How Climate Change has Effected the United States: Sociology, Economics, and Environmental Science

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Abstract

The following research was conducted to gain a more comprehensive understanding on how climate change has effected the United States. The first section of this paper introduces the issue of climate change and the importance of using an interdisciplinary approach. This paper then explores each discipline; environmental science, sociology, and economics, and how they relate to, or inform, the issue of climate change in the United States. The research on environmental science helps to gain understanding of what climate change is, how the research has been conducted, and the impacts of climate change on the United States. The sociological research conducted used statistics from surveys to identify where the public is divided on the issue of climate change. The surveys studied were taken between the mid 1900's and early 2000's to identify how opinions and perspectives have changed, but remain divided. Research on the economics of climate change has shown how, and why, adaption in the United States has been difficult. Traditional economic methods of analyzing the costs and benefits of adapting to climate change show the need to alter those methods to include non-monetary items such as ecological impacts. The conclusion found through this research is that the public is divided in how seriously the issue of climate change perceived, that scientist have found evidence that climate change is very likely human induced, and that policy makers have difficulty in measuring the costs of climate change because it largely involves non-monetary elements. Decisions made by the United States regarding climate change would have global implications, however, this research is limited to only the impacts of climate change on the United States.

Keywords: Climate Change, Believers, Sympathizers, Skeptics, Adaption, Cost-Benefit Analysis

Problem Defined

Climate change is a heavily debated and complex issue that affects everyone. Policy makers in the U.S. have received pressure for and against adaption policies. The public is divided in its level of concern and beliefs regarding climate change. Environmental scientists have conducted research on climate change which has been used to educate on the effects of climate change and ways to mitigate or adapt to climate change. Methods of adaption must be uniquely designed to fit different economic and geographic regions. The economics of adaption includes uncertainties and various methods of analysis that can act as barriers to adaption. This research aims to add to the understanding of climate change and how it has effected the United States.

Purpose of Using an Interdisciplinary Approach

This research will discuss how the issue of climate change has created a divide in society, its effects on economic decision making, and the scientific research behind climate change. Climate change is a complex issue that requires the insight of more than one discipline to address it comprehensively. The importance of using an interdisciplinary research approach is to develop a structural knowledge of sociology, economics, and environmental science and how those disciplines play a part in this complex issue. More importantly, interdisciplinary research will provide a new perspective on the issue. Using the interdisciplinary approach will show how economics, society, and environmental science relate to, and affect, each other in regards to climate change. The interdisciplinary approach will also help to reveal common ground between those three disciplines. The integration of insights from these different disciplines will reveal themes that will broaden understanding of the issue of climate change.

Environmental Science

According to Oreskes (2004), the public often sites the media and policy makers as a basis for the belief that there is not consensus in the scientific community regarding climate change. However, the Intergovernmental Panel on Climate Change (IPCC) has stated that it is likely human activities that have been modifying the chemical composition of the atmosphere. Many scientific associations and societies support the statement issued by the IPCC that warming over the last 50 years is likely caused by greenhouse gas emissions. Between 1993 and 2003, 928 abstracts, published in scientific journals with the key word climate change, were analyzed and put into six categories. Of the papers reviewed, 75% fell into the categories of "explicit endorsement of the consensus position, evaluation of impacts, [and] mitigation proposals." (Oreskes, 2004) None of the papers reviewed were found to be in disagreement with the IPCC's statement on climate change. (Oreskes, 2004)

The Fourth Assessment released by the IPCC states that since the Third Assessment Report in 2001, there has been "more comprehensive data, more sophisticated analyses of data", improvements in understanding processes, and improvements in model simulations. (Alley, 2007, p. 2) Currently, the concentration of carbon dioxide, methane, and nitrous oxide, in the atmosphere is higher than it was pre-industrialization. The burning of fossil fuels and changes in land use are cited as the primary factors for the increase of carbon dioxide in the atmosphere. Agriculture is cited as the primary reason for the increased levels of methane and nitrous oxide in the atmosphere. (Alley, 2007) The IPCC finds that the current level of carbon dioxide in the atmosphere, at 379 parts per million (ppm) in 2005, is higher than it has ever been in the last 650,000 years. The natural range is 180 to 330ppm. The warming of the earth's average surface temperature has been offset by the oceans absorbing "more than 80% of the heat added to the

climate system" (Alley, 2007, p. 5) When water warms it expands. This helps to explain why an increase in the earth's average surface temperature would contribute to sea level rise. (Alley, et al., 2007)

Though climate change is a global occurrence, there have been specific measurements for the United States. Between 1979 and 2003 "the rate of warming in the United States … has been about twice the rate of the global average." (Leggett, 2007, p. 13) Drought prone areas have averaged less rainfall while areas that have higher annual percipitation, rainfall has increased. The South East has seen a 2.6% increase in heavy percipitation, that was not associated with a hurricane, during the 20th century. Paleoclimatology is the study of past climates "using ice cores, tree rings, fossil records, and the chemical composition of shells." (Leggett, 2007, p. 15) Using those indicators paleoclimatologist have observed that during the Holocene period, the period covering the last 12,000 years, the earth has had relatively stable temperatures with minimal, and narrow, variations. However, there are no indicators "that global annual temperatures at any time during the Holocene were warmer than today." (Leggett, 2007)

There is also evidence to indicate the the earth's climate can change abruptly. About 15,000 years ago the last ice age ended due to warming events that occurred over about a decade. Past significant climate changes have also been shown to cause major "reorganizations of regional civilizations" (Leggett, 2007, p. 16) According to Leggett's research "the National Academy of Sciences concluded with high confidence that global mean surface temperature was higher during the last few decades of the 20th century than during any comparable period" going back until 900 A.D. (Leggett, 2007, p. 16) The National Academy of Sciences goes on to say that global warming during the 20th century has been occuring at a rate unprecedented in the last 1,000 years. (Leggett, 2007)

In the United States the impact of a warming climate has had varied impacts. Leggett's report indicates that "the northern boundary of successful corn production" has migrated 100 miles north. (Leggett, 2007, p. 17) Fisheries in parts of Alaska have seen record salmon catches while the Pacific North West and Canada have seen a decrease in salmon stocks. As the average temperature warms in areas such as Western Alaska, the salmon season lasts longer. However, the warming has increased to such a point in the Pacific North West that it is having an opposite affect. Decreased mountain snowpack and earlier melting of those snow packs has altered stream flows and has impacted "flood control, irrigation and summer drying of vegetation." (Leggett, 2007, p. 17) Another impact found in Leggett's research was that of over 1,600 species studied, more than half of those species life events, "egg laying and blossoming dates", as well as where they are "systematically and dominately" found, has changed in response to climate change. (Leggett, 2007, p. 18)

Sociology

The Public Religion Research Institute (PRRI) has identified three groups in the climate change issue: believers, sympathizers, and skeptics. The study conducted showed that skeptics were politically conservative and believers largely identified as liberal. The category of skeptics was found to be a small percentage of people in each group. Believers make up the majority in the study that PRII conducted. The respondents in the skeptic's category cited personal weather experience for not believing in climate change. Skeptics also largely agree that scientific evidence is insufficient or unsubstantiated. However, the study found that the majority of people believe that the scientific evidence is sufficient and well substantiated. The majority of people in the study also believe that there is consensus within the scientific community in favor of climate

change. More than half of democrats agree with scientist that climate change is human induced. Whereas only about a third of Republicans hold the same belief. (Robert P. Jones, 2014)

According to Leiserowitz (2009) Identification of human induced climate change goes back almost 200 years. Public opinion and perception of climate change is important because of its impacts on policy decisions, regulations, and treaty agreements. Approximately half of Americans believe that action on climate change should be gradual and that more research is needed before taking action. During the 1800's scientist recognized the negative consequences of rising carbon dioxide levels in the atmosphere. The predictions of global warming made by these early scientist were very similar to the climate models developed by scientist since the 1950's. (Leiserowitz, 2009,) The Intergovernmental Panel on Climate Change announced in 2007, with 90% certainty, that climate change is likely human induced. According to a 2000 Globescan poll, America ranked low in how serious the public viewed the issue of climate change. At that time it was a near equal divide between people that viewed the issue as very serious or only somewhat serious. A study found that, as of 2003, Americans perceived themselves as being disconnected from climate change and that it would affect nature and developing countries, but not the U.S. A 2006 Pew Global Attitudes survey found that America had the largest percentage of respondents who were not worried about climate change. (Leiserowitz, 2009)

The research conducted by Leiserowitz (2009) also found that though a majority of Americans are accepting of the claim that human activities contribute to climate change, many are not willing to accept human activity as the primary cause of climate change. Belief in whether human activity is just a contributor or primary cause of climate change effects support for adaption or reduction policies. A national survey conducted by Leiserowitz (2009) in 2002 showed that an "accurate understanding of the causes of global warming remains quite limited in

the United States" (Leiserowtiz, 2009, p. 17) A majority of Americans were found to believe that ozone layer depletion was the primary cause of global warming. According to the Survey "only 23% of Americans correctly identified the burning of fossil fuels as the primary cause of global warming" (Leiserowitz, 2009, p.17)

Though there is misunderstanding on the cause of climate change, Leiserowtiz's (2009) study found that many Americans agree that alternative energy is an important solution. However, the survey found that few people agreed that "driving less [is] the primary solution." (Leiserowtiz, 2009, p. 18) Leiserowitz asserts that these findings from the 2002 survey may offer insight as to why Americans support renewable and alternative energy, but not carbon taxes "or other policies intended to reduce personal fossil fuel use." (Leiserowitz, 2009, p. 18)

Economics

According to Stern (2007), climate change will disproportionately affect poor communities and agricultural communities. Though "economic reforms [have] helped to reduce wasteful use of energy" (Stern, 2007, p. 92) and have increased energy efficiency, they do not necessarily reflect reduction needed in the long run. Policy makers have received pressure to either address or ignore climate change from the public. Leggett (2007) states that as of 2007 the United States "government invests around $6 billion yearly on climate change research. (Leggett, 2007, p. 41) Because of uncertainties within the scientific community about the "magnitude, rate, geographic distribution, and other characteristics of climate change", (Leggett, 2007, p. 41) it is difficult for policy makers to make decisions on whether or not, or how, to address climate change. (Leggett, 2007)

The Fifth Assessment Report released by the IPCC describes the difficulty decision makers have in adaption responses to climate change. In the context of this paper adaption refers

to “adjustment in natural or human systems in response to actual or expected climate stimuli or their effects” (Adger, et al., 2008, p. 337) Local authroities and the federal government face barriers to decision making that can limit adaption. Economic barriers include transaction cost, information, and adjustment costs. Transaction costs are the “costs of accessing markets and information” as well as “reaching an agreement and enforcement costs.” (Dubeux, et al., 2014, p. 955) Data that is difficult or expensive to acess creates an information acquisition cost that can be a barrier to implementing adaption strategies. A large portion of adaption costs, and a potential barrier to adaption, is adjustment costs. Adjustment costs is relevant to climate change when cost is incured “while learning about new climate conditions” (Dubeux, et al., 2014)

The cost benefit analysis has been the traditional method for allocating resources based on cost effectiveness and greatest benefit. However, this method does not take in to consideration “resource depletion, environmental change, and distributional issues.” (Dubeux, et al., 2014, p. 955) Distributional issues affect where resources go and how much of needed rescources is received. While poorer communities are disproportionately effected by adverse weather conditions, they are more likely to be unable to afford resources despite it being in their best interest. (Dubeux, et al., 2014)

One method of adaption will not work in every location, or for all people, which adds to the overall cost of adaption. The uncertainty of climate change also adds to adaption costs. The “extent and patterns of future climate change” (Dubeux, et al., 2014, p. 956) are uncertain which creates another barrier to successful adaption. The use of the cost benefit analysis with regards to climate change must take in to account uncertainties, if action can be delayed to wait for new information, and non-monetary items such as ecosystem services. (Dubeux, et al., 2014)

Conflicts

There is a great divide in society between those who believe climate change to be anthropogenic, or human caused, and those who believe it is a natural occurrence. As previously mentioned, the most obvious divide stems from political ideology. Another divide in society lies with those who view personal experience as being the truth for all, or reification. Reification means “we project our meanings into the world, and then we perceive them as existing in the world, as having a reality of their own” (Pelling & High, 2005, pg. 5) Reification can apply to the intangible or physical. In regards to climate change, this belief allows people to disregard scienctific research and evidence in favor of their own perceptions of reality. This also creates a barrier to adaption.

According to Nagel, et.al, there are “reports of several governmental agencies in the United States and around the world [which] cite human activity as one of, if not the primary driver of global climate change”(Nagel, Dietz, & Broadbent, 2008, p. 9) The correlation between human activity and climate is strong enough to necessitate the need for more environmental sociologists to participate in research and adaption policy development. Sociologist and environmental sociologist are needed to help understand what behavior changes need to be made and how those changes will occur in society. (Nagel, Dietz, & Broadbent, 2008)

Economically, the adaption methods vary depending on location and ecology. However, social factors such and perception of risk, perception of value (intrinsic or not), and knowledge within and between communities affects adaption decisions. A homeowner living on the coast witnessing the shoreline eroding as well as clear cut adaption methods such as beach restoration or hard structural defenses. (Adger, et al., 2008) A community living inland from the coast

witnessing standing water and increased flooding during storms may prefer different adaption methods. Those communities may put more emphasis on storm water management or the construction higher retaining walls surrounding tidal rivers. Within the same region different communities place emphasis on different adaption methods. The adaption method proposed often correlates with perception of risk. Lack of impact from climate change may mean that an individual or community has little to no perception of risk. A community that places high value on environmental resources or green spaces is more likely to desire adaption methods than a community that does not hold the same values. (Adger, et al., 2008; Dubeux, et al., 2014; Robert P. Jones, 2014)

Economics and environmental science have largely ignored each other over the course of their development. This has led economics to operate in a context in which the natural environment, on which humans depend, is ignored. Environmental science has mostly studied nature independent of human interaction. Though the two disciplines are vitally connected, and have recently come together on the issue of climate change, there still exist conflict. Traditional models of economic systems view "interactions between people and environmental systems … of secondary importance." (Smith, 2017, p. 5) In both economics and environmental science human activity is often viewed as a disturbance or secondary influence and not a key facor. The circular model of economics views "people as different types of economic agents" who determine the flow of resources and how those resources are paid for. (Smith, 2017, p. 5) The study of natural systems does not include human activities influence on those systems. (Smith, 2017)

Economics often views the policies to reduce carbon emissions as a reduction in productivity. An economic model called "dynamic integrated model of climate and the economy

(DICE)" (Smith, 2017, p. 11) aims to analyze the impacts of reducing carbon emissions on the economy. Though this model integrates natural resources and environmental services in an economoc model, it excludes human choices which would impact the model. Human behavior is an uncertainty that exists in the issue of climate change. The issue of climate change has many uncertainties that impact adaption methods. A cost benefit analysis does not traditionally include non-monetary items such as ecosystem services. For the cost benefit analysis to effectively evaluate climate change impacts it must incorporate "impacts on public health, cultural heritage, environmental quality and ecosystems, and distributional impacts." (Dubeux, et al., 2014, p. 956)

Policy makers are pressured to make decisions on where to allocate resources in adaption methods. An issue within climate change such as sea level rise poses building issues to coastal communities. One possible method of adaption could be restricting development in certain coastal communities. If sea levels rise to a degree that makes those areas undesirable to develop then the adaption method would be beneficial. However, that community may view that decision as a barrier to economic growth. The uncertainty of the extent and pattern of climate change impacts effects government officials ability to make policy decisions. Calculating the cost of adaption to climate change has been mostly conducted on a global scale. Local estimates are often inconsistent with the global estimates. (Dubeux, et al., 2014) The impact, and cost, of climate change will vary from region to region. Such variability and unequal distribution of climate change impacts creates conflict between economics and environmental science.

It can be understood through the literature used in this research that the challenge of understanding, mitigating, and adapting to climate change will need the joint efforts of economists, environmental scientist, and sociologist. Societies impact on climate change is as complex as the issue of climate change itself. Positive or negative affects on climate change by

society depend on the type and extent of adaption methods, changes in values and behaviors, as well the type of economic growth. The inclusion of non-monetary items in economic analysis will be needed to create and implement effective adaption methods, although human behavior will also impact the effectiveness of those methods. (Adger, et al., 2008; Dubeux, et al., 2014; Pelling & High, 2005) Though there has been extensive research on climate change there are many variables that affect the extent and pattern of climate change impacts. Changes in human activity, type of economic growth, and type and extent of adaption methods will all have an affect on the future of climate change. (Alley, et al., 2007; Dubeux, et al., 2014; Leggett, 2007; Stern, 2007)

Conclusion

Society has remained divided over how serious the issue of climate change is perceived. Those that believe tend to identify as politically liberal and the skeptics largely identify as politically conservative. This divide in public opinion directly effects economic decisions on adapting to climate change. Decisions made in favor of adaption incur economic costs that not all of the public is willing to pay. Waiting to make decisions on adaption policies could mean facing greater economic costs in the future. The need to create unique adaption policies for different geographic regions is less cost effective than one adaption strategy for the whole United States, but has the greatest benefit. The uncertainties of the distribution and exact impacts of climate change on different geographic regions creates resistance from policy makers toward environmental scientist. Environmental scientist must work with economists on new methods of analyzing the costs and benefits of adaption strategies. Much of the impacts of climate change

have a greater impact on non-monetary items such as water quality and distribution, air quality, and regional ecosystems.

There seems to be little common ground between believers and skeptics of climate change. A lack of understanding of climate change in the public seems to be the main cause for the divide. However, there is some evidence that a majority of the public agrees that alternative energy sources would be beneficial whether or not climate change is an issue. Economics and environmental science seem to agree that implementing adaption strategies now is more beneficial than waiting for more information. Scientist and economist work together to understand what adaption strategies are needed and where. Researching the effects of climate change in the United States requires using an interdisciplinary approach. This interdisciplinary research paper shows that society, economics, and environmental science must have an understanding of how each discipline interacts in this complex issue. A comprehensive understanding of the connections between each discipline helps to build a better understanding of the issue of climate change and its effects on the United states.

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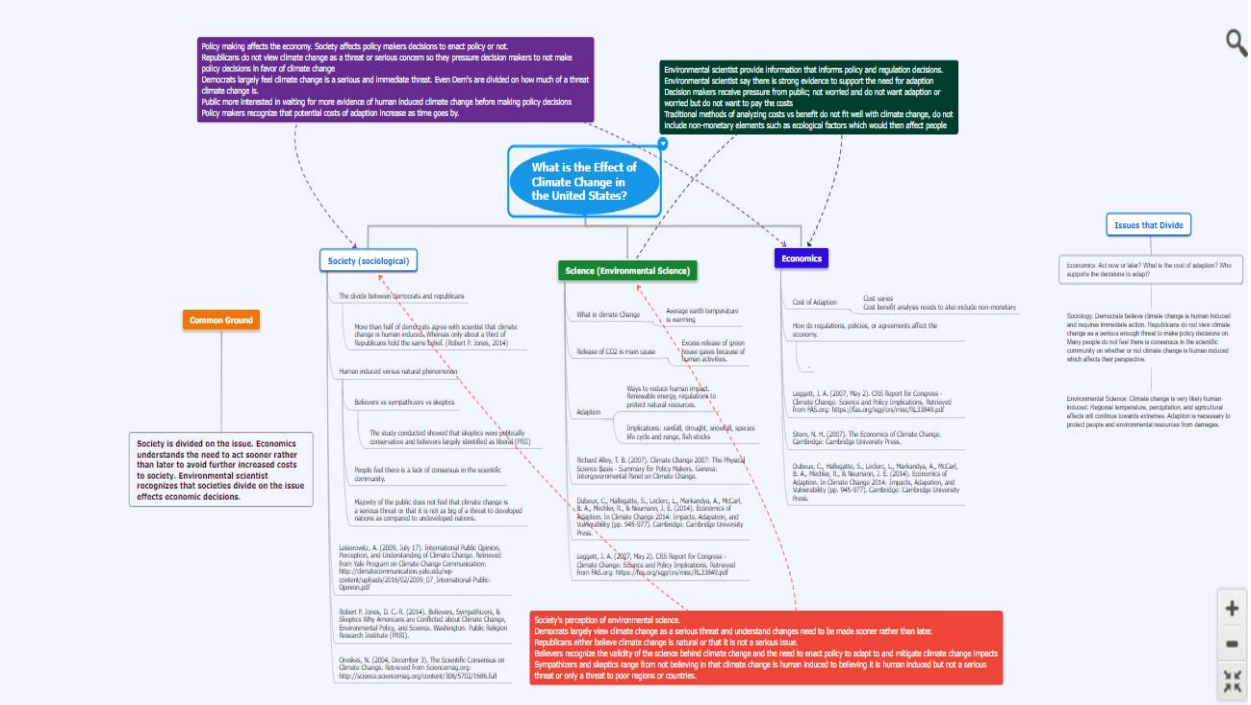

Concept map link: https://www.mindomo.com/mindmap/ids-research-64d063e9f09c4e16bd1081db0f3a9226