	Would you be prepared to make a financial contribution to local/ community-based projects that may help mitigate the effects of climate change to some extent? 1 = Yes
<b>Rtnky</b>	Are you a resident of west Tennessee/west Kentucky? 1 = Yes
<b>Gender</b>	What is your gender? 1 = male
<b>Earthclim</b>	On a scale of 1-5 how concerned are you that the earth's climate and long-term weather patterns are changing? (1 being not concerned at all, and 5 being very concerned)
<b>Agrlocal</b>	On a scale of 1-5 (1 being not concerned at all, and 5 being very concerned) how concerned are you that agriculture in your region may be affected by a changing climate?
<b>Agrglobal</b>	On a scale of 1-5 (1 being not concerned at all, and 5 being very concerned) how concerned are you that agriculture (globally) may be affected by a changing climate?
<b>Wind</b>	Do you agree that energy generated from wind can replace the use of fossil fuels (Oil/gas/coal etc.)? (1 = Agree 2 = Neutral 3=Disagree)
<b>Solar</b>	Do you agree that energy generated from sun (solar) can replace the use of fossil fuels (Oil/gas/coal etc.)? (1 = Agree 2 = Neutral 3=Disagree)
<b>Hydroelectric</b>	Do you agree that hydro-electric sources can replace the use of fossil fuels (Oil/gas/coal etc.)? (1 = Agree 2 = Neutral 3=Disagree)
<b>Biofuels</b>	Do you agree that energy generated from biofuels can replace the use of fossil fuels (Oil/gas/coal etc.)? (1 = Agree 2 = Neutral 3=Disagree)
<b>Morinfo</b>	Do you feel that you need more information about climate and climate change? (1 = Agree 2 = Neutral 3=Disagree)
<b>Climateclass</b>	Did the information provided to you at climate education events/classes add to your existing knowledge and interest in climate and climate change? (1 = Agree 2 = Neutral 3=Disagree)
<b>Climclasimp</b>	If yes, on a scale of 1-5 (1 being - very low or negligible, and 5 being - high impact level of knowledge and interest) how much did climate education event/classes in your university/community add to your existing knowledge and interest in climate and climate change?

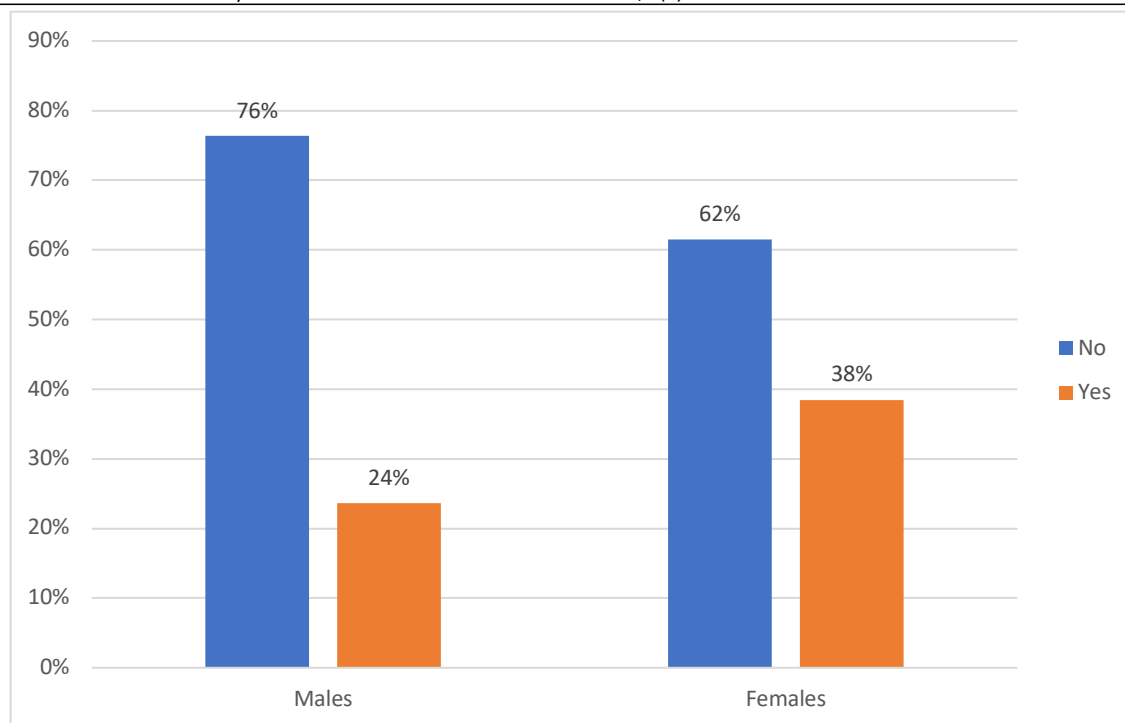
## RESULTS AND DISCUSSION

Figure 2 shows the responses to the question regarding sources that generate electricity in ways which significantly increase the risk of climate change. The purpose of this question was to evaluate the climate literacy of the participants and multiple responses could be selected. Respondents identified sources that produce more air pollution and unnatural products as being significant in increasing the risk of climate change. Solar, wind, gas/natural gas, and hydroelectric were identified as posing the least risk of exacerbating climate change.



**Figure 2. Response to the question “In your view, which of the following generate electricity in ways which significantly increase the risk of climate change? Select as many as apply.”**

Figure 3 outlines the responses by gender to the question on preparedness to make a financial contribution to local/community projects that may help mitigate the effects of climate change. It was found that 95% of the students were between the ages of 18 and 25 and that females were more willing to pay for climate change mitigation efforts when compared to male students, and highlights the plausible impact that gender may have on financial contribution for climate related efforts.

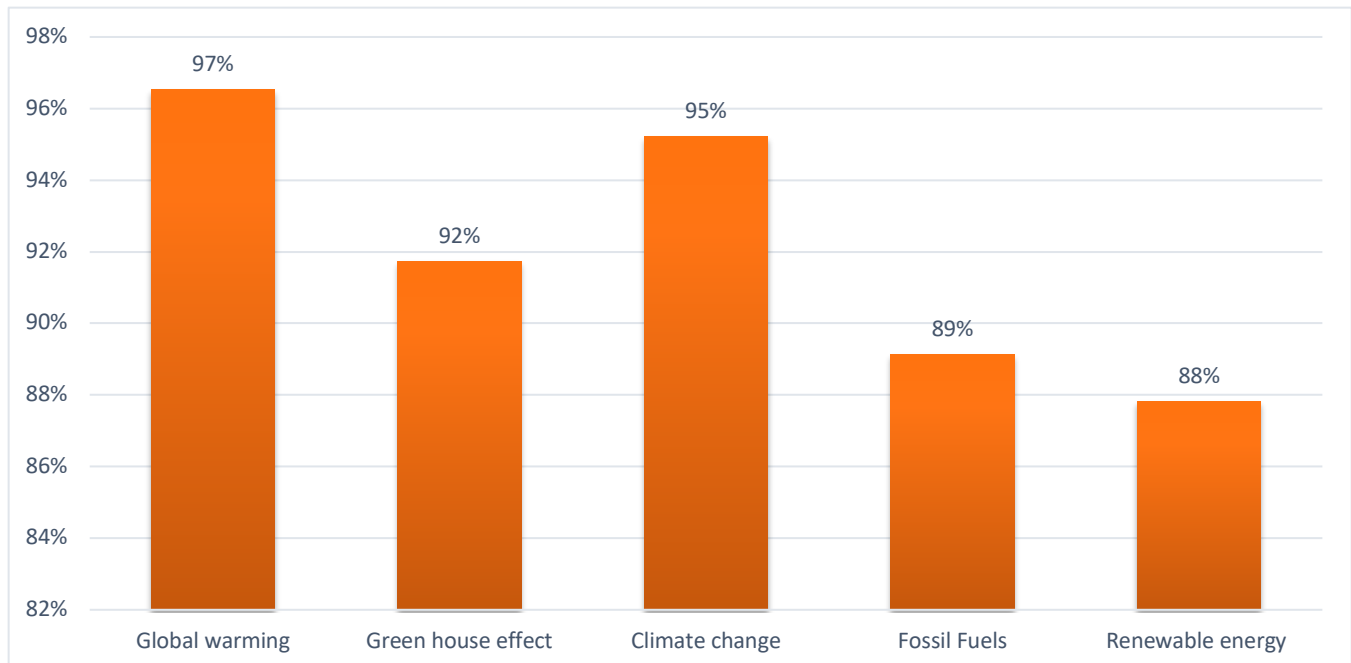


**Figure 3. Response by gender to the question “Would you be prepared to make a financial contribution to local/ community-based projects that may help mitigate the effects of climate change to some extent?”**

The questionnaire also evaluated students' concern about variables related to the weather patterns, and the impacts of climate change on agriculture, locally and globally. For the question “On a scale of 1-5 (1 being not concerned at all, and 5 being very concerned) how concerned are you that the earth's climate and long-term weather patterns are changing?”, results showed that approximately 40% of the students were neutral or indifferent to the question. Those not concerned at all were about 8% of the respondents and 18% of respondents were somewhat concerned that the climate is changing. Another question asked, “On a scale of 1-5 (1 being not concerned at all, and 5 being very concerned) how concerned are you that agriculture in your region may be affected by a changing climate?” Results indicated that about 52% of the respondents showed high levels of concern, which could be attributed to the wording of the question.

When compared with the previous question, this question asked about ‘agriculture in your region’ which may have triggered the respondents to worry about the proximity and how they may be affected due to the change. Another question that is intuitive to examining student concerns about agriculture and climate change asked “On a scale of 1-5 (1 being not concerned at all, and 5 being very concerned) how concerned are you that agriculture (globally) may be affected by a changing climate?” Interestingly, respondents were more concerned with agriculture globally than they were with agriculture locally and about 58% of the respondents indicated high levels of concern. When asking questions centered around impacts on agriculture, it makes sense that students with a major in agriculture would be more concerned with climate change affecting agriculture than they would be with the earth's climate in general. Students' prior knowledge or having taken a course about climate change related issues could also have impacted the answering of these questions.

Another question examined the awareness of students for the climate change terminology commonly used, and multiple answer choices could be selected. The purpose of this question was to obtain data on the current status of climate change related knowledge of the surveyed students. Approximately 96% of the students were aware of the term 'global warming', followed by 'climate change' at 95%, and 'greenhouse effect' at 92%. Students seemed slightly less aware of the terms 'fossil Fuels, and 'renewable energy' at 89% and 88%, respectively. These response percentages by terms are presented in Figure 4.



**Figure 4. Responses for awareness of terms related to climate change (*multiple answer choices could be selected*)**

### Results for willingness to pay analysis

Descriptive Statistics for the variables used in the estimation of the logistic regression model are provided in Table 2.

**Table 2. Descriptive statistics of the sample for individual variables**

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
Wtp	118	0.33051	0.47240	39.00000	0.00000	1.00000
Rtnky	118	0.64407	0.48084	76.00000	0.00000	1.00000
Gender	118	0.41525	0.49487	49.00000	0.00000	1.00000
Earthclim	118	3.11864	1.22767	368.00000	1.00000	5.00000
Agrlocal	118	3.48305	1.22463	411.00000	1.00000	5.00000
Agrglobal	118	3.61017	1.18418	426.00000	1.00000	5.00000
Wind	118	1.79661	0.82233	212.00000	1.00000	3.00000
Solar	118	1.65254	0.79933	195.00000	1.00000	3.00000
Hydroelectric	118	1.55932	0.71063	184.00000	1.00000	3.00000
Biofuels	118	1.64407	0.71043	194.00000	1.00000	3.00000
Morinfo	118	1.66102	0.83942	196.00000	1.00000	3.00000
Climateclass	118	1.49153	0.79255	176.00000	1.00000	3.00000
Climclasimp	118	2.84746	1.16668	336.00000	1.00000	5.00000



Maximum Likelihood Estimates were calculated with Wtp as the dependent variable. Interestingly, being a resident of western Tennessee and western Kentucky had a significantly negative impact on willingness to pay, which indicates that most students from the region were not willing to make a financial contribution for local or community based projects to mitigate the effects of climate change. Concern with the earth's climate changing also had a significantly negative impact on willingness to make a financial contribution for climate change mitigation efforts.

However, the need for more information about climate and climate change had a significantly positive relation with the willingness to make a financial contribution for climate change efforts. This reinforces the need for more information and awareness regarding the science of climate change and climate change mitigation efforts. The remaining variables in the model did not show significance for impact on willingness to make a financial contribution for local or community-based projects to mitigate the effects of climate change. Table 3 shows these results.

**Table 3. Maximum likelihood estimates for the logistic regression model (Dependent variable = Wtp)**

Parameter	DF	Estimate	Std. Error Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	0.4184	1.8460	0.0514	0.8207
Rtnky	1	-1.0940	0.5607	3.8071	0.0510*
Gender	1	-0.00620	0.5894	0.0001	0.9916
Earthclim	1	-0.8291	0.2871	8.3410	0.0039***
Agrlocal	1	-0.2567	0.3590	0.5114	0.4745
Agrglobal	1	-0.0367	0.4025	0.0083	0.9273
Wind	1	0.0213	0.5103	0.0017	0.9667
Solar	1	0.0338	0.5605	0.0036	0.9519
Hydro	1	0.2164	0.5624	0.1480	0.7004
Bio	1	0.6762	0.4873	1.9257	0.1652
Morinfo	1	0.9717	0.3659	7.0535	0.0079***
Climateclass	1	0.4814	0.4241	1.2884	0.2563
Climclasimp	1	0.4345	0.2785	2.4330	0.1188

\*denotes 10%, \*\*5% and \*\*\*1% level of significance

## CONCLUSION

Existing studies have revealed a disconnect between agriculture stakeholders and the wider climatological community in the U.S., which impacts the process of making informed decisions in response to climate related issues in agriculture. This study is part of a larger project with a focus on promoting within the agriculture community in western Tennessee and western Kentucky, awareness of the science of climate change and its impacts on agriculture to develop the knowledge, skills, and adaptive strategies required to meet the challenges associated with a changing climate. Evaluating college students' willingness to make financial contributions to local or community-based projects provides an insight into their current perspective and preparedness for dealing with climate change. Results highlight the need for providing more information and promoting awareness about climate change and how it affects rural communities. Studies such as the one in

hand potentially enhance existing literature on the future workforces' understanding of climate change mitigation efforts and provide insights for policy recommendations.

### **Disclosure statement**

No potential conflict of interest was reported by the authors.

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