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A Comparison of Farmers' Perceived Impacts on the Environment in Belize and Kentucky

Laura Bronte Murrell and Douglas W. Hume
Northern Kentucky University

Abstract: This paper explores how farmers in Belize and Kentucky perceive their impacts on the environment. Ethnographic data were collected from rural farming villages in Orange Walk District (OWD), Belize, and from rural farming communities in northern Kentucky, United States. The findings of the interviews reveal how these two cultures perceive environmental problems, how environmental problems impact them, and how farmers influence the natural world. In addition to examining how rural Belizeans and Kentuckians understand their impacts on the environment (i.e., climate change, water pollution, biodiversity loss, deforestation, energy use and pollution, agricultural pesticide and herbicide use, genetic engineering, soil erosion, invasive species, and population growth), this paper also discusses how perceived environmental concerns and impacts are both similar and different between Belizean and Kentuckian farmers.

Keywords: environmental perceptions, natural world, farmers, Belize, Kentucky

¹ Correspondence concerning this article should be addressed to Laura Bronte Murrell, Sociology, Anthropology, and Philosophy Department, Northern Kentucky University, 1 Nunn Drive, Landrum 228, Highland Heights, KY 41099, murrell11@nku.edu, 859-572-5702

A COMPARISON OF FARMERS' PERCEIVED IMPACTS ON THE ENVIRONMENT IN BELIZE AND KENTUCKY

INTRODUCTION

Within the background of the current scientific and public discussion of climate change, this paper examines how two groups of rural farmers, one in northern Belize and another in northern Kentucky, perceive their impacts on their environment. Ethnographic data were collected from rural sugar cane farming villages in Orange Walk District (OWD), Belize, and from rural mixed farming communities in northern Kentucky, United States. The focus of ethnographic interviews was to collect information on how these farmers perceive environmental problems, how environmental problems impact the farmers, and how farmers influence the natural world. Both communities recognized different environmental impacts that affected their communities; among Kentucky farmers the spread of invasive species impacting their crops and among Belize farmers pollution enabling the spread mosquito-borne illnesses and threatening air quality.

PREVIOUS RESEARCH ON ENVIRONMENTAL ISSUES IN BELIZE

Three important themes concerning northern Belize's agricultural history of the past two hundred years are the colonization of Belize by the British, the Maya Caste Wars, and the growth of the sugar industry. Sugar cane farming first came to Belize when survivors of the Maya Caste Wars introduced sugar cane in the mid 1800s, which was swiftly followed by British control of farmlands as an attempt to overpower the indigenous population. It was not until 1972 that plantations closed due to competition from independent small farms (Higgins, 1998, pp. 11-12). Belizean agriculture also has a history of Dichlorodiphenyltrichloroethane (DDT) use throughout the second half of the 20th century, from 1957-1997. While DDT was outlawed in 1997 by the Belizean government, current soil testing suggests that it has been used more recently in the region, however the source of the

DDT has not been determined. Though it is unclear if DDT is still being applied by the farmers themselves, there are other practices with negative environmental consequences being employed by farmers such as *milpa* (swidden/slash-and-burn farming of maize, squash, and beans). The environmental impact of *milpa* farming is dependent upon scale. For example, a recent study found that Q'eqchi Maya villagers believed *milpa* farming to be harmful to the environment only when practiced on a large scale, such as the mass-produced banana farming that the Q'eqchi had engaged in after European contact (Downey, 2009). In a 2014 report performed by the Belize Sugar Industry (BSI) and the American Sugar Refinery (ASR), BSI and ASR reported that they intend to improve sustainability by producing cogenerated electricity and increasing renewable energy (burning of *bagasse* [sugar cane plant pulp residue] to create electricity), which should reduce Belize's carbon footprint and offset the high costs of importing energy, such as coal and oil. BSI and ASR both recognize that climate change is a threat to Belize because of its long coastline, which is vulnerable to changes in sea level (2014, p. 1). Smaller organizations, such as the Progressive Sugar Cane Producers Association and the Corozal Sugar Cane Producers Association, are also involved in improving environmental sustainability; such as working with Fair Trade and helping farmers develop environmentally friendly farming practices (Sugar Industry Research and Development Institute, 2016, p. 2).

Since 2013, an annual ethnographic field school organized by the Center for Applied Anthropology at Northern Kentucky University has focused their research on sugar cane farming in OWD villages. The ethnographic field school's first report noted that most anthropological research in Belize has focused on agriculture, as it is an important industry in the country and an important means of subsistence (Hume et al., 2014). The report stated that in northern Belize, villagers earn some portion of their income from sugarcane farming by either owning farms, driving cane trucks, or working in the fields, but those jobs

are mostly seasonal because they only plant and harvest the sugarcane during short periods at certain times of the year (Hume et al., 2014, pp. 2-12). The 2014 field school conducted interviews that focused on education and sugarcane farming, reporting that there was concern amongst the villagers that climate change impacts farming by temporally shifting the rainy season to start earlier in the year, which complicates farmers' ability to predict the weather and therefore maximize the product of the farm (Hume et al., 2015, pp. 3-21). The field school's 2016 study explored issues related to cultural models of nature.

PREVIOUS ANTHROPOLOGICAL RESEARCH ON ENVIRONMENTAL ISSUES IN THE UNITED STATES

Anthropologists have recently seen rapid changes in cultural concepts of the environment, linking environmental beliefs to economic states of groups and individuals (Harper, 2001, p. 101). In 2002, researchers from Pennsylvania State University conducted research to determine what social aspects influence a person's support of environmental regulation. One finding of this research was that Central Pennsylvanians did not consider their personal energy use (i.e., coal and oil consumption) or home heating and cooling as contributions to climate change (O'Connor et al., 2002, p. 15). The researchers also found that people who are knowledgeable about climate change and expect negative repercussions from it are more likely to support government reduction of fossil fuel use (O'Connor et al., 2002, p. 1). More predictors of a person's concern about the environment are the individuals' perception that environmental protection does not threaten their employment, limit their personal freedoms, or harm the economy (O'Connor et al., 2002, p. 15). Another study on environmental values in the US in 1996, interviewing residents of Maine and New Jersey from various social backgrounds, found that people attributed humans with changes in climate for several reasons, of which the most often mentioned was pollution (Kempton, Boster, and Hartley, 1996, p. 20). Most of the participants also believe that the climate has already changed, connecting many of their personal experiences with global warming

(Kempton, Boster, and Hartley, 1996, pp. 78-80).

THEORETICAL APPROACH

The concepts of mental and cultural models enable people construct models of the world instead of simply adding new information to an unorganized collection of previously acquired information (Kempton, Boster, and Hartley, 1996, pp. 10-11). Mental models are simplified versions of the ideas that allow us to interpret the world and perform in it (Kempton, Boster, and Hartley, 1996, p. 10). Mental models of nature can be drastically different between individuals within the same populations who inhabit the same area and perform many of the same activities (Atran, Medin, and Ross, 2005, p. 744). Simply stated, cultural models are a collection of the mental models of a group of people. Cultural models of nature (organizations of constitutive components, i.e., animals, plants, physical environment, weather, humans, supernatural, etc.) are woven together by causal models (e.g., reasons for change due to natural or supernatural entities) (Bennardo, 2013). Cultural cognitions can impact environmental values and environmental decision-making (Atran, Medin, and Ross, 2005, p. 771).

METHODS

For data collection in both northern Belize and northern Kentucky, unstructured and semi-structured interviews were performed. Unstructured interviews were used to gain primary information, develop topic guides for semi-structured interviews, and to learn what questions to include in the questionnaire (Stillitoe, Dixon, and Barr, 2006, p. 101). Semi-structured interviews were conducted due to their having the flexibility of unstructured interviews, but have enough consistency of content and framework to produce results that are quantifiable. (Schensul, Schensul, and LeCompte, 1999, p. 149). During person-centered interviews, participants were asked questions that switch between respondent (e.g., what concerns do people have about pollution in your community?) and informant (e.g., what concerns do you have about pollution in your community?) styles, allowing the interviewer to determine the differences between individual and community perspectives (Levy and Hollan, 1998, pp. 337-355). The unstructured interviews

consisted of six open-ended questions to elicit information on how participants viewed environmental issues and how other people in their community viewed those issues. Topics covered included what the informant thought environmental problems were, how people impact those problems, and how those problems impacted them. Unstructured interviews also consisted of both respondent and informant style questions, beginning with rapport building questions to facilitate the informant to be comfortable and engaged in the interviewing process. In both northern Belize and northern Kentucky, roughly ten unstructured interviews were asked to collect common answers. After that stage, the interviews became semi-structured, increasing from six to 22 questions. A list of environmental issues was drafted, featuring the results from a study done at the University of Connecticut that aggregated the most talked about environmental problems amongst students at the university (Hume, 2004). The list of environmental issues included climate change, water pollution, biodiversity loss, deforestation, energy use and pollution that results from it, agricultural pesticide and herbicide use, genetic engineering, soil contamination, spread of invasive species, and human population growth. Initially, participants were asked how concerned they were about each issue and participants were given the opportunity to add any other environmental issues that were not provided. After participants were asked about their concern for different topics, the interviewer asked how or if an issue had impacted the participant, asking about each issue separately. The last questions of the interview inquired about the different ways members of either culture learned about environmental issues, who they talked about the issues with, and if there were any groups or individuals in their community working to fix

any of these issues.¹

Accompanying the Center for Applied Anthropology at Northern Kentucky University's (NKU) Ethnographic Field School in Belize, all OWD interviews were conducted during June of 2016. Interviews were conducted in the villages of San Estevan, San Lazaro, and Yo Creek. Participants were found using a house-to-house approach and conducted on the participant's property. Forty-one participants were interviewed for this project in OWD. Twenty-two percent of the participants were male (9 of 41)² and 78 percent of participants were female (32 of 41)³. The disparity between the genders of the informant was a construct of the interviews being conducted during the early afternoon, when more women than men were working in the home. Nine of the participants were homemakers, two were students, three were shop owners, four were employed in the cane industry, seven were retired, four were unemployed, four did not respond to the question, and eight held various jobs throughout their village, including hairstyling and baking. Most of the participants were between the ages of 18 and 39 (23 of 41), 17 of the participants were between the ages of 40 and 70, and two of the participants were older. When asked about their highest level of education, eight of the participants answered that they had completed the primary level, 19 finished school at the secondary level, four received college degrees, two attended trade schools, one did not attend any school, and seven did not answer the question.

Because rural communities on northern Kentucky are more dispersed and less defined than in Belize, participants were not acquired by visiting houses, rather, participants were recruited by sending letters to farmers in northern Kentucky, visiting farmers markets, through attending a Farmland Work Group

¹ Because interviews were first conducted in Belize and because these questions were established in the field while in OWD, not all the semi-structured interviews in Belize featured these questions while all the semi-structured interviews in northern Kentucky did.

² Throughout the text, the first number represents the fraction of participants who made similar statements and the second number represents all the participants that were asked the same question from that group.

³ Because it would have been impolite to ask how old the participants were or what their sex was, the interviewer estimated their age and sex.

meeting for the Campbell County Conservation District, and through emailing NKU students, requesting the participation of students that lived in rural communities in northern Kentucky. Participants found at farmers markets were interviewed in person while the other interviews were conducted over recorded phone calls. Interviews began in September and ended in December of 2016. Fifteen participants were interviewed in northern Kentucky, five of which were female and ten of which were male. Most of the participants appeared to be 40-60 years old (8 of 15), four appeared to be in their 30s or younger, and two participants were older. All the participants in northern Kentucky received higher than a high school education, of which two attended some college, four obtained an associate's degree, two obtained bachelor's degrees, three obtained trade school degrees, four obtained masters degrees, and one obtained a PhD. Most of the participants were full time farmers (9 of 15), four were part time farmers that held other occupations (4 of 15), one was a student, and one held a different full-time job.

During analysis, data was aggregated by group (Belize and Kentucky) as well as by the question type (unstructured and semi-structured). For unstructured interviews, the answers from participants for each question were analyzed, noting the various environmental problems, reported impacts, and other factors by keeping record of how often they were mentioned and under what context. During the analysis of semi-structured interviews, different types of responses were coded; answers regarding environmental concern were coded as concerned, not concerned, partially concerned, unclear answer, or unanswered. When analyzing responses about environmental impact in semi-structured interviews, answers were either coded as unanswered, no impact, undetermined impact, positive impact, and negative impact. When a participant did not answer a question and their response was coded as unanswered, it was not added to the total number of responses per question. The unclear category held responses where the participant became off topic, presented no sign of whether they were concerned, or did not understand the topic. A response was coded as positive impact when the participant implied that they mitigated the

human impacts of an environmental problem but reported that they impacted it, as negative impact when the participant implied that they contributed to human impacts of an environmental problem, and as undetermined when the participant implied that they contributed to human impacts of an environmental problem. Answers about concern and impact for each environmental problem were then analyzed for explanations about why participants were concerned or impacting. When comparing the responses of participants from northern Belize and northern Kentucky, the number of responses for each coded category, the reasons for concern, the types of impacts, and the reasons for impacts were considered.

RESULTS

Unstructured Interviews

When Belizean participants were asked what people considered to be environmental problems, one of the most cited issues was littering (5 of 11). Two of the participants noted that trash littered in yards or the streets collected rainwater, which attracted disease-carrying mosquitoes. Other environmental issues prompted by this question included rises in temperatures (2 of 11), changes in the rainy season (1 of 11), smoke from the cane fields (1 of 11), animals living within the villages (2 of 11), and deforestation (1 of 11). When asked what the participants personally considered to be environmental problems, answers included littering (3 of 11), dirty yards (1 of 11), climate change (1 of 11), pollution (1 of 11), lack of drinking water (1 of 11), use of chemicals (1 of 11), and smoke from the sugar factory (1 of 11). When asked how people impacted environmental problems in Belize, only littering (4 of 11) and deforestation (1 of 11) were mentioned. When asked how they personally impacted environmental problems, two stated that they did not impact environmental problems, but the nine other participants recognized that they impacted environmental problems through their environmental activism in their villages (3 of 11), the burning of sugarcane (1 of 11), the lack of good drinking water (1 of 11), and having a dirty yard (1 of 11). When asked if environmental problems impacted Belizeans, four participants responded that it impacted the community because of

mosquito-borne illnesses. When asked if any environmental problems impacted them personally, three of the participants responded that they were not personally impacted, one stated that littering impacted them, and one stated that mosquitoes impacted them.

When Kentuckian participants were asked what people considered to be environmental problems, there was little consensus in the responses; global warming and air quality were mentioned only by two participants, and air quality, pollution, groundwater pollution, one participant only mentioned water quality, genetic engineering, and chemical use. One participant did not believe in the greenhouse effect. When asked what they personally considered to be environmental problems, four participants responded that they were concerned about water pollution. When asked how people impact environmental problems, automobile use (2 of 8), shopping habits (2 of 8), and water quality (2 of 8) were mentioned. When asked how they personally impacted environmental problems, six participants responded that they positively impacted the environment, two of which explained that they mitigated the impacts of environmental problems more than they contributed to them. Three of the participants responded that they negatively impacted environmental problems through carbon emissions (1 of 8), strip farming and soil erosion (1 of 8), and using agrichemicals (1 of 8). When asked how environmental problems impacted Kentuckians, participants identified the impacts of water pollution (3 of 8), air pollution (1 of 8), automobile use (1 of 8), and the impacts of environmental issues on food (1 of 8) and lifestyle (1 of 8); one participant stated that environmental problems did not impact people. When asked how environmental problems impacted them personally, two participants responded that environmental problems did not impact them. Four participants responded that environmental problems did impact them through conversation about it (1 of 8), environmental regulations that make their job

harder (1 of 8), families members having cancers caused by pollution (1 of 8), and changes in the growing season (1 of 8).

Semi-Structured Interviews

Climate Change

Of those concerned about climate change in Belize (15 of 30, see Table 1 for summary of findings), participants were concerned because they recognized its impact on their weather patterns (9 of 15), especially regarding its effects on the rainy season (7 of 15). When participants discussed climate change's impact on the rainy season, they mentioned that the rain patterns are irregular with rain coming later than expected and when asked about how concerned they were about climate change, some participants (3 of 15) recognized that human pollution contributes to climate change. Of the 12 Belizean participants that were not concerned about climate change, one of them acknowledged that there was a change in the rainy season. Of the 24 Belizeans asked about their impact on climate change, 10 of them noted that they have an impact, of which seven did not explain how they influenced climate change, three stated that they have a positive impact, and one responded that they have a negative impact. The one participant that considered their impact to be negative had a broad answer, not specifying how exactly they contributed to climate change. The two that considered their impact to be positive thought this way because they have changed how they perform behaviors or because they educate others about the issue.

In northern Kentucky, those concerned about climate change (5 of 7) considered changes in weather and its impact on farming to be drawbacks of climate change. Four of the seven Kentuckians did not say that they had an impact on climate change, one of which considered their use of public transportation to be their method for reducing their impact. Those who did consider their behaviors to impact climate change had various reasons, including consuming goods produced through pollution, using fossil fuels, and using electricity.

Table 1. Number of Participants⁴ Concerned and Impacting per Environmental Issue.

Environmental Issue	Northern Belize Concern	Northern Belize Impact	Northern Kentucky Concern	Northern Kentucky Impact
Climate change	16 of 30	10 of 24	5 of 7	3 of 7
Water pollution	22 of 30	8 of 26	7 of 7	2 of 7
Biodiversity loss	9 of 29	4 of 22	5 of 7	1 of 7
Deforestation	10 of 29	3 of 24	4 of 7	1 of 7
Energy use and pollution	22 of 29	13 of 26	4 of 7	4 of 7
Agricultural pesticide and herbicide use	9 of 29	5 of 24	4 of 7	3 of 7
Genetic engineering	2 of 28	1 of 22	2 of 7	0 of 7
Soil erosion	6 of 29	2 of 24	5 of 7	2 of 7
Invasive species	1 of 28	0 of 23	7 of 7	4 of 7
Population growth	10 of 29	2 of 26	4 of 7	2 of 7

Water Pollution

When asked about water pollution, responses tended to focus on pollution in the New River. Of the participants concerned about water pollution (21 of 30), 57 percent of them were in San Estevan, which is the village downstream of the sugar factory. Five of the 21 concerned about water pollution considered the sugar factory to be the cause of water pollution in the region. Five participants considered trash to be the cause of water pollution and one participant considered oil from fabric cleaning to be the cause. Four participants responded that water pollution was not a problem in their region. Of the eight participants that reported they had an impact on the environment, two of them appeared to have negative impacts on water pollution while one appeared to have a positive impact, mitigating water pollution. The two that had negative impacts listed gasoline-use and throwing trash into the water as water pollution-impacting behaviors. The one who had a positive impact did so through environmental education, including teaching children how to keep rivers clean.

Of the northern Kentuckians, six were concerned about water pollution. Of those concerned about it (7 of 7), two participants considered water pollution to be a local problem,

two considered chemicals to be the cause of it, and two considered human waste to be the cause of it. Of those northern Kentuckians that did not perceive themselves to have an impact on water pollution (4 of 7), one cited their lack of littering to their reason for not contributing, another cited not being a farmer, and another cited their proper disposal of waste. Of those that did report themselves to impact water pollution (3 of 7), they considered their contributions to be from household uses of water.

Biodiversity Loss

When Belizean farmers were asked about how concerned they were about biodiversity loss, nine of the 29 participants considered themselves to be concerned about it. Of those nine, five were concerned about local biodiversity loss, while four of the nine spoke about the issue in a broader context. The issues listed included the loss of regional birds and as well as different species of trees and other plants. Most participants concerned about biodiversity loss went on to discuss the causes of biodiversity loss, which included changes in weather, human pollution and land use, and dry streambeds. Most of those not concerned about biodiversity loss (15 of 29) did not discuss the reasons for the perspective, except for one who mentioned that biodiversity loss was not a

⁴ Some participants did not answer every question, which was sometimes due to language barriers, the exhaustion of the participant, or a lack of comprehension about the topic.

problem in the region. When asked about how they view their impact on biodiversity loss, 16 of the 22 participants did not consider themselves to have an impact. Four participants did consider themselves to have an impact, but only one of them elaborated on his impact, considering his contribution to climate change to be relevant. Another spoke about how she had witnessed the disappearance of a fruit tree that the Maya used to use as a food source.

Amongst northern Kentuckians concerned about biodiversity (5 of 7), there was an overall agreement that biodiversity loss was harmful to the natural world. Of the two not concerned, one commented that biodiversity loss is not a local problem. Only one participant considered themselves impactful of biodiversity loss, noting that their behaviors benefitted the ecosystem because they plant a variety of trees.

Deforestation

Belizeans concerned about deforestation (10 of 29) were concerned because trees were not replanted after cutting (5 of 10), because deforestation impacts climate change (1 of 10), and because deforestation destroys animal habitats (2 of 10). Of those not concerned (15 of 29), two participants did not consider deforestation to be a problem in their region because cane farming, and not logging, is the dominant occupation in the area. 18 of the 24 participants asked about their impact on deforestation did not consider themselves to have an impact, two of which cited deforestation not being a local problem to be the reason they do not have an impact. Three participants responded that they impacted the environment, but did not say whether it was positive or negative.

In northern Kentucky, participants concerned about deforestation (4 of 7) varied in their concerns, including whether deforestation was a global or local problem. Of those not concerned about deforestation, the same difference occurred. Six of the seven participants did not consider themselves to impact deforestation and the reasons they cited for not impacting it included behaviors of mitigation, including planting trees and not using paper. One participant responded that they had an impact on deforestation, but did not say whether

it was positive or negative.

Pollution

Of the 22 of 29 Belizean participants concerned about pollution in general, eight considered littering to be pollution and five considered burning sugar cane to be pollution. Other concerns mentioned included people burning trash (3 of 8), littering in yards because it attracts mosquitoes (2 of 8), and how pollution impacts the health of the community (2 of 8). Five of the participants were not concerned about pollution, two of which noted that their lack of concern was due to not being personally impacted by pollution. When asked about their impact on pollution, nine of the 26 participants responded that they did not have an impact on pollution, two of which thought this because they do not consider it to be a problem in their community. Thirteen participants reported having an impact on pollution, one of which only had a global impact and not a local one. Six of the participants appeared to have negative impact on pollution through contributing to littering (3 of 6) and contributing to trash burning (2 of 6).

Of the six northern Kentucky participants asked about pollution, four were concerned about it, one of which considered it to be a local problem. Participants concerned about pollution talked about its causes, including carbon emission (2 of 4), coal (1 of 4), and fossil fuel emissions (1 of 4). Two participants reported not being concerned and one participant explained that they were not concerned because pollution was already being mitigated. Three participants responded that they did not have an impact on pollution, while four stated that they did, two of which appeared to have a positive impact on pollution through conserving energy and two of which appeared to have a negative impact using electricity.

Agricultural Pesticide and Herbicide Use

When asked about agricultural pesticide and herbicide use, nine of the 29 Belizean participants reported being concerned because it is detrimental for environmental health (2 of 9), human health (3 of 9), especially the health of those who spray the chemicals (2 of 9). Of those not concerned (14 of 29), two explained that they were not concerned because pesticides and

herbicides were no longer being used. When asked about their impact on agricultural pesticide and herbicide use, 18 of the 24 participants did not consider themselves to have an impact. Four participants reported having an impact, but did not say whether it was positive or negative.

Of the seven northern Kentucky participants asked about agricultural pesticide and herbicide use, four stated that they were concerned about it, two of which stated that they were especially concerned about chemical pesticides. Three participants were partially concerned, one of which did not consider it to be a local problem. When asked about their impact on agricultural pesticide and herbicide use, two of the participants explained that they did not have an impact on the issue because they applied as little pesticide or herbicide as possible. Three participants responded as having an impact on the topic, two of which noted that they have tried to lessen the amount of pesticide or herbicide that they spray.

Genetic Engineering

Of the 28 Belizeans asked about genetic engineering, two were concerned. Ten of the participants did not know about genetic engineering and 16 participants were not concerned about the issue, one of which did not consider it to be a local problem. Of the 22 participants asked about their impact on genetic engineering, 18 reported not being having an impact and one participant explained their having an impact because they consume foods that have been genetically engineered.

When asked about genetic engineering, five of the seven northern Kentucky participants reported concern, one of which was concerned because it is unnatural. Five participants were not concerned. When asked about their impact one genetic engineering, seven of the seven participants responded that they did not have an impact, one of which noted that they did not have an impact because they did not buy food that was genetically engineered.

Soil Erosion

When asked about soil erosion, six of the 29 Belizean participants were concerned, two of which cited agrichemicals as being the cause. 21 of the participants reported that they were not concerned about soil erosion, four of

which did not consider it to be a local problem. Two participants did not know about soil erosion. When asked about their impact on soil erosion, 19 of the 24 participants reported not having an impact on it. Two participants explained having an impact on soil erosion by noting that they farm.

In northern Kentucky, five of the seven participants asked about soil erosion were concerned because soil is necessary for farming (2 of 5). One participant was not concerned and one participant reported being partially concerned. When asked about their impact on soil erosion, five of the seven participants responded that they did not have an impact, two of which explaining that they limit the use of agrichemicals on their farms. Two participants responded that they did have an impact on soil erosion, where one cited their disposal of garbage as a contribution and the other cited the storm water drain in their yard as a contribution.

Invasive Species

Of the 28 Belizeans asked about invasive species, one participant was concerned but noted that it was not a problem in the area. One participant did not know what invasive species were and 27 participants reported not being concerned, one of which responded that it was not a local problem. Of the 23 participants asked about their impact on invasive species, 20 reported not having an impact. The other three participants did not know if they had an impact.

When asked about invasive species, seven of the seven northern Kentucky participants were concerned because invasive species kill other species (2 of 7) and take over the forest (2 of 7). When asked about their impact on invasive species, three of the seven reported not having an impact, one of which commented that they felt that way because they do not personally combat invasive species. Four of the participants appeared to have a positive impact on invasive species, personally combating them on the participants' land (4 of 7).

Population Growth

In Belize, 10 of the 29 participants asked about population growth were concerned about it, four of which recognized that it was a local problem. Twelve of the participants were not concerned about population growth. Four

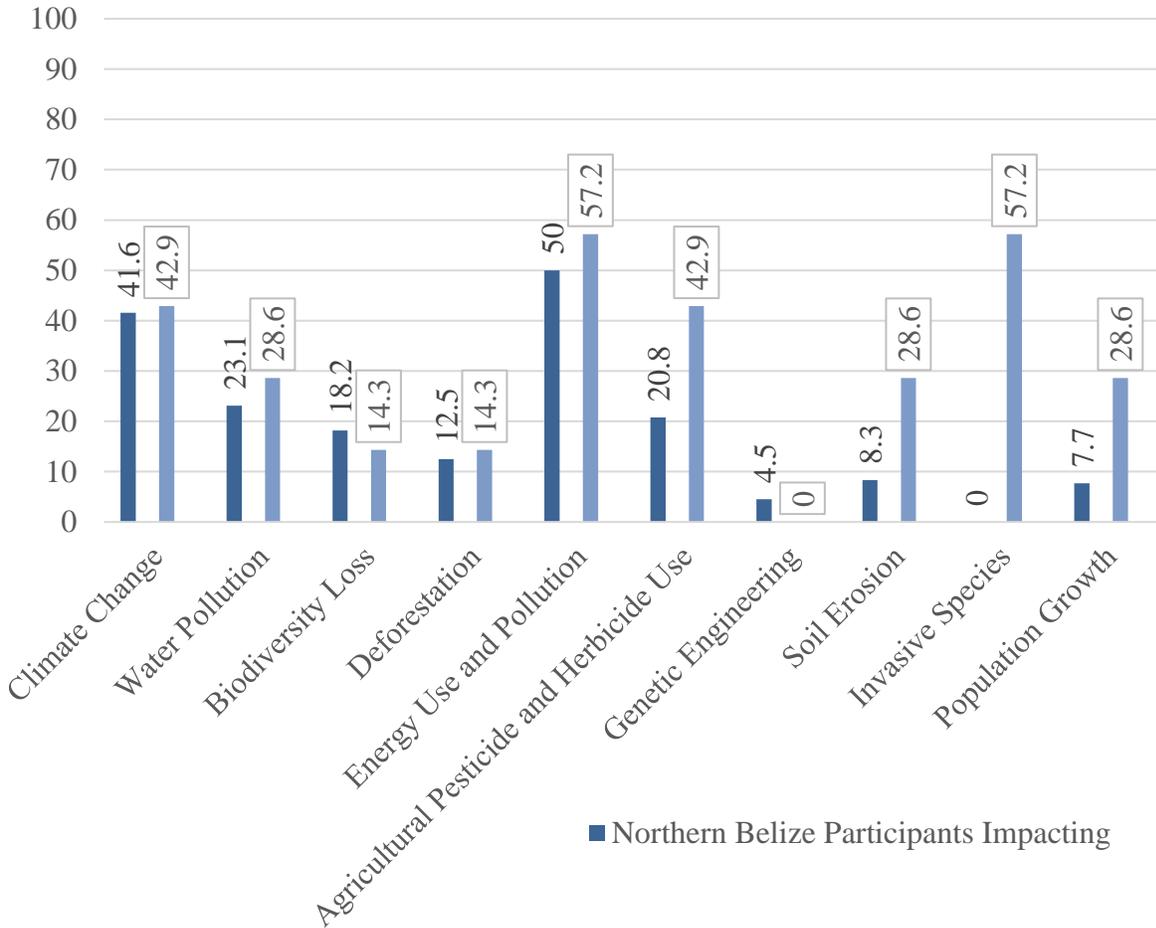
were concerned about the population decreasing because the younger generation is having fewer children (2 of 4), and three of the participants reported that population loss was a local problem. Two participants were only somewhat concerned about population growth. When asked about their impact on population growth, 23 of the 26 participants responded that they did not have an impact, three of which noted that they had small families. Two of the participants explained having an impact on population growth because they have children or want to have children.

Of the seven participants in northern Kentucky asked about population growth, four were concerned about it and three were not concerned. When asked about their impact on population growth, five of the seven participants reported that they did not have impact while two stated that they did have an impact because they have children.

DISCUSSION

Considering demographics, there is variation between the participants in northern Belize and northern Kentucky. More participants were interviewed in Belize than in the US, which admittedly impacts the results of this research. Another important factor to consider is occupational variations between Belizean and Kentuckian participants. The Belizean participants in this study held a more diverse set of jobs than the Kentuckian participants who were either full- or part-time farmers. The general ages of participants also differed between the two cultures, where most Belizean participants were younger than the Kentuckian participants. Lastly, the two cultures also varied in education attainment, with many of the Belizean participants not obtaining college or trade school degrees whereas all the participants in northern Kentucky attended at least some college.

Figure 1. Summary percentage of perceived impacts on the environmental issues.



Northern Kentucky participants appeared concerned about more environmental problems than Belizean participants and reported impacting more of them (see Figures 1 and 2, Tables 2 and 3). When examining environmental problems where 50 percent or more of the participants noted being concerned, the Belizean participants only responded being concerned about climate change (53%), water pollution (70%), and pollution and energy consumption (72.4%). Comparatively, northern Kentuckian participants were concerned about every issue except for genetic engineering (28.6%). While the Kentuckian participants responded being

concerned about nine of the ten given environmental problems, most of the participants did not report having an impact on most of them. The environmental problems that Kentuckian participants reported having an impact on included energy use and pollution, and invasive species. That human impacts on pollution or energy consumption were recognized by the American participants is similar to the conclusion drawn by Kempton, Boster, and Hartley that people most often attribute humans with impacting weather changes in reference to pollution (1996, pp. 78-80).

Figure 2. Summary percentage of concern on the environment issues.

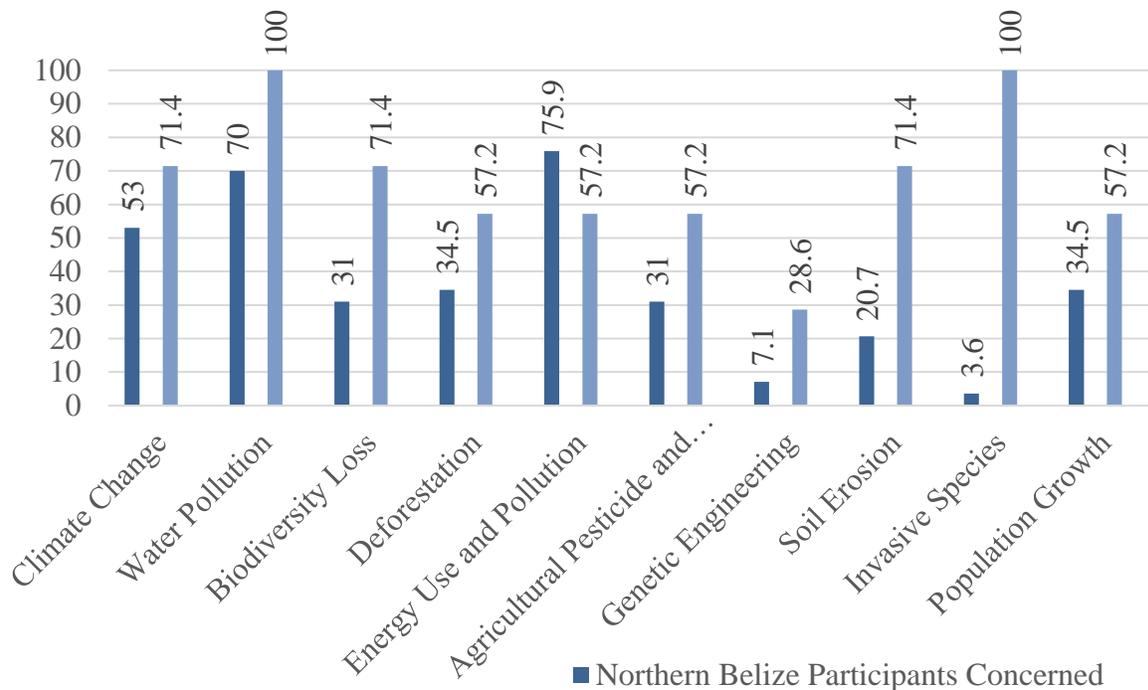


Table 2. Impact Type per Environmental Issues for Northern Kentucky Participants

Environmental Issue	N ⁵	Unclear** ⁶	No Impact	Undetermined Impact	Positive Impact	Negative Impact	Impact Total
Climate change	7	0	4	0	0	3	3
Water pollution	7	0	4	1	0	2	3
Biodiversity loss	7	0	6	0	1	0	1
Deforestation	7	0	6	0	0	1	1
Energy use and pollution	7	0	3	0	2	2	4
Agricultural pesticide and herbicide use	7	0	4	0	1	2	3
Genetic engineering	7	0	7	0	0	0	0
Soil erosion	7	0	5	1	0	1	2
Invasive species	7	0	3	0	4	0	4
Population growth	7	0	5	1	0	1	2

⁵ Some participants did not answer every question, which was sometimes due to language barriers, the exhaustion of the participant, or a lack of comprehension about the topic.

⁶ Some participants' responses either did not respond to the question or reported that they did not have an answer.

Table 3. Impact Type per Environmental Issues for Belize Participants

Environmental Issue	N⁷	Unclear⁸	No Impact	Undetermined Impact	Positive Impact	Negative Impact	Impact Total
Climate change	24	3	11	7	2	1	10
Water pollution	26	3	15	5	1	2	8
Biodiversity loss	22	2	16	2	0	2	4
Deforestation	24	3	18	2	0	1	3
Energy use and pollution	26	4	9	6	1	6	13
Agricultural pesticide and herbicide use	24	1	18	1	0	4	5
Genetic engineering	22	3	18	0	0	1	1
Soil erosion	24	3	19	1	0	1	2
Invasive species	23	3	20	0	0	0	0
Population growth	26	1	23	2	0	0	2

The only environmental problem that Belizean participants collectively reported having an impact on was energy use and pollution (50%, see Table 3). It is important to consider that when participants in northern Belize discussed why they were concerned about pollution they did not explain how it impacted the environment, but how pollution impacted the health of people. The most talked about pollution activity amongst Belizean participants was the disposal of garbage, including trash burning and littering. Littering was a concern discussed in both unstructured and semi-structured interviews because garbage creates breeding grounds for mosquitoes after it rains. According to the participants, those mosquitoes carry diseases such as dengue fever, and can be dangerous for the community. During the unstructured interviews where discussion about pollution was not prompted, littering within the villages was mentioned, listing it as an environmental problem, something that impacts the community by causing mosquito-borne illnesses, and something to which humans contribute.

Table 4. Concern for different types of pollution among informants.

Type of Concern for Pollution	Northern Belize	Northern Kentucky
Littering	13 of 29 ⁹	0 of 7
Air pollution	10 of 29	4 of 7

⁷ Some participants did not answer every question, which was sometimes due to language barriers, the exhaustion of the participant, or a lack of comprehension about the topic.

⁸ Some participants' responses either did not respond to the question or reported that they did not have an answer.

⁹ Second number in proportions refer to the number of participants from semi-structured interviews.

Table 5. Concern for the impact of different types of pollution among informants.

Type of Impact for Pollution	Northern Belize	Northern Kentucky
Littering	3 of 26	0 of 7
Automobile Use	1 of 26	1 of 7
Energy Use in the Home	2 of 26	3 of 7
General	0 of 26	1 of 7

There were no instances where a participant or either culture did not express having an impact on an environmental problem without first reporting being concerned about it, which suggests that for northern Belizean and northern Kentuckian participants, being concerned was a prerequisite for perceiving an impact on any environmental problem. Concern was higher than perceived impact for every issue, except for northern Kentuckian participants on energy use and pollution where concern and perceived impact were equal. The finding that concern is higher than perceived impact suggests that while concern might be a requirement for perceiving an impact on an environmental problem, being concerned about an environmental problem does not necessarily determine whether an impact is perceived.

When analyzing how both cultures viewed how they impacted environmental problems, there did not seem to be many trends. While participants often recognized that they had an impact on the various environmental problems, many participants did not clarify how they impacted each environmental problem. In northern Kentucky, all the participants that reported having an impact on invasive species were also farmers. The farmers appeared to have positive impacts on the spread of invasive species, mentioning mitigating behaviors such as burning, cutting, and removing invasive plant species from their farmlands.

CONCLUSION

There were cases in both northern Kentucky and northern Belize to suggest that concern and recognition of environmental impacts were most common when the environmental problem impacted a community. In Kentucky, only the farmers considered themselves to have an impact on the spread of invasive species, which is due to the farmers

combating them. In Belize, participants most impacted and were most concerned about pollution because it exasperated the spread of mosquito-borne illnesses and threatened air quality in the community. With the finding that concern about an environmental problem is a prerequisite for perceiving an impact on both the individual and cultural scale, it is important to consider the implications that it could have on environmental awareness; if being concerned is the first step to being aware of environmental impacts, then the goal of environmental activism should be to increase not just awareness, but also concern.

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