The Sociology of Greenhouse Gas Emissions

*A Brief Overview**

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Introduction

As noted recently in the leading scientific journal *Nature Climate Change* (Rosa and Dietz, 2012), sociologists in the past two decades have significantly increased our collective understanding of the anthropogenic drivers of greenhouse gas emissions and thus climate change. Anthropogenic, or human drivers, refers to the range of human actions that lead to the emissions of greenhouse gases into the atmosphere. In this article we briefly summarize the ways in which sociologists conduct research on the human causes of greenhouse gas emissions, and we provide a modest overview of the findings from this growing area of scientific inquiry.

We begin with a description of the different ways in which greenhouse gas emissions—specifically carbon dioxide emissions—are measured in comparative research. We continue by discussing the most frequent unit of analysis in the area of research: the nation-state. This is followed by an overview of the most common findings that concern the effects of population, economic development, and forms of globalization on national-level carbon emissions. We conclude by noting some of the likely future directions in sociological research on the human drivers of emissions.

Different Ways of Measuring Greenhouse Gas Emissions

The dependent variable for the vast majority of sociological research on greenhouse gases is carbon dioxide emissions, measured as total emissions, per capita emissions, or emissions per unit of production (per unit of GDP). Some studies focus on one of the three carbon emissions measures, while others treat two or all three as separate dependent variables. The first measure, total emissions, focuses on scale. It is the most important measure when considering climate change, given that it is the overall accumulation of emissions in the atmosphere that contributes to global warming (e.g., U.S. National Research Council 2010). The

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second measure is per capita emissions. From a sociological perspective, per capita emissions assess international inequalities in carbon emissions. From this perspective, every person in the world has equal rights to the atmosphere, and the amount of allowable pollution should be determined on a per capita basis (Roberts and Parks, 2007). The third measure, emissions per unit of production (per unit of GDP), is used to quantify relative levels of ecoefficiency (European Commission, 2005).

The primary reasons that sociologists employ measures of carbon dioxide emissions as dependent variables are threefold (Jorgenson and Clark, 2012). First, there is scientific consensus that anthropogenic carbon dioxide emissions are a primary contributor to climate change (U.S. National Research Council, 2010). Second, countless economic-related activities require the burning of fossil fuels, which results in carbon dioxide emissions. Third, there are much more data available for anthropogenic carbon dioxide emissions than any other type of greenhouse gas (e.g., methane) or environmental degradation (e.g., industrial water pollution, deforestation), and these data are reliable and valid for empirical research (World Bank, 2012). However, sociologists have conducted a small number of cross-national studies on anthropogenic methane emissions as well, which is also a potent greenhouse gas (e.g., Jorgenson, 2006; Jorgenson and Birkholz, 2010; Rosa et al., 2004).

The Nation-State as the Most Common Unit of Analysis

The nation-state is the unit of analysis in the majority of sociological research on the drivers of anthropogenic greenhouse gas emissions. The primary reasons for this are twofold. First, and increasingly so, there are simply more data available for dependent and independent variables at the nation-state level to do comparative analyses of greenhouse gas emissions. Second, foundational theoretical perspectives in sociology and sister disciplines that are of relevance for drivers of emissions research largely focus on country-level characteristics and interrelationships (Jorgenson and Clark, 2012).

Common Findings

The body of sociological research on national-level greenhouse gas emissions provides robust evidence that population size is a primary anthropogenic driver of total carbon emissions, and development is a primary driver of per capita and total carbon emissions. Further, there is mounting evidence that economic globalization characteristics increase total and per capita emissions in lower income nations while forms of political globalization have the opposite impacts. We briefly review these consistent findings in the following paragraphs. However, for emissions per unit of production the findings up to this point are quite mixed. These mixed results have led some researchers, including the first author of this article, to call into question the utility of such a measure of carbon emissions for policy-relevant research. This is a significant issue well beyond the scope of the current discussion, and will likely continue to garner attention and serious debate in academic and policy communities. For more in-depth sociological discussions on this issue, we direct readers to Jorgenson and Clark (2012) and York (2010).

In the context of total emissions, and as expected, population size is consistently found to be a key societal-level driver. This holds for both cross-sectional studies (e.g., Rosa et al., 2004; York et al., 2003) as well as longitudinal studies (Jorgenson and Clark, 2010). Cross-sectional studies are those that focus on relationships between a dependent variable and independent variable for one time point, and thus provide a snapshot of relationships. However, such modeling techniques don't focus on how changes through time in independent variables might lead to changes through time in dependent variables. Earlier sociological research on drivers of emissions tended to be cross-sectional due to data availability constraints. Fortunately, longitudinal data for most nations in the world are now readily available, allowing researchers to analyze changes through time, and such approaches are better suited at assessing causal relationships using sophisticated modeling techniques. While longitudinal studies consistently show that population size is a key factor, they also show that the estimated effect of population size on total national-level emissions has remained relatively stable through time, and this holds for both high income and lower income nations (Jorgenson and Clark, 2010), but with some moderate regional-level variation (Jorgenson and Clark, 2013).

Research also provides robust evidence that at the national level, affluence is a primary driver of emissions. More specifically, in cross-sectional and longitudinal analyses of (1) total carbon emissions (Rosa, et al., 2004) and (2) per capita emissions (Jorgenson, et al., 2007; Roberts, et al., 2003), levels of affluence or levels of economic development (measured as GDP per capita) exert positive effects, meaning higher levels of affluence/economic development, higher levels of emissions. A common explanation is that economic development is a treadmill-like process that requires ongoing and potentially increasing amounts of material inputs, which can lead to increases in levels and rates of waste, including carbon emissions (Gould et al., 2008). It is indeed empirically verified that development often involves technological advances that lead to increased efficiency in fossil fuel use (Mol et al., 2009), but the benefits accrued through such technological inputs are to some extent outstripped by the harms associated with the increasing scale and intensification of production and energy use that accompanies it (Jorgenson and Clark, 2012). In other words, technological advances by themselves that increase energy efficiency are not able to effectively lower carbon emissions associated with societal-level economic development (Polimeni et al., 2009).

Longitudinal research shows that the estimated effect of affluence/economic development on carbon emissions changes through time for some nations relative to others. For example, in a study recently published in American Journal of Sociology (Jorgenson and Clark, 2012), the authors found that for high income nations, the estimated effect of development on total carbon emissions slightly decreased in size from 1960 to 2005, while for lower income nations the estimated effect remained large and stable through time. For per capita emissions, the estimated effect of development remained large and stable for high income nations, but slightly increased in magnitude in lower income nations for the same 45-year period. Further, the effect of development on per capita emissions is much larger in high income nations than in lower-income nations and continues to be so for the entire period covered in the study. In a similar study of transition economy nations in Central and Eastern Europe for the 1992 to 2005 period, Jorgenson, Clark, and Giedraitis (2012) find that the estimated effect of development on total emissions, per capita emissions, and per unit of production emissions increased in magnitude through time, indicating that whatever development took place in these nations during this period

tended to be more energy intensive, carbon emitting, and relatively less energy efficient (see also York, 2008).

Other sociological research suggests that the non-trivial changes in the estimated effects of development on total and per capita emissions in high income nations relative to lower income nations are to some extent tied to economic globalization dynamics, especially the shifting of much manufacturing and related activities to lower income nations, with the goods largely produced for the consumer markets in high income nations and emerging economies of various middle income nations (McMichael, 2012). More specifically, research shows that the globalization of production and the globalization of trade have contributed to increases in carbon emissions in lower income nations (Jorgenson, 2009, 2012; Roberts and Parks, 2007) as well as the transition economy nations in Central and Eastern Europe (Jorgenson, 2011). Such results illustrate the growing challenges associated with sustainable development since other bodies of research suggest that economic globalization often stimulates economic development in lower income and transition economy nations, but such globalization dynamics also exert unintended environmental consequences, and in the context of carbon emissions these shifts and relationships are commonly referred to as environmental load displacements (Hornborg, 2009) or ecologically unequal exchanges (Jorgenson, 2012).

On the other hand, sociological research shows that forms of political globalization, such as the increasing number of environmental international nongovernmental organizations with members and offices in lower income nations, are able to partially mitigate the harmful effects of economic globalization on carbon emissions through the pressuring of facilities to use more environmentally friendly methods and for governments to enforce new and preexisting environmental regulations (Jorgenson et al., 2011; Schofer and Hironaka, 2005; Shandra et al., 2004). They are also likely to increase individual-level concern for the environment, and such civil society attitudes if strong enough often lead to the formation of social movement organizations and other citizen groups that can potentially influence firms to increase their environmental standards and thus reduce their carbon emissions (Givens and Jorgenson, 2013).

Conclusion

In the past two decades a noteworthy body of research conducted by sociologists indicates that national-level carbon emissions are largely caused by certain demographic and economic characteristics, some of which change through time. Characteristics of economic globalization contribute to increases in emissions in lower income nations, while forms of political globalization appear to have opposite effects, the latter of which is encouraging from a sustainability perspective. This research also identifies the clear limitations in focusing solely on technological solutions to reducing emissions. Without doubt, future sociological research will likely continue to identify human factors that contribute to national-level emissions. Perhaps more importantly, with increasing availability of data at smaller units of analyses, such as the U.S. State level, the city level, and even the facility level (e.g., power plants), future comparative research will begin to identify the human drivers of emissions at these smaller scales. Overall, such future studies at multiple scales will lead to a broader and deeper understanding of the human dimensions of global climate change, and this broader and deeper understanding will be critical in the formation of more effective mitigation policies and programs for dealing with reducing greenhouse gas emissions.