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Alienation, Modernization, and Animal Welfare: Human-Animal Relationships at the Farm, State, and Country Levels

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ALIENATION, MODERNIZATION, AND ANIMAL WELFARE: HUMAN-ANIMAL RELATIONSHIPS AT THE FARM, STATE, AND COUNTRY LEVELS

by

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ABSTRACT

Alienation, Modernization, and Animal Welfare:
Human-Animal Relationships at the Farm, State, and Country Levels
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Human-animal relationships are changing because of modernization, which includes economic growth, technological innovation, and globalization. The changes in these relationships affect both humans and animals and pose a challenge for sustainability. This study analyzes the social factors that influence human-animal relationships at three different scales: farm, U.S. state, and country. I present my research in three empirical chapters.

In the first empirical analysis I conducted a survey and semi-structured interviews with dairy farmers in Washington state to understand how farm size and modern technologies and practices influence their relationships with their work and with their cows, and how these relationships influence their overall life satisfaction. The results of my analysis showed that increased farm size is associated with increased alienation from cows but increased use of technologies and practices is associated with decreased alienation from cows. Both relationships with work and cows are statistically significant predictors of overall life satisfaction.

In the second empirical paper I analyzed the relationship between economic growth and animal welfare protection in the United States. I conducted two types of analysis: fixed effects panel regression analysis for the years 2012 to 2017 and cross-sectional OLS regression analysis for the year 2017. I used administrative data from several governmental sources as well as the Humane Society of the United States' "Humane State Ranking". Overall, the results of these analyses showed that increased GDP per capita is associated with higher overall animal welfare protection, wildlife protection, and research animal protection.

Finally, in the third empirical chapter I tested for the existence of a farm animal welfare Kuznets curve (AWKC) as well as for an ecologically unequal exchange (EUE) of farm animal cruelty at the global level. The results showed some support for the AWKC hypothesis when it comes to overall farm animal cruelty, and a negative linear relationship between GDP per capita and sanctioning farm animal cruelty. There is evidence of a positive linear relationship between GDP per capita and consumption of farm animal cruelty – the number of animals consumed and the proportion of protein in diets from animal sources. I found that increased trade with high income countries was associated with decreased overall farm animal cruelty and production of farm animal cruelty.

(253 pages)

PUBLIC ABSTRACT

Alienation, Modernization, and Animal Welfare:
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Michael D. Briscoe

Our relationships with animals are important for us as humans, for the environment, and for the animals themselves. In this dissertation I look at the relationships between humans and animals at three scales: farm, U.S. state, and country. Specifically, I address how factors like economic growth, technological innovation, and globalization affect human relationships with animals. Understanding how these factors influence human-animal relationships is important for improving these relationships and deciding which directions will most contribute to sustainable outcomes. I address the social factors that influence human-animal relationships in three studies.

In the first study I surveyed and interviewed dairy farmers in Washington. I asked them how farm size and the technologies and practices they used on their farm influenced their relationship with their work and with their cows. I then analyzed how these relationships influenced their overall life satisfaction. Farmers reported that farm size made it difficult to stay connected with their cows but that new technologies helped farmers connect in new ways with their cows while avoiding conventional negative interactions. Both relationships with work and cows were related to life satisfaction, which is important for farmers, who as a population face high levels of stress.

In the second study I used data from government sources and the Humane Society of the United States to assess how economic growth influenced farm animal protection in the United States. The results of my analyses suggest that economic growth may have a positive effect on farm animal protection. This is encouraging news for policymakers hoping for win-win scenarios to improve animal welfare – though more research on direct animal welfare is needed.

Lastly, in the third study I used data from Voiceless: The Animal Protection Institute and the World Bank to see how economic growth influenced farm animal cruelty on a global scale. The results suggest that economic growth reduces some types of farm animal cruelty but increases others. Trade with high-income countries may have a spillover effect with lower-income countries that reduces farm animal cruelty in those countries.

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CHAPTER 1 – INTRODUCTION

Current human relationships with animals are not sustainable for society, the environment, or for the animals themselves. These relationships contribute to problems with human health (Goldberg 2016; Hu, Cheng, and Tao 2017), environmental degradation and greenhouse gas emissions (aan den Toorn, van der Broek, and Worrell 2017; Djekic and Tomasevic 2016), and animals being slaughtered at only a fraction of their natural lifespan (Leroy and Praet 2017). Understanding how to improve these relationships is a key question for sociologists because of the linkages between animal welfare, social, and environmental well-being. Environmental sociology often examines modernization (economic growth, technological innovation, globalization) as either the driving force leading to unsustainable outcomes or as a necessary pathway to solving society's current social-environmental problems. This dissertation aims to better understand the role of modernization in shaping human-animal relationships.

My dissertation addresses the overall question of the effect of modernization on human-animal relationships. It also addresses several specific issues brought up by previous human-animal studies including disputes between academic disciplines, variation in the experience of animals by species, and the importance of scale in studying human-animal relationships. In this introductory chapter, I give a brief background of the human-animal literature. In particular, I highlight human-animal studies perspectives within and connections to environmental sociology. Next, I outline three issues in previous human-animal studies that my dissertation addresses: academic discipline,

species, and scale. I then outline the three main chapters that I use to answer the overarching research question of this dissertation. Each chapter addresses the human-animal relationship at a different scale: farm, U.S. state, and country, and I employ unique research methods in each: survey and interviews, panel regression and OLS regression, and a Kuznets curve analysis and analysis of ecologically unequal exchange (both of which use OLS regression). Table 1-1 outlines the basic information of each empirical chapter in this dissertation.

Table 1-1: Overview of Empirical Chapters

Chapter	Chapter 2	Chapter 3	Chapter 4
Scale	Farm	U.S. State	Country
Research Question	How does modernization affect dairy farmer relationships with their work and their cows?	How does economic growth affect animal welfare protection?	How do economic growth and international trade affect farm animal cruelty?
Theories	Metabolic Rift Theory Ecological Modernization Theory	Ecological Modernization Theory Treadmill of Production Theory	Animal Welfare Kuznets Curve Treadmill of Production Theory Ecologically Unequal Exchange Theory
Methods & Analysis	Internet and Mail Survey: OLS Regression Semi-structured Interviews	Administrative Data Analysis: Panel Regression & OLS Regression	Administrative Data Analysis: OLS Regression
Dependent Variables	Alienation from Work Alienation from Cows Life Satisfaction	Humane State Ranking: Wildlife, Companion Animal, Research Animal, and Farm Animal Protection	Voiceless Animal Cruelty Index: Consumption, Production, and Sanctioning of Farm Animal Cruelty
Key Independent Variables	Farm Size Technologies and Practices Used	GDP per Capita Research and Development as a % of GDP	GDP per Capita % of Trade with High-Income Countries

SUSTAINABILITY AND HUMAN-ANIMAL RELATIONSHIPS

Today, humans exert a historically unprecedented influence over the environment and other animals. Crutzen and Stroemer (2000) refer to this era characterized by human influence as the Anthropocene. Some argue that because of this influence humans have moral duties and obligations toward animals that are not being met (Bekoff 2010; Keulartz and Bovenkerk 2016; Singer 2009). In other words, modern relationships between humans and animals have often resulted in decreased animal welfare. Animal welfare on its own is a topic that warrants investigation and research. However, even from a purely anthropocentric view (one focused primarily on human interests), human-animal relationships are a critical issue in environmental sociology because they are intimately tied to environmental and social outcomes (Pinillos 2018; Zinsstag et al. 2011). In other words, despite ideological differences over animal welfare, improving animal welfare will likely reduce environmental degradation and improve human well-being. It is therefore an important issue for sociologists to address. In this section, I primarily focus on environmental and social impacts associated with animal agriculture, which help illustrate the relevance of this research and connections with broader sociology.

Animal welfare is connected to environmental outcomes both directly and indirectly. Animals are directly related with environmental outcomes through measures of biodiversity and conservation of endangered species. These variables are often treated as environmental outcomes themselves although they are measures of animal populations. Indirectly, the way that humans use animals to produce food has a dramatic

impact on the environment. In this dissertation I focus primarily on the environmental issues related to animal agriculture. The United Nations Food and Agriculture Organization (FAO 2006) outlines the impacts of modern animal agriculture as contributing to water use, water pollution, land degradation, biodiversity loss, and as contributing to "an estimated 18 percent of total anthropogenic greenhouse gas emissions" (p.112). A large portion of these emissions are methane, which traps more much heat than carbon dioxide (EPA 2021; FAO 2006). The exact contribution of animal agriculture to environmental problems is debated (see Glatzle 2014), but there is a general consensus that the current system of animal production is less environmentally sustainable than one based on plants (Clark and Tilman 2017; Ernstoff 2019; Meier and Christen 2013; Eshel et al. 2014; Pimental and Pimental 2003; Reijnders and Soret 2003; Ritchie and Roser 2020).

Social outcomes are also intimately tied to animal welfare. The polluting effects of animal agriculture also cause social problems including respiratory health problems (de Rooij et al. 2019), lowering of nearby home values (Lawley 2021), and a decrease in social engagement as people are less willing to spend time outside due to foul odors (Estabrook 2015). Beyond the farm, modern meat packing plants operate at high speeds to increase productivity, which contributes to above average occupational injury rates (BLS 2019; Genoways 2015; Leiber and Perry 2017). These numbers are likely even higher as workers in these settings are typically vulnerable populations and underreport injury out of fear of losing their job (GAO 2016). Lastly, modern animal production systems have led to the emergence of zoonotic diseases including swine flu (Schmidt

2009) and most recently COVID-19 (Shereen 2020), both of which had devastating health and economic outcomes. In sum, production systems designed to maximize profit at the expense of animal welfare have also created a number of social and environmental problems.

Human-animal relationships are not only negative. There is growing evidence that confirms what most pet guardians already know – that human-animal contact can have positive psychological and physiological health impacts (Beck and Katcher 2003). Irvine (2008) asserts that similarly to how we develop our "self" through interaction with other humans, the self also develops through interaction with animals. The importance and impact of positive human-animal relationships extend beyond companion animals to relationships with farm animals (Arvidsson 2017) and wild animals (Smith, Ham, and Virginia 2011). Chapter 2 of this dissertation addresses the positive aspects of the human-animal relationship between dairy farmers and their cows and the social forces that influence this relationship.

ACADEMIC DISCIPLINE, SPECIES, AND SCALE

Three major challenges in studying human-animal relationships are academic discipline, species, and scale. Human-animal relationships do not fit neatly into a society/environment dichotomy. These relationships have therefore gone understudied by both environmental scientists and sociologists. Arluke (2002) addresses this challenge in sociology saying, "I am convinced that the most formidable barriers to the future development of sociological nonhuman animal studies are internal rather than external to

sociology" (p.369). Environmental studies on the other hand addresses animal issues but tends to have a holistic view of animals – valuing them for the contributions they make to ecosystem health rather than as individual beings (Noske 1997; Peterson 2013). According to this perspective, domesticated animals are considered relevant only insofar as they pollute or damage ecosystems. There is no fear of cow species on farms going extinct, and they do not make a meaningful biodiversity contribution to ecosystems as they have been largely removed from these systems. The result of these academic distinctions and boundaries is that human-animal relationships, particularly with domesticated animals, are understudied by both sociology and environmental studies. The human-nature dichotomy is a flawed model and the lines between society are environment, along with the types of human-nature relationships people engage in, are constantly shifting and vary based on context (Flint et al. 2013). I address this gap in the literature throughout my dissertation and conceptualize human-animal relationships as a type of human-nature relationship. Conceptualized this way, theory in environmental sociology helps explain these relationships.

The second challenge with studies of the human-animal relationship is that animals are a broad group, and human relationships with them vary greatly based on species. For instance, Arluke and Sanders (1996) argue that in modern homes "companion animals are regarded as almost human and are treated paternalistically as babies" (Arluke and Sanders 1996:170). Kortetmäki (2019) argues on the other hand that farm animals in modern society have been stripped of their animality and treated as "things" rather than living beings due to new modes of agricultural production. This

makes it hard to draw conclusions about the effect of modernization on animal welfare. On one hand the percentage of US households owning a pet has increased from 56% in 1988 to 67% in 2020 (Miller 2021). Pets, or companion animals, receive perhaps the best treatment of any animals in modern society, and rising ownership may indicate an increased desire for meaningful human-animal relationships. However, during this same period the number of animals slaughtered per capita for food also increased (Sanders 2020). Even within agriculture, welfare outcomes vary greatly by species. Chickens, for example, are excluded from the Humane Methods of Slaughter Act (Matheny and Leahy 2007). The majority of this dissertation focuses on farm animals, but Chapter 3 specifically analyzes how economic growth affects animal welfare legislation differently based on species.

Lastly, scale presents a challenge to understanding the effect of modernization on the human-animal relationship. At the individual level, there has been an increase in concern for animal welfare, but this concern does not necessarily translate to action (Tawse 2010), and at the global scale the number of animals slaughtered continues to rise (Sanders 2020). Globalization has also affected how animals are raised and slaughtered as they are shipped around the world to satisfy consumer demands. Because of this, considering animal welfare only at the level of a single country would be insightful but would leave out key aspects of modern animal production. Studies at multiple scales are needed to get a fuller picture of the state of animal welfare, and the effect that modernization has on it. This dissertation addresses this challenge in previous literature

by analyzing human-animal relationships at three scales: farm, U.S. state, and country.

RESEARCH DESIGN

The overall aim of this dissertation is to understand how modernization affects human-animal relationships. I do this with three research papers rooted in environmental sociology that address different human-animal relationships at three different scales. Chapter 2 is at the farm level and analyzes farmer relationships with their cows. Chapter 3 is at the U.S. state level and analyzes animal welfare protections for companion, wild, laboratory, and farmed animals. Chapter 4 is at the international level and analyzes the production, consumption, and sanctioning of farm animal welfare. I give a brief outline of these chapters and their research methods here.

Chapter 2

Chapter 2, "Alienation of Dairy Farmers from Their Work and Animals," addresses three questions: 1) how does modernization affect farmer alienation from their work, 2) how does modernization affect farmer alienation from their cows, and 3) how do alienation from work and alienation from cows affect farmers' overall life satisfaction? York, Rosa, and Dietz (2010) define modernization as "the combined effects of industrialization, economic growth, the expansion of markets, urbanization, globalization, and the acceleration of scientific and industrial development" (p.77). Capturing all these factors in a single analysis would be difficult and create issues of multicollinearity. At the level of the dairy farm, I operationalize modernization as increased farm size and use of

technology. I apply metabolic rift theory and ecological modernization theory to form the hypotheses for this chapter. Metabolic rift theory posits that modern systems of production alienate people from both their work and from nature – in this case cows being considered nature (Foster, Clark, and York 2011; McClintock 2010). Ecological modernization theory on the other hand rejects this more pessimistic view of modernity, asserting that technology can have a positive impact on human-nature relationships (York, Rosa, and Dietz 2010).

Previous research has found mixed results about the impact of precision farming technologies on the farmer-animal and farmer-work relationship. These technologies, such as automatic milking systems, can give farmers more flexibility, but can also contribute to decreased interaction time with animals (Wildridge et al. 2020). On the other hand, a decrease in quantity of time spent with cows does not necessarily translate to a loss of quality of interactions. Schewe and Stuart (2015) find that for dairy farmers installing automatic milking systems changed the types on interactions they had with their cows and overall had a positive impact on these relationships. Much of this dairy research is based in Western Europe, which has higher adoption rates of precision technologies (de Koning 2010). Even within the United States, dairy production varies greatly by region. My study contributes to this literature by focusing on dairy farmers in Washington state. The Western region of the United States (CA, CO, ID, OR, and WA) has a higher than average proportion of large farms (more than 499 cows) and the trend continues to be toward larger farms (MacDonald, Cessna, and Mosheim 2016; MacDonald et al. 2007). In Washington, 31.3% of cows were on dairy farms with more

than 499 cows in 1992 compared to 82.0% in 2012 (MacDonald, Cessna, and Mosheim 2016). Washington is therefore a good site to study how modernization affects the farmer-cow relationship on dairies.

I use a mixed methods approach to analyze alienation of dairy farmers in Washington state. First, I conduct a mixed-mode survey. The survey was initially emailed to all principal operators of dairy farms in Washington. I then sent a mail version of this survey to those farmers who did not complete it online. In total 54 farmers completed this survey. I then contacted the farmers who completed the survey to participate in semi-structured interviews. Thirteen farmers completed an interview. Overall, the results indicate that increased farm size is associated with increased alienation from cows, but that that a higher number of technologies used on the farm is associated with decreased alienation from cows. The interviews with farmers help explain that farmers have a complicated relationship with their work. On one hand, dairy farmers are passionate and proud about what they do. On the other, they face a number of challenges such as maintaining economic profits and restrictive regulations that cause them stress at work. Farmer alienation from work and alienation from cows are both associated with decreased overall life satisfaction. This final finding illustrates the relevance and importance of analyzing alienation among farmers.

Chapter 3

Chapter 3, “Ecological Modernization and Animal Welfare Protection in the United States, 2012-2017” asks is there a relationship between economic growth and

animal welfare protection in the United States. Ecological modernization theory predicts that continued economic growth will lead to positive environmental reforms as ecological goods and values are incorporated into economies and legislative reform is a key aspect of ecological modernization theory (Mol and Spaargaren 1993). Treadmill of production theory on the other hand asserts that these reforms will only take place when the economic bottom-line will not be impacted and sees economic growth as driving environmental degradation (Schnaiberg 1980; Schnaiberg and Gould 1994). I apply these two theories to animal welfare protections, and analyze legislative outcomes for companion, wild, laboratory, and farm animals.

I analyze animal welfare protection at the US state level, using a combination of administrative data from governmental and nonprofit organizations. To analyze animal welfare protection, I use a measure developed by the Humane Society of the United States, the Humane State Ranking, which assigns states a percentage score based on the number of animal welfare protections they enact. I analyze these data for the years 2012 to 2017 using panel regression, but I also include a cross-sectional analysis using data just from 2017. Overall, the panel regression does not show statistically significant relationships between economic growth (measured by GDP) and animal welfare protection, but the cross-sectional analysis grants some support to ecological modernization theory, finding that states with higher GDP and higher GDP growth are associated with more animal welfare protection.

Chapter 4

Chapter 4, "Animal Welfare Kuznets Curve or Unequal Exchange of Cruelty?: A Global Analysis of the Production, Consumption, and Sanctioning of Farm Animal Cruelty," addresses the relationship between economic growth and international trade and the production, consumption, and sanctioning of farm animal cruelty. Previous research has suggested that an animal welfare Kuznets curve may exist where economic growth is initially associated with an increase in animal cruelty, but that after a point this relationship reverses, and further growth is associated with decreased animal cruelty (Frank 2008; Morris 2021). There are two issues with analyses of animal welfare Kuznets curves. The first is that the relationship between economic growth and animal cruelty can change more than once. Morris (2021) finds that a Kuznets curve exists when analyzing purchasing power parity (PPP) and the production of farm animal cruelty. However, after a point this relationship reverses and higher PPP is associated with higher production of cruelty again. Second, animal production and consumption no longer take place within the borders of a single country. Animals can be raised in one country, slaughtered in another, and consumed in a third. Ecologically unequal exchange theory posits that high-income countries benefit disproportionately from trade relationships with lower-income countries (Givens, Huang, and Jorgenson 2019), and I hypothesize that this same dynamic exists in the context of animal cruelty. In other words, an animal welfare Kuznets curve may exist when looking at individual countries' production, consumption, and sanctioning of animal cruelty, but high-income countries may simply be avoiding animal cruelty by importing it from other countries.

To analyze the existence of a global animal welfare Kuznets curve and ecologically unequal exchange of animal cruelty I use administrative data from the World Bank and from Voiceless: The Animal Protection Institute (VAPI). VAPI (2017) created an index of farm animal cruelty comprised of three sub-indices measuring the production, consumption, and sanctioning (meaning allowing) of farm animal cruelty, and I use this index and sub-indices as the dependent variables in this chapter. Currently these data are only available for the year 2014 and the analyses in this chapter are therefore cross-sectional. The results suggest the existence of a Kuznets curve in overall farm animal cruelty and consumption of farm animal cruelty. However, consumption of cruelty does not continue to decline with GDP growth. Rather, this trend reverses and consumption of cruelty begins to rise again. Sanctioning farm animal cruelty is negatively associated with GDP. In the analysis of ecologically unequal exchange, the results show that increased trade with high-income countries is actually associated with lower overall farm animal cruelty and lower production of cruelty as well – the opposite of my ecologically unequal exchange theory derived hypothesis.

Chapter 5

Chapter 5 is the concluding chapter of this dissertation. In it, I summarize the key findings of my research and its contributions to sociology, environmental sociology, and broader human-animal studies. As I summarize the findings of this research, I also make suggestions on how future research could build on the work I have done here. I then address a final limitation associated with research on human-animal relationships and

animal welfare: subjectivity. Lastly, I outline my agenda for future research on modernization and human-animal relationships. The first study on this agenda is an analysis of how farm modernization affects farmers' community engagement. The second is an analysis of the animal welfare Kuznets curve using nonprofit animal-based organizations as a dependent variable – an analysis that would also contribute to world polity theory.

SUMMARY

In this dissertation I address an oftentimes overlooked issue in sustainability research – human-animal relationships. I apply theories from environmental sociology to hypothesize the relationship between modernization and human-animal relationships, and address three aspects of human-animal relationships that contribute to the need for ongoing research: academic discipline, species, and scale. I do this by applying sociological theory to human-animal relationships, by analyzing legislative outcomes for different species of animals, and by analyzing human-animal relationships at three scales: farm, U.S. state and country. I use different methodological approaches in each chapter that give additional insights into human-animal relationships.

Overall, this dissertation makes a contribution broader sociology, environmental sociology, and human-animal studies. In this research I demonstrate the continued relevance of classical sociological concepts such as alienation in the context of dairy farmers. I also highlight the connections between social factors and animal outcomes on national and international scales. Environmental sociologists have called for the

expansion and application of theory to novel situations, including to human-animal relationships. I do so, and provide empirical tests of prominent theories in environmental sociology including ecological modernization, metabolic rift, treadmill of production, the animal welfare Kuznets curve, and ecologically unequal exchange theories. And finally, my dissertation contributes to human-animal studies and suggests ways to improve human-animal relationships and directions for future research.

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CHAPTER 2 – DAIRY FARMER ALIENATION FROM WORK AND COWS

As I toured a dairy farm in 2019 a farmer told me that his farm had become more like a factory than he would like, but that the lifestyle his grandfather had living on a farm with ten cows was no longer possible. A growing body of literature suggests that this farmer is not alone in feeling the effects of modernization (farm growth and technological innovation) on his farm. Rapid changes in the farming workplace, an aging farming population, and economic difficulties all contribute to an agricultural crisis as farmers experience high stress, mental health problems, and suicide rates above the national average (Fraser et al. 2005; Widmar 2015). This crisis demands attention from sociologists to better understand how modernization affects farmers. Specifically, I address three research questions in this paper: 1) how does modernization affect the farmer-work relationship, 2) how does modernization affect the farmer-animal relationship, and 3) how do these relationships affect overall life satisfaction for farmers?

Environmental sociology frequently examines modernization and its impact on human-nature relationships. The discipline is therefore uniquely positioned to address farmers' experience in a modernizing dairy industry. In this paper, I apply metabolic rift theory and ecological modernization theory to analyze the farmer-cow relationship. Metabolic rift theory suggests that modernization of agriculture has alienated farmers from both their animals and their work and places this relationship within a broader context of rifts in resource cycles such as animal feed and manure (Foster 2002). Alternatively, I apply ecological modernization theory to suggest that modernization may

change farmers' experience, but that this change can be for the better – that modernization can free farmers from traditional farming tethers and alter the human-nature relationship for the better. These different theoretical perspectives on modernization are important because they can help inform future policy direction for improving farmer well-being: whether to continue into further modernization or whether to restructure broader political economic systems that incentivize infinite growth and profit.

Dairy farms are an area where human relationships to work and animals are inseparably connected in the farmer-cow relationship, and modernization is changing this relationship. The dairy industry has undergone rapid industrialization in the past several decades, including large economic changes. The number of dairies has declined while the number of cows on each farm has risen (MacDonald, Law, and Mosheim 2020). Milk production per cow has also increased, facilitated by technological innovations like milking machines (de Koning 2010). For both metabolic rift and ecological modernization theories, this rapid modernization that includes farm growth and the innovation and adoption of new productive technologies is an important factor in shaping farmers' experience and relationship to their work and cows.

This chapter uses survey and interview data from dairy farmers in Washington state to analyze farmer relationships with their work and their cows within this context of modernization and industrialization and then analyzes the impact these relationships have on overall life satisfaction among farmers. The chapter begins with a discussion of the modern changes to the dairy industry, its current state, and issues facing farmers. I then

address the origins of metabolic rift and its application to dairies, including the concepts of alienation and nature – highly contested terms, used in multiple ways depending on who is using them. Ecological modernization theory offers an alternative perspective of the modernization of dairy farms, one that does not see automation and growing farm size as inherently alienating. Next, I outline the mixed-methods survey and interview modes used to collect data for this study. The results show mixed support for metabolic rift theory and ecological modernization theory and highlight the complex nature of alienation and the importance both alienation from work and alienation from cows have for farmers' overall life satisfaction. Finally, I discuss the findings of this analysis and the implications of these findings for the dairy industry, environmental sociology, and the field of sociology more broadly.

THE INDUSTRIALIZATION AND MODERNIZATION OF DAIRY AND ANIMAL WELL-BEING

Agriculture generally, and the dairy industry specifically, experienced rapid changes in the United States during the 20th century, a trend that continues today. Farmers were able to grow more food on smaller plots of land with new technologies such as synthetic fertilizer, the development of high-yielding crop varieties, and machinery that allowed for more efficient planting and harvesting (Evenson and Gollin 2003; Konefal and Hatanaka 2021). Animal agriculture also industrialized during this time in the U.S., a process that included consolidation of production into the hands of a few large companies (Fitzgerald 2015; Leonard 2014), and the deployment of new technologies and practices including genetic selection, hormone and antibiotic treatments,

and new types of machinery (Blayney 2002; Roberts 2000). Dairy is unique in its rapid rate of industrialization and change; "dairy production has been shifting to larger farms for several decades, and at a pace that exceeds the pace of consolidation in most U.S. agriculture" (MacDonald, Law, and Mosheim 2020:40). In the United States, there were 21 million cows on 4.6 million farms in 1940, and by 1980 there were 11 million cows on 334,180 farms – a 93% decrease in dairy farms and 48% decrease in dairy cows (Von Keyserlingk et al. 2013). Similar trends of dairy intensification occurred during this same time period in the European Union, Australia, and New Zealand (Clay, Garnett, and Lorimer 2019), and more recently in China (Tao et al. 2016). Despite the decrease in the number of dairy cows in the United States, milk production continued to grow during this period and after because of advances in genetics, nutrition, and herd management (Capper, Cady, and Bauman 2009; Von Keyserlingk et al. 2013). "The dairy population required to produce 1 billion kg of milk in 2007 was only 21% of that required in 1944" (Capper, Cady, and Bauman 2009:2163).

Innovations in dairy technology such as milking machines have greatly increased milk production on dairies, but raise questions and concerns among farmers, the public, and sociologists. "No other new technology since the introduction of the milking machine, has aroused so much interest and expectations among dairy farmers and the periphery" (de Koning 2010:1). Milking machines have been around in one form or another since 1819 (see Baiju 2020), but still typically required direct farmer intervention between cow and machine, the machine simply replacing or making simpler the act of milking. By the 1970s and 80s the first automatic milking systems were patented which

allowed farmer oversight but relied on robotics to perform all the essential milking functions (Baiju 2020).

The development of these new technologies has increased productivity, but raises questions about their effect on the farmer-cow relationship, and how they influence the well-being of both farmers and cows. Critics of the modernization of animal agriculture argue that in these mechanized systems animals are seen and treated like pieces of machinery themselves (Noske 1997). The concept of reification, "a process in which certain entities or social relations take on the character of a thing: they are treated merely as quantifiable things" (Kortetmäki 2019:487), can be applied to explain this change in relationship between humans and animals in modern production systems. Others argue that technologies like automatic milkers have improved animal welfare and in fact give animals greater agency to choose when to be milked (Driessen and Heutinck 2015; Jacobs and Siegford 2012). Research on direct animal welfare outcomes has been somewhat mixed, with some research finding increased stress response among cows on farms with automatic milkers (Wenzel, Schönreiter-Fischer, and Unshelm 2003). Other comparative research finds that cow stress when using conventional and milking systems compared to automatic systems is not substantively different (Hagen et al. 2005; Hopster et al. 2002). In terms of animal health, these systems allow for increased and more accurate monitoring of cow health (Tse et al. 2017), but can fail to detect things a farmer would, such as whether or not a teat is clean – a condition that can lead to mastitis if not addressed properly (Hovinen and Pyörälä 2011). In summary, the effect of modernization

on dairy cow welfare is still being debated and researched.

MODERNIZATION AND FARMER WELL-BEING

Farmers, in addition to animals, are also affected by modernization of the dairy industry. Public opinions help shape regulation and influence the experience of farmers. Changes in dairy farming structure (e.g. expanding farm size, import of feed) and practices (e.g. automatic milking systems, artificial insemination, manure management) have raised concerns among the public – a factor that can contribute to farmer stress (Kallioniemi et al. 2016; Simkin et al. 1998). A survey of the public in the Netherlands, where automatic milking technologies are highly utilized (see de Koning 2010), found that "a decrease in farmer-animal contact was the least acceptable" change on dairy farms related to modernization for members of the public (Boogard et al. 2011:272). However, a German study conducted more recently found that the public viewed digital farming technology (including automatic milking technologies) positively and believed they had the potential to improve animal welfare and environmental outcomes (Pfeiffer, Gabriel, and Gandorfer 2020). These attitudes are influenced by public-farmer trust. "Accepting digital farming technology and agreeing to their subsidization is mainly based on positive general attitudes toward farming and trust in farmers" (Pfeiffer, Gabriel, and Gandorfer 2020:16).

Modernization affects farm productivity and animal well-being, as well as the farmer-cow relationship. New technologies have changed farmers' daily routines, including the ways they interact with their animals and their day-to-day work tasks. One

study finds that although farmers who transition from conventional to automatic milkers may not experience attitudinal changes toward cows, farmers using conventional milking systems spend an average of 5.6 hours per day interacting with cows compared to 2.6 hours per day on farms with automatic milking systems (Wildridge et al. 2020). However, on many farms, milking is one of the first tasks assigned to laborers by primary operators (Driessen and Heutinck 2015). Milking may be a common source of interaction on conventional dairy farms, but not necessarily the highest quality interaction. Transitioning to automatic milking machines may allow farmers to pursue the quality interactions they desire (Stuart and Schewe 2014). An accepted practice for measuring the farmer-cow relationship is the avoidance distance test, where researchers measure how close the farmer can approach the cow before the cow withdraws (Waiblinger, Menke, and Fölsch 2003; Windschnurer et al. 2008). Wildridge et al. (2020) find that this distance was shorter on farms with automatic milking systems, suggesting a more positive human-animal relationship despite decreased interaction time milking.

Modernization has changed multiple technologies and practices on dairy farms, not just those related to milking. One of the major technological changes that has received attention from researchers is automatic milking systems, but these systems are still highly concentrated in western Europe (De Koning 2010) and thus much of the research on the farmer-cow relationship has been conducted outside of the United States (e.g. Bertenshaw and Rowlinson 2009; Bertenshaw et al. 2008; Driessen and Heutinck 2015; Ivemeyer, Knierim, and Waiblinger 2011). In the United States other technologies and practices have also gained prominence on dairy farms including milking three times a

day, computer delivery of feed, artificial insemination, purchasing feed off-farm, and raising replacement heifers off-farm (MacDonald, Cessna, Mosheim 2016; MacDonald, Law, Mosheim 2020). These practices contribute to the critique that modern farms are more akin to factories where animals are integrated into the machinery (Noske 1997) but have received less attention from empirical research than changes in milking systems.

In addition to the increasing use of technologies, a common process of modernization in the dairy industry is consolidation, a process that began in the 1900s and continues today (Capper, Cady, and Bauman 2009; MacDonald, Law, and Mosheim 2020; Shields 2010). As described above, this process involves a shrinking number of farms with an increasing number of cows on each farm. Consolidation of the dairy industry in the United States has coincided with a concentration of milk production and processing into the hands of a smaller number of firms – a situation that means there is less market competition and power is thereby shifted away from smaller farmers with less ability to bargain (Shields 2010). This lack of control contributes to dairy farmer stress (Lunner Kolstrup et al. 2013). An opinion piece in *Farmers Forum* (2019) identifies the reasons dairy farmers are leaving the business: technology, regulations, growing expenses, and health of farmers and their cows. These factors are all related to the consolidation of the dairy industry. Modernization of the dairy industry is an ongoing process that requires attention from sociologists.

THEORIES OF MODERNIZATION

Farms, and farms dedicated to animal agriculture especially, are a unique workplace that blends nature and society. Theory in environmental sociology can therefore help explain the processes of modernization occurring on farms, and the effect this may have on farmers. I employ two main theories in environmental sociology in this study: metabolic rift theory and ecological modernization theory.

Metabolic Rift Theory

Metabolic rift theory focuses on the flow of materials and energy between society and the environment to understand human-nature relationships and posits that modern systems of production alienate laborers from their work as well as from nature. Foster (1999) initially drew attention to Karl Marx's overlooked ecological writings and introduced the theory of metabolic rift to wider environmental sociology (see also Schneider and McMichael 2010). Marx was particularly concerned with the movement of energy and materials in society and captured this concept in the term "social metabolism" (Martinez-Allier 2003). Extending this idea of metabolism to nature, Marx analyzed the flows of materials and energy between society and the environment, concluding that capitalism disrupted these flows, thereby creating metabolic rifts – rifts in natural cycles of energy and materials (Foster 1999).

Marx's earliest work on the metabolic rift was in his comments on the guano trade between South America and Europe, where Europe imported guano to use as an agricultural fertilizer (Foster 1999; Foster, Clark, and York 2011). As Europe urbanized

the flow of materials shifted. Farmers grew crops in the country then transported them to cities for consumption. Then, rather than returning waste to farms where it could be used as fertilizer, it became concentrated in cities, polluting waterways (Foster 1999). This was a metabolic rift, a disruption in the flow of energy and materials, which humans attempted to solve by moving guano from Peru to Europe (Clark and Foster 2009; Foster 1999). In reality, this "solution" created yet another metabolic rift as Europeans transported guano across the world to be used as fertilizer. Thus, the smaller-scale town/country rift developed into a global rift. To summarize, metabolic rifts can be thought of as rifts in natural cycles created by systems of capitalist production. These rifts exist at multiple scales and for different types of resources and wastes exchanged. Analyses of animal agribusiness have pointed to metabolic rifts in the carbon, nitrogen, and water cycles (Gunderson 2011).

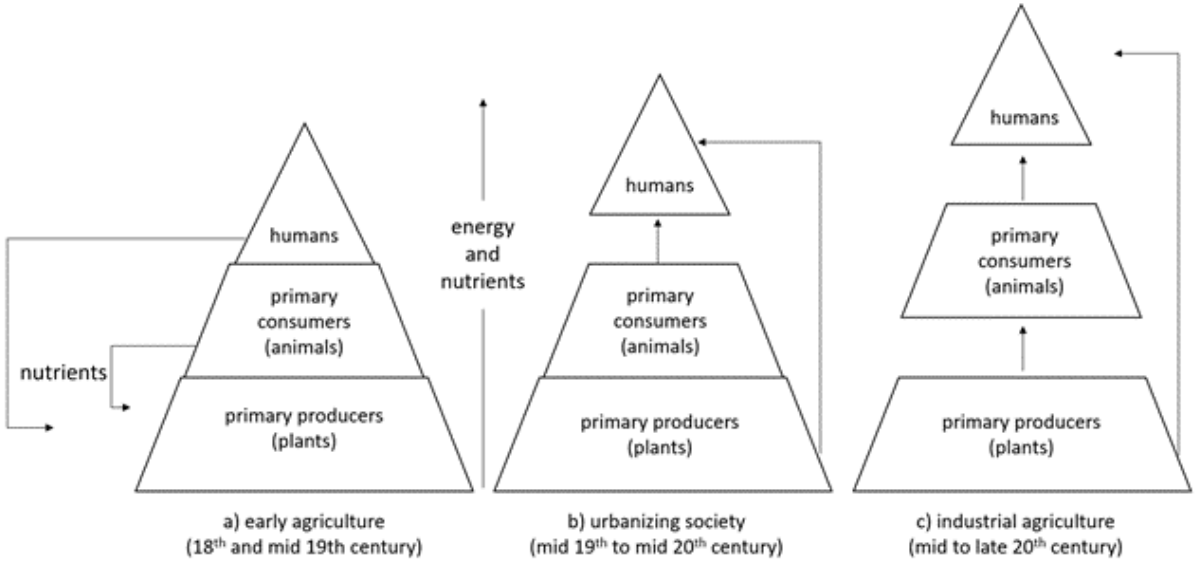
In addition to broad ecological and social metabolic rifts, there are also individual metabolic rifts, which have frequently been overlooked by research on metabolic rift, which often takes a macro-scale approach (McClintock 2010; Sbicca 2014). Whereas the distance between food production and consumption used to be very short, it is now extended to a global level with sometimes many steps in between production and consumption (Fitzgerald 2015). In an urbanizing world, individuals also become disconnected from production processes associated with the goods they consume, including food. This disconnection is a metabolic rift, which can be understood on a regional or even global scale, but that also creates rifts between individuals and the goods they consume and produce – individual metabolic rifts. Individual metabolic rifts have a

physical dimension like broader ecological metabolic rifts, but the individual metabolic rift also refers to alienation, which is "the internalized dimension of metabolic rift" (McClintock 2010:10). In other words, individual metabolic rifts refer to the individual consequences of broader social and ecological rifts and the systems that create them, which simultaneously alienate, or estrange (both physically and psychologically), people from both their work and from nature (McClintock 2010).

Dairy farmers can experience individual metabolic rifts – alienation from their work and from nature. Analyses of individual metabolic rifts have tended to focus on consumer alienation, such as individuals living in urban environments who are physically and socially alienated from food production (McClintock 2010; Sbicca 2014), but these analyses typically do not address the experience of producers at the heart of metabolic rifts. Marx's work on alienation made it clear that alienation was a key part of the production process and research must therefore address individual metabolic rifts among producers. The factory worker is not free from alienation because they are physically close to the production process (Marx and Engels 2009). So too, farmers, though physically close to production, may experience individual metabolic rifts as industrialization processes in agriculture alienate them from traditional interactions with nature. In urbanizing society humans became alienated from farms, but with the development of industrial agriculture metabolic rifts have developed at multiple levels in the farming process, with animals themselves being alienated from the food they consume as it becomes cheaper for specialized farmers to buy their feed from an outside source. Figure 2-1 (adapted from Foster 2002:162) illustrates the metabolic rifts that have

developed in agriculture, where energy and nutrients originally flowed from plants to animals to humans, with nutrients being returned along the way – a flow that is broken in modern agricultural systems. Analyzing farmer alienation through the lens of metabolic rift situates individual alienation in a broader ecological context, and connects classical sociology and environmental sociology literatures to better understand the effects of modernization on individuals and society.

Figure 2-1: Metabolic Rifts of Agriculture (Adapted from Foster 2002:162)



Alienation

Alienation as a term has become so widely used that its definition is not always clear. Many times, researchers do not even bother to provide a definition while employing the term (Scheff 2008). Although the term has roots in ancient religious

discourse, its modern use is often attributed to Hegel and Marx (Fromm 2013; Sarfraz 1997). Marx asserted that capitalist production alienated workers from their product, from the production process, from their species-being, and from fellow workers (Marx and Engels 2009). Nair and Vohra (2009) provide a definition of alienation in this context; "a common theme appearing in most conceptualizations of alienation appears to be the notion of estrangement or separation. In keeping with this understanding, an operational definition of work alienation that we have advanced is *estrangement or disconnect from work, the context or self"* (p.296). I use Nair and Vohra's (2009) definition of alienation from work in this study, as it seems consistent with the alienation described by Marx and metabolic rift theory.

Foster's (1999; 2010) work on metabolic rift sheds light on another form of alienation: alienation from nature. In line with a Marxist approach, metabolic rift theory asserts that capitalist production drives alienation from nature (Foster 1999). Marx and Engels addressed a broad array of ecological issues including "deforestation, desertification, climate change, the elimination of deer from forests, the commodification of species, pollution, industrial wastes" and more (Foster 2010:109). According to metabolic rift theory, there is a physical alienation associated with modern production (see Figure 2-1; Foster 2002). This physical alienation is also accompanied by a social alienation from nature and from labor (Clausen and Clark 2005).

The concept of alienation from nature poses even more problems than alienation alone because nature also has different meanings depending on who is referencing it. Hailwood (2015) provides three definitions of alienation: 1) estrangement – being cut off

from something, 2) alienation – a renunciation of ownership, 3) reification – reduction of people, processes, and products to things; and gives three definitions of nature: 1) the natural world – "the encompassing sense of nature, in which it is wider than humanity and of which humanity is a part but not the whole" (p.16), 2) nonhuman nature – nature that has not been shaped by humans for anthropocentric needs, 3) the humanized environment – landscape, or the natural world that has been shaped by humans. Considering the way alienation from nature has been conceptualized in metabolic rift research, Hailwood's (2015) definitions of estrangement from the natural world are useful. These definitions will be used as this paper refers to alienation from nature, and more specifically alienation from animals.

Alienation from nature is associated with negative environmental outcomes (Foster, Clark, and York 2011), but also has profound impacts on the people and communities experiencing alienation. For example, alienation is associated with feelings of being neglected and abandoned, feelings which foster social disorder and the adoption of radical identities (Harvey 2019; Langman and Kalekin-Fishman 2006). It is therefore important to study alienation of farmers from their work and from nature, as feelings of alienation might contribute to the increasingly complex challenges already facing farmers and affect their overall life satisfaction. However, it is also important to recognize competing perspectives on modernization and alienation that suggest that modernization can have a positive effect on human-nature relationships, such as ecological modernization theory.

I conceptualize alienation from cows as a type of alienation from nature, but it is important to note that human-nature relationships are not fixed, and change based on context (Flint et al. 2013). Cows on farms blur the lines between nature and society. In speaking with dairy farmers about how they think about their cows this blurring was evident as cows are both part of nature, of the business, and even of the family for some farmers. So, although I conceptualize cows as nature in studying farmer alienation from nature, there are other relationships that farmers have with nature (e.g. landscapes) that would likely be expressed and experienced in different ways than their relationship with cows.

Ecological Modernization Theory

Ecological modernization theory challenged the long-held belief of political economic theorists that the environment and economy were in an enduring conflict with each other, instead seeing economic growth as a way to reduce environmental impacts (Langhelle 2010). "The lynchpin of the theory is that the authors see continued industrial development as offering the best option for escaping from the ecological crises of the developed world" (Fisher and Freudenburg 2001:702). For ecological modernization theory, technology is a key tool to reducing environmental impacts through increased energy and resource efficiency (Spaargaren and Mol 1992). "At the heart of ecological modernization is a relatively optimistic view of the potential for technological change to lead to solutions for environmental problems" (Gibbs 2006:196). To summarize, in contrast to metabolic rift theory, ecological modernization theory sees modernization as a

force contributing to greater environmental sustainability (Mol 1995; Mol, Spaargaren, and Sonnenfeld 2013; Spaargaren and Mol 1992).

In broader modernization theory, individualization (discussed by Seippel as a type of alienation) is an important concept, "this topic however, is strikingly absent in the ecological modernization discourse" (Seippel 2000:298). Part of this omission is likely due to the way that ecological modernization developed as a theory meant to provide an alternative to the more Marxist-oriented environmental theories in the United States (see Dunlap 2010; McLaughlin 2012). Spaargaren and Mol (1992;2010) identify one of the weaknesses of ecological modernization theory: that it tends to focus on natural resource use and pollution, and "pays no attention whatsoever to the experienced nature of everyday life" (Spaargaren and Mol 2010:72). Alienation is a key aspect of this everyday experienced nature, and using ecological modernization theory to analyze it helps contribute to the development of the theory and provides an alternative to metabolic rift theory.

According to the logic of ecological modernization theory, the expansion of farm size and increase in modern technology could grant farmers the flexibility to reconnect with their cows in more meaningful ways. Ecological modernization theory asserts that modernization leads to decreased environmental degradation, and the mechanism for this is shifting societal attitudes and behaviors toward the environment facilitated by increasing income and technological efficiency (Mol 2010). These changes in attitude and behavior could be conceptualized as reconnection with, or de-alienation from, nature. In other words, alienation (conceptualized here as estrangement) implies a disconnect,

unfamiliarity, or indifference from nature. The outcomes of affluence posited by ecological modernization theory: development of greater environmental concern, greater valuing of nature, and an ecological rationality, can be thought as the opposite of alienation, or least as an expression of a desire to reduce alienation.

To reiterate, alienation is not typically addressed by ecological modernization theory (Seippel 2000). My use of ecological modernization theory in this analysis is therefore twofold. First, it serves as a counterview to metabolic rift theory and informs the alternative hypotheses of this study. Second, by employing ecological modernization theory to the issue of farmer alienation from their cows, I am responding to the call of Spaargaren and Mol (1992) for an ecological modernization theory that addresses "the ways human actors deal with nature, its integrity, its intrinsic value, and its value for human agents" (p.85).

METHODS

Population and Sample

To analyze dairy farmer alienation from their work and cows, as well as their overall life satisfaction, I use a mixed-methods approach of a survey and semi-structured interviews with dairy farmers in Washington State. Washington ranks tenth in terms of overall milk production by state, and ninth in milk per cow (USDA 2020). The state's dairies are somewhat evenly distributed between small (40.4%), medium (29.5%), and large (30.1%), which makes the state's dairy population ideal for this study which analyzes how dairy size affects the experience of farmers. According to the Washington

Department of Agriculture public disclosure documents, there are 307 principal operators of dairies in the state. All of these operators were invited to participate in this study, and 5 responded that they were no longer operating dairies, meaning the final population in this study is 302.

Dairy operators in Washington were initially invited via email to participate in the online survey. I sent follow-up emails to participate in the survey two days and five days after the initial invitation. Then, I mailed a printed copy of the survey to the operators who had not yet responded. Lastly, I followed-up by mailing a postcard to nonresponsive farmers six days later. In sum, 26 dairy operators responded via the online survey and 28 responded via mail for a total sample size of 54 and a response rate of 17.9%.

A response rate of 17.9% is lower than desired, but is reflective of broader trends of declining response rates in survey research (see Stedman et al. 2019). "Although response rates are declining universally, environmentally focused surveys conducted in rural areas are of particular concern" (Coon et al. 2020:2). Dairy farmers are frequently selected for surveys, and response rates around this level have been reported in other recent dairy farmer research (Denis-Robichaud et al. 2016; Gargiulo et al. 2018; Heuwieser et al. 2010; Russel and Bewley 2013). Response rates are important, but other measures should also be used to analyze nonresponse bias (Stedman et al. 2019). I take several steps to analyze how nonresponse bias may influence the results of this study (discussed below).

Survey

Prior to designing survey questions, I toured several dairies in northern Utah where I spoke with dairy farmers about their experience. I then created a survey using the tailored design method outlined by Dillman, Smyth, and Christian (2014) as a guide. Next, I solicited feedback on the draft survey from the Associate Director of the Center for Sustaining Agriculture & Natural Resources at Washington State University, the Producer and Community Relations Manager at Dairy West (an organization that represents dairy farmers in Utah and Idaho), and an emeritus faculty member at Utah State University with dairy, survey, and statistical experience. Based on their feedback I revised the survey to improve readability and relevance to dairy farmers.

The survey has five sections. Section one asks farmers about their farm characteristics: employees, size, and manure and feed management. Section two asks about environmental and dairy related concerns. Section three asks about community attachment and engagement. Section four asks about alienation from their work and from cows. The final section asks about demographic information (see Appendix A for a complete list of measures).

Interview

Dairy farmers who completed the survey were contacted via telephone and email to participate in semi-structured interviews. These interviews served three primary purposes: 1) serve as a benchmark to compare the results of the survey, 2) provide additional context for farming issues, 3) discuss concepts that could not be adequately

captured by the survey such as change over time. The interview consisted of 8 general questions and several follow-up prompts (Appendix B provides a full list of interview questions). 13 farmers agreed to be interviewed for the study, and the average interview length was around 41 minutes. One farmer asked not to be recorded but agreed to participate in the study and allowed me to take notes while we spoke. Another interview suffered from a technical problem that led to part of the audio to not be captured, but in a follow-up email the farmer summarized some of their thoughts for some of the questions asked in the first half of the interview that was lost.

Nonresponse Bias

All studies run the risk of nonresponse bias, but this risk is elevated in studies with low response rates. There are multiple ways to address nonresponse bias in survey research, and I employ three in this study: secondary data comparison, wave analysis, and benchmarking (Coon et al. 2019; Fowler 2014; Halbesleben and Whitman 2013). Secondary data comparison compares the sample used in this study with the broader dairy operator population in Washington. Wave analysis compares the responses of the online sample with that of the mail sample. Lastly, benchmarking compares results of this study against similar research (Olson 2006), as well as against the qualitative interview data obtained in this survey. In this section I present the results of the secondary data comparison and the wave analysis, and I address benchmarking later in the discussion section.

To better understand this survey sample, I compare the sample with data from a secondary administrative source – the Washington Department of Agriculture. The Washington Department of Agriculture provides some basic information about dairies in the state, mainly focused around dairy size. Small dairies are categorized as having 1-199 milking cows, medium dairies between 200-699 cows, and large dairies as 700+ cows. In the survey, respondents reported their gender. The Washington Department of Agriculture does not provide information on gender but I assigned gender for the population based on names. This gender information therefore should not be seen as definitive, but gives a general idea of how the sample in this survey compares to the overall population. Table 2-1 shows a comparison of the population and sample, with the sample being broken down by online response, mail response, and interview response (which is a subsample of the online and mail response groups).

Table 2-1: Comparison of Farm Size and Farmer Gender by Response Mode and General Population (Percentages)

	Small (1-199)	Medium (200-699)	Large (700+)	Male	Female
Population	**40.4**	**29.5**	**30.1**	**90.37**	**9.63**
Online	35.7	32.1	32.1	92.3	7.7
Mail	50	34.6	15.4	72.7	27.3
Combined (Mail and Online)	42.6	33.3	24.1	83.3	16.7
Interview	61.5	15.4	23.1	93.3	7.7

In addition to farm size, I compare the gender of my sample to the overall population of Washington dairy farmers. Previous research finds that women farmers

report higher job satisfaction than men (Hansen and Stræte 2020). The online sample skews more toward medium and large farms compared to the overall population with a similar ratio of male to female dairy operators. The mail sample skews more toward medium and small farms and female operators. The combined sample is fairly similar to the overall population but again skews slightly more toward medium and small farms, with a higher ratio of female to male operators. Lastly, the interview subsample skews more heavily toward small farms, with medium farms being the most underrepresented.

As part of the nonresponse bias wave analysis that compares the online and mail samples, I continue to present comparisons between respondents who answered via mail and online for all independent and dependent variables. The results section will address the benchmarking method for assessing nonresponse bias as interview data are presented in conjunction with survey data.

Nonresponse bias is not the only form of bias present when conducting survey and interview research, the researcher can influence results with their presence and positionality. Some of the farmers included in this study expressed some hesitancy in participating because I am a sociologist rather than someone more explicitly linked with agriculture. Questions about animal welfare and the environment may have also influenced farmer responses. Dairy farmers in Washington feel attacked on these issues (Jenkins 2017), and therefore may alter their responses. Based on these factors this sample may consist of farmers who are less alienated from their work and cows and therefore more willing to discuss these controversial topics with an outsider. Similarly, farmers may have felt pressure to report a close connection with their work and cows. I

took steps to assure farmers that my intentions as a sociologist were not to assess animal welfare or to make farmers look bad, but rather to understand their experience on the dairy. Still, my positionality as an outsider should be considered when interpreting the results of this study and comparing them to those conducted by individuals directly involved in agriculture.

Dependent Variables

This study aims to answer three questions: 1) how does modernization affect farmers' relationship with their work? 2) how does modernization affect farmers' relationship with their cows? And 3) how do these relationships with work and cows affect farmers' overall life satisfaction? The key dependent variables in this study therefore are farmer alienation from work, alienation from cows, and life satisfaction.

I use Nair and Vohra's (2009) definition of alienation from work and the scale they developed to measure this alienation. This alienation from work scale has been used in subsequent research on alienation and found to be reliable (Fedi et al. 2016; Rollero, Fedi, and De Piccoli 2015; Shantz, Alfes, and Truss 2014). This scale consists of eight measures that ask respondents about their feelings towards and experiences with work. Respondents answer eight five-point Likert type questions ranging from strongly disagree to strongly agree for the following items: (1) I enjoy my work, (2) facing my daily tasks is a painful and boring experience for me, (3) work to me is more like a chore or burden, (4) I feel like putting in my best effort at work, (5) I feel estranged/disconnected from myself, (6) I feel connected to events in my workplace, (7) over the years I have become

disillusioned about my work, and (8) I often wish I were doing something else. In this sample, the alienation from work scale has a Cronbach's alpha of .709, indicating high internal reliability.

There is no established scale to measure alienation from animals, nor specifically cows, in the literature. Several scales have been created to assess general attitudes toward animals, including the "animal attitude scale" (Herzog, Betchart, and Pittman 1991; Herzog, Grayson, and McCord 2015). This scale is too broad for this study, as it covers attitudes toward animals in many different areas including research, hunting, agriculture, zoos, companion animals, and wildlife. Other measures have been used for specific attitudes toward cattle (Boivin et al. 2007). These measures, though focused on cows, are too general: they measure general attitudes toward cows as a species, not a farmer's relationship with his herd. Alienation, the focus of this study, is about personal relationships and estrangement from those relationships more than general attitudes. Based on prior research and discussion with experts in the field, mentioned above, I designed a novel scale using seven Likert-scale measures asking farmers about their relationships with their cows. Respondents were given the following prompts and asked to provide a response ranging from strongly disagree to strongly agree: 1) if my cows are doing well, I am doing well, 2) I feel attached to the cows I manage, 3) I know my cows individually, 4) I often feel unsure about my cows needs, 5) I frequently spend time physically near my cows, 6) I wish I had more time to spend with the cows I manage, 7) my cows have unique personalities.

Table 2-2: Principal Components Analysis – Alienation from Cows Measures

	Component 1	Component 2
1. If my cows are doing well, I am doing well.	0.374	-0.153
2. I feel attached to the cows I manage.	0.477	-0.007
3. I know my cows individually.	0.449	-0.002
4. I often feel unsure about my cows' needs.	0.100	0.667
5. I frequently spend time physically near my cows.	0.443	0.099
6. I wish I had more time to spend with the cows I manage.	-0.075	0.722
7. My cows have unique personalities.	0.468	0.102
Eigenvalue	3.017	1.395
Cronbach's Alpha	0.827	NA

I conducted a principal components analysis on the alienation from cows measures, presented in Table 2-2. Results from the principal components analysis indicate that measures four and six do not fit well in a combined scale with the other measures, and load on their own component. On further reflection, these questions may capture an aspect of the farmer-cow relationship, but are also reflective of the farmer themselves. Farmers typically take great pride in what they do, and in this sample have an average of 37.12 years of experience as dairy farmers. Therefore, even if they do feel estranged from their cows, they may be unlikely to report that they are unsure of their cows' needs. I use the five measures that load above .3 on component one to create an alienation from cows scale. This scale has a Cronbach's alpha of .827, again indicating high internal reliability. Future research can build on this scale and tailor it to specific contexts outside of the dairy industry, but as an initial scale it performed well.

Alienation from work and cows are important factors that are connected to animal welfare and farm productivity (Waiblinger, Menke, and Fölsch 2003; Zulkifli 2013) but I

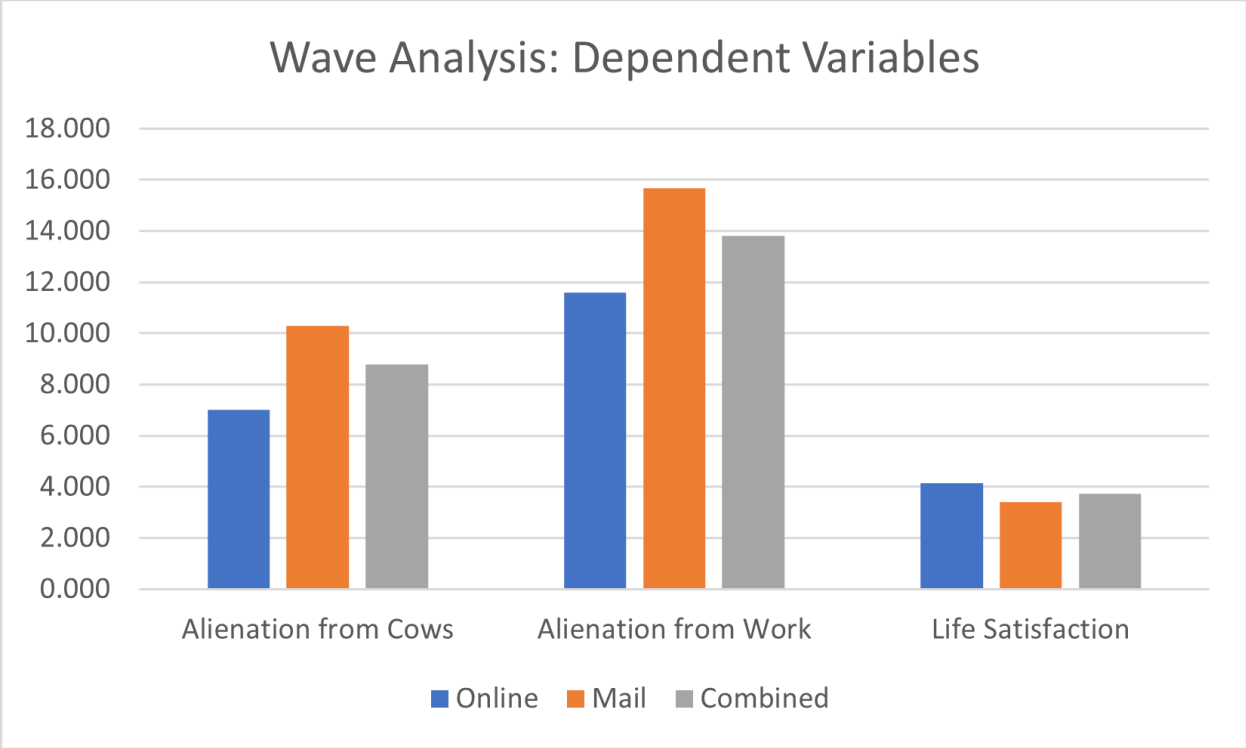
am also concerned with what these two types of alienation mean for farmers in terms of overall life satisfaction. Therefore, the third and final dependent variable in this study is life satisfaction, which is measured by asking farmers, "overall, how satisfied are you with your life nowadays?" with potential responses ranging from not at all satisfied to completely satisfied. Prior research shows that alienation from work is associated with decreased happiness and life satisfaction (Osin 2009), and connection with nature (the opposite of alienation) is associated with increased happiness (Zelenski and Nisbet 2014) and well-being (Howell et al. 2011).

Table 2-3: Descriptive Statistics for All Dependent Variables

	Mean (Online)	Mean (Mail)	Mean (Combined)	Std. Deviation (Combined)	Min	Max
Alienation from Cows	7.000	10.308	8.792	3.242	5	15
Alienation from Work	11.609	15.667	13.800	3.887	8	27
Overall Life Satisfaction	4.130	3.407	3.740	1.006	1	5

Table 2-3 and Figure 2-2 show descriptive statistics for the three dependent variables compared by online, mail, and the full combined sample. Mean scores for alienation from work and from cows are higher in the mail sample compared to the online sample, and life satisfaction is lower in the mail sample compared to the online sample.

Figure 2-2: Wave Analysis of All Dependent Variables



Independent Variables

According to metabolic rift theory, industrialization and modernization of productive technologies and practices contribute to alienation of humans from nature and from their labor. Ecological modernization theory sees these forces as potentially liberating – granting people the luxury to pursue their own interests including stronger relationships with nature that would be more difficult under conventional modes of production. Therefore, the key independent variables in this study are farm size and technological modernization.

The first independent variable is farm size. Farm size is categorized by the Washington Department of Agriculture as small, medium, and large. Small farms range

from 0-199 milking cows, medium ranging from 200-699 cows, and large 700 or more. These size designations were created to preserve some confidentiality for farmers, and sorted this way are somewhat arbitrary. A farm with 199 cows could be categorized as small, while a farm with 200 is categorized as medium, while the true difference between them is minimal. I use these ordinal categories, but future research could measure farm size as an interval variable with the exact number of cows on each farm. This survey sample has a higher proportion of small farms than the overall population (42.6% compared to 40.4%), a higher proportion of medium farms than the population (33.3% compared to 29.5%) and a lower proportion of large farms compared to the population (24.1% compared to 30.1%; see Table 2-1). Respondents were assigned a "1" for small farms, a "2" for medium farms, and a "3" for large farms. The mean farm size of this sample is 1.815, meaning that the average farm size of respondents was between small and medium.

I measure modernization of farm technologies and practices by asking farmers to indicate which technologies and practices are currently being used on their dairy. Originally, this question used the several of the same categories as MacDonald, Cessna, and Mosheim's (2016) survey of dairy farmers. However, while soliciting feedback on the measures I was told that asking about computer use would likely not show much variation because computers have become ubiquitous in dairy farming. Based on this suggestion I instead ask about the use of robotics, which are not as widely adopted but becoming more common. The final technologies and practices included are: 1) artificial insemination, 2) routine vet service, 3) nutritionist service, 4) replacement heifers raised

off farm, 5) robotic milkers, 6) robotic feed delivery, 7) robotic manure management, 8) forward contracts for inputs, and 9) bovine growth hormone (rBST). Farmers were assigned a score based on the total number of technologies and practices employed, which in this sample ranged between 2 and 7 with an average of 3.776.

In addition to these key independent variables, I also include age as a control variable. In their study of grazing livestock producers, Peterson and Coppock (2001) find that age plays an important role in the adoption of new technology. Similar research with dairy farmers finds that older populations feel greater stress when adopting new technology (Alpass et al. 2004). Metabolic rift theory asserts that economic constraints incentivize the adoption of new technologies for farms to stay competitive. If older populations feel greater stress from these new technologies, that likely also contributes to a feeling of alienation from their work. Age was measured using ranges of 1) 18-24, 2) 25-34, 3) 35-44, 4) 45-54, 5) 55-64, 6) 65-74, 7) 75 or older. The farmers in this sample have a mean age score of 4.96, meaning they are just about in the 55-64 age range on average. Comparing the mail and online survey samples, the online mean age (4.727) is slightly younger than those who completed the survey via mail (5.143, see Table 2-4).

Finally, I include gender as an independent variable. Previous research on alienation from work has found differences based on gender (Rollero, Fedi, and De Piccoli 2015). Men and women interpret aspects of alienation (such as isolation and powerlessness) in different ways (Steitz and Kulpa 1984), which may affect the way they respond to questions about alienation. Gender is also connected to alienation from nature. “In addition to the general alienation experienced by the working man, women have been

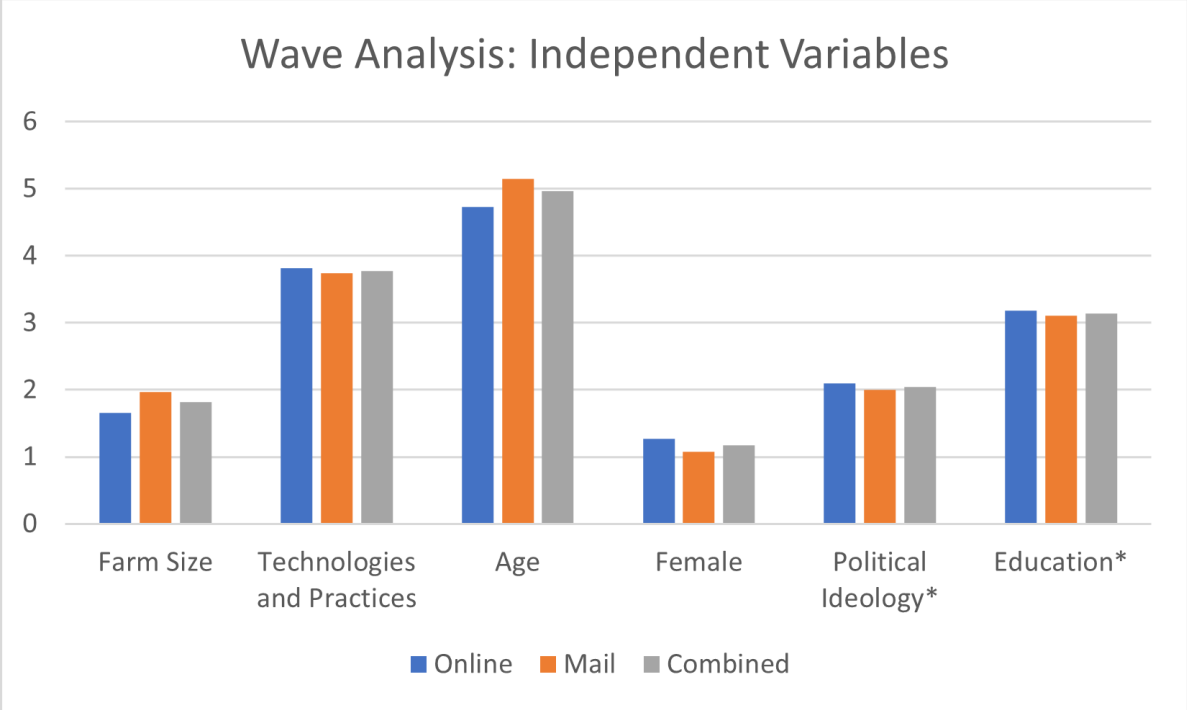
oppressed by being treated ideologically as part of nature; by having less than fully human status" (Salleh 2010:208). Lastly, women dairy farmers tend to report higher life satisfaction than men regardless of milking system, perhaps due to the weight they give to factors outside of work in evaluating their satisfaction (Hansen and Stræte 2020). 83.3% of respondents are male, and 16.7% are female. Gender is coded as a dichotomous variable with male coded as 1 and female coded as 2.

With a low sample size of 54 respondents, the number of variables that can be included in an analysis is somewhat constrained. However, as part of the wave analysis, which compares respondents from the online survey to respondents of the mail survey, I analyze descriptive statistics for educational attainment and political ideology as well. I measure educational attainment by asking the highest level of education completed by farmers, with options of: 1) less than high school, 2) high school/GED, 3) some college (associate's degree), 4) bachelor's degree, 5) graduate degree. The average education score was 3.143, meaning the average respondent has between an associate's degree and bachelor's degree. Political ideology was measured by using a 5-point scale ranging from very conservative to very liberal and asking respondents, "which of the following best represents your political ideology?". The mean political ideology score is 2.04, indicating this sample is more conservative than liberal on average. 71.7% of respondents indicated they were republican, 21.7% independent, 4.4% democrat, and 2.2% were affiliated with a different political party.

Table 2-4:Descriptive Statistics for All Independent Variables

	Mean (Online)	Mean (Mail)	Mean (Combined)	Std. Deviation (Combined)	Min	Max
Farm Size	1.654	1.964	1.815	0.803	1	3
Technologies and Practices	3.818	3.741	3.776	1.141	2	7
Age	4.727	5.143	4.96	1.068	2	7
Female	1.273	1.077	1.167	1.068	1	2
Political Ideology*	2.091	2.000	2.040	0.781	1	5
Education*	3.182	3.111	3.143	1.080	1	5
*Not included in regression models						

Figure 2-3: Wave Analysis of All Independent Variables



Descriptive statistics for all independent variables by response mode are presented in Table 2-4 and Figure 2-3. Figure 2-3 presents mean scores of each

independent variable for each survey mode (mail, online, and combined). The y-axis in Figure 2-3 varies depending on the independent variable. The wave analysis comparing means by survey mode shows that for these independent variables the differences between groups are not large. The largest difference is age; the online sample is slightly younger on average than the mail sample. Other than small differences, the samples appear to be fairly similar demographically. Table 2-5 presents a correlation matrix of all dependent and independent variables, marked for significance at the .05 level.

Table 2-5: Correlation Matrix of All Dependent and Independent Variables

	1	2	3	4	5	6	7
1. Alienation from Cows	-						
2. Alienation from Work	0.431	-					
3. Life Satisfaction	-0.266	-0.656	-				
4. Farm Size	0.514	0.195	-0.076	-			
5. Technologies and Practices	-0.020	0.088	-0.185	0.314	-		
6. Age	0.075	-0.026	0.081	-0.147	-0.302	-	
7. Female	-0.407	-0.114	0.298	-0.194	-0.263	0.026	-

Hypotheses

Romesburg (1981) explains that a research hypothesis must follow the logic of theory applied in unique and specific contexts. Metabolic rift theory posits that modernization of production systems leads to alienation of workers from their work and from nature (Foster, Clark, York 2011; McClintock 2010). In the case of dairy farmers, I conceptualize the farmer-cow relationship as a human-nature relationship. Applying

metabolic rift theory, and specifically considering individual metabolic rifts (see McClintock 2010), I posit the first two hypotheses:

H1: Increased farm modernization is associated with increased farmer alienation from work.

H2: Increased farm modernization is associated with increased farmer alienation from cows.

Ecological modernization theory forms the alternative hypotheses in this study. Ecological modernization theory sees modernization as a positive process that can improve human-nature relationships (Huber 2000; Perga 2017). Rather than seeing human-nature contacts as disappearing under modern systems of production, ecological modernization theory sees them as becoming altered – often for the better (Cohen 2006). This logic applies to workers' connections to their work as well. Labor has changed significantly in the past century, including on dairy farms, but these changes can have positive effects such as reduced physical strain and risk of injury for farmers (De Koning 2010; Lunner Kolstrup et al. 2013). Farmers' day-to-day tasks may change with modernization of agriculture, but this could actually increase their connection to work as they are able to spend time pursuing the aspects of work they find most enjoyable and completing more diverse tasks. I therefore posit, in contrast to metabolic rift theory, the following two hypotheses in line with ecological modernization theory:

H3: Increased farm modernization is associated with decreased farmer alienation from work.

H4: Increased farm modernization is associated with decreased farmer alienation from cows.

Alienation is often framed as a negative outcome, whether discussing alienation from nature, from work, or the self. However, alienation is not a dichotomous state of being – people exist in various stages of alienation, and when it comes to alienation from nature (distance or estrangement from the natural world), many people actually want at least some degree of alienation from nature (Hailwood 2015). For example, most people want to be able to separate ourselves from adverse weather or from unwanted species entering our living space. Still, research consistently shows that the human connection with nature is associated with life satisfaction (Capaldi, Dopko, and Zelenski 2014), and alienation from work is negatively correlated with life satisfaction and happiness (Osin 2009). I hypothesize that alienation from work and alienation from cows are both associated with decreased life satisfaction for farmers:

H5: Increased alienation from work is associated with decreased life satisfaction.

H6: Increased alienation from cows is associated with decreased life satisfaction.

Analytic Technique

To analyze the first and second dependent variables (farmer alienation from work and farmer alienation from cows respectively), I use ordinary least squares (OLS) multiple regression. These two dependent variables are scale measures, and therefore OLS regression is best suited for analysis (Field 2017). OLS regression is not suitable to

analyze life satisfaction, an ordinal variable. I therefore use ordered logistic regression (OLR) to analyze life satisfaction.

In addition to the survey analysis, I conducted interviews with farmers and asked them to comment on the results of the survey and share more of their experiences. These interview data were transcribed and analyzed with NVivo 12. I used a two-step process of open coding followed by axial coding. The goal of open coding is "to build a descriptive, multi-dimensional preliminary framework for later analysis" (Khandkar 2009:8). During this first step I went line by line through all interviews assigning a code describing each sentence based on the wording used by the famers (see Khandkar 2009; Merriam and Tisdell 2015; Miles, Huberman, and Saldaña 2014). Axial coding, step two, involves analyzing the open codes and organizing them into themes and categories (Williams and Moser 2019). Unlike a purely grounded theory approach, my goal with these interviews as not to look for broad emergent themes, but rather to ask about specific issues related to the survey measures on alienation. Results from the interviews are presented in conjunction with the regression analyses to 1) serve as a benchmark and validate the statistical results, and 2) give greater context to farmers' complex relationships with their work and cows.

RESULTS AND DISCUSSION

This results and discussion section is divided into sections by dependent variable: 1) alienation from work, 2) alienation from cows, and 3) life satisfaction. In each subsection I first present the results from the regression analysis using survey data,

followed by results from the semi-structured interviews with farmers. I then present these findings and their implications for farmers and for future research in the concluding section of this paper.

Alienation from Work: "I Enjoy It, Yes. But How Can You Enjoy It When You're Not Seeing Any Benefits?"

Table 2-6 presents results from the OLS regression predicting alienation from work with regression coefficients marked for significance and standard errors in parentheses. Model 1 includes only farm size, Model 2 includes only technologies and practices, Model 3 includes all independent variables, and Model 4 includes all independent variables and the alienation from cows scale. Farm size is not significantly associated with alienation from work in any model, nor are technologies and practices, age, or gender. The only significant association is that of alienation from cows, which is positively associated with alienation from work ($b=.615$ $p<.05$).

Table 2-6: OLS Regression Predicting Alienation from Work

	Model 1	Model 2	Model 3	Model 4
Farm Size	.929		.885	-.314
	(.673)		(.761)	(.888)
Technologies and Practices		.302	-.020	.377
		(.503)	(.576)	(.581)
Age			-.067	-.217
			(.572)	(.540)
Female			-.790	1.145
			(1.641)	(1.698)
Alienation from Cows				.615*
				(.233)
Constant	12.090***	12.625***	13.519**	7.276
	(1.353)	(1.991)	(4.988)	(5.258)
Adjusted R-Squared	.018	-.014	-.044	.092
Regression coefficients are presented in line 1 and marked for statistical significance. Standard errors presented in line 2 in parentheses. *p<.05, **p<.01, ***p<.001				

Interview data help make sense of the regression analysis that did not find a significant relationship between farm size and alienation from work or technologies and practices and alienation from work. Every farmer interviewed reported that they enjoyed their work, but enjoying work and alienation from work are related yet distinct concepts. Alienation implies estrangement – a distancing from work. So, while farmers did seem to consistently report that they enjoyed their work, some seemed to make a distinction between the caring for cows aspect of their work which they enjoyed, and the business aspects that may be contributing to a sense of alienation from modern dairying not captured in the regression analysis. One farmer lamented the economic struggles currently facing their farm. When asked whether they still enjoyed the work they said, *"oh yeah I love the dairying part of it. I enjoy it, yes. But how can you enjoy it when you're not seeing any benefits?".* Another farmer talked about the changing economic

landscape in both positive and negative terms; *"I love dairying. I love having a full truckload of milk leaving my yard and I like full truckloads of feed coming in. That's a good feeling to me. I like trying not to deal with bankers, so that I don't have to lose the decision-making part of my farm."* One farmer expressed their enjoyment but pointed out the drawback of a heavy workload and lack of vacation:

> *Yeah, I enjoyed it a lot. I'm one of the fortunate ones that are in my mid-fifties and enjoying my work…I'm enjoying what I'm doing a lot. And the biggest challenge is like I was saying earlier, the drawback is having to do it 350, 365 days a year kind of, or kind of that way. It's not that easy for me to get away even. I would have time if I could work 12 hour days, two days a week, and then I could take off for five days, but that doesn't work that way.*

In sum, farmers unanimously expressed enjoyment of their work while simultaneously pointing out factors that contribute to the stress of the job.

Farmers are proud of the work they do. One farmer expressed that he enjoyed it and said, *"I told somebody in an interview here a while back that like a dirt farmer they say has dirt in their blood so if you really like milking cows you must have, like, milk in your blood".* This may contribute to the reporting of enjoying the work. However, I also asked several farmers a follow-up question - if they would recommend the job to someone else. On this point farmers were split 50/50. Those who would not recommend it stressed the economic stresses of farming. The first said:

> *Unfortunately, probably not. With the way society is and how these, especially state workers, get a fair wage, full medical dental benefits, and they have paid time off, sick leave time, they… The stresses of dairy are huge… Lot of problems. So you have to enjoy the job. Like my kids, I don't know if I want to wish dairy farming on my kids. They'd have to be set up really well and low debt. Even still, it's a lot of stress, so…*

The second farmer expressed a similar sentiment, but focused on the capital to break into the system. In Washington, the primary milk processor is Darigold, which has a cap on how much milk it can process. Farmers therefore cannot sell unless they are able to buy or inherit a contract.

> *No, I don't see how anybody else can get into it now, unless they're related to somebody well off and they just want to put them in there for a go, because it takes so much capital. It's just impossible to get started. The entry is very difficult. You could work for somebody else, but becoming your own business is going to be very difficult.*

Other farmers said that they would recommend dairying to others. These farmers acknowledged the economic challenges that come with farming but stressed individual work ethic and interest in determining whether the work would be fulfilling or not. One joked about other dairy farmers attitudes before giving his endorsement:

> *Dairy farmers are trained to whine so maybe I wouldn't recommend it if I was listening to them. But if I look at the trajectory of my own life and career, hell yes! Who wouldn't want to do this? Literally. Who wouldn't want to do this? Nobody has it better than we do. Yes, I am a dairy farmer, you called the right number.*

And another farmer expressed a similar sentiment, saying, *"I would recommend it to a certain kind of person, but I think you have to want to work hard also, because there's opportunities there and there's benefits and there's financial benefits to it, too."*

Lunner Kolstrup et al. (2013) explain, "farming, especially livestock farming, differs in many ways from other occupations. Epidemiologists consider the working environment on farms to be especially challenging, because of the diversity and complexity" (p.245). These interviews with dairy farmers capture a piece of this complexity. Farm size was not significantly associated with farmer alienation from work

as hypothesized. One explanation for this is that farmers interviewed here expressed economics as factors influencing their relationship with work, and larger farms tend to have larger profits (MacDonald 2020). On the other hand this increased size comes with new stresses of managing employees and meeting regulatory standards (Lunner Kolstrup et al. 2013). Similarly, increased technology on the farm on the one hand can relieve farmers from performing time-consuming and repetitive tasks, but on the other can make it so farmers are on call 24/7 if a machine needs to be serviced (De Koning 2010; Hansen and Stræte 2020). One thing expressed in previous research and again in this analysis remains clear: farmers' relationships with their work is complex.

Alienation from Cows – "Of Course There's a Disconnect"

Results of the OLS regression predicting farmer alienation from cows are presented in Table 2-7. Regression coefficients are marked for significance and standard errors are presented in parentheses. In Model 1 larger farm size is associated with greater alienation from cows ($b=2.018$, $p<.001$), and remains significantly associated when controlling for other independent variables in Model 3 ($b=2.074$, $p<.001$), and Model 4 ($b=1.912$, $p<.001$). The use of technologies and practices is not associated with alienation from cows when analyzed alone in Model 2. However, in Models 3 and 4 this relationship gains significance, with a higher number of technologies and practices being associated with lower alienation from cows ($b=-.818$, $p<.05$; $b=-.760$, $p<.05$). Age was not significantly associated with alienation from cows in either Model 3 or Model 4. Gender was significantly associated with alienation from cows in Model 3 ($b=-3.178$,

p<.01) and Model 4 (b=-2.867, p<.01), with being female associated with lower alienation from cows. Alienation from work was not associated with alienation from cows.

Table 2-7: OLS Regression Predicting Alienation from Cows

	Model 1	Model 2	Model 3	Model 4
Farm Size	2.018***		2.074***	1.912***
	(.497)		(.488)	(.468)
Technologies and Practices		-.057	-.818*	-.760*
		(.419)	(.370)	(.346)
Age			.199	.234
			(.362)	(.337)
Female			-3.178**	-2.867**
			(3.113)	(.970)
Alienation from Work				.242
				(.091)
Constant	5.050***	9.007***	10.807***	6.960*
	(1.007)	(1.643)	(3.113)	(3.189)
Adjusted R-Squared	.248	-0.021	.380	.468
Regression coefficients are presented in line 1 and marked for statistical significance. Standard errors presented in line 2 in parentheses. *p<.05, **p<.01, ***p<.001				

Prior to conducting interviews with farmers, I conducted a preliminary analysis of the survey data and found that that increased farm size was associated with increased alienation from cows. In the interviews with farmers I therefore included the question, "in the survey you and other farmers completed, nearly everyone mentioned that their personal well-being was tied to their cows, but operators of larger dairies may have a harder time staying connected to their cows (being able to spend time with them, getting

to know their unique personalities). Do you think that is accurate? Why or why not?" In total, 12 out of 13 farmers interviewed agreed that this was an accurate finding.

Three themes emerged as farmers explained why they saw larger farms as contributing to farmer alienation from cows. The first theme that emerged was a shift in managerial duties away from cows and towards employees. One farmer summarized this:

> *Yeah, that's very true, because when they get large, like they're milking 30,000, they're very specialized. They have people; it's all shift. And then the owners are off doing business and talking to lawyers and bankers and vets and nutritionists, and they probably don't need to spend time with their cows anymore.*

Another farmer agreed:

> *It probably is accurate on the larger scale of dairies. Because on a smaller dairy, or medium sized dairy – I don't know the classifications, how many numbers you put on those – but if you're running a 3000 cow, 1500 cow operation and you're the owner you're a manager of people and problem-solving and commodities and that's your main job. And you hire somebody to be a herdsman to take care of your cows and so there would be a loss of individual cow numbers, stuff like that. The larger you get the more removed you are probably.*

The second, related theme that emerged was that remaining connected with cows is just not logistically feasible on larger farms. Managers shifting to managing people is a type of logistical shift, but these logistical shifts that farmers mentioned were about more than managing employees – they discussed how the models of farms changed to be more business-like, and how that fundamentally changed the role that the farmer played on their farm, and in particular in relation to their animals. One farmer explained that alienation of farmers from cows on large dairies *"goes without saying. Their rubber boots are probably pretty clean. There's no role for them, everything's mapped out. Of*

course there's a disconnect… Those aren't farms, they're businesses. You mentioned a human-animal bond – that doesn't happen on large farms." Another said:

> *Yeah things change with size. Even on our operations, I used to do probably 50% of the work or better when I had 120 cows. Now that we're growing and got three places, how much do I spend day to day now? Almost zero… You just naturally look at it a little bit more economical now. I won't hang onto a cow that ain't producing quite as long as I used to, probably. If she was the one that came up and I scratched every day and was one of my favorites, I would probably keep her a little longer if she wasn't producing. You probably don't have that, right? You look at it a little more economical now, I would say, naturally, right? I would say that's one of the worst parts of it.*

Absentee landowners in agriculture is another logistical issue that came up in interviews. In general, larger farm operators are more likely to rent their land (Bigelow, Borchers, and Hubbs 2016). One farmer recounted:

> *Well, I have a neighbor here, it's quite a big dairy and he doesn't even live here and he's only been here once a year. So how can he be connected to – I don't see that he has a real strong emotional tie to... Because he's got other investments and stuff that he deals with. The bottom line is, it's all about money.*

Perhaps the biggest logistical challenge associated with farmer alienation from cows is simply the number of cows. A person can only know and interact with so many individual cows at a time, and so as this number increases it becomes impossible to keep up. One farmer explained, *"Yes, it is [an accurate finding], I mean, just because of the sheer reality of it, that you're dealing with numbers and movement."* Another farmer expressed their belief that technology had helped facilitate this change as well, as monitoring systems shift farmer views of animals from the individual to the herd; *"there's a lot of people that just go by whatever dates are on the spreadsheet, you know –*

that don't know the cow enough. They just make a decision without even looking at them, just the spreadsheet."

The third and final theme that emerged in explaining farmer alienation from cows is the loss of intimacy associated with specialization on larger farms. Specifically, farmers mentioned the importance of knowing their animals over their lifespan from calves to cows, which they saw as lost on larger farms which may buy replacement heifers off-farm and be less involved in daily tasks like milking and feeding.

> *Just like getting to know a person one would have to be around the individual to get to know them. How can a manager or owner on a larger farm know their cows? If they don't feed them as calves, watch them grow as heifers, watch and assist calvings and most importantly actually milk that cow.*

Again, when asking whether they agreed with the finding that larger farms experience increased alienation from their cows one concurred:

> *Yeah, I would say because they're not spending time physically with their cows. They're…They have employees who probably spend time with the cows but the smaller scale guys a lot of times will even feed the cows, the baby cows. So they're seeing the baby cows when they're little. They're seeing the baby cows when they're teenagers. They can see their cows and then when the cow has a calf you're connected with – 'oh that's number 500, I remember the day she was born.' Like my son had one that was born on his birthday, so he always remembered that was the one that was born on my birthday.*

Although the majority of farmers agreed with the finding that larger farmers experience more alienation from their cows, one respondent disagreed. However, this respondent seemed to think of connection with animals as being synonymous with empathy toward animals. I clarified that by connection I meant spending time physically

near or knowing individual cows, but the farmer's response still reflects this concept of farmer empathy, and stresses the importance of individual characteristics over farm size:

> *I think I would be most confident making the statement that the answer to the question is size neutral. I think empathy and intimacy are wildly different words. So whether you have 10 cows with a name on their neck chain or 10,000 with a five-digit number hung in their ear, I don't think impacts whether a human is empathetic or not. And if you're an empathetic person causing well-being in 10,000 animals is more rewarding than causing well-being in 10. So I do not think this is a size question… I completely disagree with your premise… The guy with 10,000 is a human. They're either empathetic or they're not.*

With the exception of this last respondent, dairy farmers agreed with the finding of the regression analysis that larger farm size is associated with increased farmer alienation from dairy cows. However, when it comes to modernization of technologies and practices, the regression models show that increased modernization of technologies and practices is associated with decreased farmer alienation from their cows. Technology was a common topic brought up by farmers in my interviews with them. When discussing the farmer-cow relationship, perhaps the most commonly thought of form of interaction is milking. The public may perceive milking as a generally positive interaction between farmer and cow but this assumption does not always hold true. One farmer expressed the positive impact that automated milking systems have had on their relationship with their cows:

> *My relationship with them has changed because I'm not physically milking my cow every day… My belief is the largest portion of animal abuse happens in the milk parlor. It's where human and cow interactions can be negative. Because if that cow, say, kicks that milker. Maybe does that once, but if they do that multiple times if that milker gets angry and hits that cow with something…*

They continued to explain that the type of interactions they have with their cows have changed, but are still there and have contributed to a better relationship for both the farmer and their cows:

> *That part of it has changed because I don't physically touch my cows twice a day. I'll go walk through them… I just go out there and walk with them but they have become more docile…And some will come up and want petted. And all the robot farmers will tell you their cows' demeanor has changed since they put in robots. It's just one of the things – a veterinarian will tell you. You walk in a farm with a robot, different group of cows.*

This farmer's comments align with research on the human-animal relationship on dairies with automatic milking systems that find that cows on farms with automatic milking systems are more relaxed, and farmers feel less disruptive to the herd (Driessen and Heutinck 2015). Rather than eliminating contact between farmers and animals, some research suggests, like this interviewed farmer, that the types of interaction change but that this can be positive (Schewe and Stuart 2014). Among Dutch farmers who adopted automatic milking systems, all "agreed that relationships with their cows were more positive and that the cows were more relaxed" after implementing the new milking systems (Schewe and Stuart 2014:9). Variety in human contacts also reduces fear in cows (Des Roches 2016), and so it is possible that new technologies and practices introduce new varieties of contact.

Driessen and Heutinck (2015) assert that when it comes to the farmer-cow relationship "things may be more complicated than this dichotomous story of alienation and the decline of meaningful relations" (p.14). The findings of this study illustrate this point again, suggesting that more research is needed in additional contexts. Previous

research has addressed the effect of automatic milking machines on the human-animal relationship (Driessen and Heutinck 2015; Schewe and Stuart 2014; Wildridge et al. 2020). This analysis includes automatic milkers but also other modern technologies and practices– some of which farmers identify as contributing to alienation from cows. For example, one farmer mentioned purchasing replacement heifers from off-farm as a practice that alienates farmers from their cows. Future research with a larger sample could analyze these technologies and practices individually rather than as a composite measure. Previous research has shed some light on farmer alienation, and this study contributes to that literature with the finding that increased farm size is associated with increased alienation from cows, but increased modernization of technologies and practices is associated with decreased alienation from cows. The final contribution of this study is an analysis of why farmer alienation from work and alienation from cows matter – how they are related to overall life satisfaction of dairy farmers.

Life Satisfaction

Table 2-8 presents results from the ordered logistic regression predicting overall life satisfaction. Odds ratios (OR) are presented and marked for significance with log odds in parentheses. Farmers who are more alienated from their cows are less likely to report higher levels of life satisfaction (Model 1 OR=.825, $p<.05$), but this relationship loses statistical significance when controlling for alienation from work in Model 3 and all other independent variables in Model 4. Increased alienation from work is associated with lower life satisfaction in Model 2 (OR=.657, $p<.001$), Model 3 (OR=.668,$p<.001$),

and Model 4 (OR=.637,p<.001). In these data age is not associated with life satisfaction. Gender is statistically significantly associated with life satisfaction, with female farmers being more likely to report higher life satisfaction than males (OR=7.547,p<.05).

Table 2-8: Ordered Logistic Regression Predicting Life Satisfaction

	Model 1	Model 2	Model 3	Model 4
Alienation from Cows	.825*		.967	1.068
	(-.193)		(-.033)	(.066)
Alienation from Work		.657***	.668***	.637***
		(-.420)	(-.403)	(-.452)
Age				1.110
				(.105)
Female				7.547*
				(2.021)
Pseudo R2	.040	.204	.205	.250
Line 1: Odds ratios, marked for significance (*p<.05, **p<.01, ***p<.001) Line 2: Log odds in parentheses				

This study finds that farmer alienation from work and alienation from cows are associated with decreased life satisfaction[1]. Of these two types of alienation, alienation from work explains a greater amount of variance in overall life satisfaction. None of the independent variables included in this analysis are statistically significantly associated with alienation from work, except alienation from cows. Taken together these findings may suggest that alienation from work is acting as a mediating variable in the relationship between alienation from cows and overall life satisfaction. In other words, it may be that alienation from cows contributes to alienation from work which is then associated with

[1] To verify the relationship between alienation from cows and alienation from work and life satisfaction I ran a sensitivity analysis with farm size and modernization of technologies and practices as predictors of life satisfaction. Neither variable was significantly associated with overall life satisfaction.

life satisfaction. This makes sense conceptually for dairy farmers as their relationship with their cows is a central aspect of their work, but only one of several factors that contribute to work alienation and life satisfaction. Future research could explore this possibility further with a mediation analysis, a path analysis, or even structural equation modeling with a large enough sample size.

The gender-related finding that female farmers are more likely to be satisfied with their lives is consistent with previous research on gender and farming (Hansen and Stræte 2020). Hansen and Stræte (2020) argued that future research needed to analyze how relationships between farmers and their animals influenced their life satisfaction. This study concludes that alienation from work is an important factor that decreases farmer life satisfaction, and this is associated with alienation from cows, however more research is needed on the complex factors that contribute both alienation from work and farmer life satisfaction.

CONCLUSION

Dairy farmers perform a stressful job in an industry that is rapidly changing and modernizing. These changes raise the question, what effect does modernization have on farmers' relationships with their work, with their cows, and how do these types of alienation affect farmers' overall life satisfaction? Environmental sociology can help answer this question. In this study I tested hypotheses derived from metabolic rift theory and ecological modernization theory to analyze farmer relationships with their work and cows.

The first question I address with this study is what effect does modernization have on farmers' relationships with their work? This survey analysis did not find a significant relationship between modernization (as measured through farm size and use of technologies and practices) and farmer alienation from work. However, these findings should be interpreted with caution because of the small sample size that increases the risk of a type II error - asserting that no relationship exists between variables when in fact one does. The statistical power of this analysis was limited because of the sample size and future research should be conducted with a larger sample, including dairies outside of Washington. The interviews with farmers supplemented the survey analysis and revealed the complex relationships farmers have with their work. These farmers enjoy their work but recognize that it comes with immense stresses. A second point to consider when interpreting the results related to alienation from work is that this study may suffer from survivorship bias. Dairy as an industry has consolidated, with hundreds of operators leaving the business. The farmers included in this study are those who have outlasted the forces that drove other operations out of business. It is possible, therefore, that these farmers have a particularly strong attachment to their work that is not as easily influenced by other factors. Future research on this topic could survey and interview farmers who have left the industry and compare their experience with farmers who remain. Five farmers I contacted to participate in this study responded that they were no longer dairying. This group could serve as the initial group in a snowball sample for a future analysis of dairy farmers who have left the business.

The second question addressed by this study is what is the effect of modernization on farmers' relationships with their cows? The survey analysis of farmer alienation from cows shows significant findings that lend support for both competing theories. Farm size is associated with greater alienation from cows - a finding that supports metabolic rift theory, while increased technologies and practices is negatively associated with alienation from cows – a finding that supports ecological modernization theory. The findings in support of both metabolic rift theory and ecological modernization theory confirm Driessen and Heutinck's (2015) assertion that farmer alienation is perhaps more complicated than conceptualized in broad theories. The mixed methods approach I used help validate these statistical findings. In their interviews, farmers generally expressed agreement with the findings from the survey. They agreed that increased farm size created challenges for farmers to stay connected to their cows, including: a managerial shift from cows to people, logistical challenges associated with managing so many cows, and a loss of intimacy with cows over their lifespan due to specialization. In terms of the effect of technology on their relationship with cows, farmers reported that it typically helped them avoid or reshape the most negative interactions with their cows, and that they remained connected in different ways as technology altered these interactions.

The final research question of this study is how do alienation from work and from cows affect farmers' overall life satisfaction? Results from the survey indicate that both types of alienation are negatively associated with life satisfaction. In other words, the more alienated farmers feel from their work and cows the less likely they are to be satisfied with their life. This makes sense given the way dairy farmers I interviewed

expressed farming as a key part of their identity – having "*milk in your blood*." This finding is also consistent with previous research that finds a negative relationship between alienation and well-being (Shantz, Alfes, and Truss 2014), and Marx's (2009[1844]) original conception of alienation, which he asserted for the worker, "mortifies his body and ruins his mind" (p.30), and generally rendered them unhappy.

This study has several limitations that should be considered and addressed in future research. The first is that the sample size is small and limited to Washington state. The experience of farmers in other regions of the United States and outside it may vary and should be investigated. Second, I have addressed nonresponse bias in several ways in this study, but the response rate is still low and should be considered when interpreting and generalizing these results. And lastly, the measures used in this study are limited. I developed my own measure of farmer alienation from cows, but this scale can be refined and adjusted in future studies. To measure life satisfaction, I asked a single item question, but life satisfaction, happiness, and well-being can be measured in many different ways (Layard 2010). Life satisfaction can also vary day-to-day and a cross-sectional analysis is therefore limited (Layard 2010). One of the challenges with this study is the complexity of both alienation and modernization, which will require additional research. Although certainly not the only factors influencing farmers life satisfaction, alienation should receive continued attention from researchers and policymakers hoping to improve outcomes for farmers.

Alienation as a concept has received broad and interdisciplinary attention. Research suggests that farmer alienation from their cows affects the animals' well-being

(Lunner Kolstrup et al. 2013; Waiblinger, Menke, and Fölsch 2003; Zulkifli 2013), and in this study I wanted to understand how alienation affected the farmers' well-being (in this case self-reported life satisfaction) as well. This study makes contributions to broader sociology, environmental sociology, and understandings of dairy farmers. First, it contributes to sociology more generally by demonstrating the relevance of alienation – a classical sociological concept – in understanding the experience of dairy farmers. Second, it applies theories in environmental sociology to understand the farmer-cow relationship and finds support for both metabolic rift theory and ecological modernization theory. This study contributes to the research on alienation and modernization by highlighting the possibility that different aspects of modernization (growth and technological innovation) may affect individual relationships with nature and work in unique ways. Rather than seeing alienation and modernization in a black and white way, future sociological research on this topic should be conducted in multiple contexts, recognizing the mixed effects that modernization can have. Lastly, my research contributes to an understanding of the experience of dairy farmers, and highlights the importance of their connection with their work and cows in addressing the mental health crisis facing the industry.

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CHAPTER 3 – ECOLOGICAL MODERNIZATION AND THE ANIMAL TREADMILL: ANIMAL WELFARE PROTECTION IN THE UNITED STATES, 2012-2017

Animal welfare is a structural issue and therefore requires a structural response to address it. A primary way of doing this is through legislation and governmental policy. This leads to a key question, is there a relationship between economic growth and animal welfare protections in the United States? This is an important question for sociologists to address because of the power humans exert over other animals. Theory in environmental sociology can help inform hypotheses about the role that economic growth and inequality have on animal welfare outcomes for different types of animals.

Human-animal relationships are a form of society-nature relationship. Though humans have always interacted with other animals, in the past several hundred years these relationships have changed dramatically in ways that affect animal welfare, often arguably for the worse (Leonard 2014; Nibert 2002). In pre-capitalist societies, some scholars argue that a "dialectical dualism" existed, a relationship that acknowledged differences between humans and other animals "but did not necessarily lead to exploitation or oppression of animals on a wide-scale level" (MacDonald 2016:41; see also Berger 2007). As industrial animal agriculture become more prominent, it brought with it a number of new environmental problems as well as animal welfare issues that environmental sociologists have addressed (Fitzgerald 2015). Some scholars argue the new human-animal relationship under capitalism took on the form of "alienated speciesism" where farmed animals were reduced to a few functions, in other words, they

were reduced to "things" that could be commodified (Foster and Clark 2018; MacDonald 2016). Prior research has called on environmental sociologists to address the human-animal relationship as a human-nature relationship, including analyses of how environmental, social, and animal outcomes are connected (Bekoff 2010; Noske 1997; Peterson 2013; Stuart and Gunderson 2019).

Much of the literature examining the relationship between political economic structures and animals has focused on farm animals (animals typically raised for consumption, e.g., cows, pigs, chickens). One of the challenges of studying the way political economic structures have shaped social relationships with animals is that animals are not a monolithic body. In some ways farm animals have been reified and "de-animalised" – integrated into farming machinery (Kortetmäki 2019). On the other end of the spectrum, companion animals (animals typically kept as pets, e.g., dogs and cats) in some cases have been de-animalised in an opposite way - they are almost freed from their looked down upon status as "only" animals and thought of as friends and even family (Charles 2014; Shir-Vertesh 2012). Companion and farm animals form the most frequent interactions of the public with animals, but there are also millions of animals in less visible arenas that are directly affected human society including wild animals (undomesticated animals) and research animals (animals used in research and education, e.g., rats and mice).

Animal categorizations of farm, companion, wild, and research give a general idea of the ways in which animals are valued and treated both socially and legally, but they are not always mutually exclusive and can vary by individual animal. For instance, a

rat can be a companion animal if cared for by a family, a research animal if owned by a university, or a wild animal not owned or cared for by any group and in fact perhaps a target for extermination by humans. Laws also apply differently based on the context in which an animal lives: the pet rat will receive substantially greater legal protections than the laboratory or wild rat (Frasch et al. 2011). Not only do social relationships with animals vary based on species and classification but also by context: both spatial and temporal. It is therefore important for sociologists to continue to analyze multiple types of human-animal relationships in different contexts.

A central debate in environmental sociology is the effect of economic growth on environmental outcomes – a debate which usually falls into the camps of treadmill of production theory and ecological modernization theory. Treadmill of production theory sees economic growth as being in conflict with environmental outcomes (Schnaiberg 1980; Schnaiberg and Gould 1994). Ecological modernization on the other hand sees economic growth as a pathway to environmental sustainability (Mol 1995). This debate plays such a central role in environmental sociology because of the stark contrast between the theories and urgency to find sustainable solutions to environmental problems. Animal welfare is an outcome that is important to environmental sustainability for several reasons. First, the welfare of wildlife is important for maintaining biodiversity and ecosystem health (Pacquet and Darimont 2010). Second, intensification of animal agriculture systems has been disastrous in terms of both animal welfare and environmental degradation (DeMello 2012; Hribar 2010). And third, because the human-animal relationship is itself a society-nature relationship that is highly valued (Peterson

2013) – to say nothing of animals' intrinsic value. This chapter contributes to the environmental sociology literature by applying treadmill of production theory and ecological modernization theory to analyze the impact of economic growth on animal welfare protections for companion, wildlife, research, and farm animals in the United States.

This chapter begins with a discussion of the way animals are currently considered under United States law. I then discuss ecological modernization theory and treadmill of production theory, which each can be applied to understand the relationship between economic growth and animal welfare protections. The next section outlines the measures and research methods, then presents an analysis of panel data from the years 2012 to 2017 as well as a cross-sectional analysis of data for the year 2017. Finally, I address the results and their implications for environmental sociology, policy, and future research.

FEDERAL AND STATE ANIMAL PROTECTION

Animal welfare protections in the United States vary based on the types of animals being considered, the time period, and the animals' use-value in society. In the past transportation and work animals (often horses) played a larger role in U.S. society, but this relationship has shifted to one where more common types of work animals are service animals (often dogs) for individuals with disabilities, or canines used in police and military operations. Humans also interact with animals in other realms such as entertainment (rodeos, bull-fights, movies), and in captivity (zoos, aquariums). These are important animal welfare areas to study but are beyond the scope of this particular study,

which focuses on four areas that encompass the largest number of animals and the most frequent human-animal interactions: farm animals, companion animals, research animals, and wildlife.

Although concern for animal welfare is rising, "the United States has among the weakest farm-animal-welfare standards in the developed world" (Matheny and Leahy 2007:325). Animals are considered property by U.S. law, which limits the protections and legal standing of animals (Frasch et al. 2011). There have been several legislative attempts to improve animal welfare, however. The major pieces of federal legislation addressing animal welfare are the Twenty-Eight Hour Law (1873), the Humane Methods of Slaughter Act (1958), the Animal Welfare Act (1966), and the Endangered Species Act (1973). Marceau (2018) asserts that these laws have accomplished little in terms of improving actual animal welfare but have done much for soothing public concern. Looking at the exceptions provided in these bills, it is evident that they are restrained – trying to address public demands while maintaining the economic bottom-line of animal industries, and "when animal welfare competes with economics, economics usually wins" (Matheny and Leahy 2007:328). Next, I present a brief overview of the four categories of animals considered in this study (farm, companion, lab, and wild), and how these major pieces of legislation provide, or more often fail to provide, protection for their welfare.

Farm Animals

One of the earliest pieces of animal welfare legislation is The Twenty-Eight Hour Law, which mandates that farm animals being moved (often from farm to

slaughterhouse) not be confined in transport for more than 28 hours at a time without breaks for food, water, and rest (Frasch et al. 2011). However, this piece of legislation has several loopholes that have severely limited its impacts on animal welfare. Until 2006 trucks were not considered transportation vehicles, and poultry are still not considered livestock protected by this law (Frasch et al. 2011; Greger 2007). The magnitude of this exemption is illustrated by slaughter statistics. In the U.S. in 2018, 9.16 billion chickens were slaughtered along with 237 million turkeys compared to 125 million pigs, 34 million cattle, and 2 million goats (Ritchie and Roser 2019). Similar exemptions exist for the Humane Methods of Slaughter Act.

The Humane Methods of Slaughter Act addresses the slaughter of livestock, and mandates that livestock be rendered senseless before slaughter unless being slaughtered in accordance with religious ritual (Frasch et al. 2011). However, the interpretation of the word "livestock" is up to the United States Department of Agriculture and has been interpreted in an extremely narrow way. Current interpretations of "livestock" exclude birds and fish, and thus the law "protects only one percent of farm animals from being slaughtered while fully conscious" (Matheny and Leahy 2007:334-335).

Research Animals

The Animal Welfare Act does not address farm animal welfare at all. This piece of legislation was enacted to ensure the welfare of research animals, companion animals, and non-farm animals being transported (Collis 2016). Like other federal regulations, the Animal Welfare Act has many exceptions on which types of animals are protected that

limit its actual impact. “USDA regulations exclude non-vertebrate animals, animals used for breeding purposes, agricultural animals, and birds, aquatic animals, rats and mice bred for research and some others” (Frasch et al. 2011: 322). Like the farm animal welfare legislative exclusions of poultry, which make up the majority of slaughtered animals, the animals excluded from the Animal Welfare Act make up the majority of animals used in research. Most estimates of animals used in research are estimates because labs are not required to report this information, but The Hastings Center (2013) estimates that there were 25 million mice, rats, fish, and birds used in research in the United States in 2010 compared to 1 million of all other species. The Animal Welfare Act therefore covers only a small fraction of animals used in research.

Companion Animals

In terms of companion animals, the Animal Welfare Act does provide some protections. First, it sets requirements for shelters to care for dogs and cats for at least five days to give guardians a chance to claim their animal (Cohen 2006). Second, it prohibits most types of animal fighting, except for bird fighting and prevents transporting animals for fighting across state lines (Cohen 2006). Still, most prosecution of animal fighting is left up to individual states, where the severity of charges and types of animals covered varies state to state (Frasch et al. 2011).

Companion animals typically enjoy the greatest amount of legal protections in the United States, which often take the form of criminal anti-cruelty laws enacted by states (Frasch et al. 2011). Anti-cruelty laws typically protect animals from a number of

intentional and negligent acts including: abandonment, cruelty, fighting, sexual assault, and theft (Frasch et al. 2011). Although companion animals are still considered property in the eyes of the law, courts are increasingly recognizing that companion animals have some intrinsic value and that simply paying the cost to buy a new similar animal (which is the normal penalty for property crimes) is insufficient for companion animals with which human guardians share a unique bond (Collis 2016). Other companion animal laws are gaining support such as laws against leaving animals in hot cars or tethered outside, or declawing cats (ALDF 2021). Companion animals typically enjoy a wider range of legal protections, but because these are at the state and local level there is variation in the types of laws enacted and criminal penalties associated with them.

Wildlife

The Endangered Species Act is one of the strongest pieces of environmental legislation and has been somewhat successful in the recovery of endangered species populations (Greenwald et al. 2019; Taylor, Suckling, and Rachlinski 2005). However, various administrations have tried to weaken the act, which they see as a challenge to economic growth (Aguilera 2019; Engelsman 2005). Like the other major pieces of federal legislation, the Endangered Species Act only covers a small fraction of animals – the point after all is to ensure the survival of populations at risk of extinction. This means that the majority of wildlife do not receive welfare protections from this law. In summary, these broad federal pieces of legislation address animal welfare in a limited

way, leaving it up to individual states and localities to enact more specific animal welfare protections.

State Protections

State animal protection laws increased in the 1980s and 90s, including the designation of new felony-level protection laws (Otto 2005), but the specific laws and levels of animal protection vary greatly between states as well as by species of animal (Matheny and Leahy 2007; Otto 2005). For instance, some states require veterinarians to report animal cruelty to law enforcement while others allow it but do not require it, and Kentucky actually prohibits veterinarians from reporting animal cruelty (ALDF 2019; Callahan 2017). Engelsman (2005) summarizes that "while state anti-cruelty laws are slightly better than federal animal protection laws, they still leave much to be desired" (p.342). The complete gamut of state laws and regulations is too vast to discuss here, but organizations like the Animal Legal Defense Fund and the Humane Society of the United States track these laws across states by year, and data from the latter is used for this study. The variety in state legislation raises a question for sociologists: what social factors contribute to animal welfare protections? Human-animal relationships are shaped by economic and symbolic values humans assign to animals (DeMello 2012). Theory in environmental sociology can help explain shifts in these values. In particular, ecological modernization theory and treadmill of production theory can address how economic growth is related to animal welfare protections.

ECOLOGICAL MODERNIZATION THEORY

Ecological modernization theory asserts that continued economic growth, technological innovation, and policy reform are necessary to remedy the ecological problems currently facing the world (Mol 1995; Speth 2008; York and Rosa 2003). Ecological modernization theorists do not deny the role that economic growth has played in perpetuating environmental degradation in recent history, but they assert that this destructive relationship is not necessary – that economic growth and environmental degradation can in fact decouple (Mol and Spaargaren 2000; Pellow and Brehm 2013; Spaargaren and Mol 1992). In fact, more than merely decoupling, ecological modernization sees economic growth and technological development as a necessary pathway to improved environmental outcomes (York, Rosa, and Dietz 2010).

The mechanism by which ecological modernization explains the predicted relationship between economic growth and environmental outcomes is ecological rationality (Mol, Spaargaren and Sonnenfeld 2014). Ecological rationality encapsulates the idea that as societies modernize people begin to challenge old political and economic rationalities in a reflexive process, demanding that social institutions and practices begin to prioritize environmental outcomes (Frouws and Mol 1997; York, Rosa, and Dietz 2010). This ecological rationality is facilitated by economic growth and technological innovation. The logic of ecological modernization theory is that 1) for individuals, economic growth helps satisfy basic needs and allows people to turn their concerns outward to issues like the environment and also demand a higher standard of living, which includes a cleaner environment (Givens and Jorgenson 2011; this process is also

captured by the Environmental Kuznets Curve Hypothesis – see Dinda 2004); and 2) for institutions economic growth necessitates environmental reform of economies and technologies in order to avoid radical changes to social structures (York and Rosa 2003). Ecological modernization theory is a theory of broad social change, but societies and institutions value and approach environmental problems in unique ways. It is therefore important to test ecological modernization theory in different contexts and with different social-environmental relationships, including the human-animal relationship.

Research using ecological modernization theory has addressed animal-related industries, such as animal agriculture, but these analyses have focused on resource use and pollutants and would benefit from analyzing the human-animal relationship itself. Previous ecological modernization analyses of animal agriculture have focused environmental outcomes associated with farming such as manure management (Glenna and Mitev 2009) and greenhouse gas emissions (Duru and Therond 2015). Animal welfare is typically mentioned only in passing in these types of ecological modernization analyses and may be seen by some as outside the scope of ecological modernization theory, which has tended to focus on resource depletion and efficiency (Spaargaren and Mol 1992). In fact, Frouws and Mol (1997) make a distinction between ecological rationality and concern over animal welfare. In other words, they argue that concern for animal welfare is not captured by the concept of ecological rationality (and therefore not necessarily a valid subject for ecological modernization). Frauws and Mol's (1997) conceptual distinction between animal welfare and ecological rationality is reflective of broader environmental theory, which tends to view animals in primarily holistic ways

that relate back to ecosystems. Noske (1997) and Peterson (2013) critique this approach to environmental theory as overly narrow and an approach that leaves farm, companion, and research animals in a type of theoretical limbo – overlooked and excluded from both social and environmental theory. I argue here that the logic underlying ecological modernization theory applies to the human-animal relationship, and that ecological modernization theory can help explain changes in animal welfare legislation in the United States.

According to ecological modernization theory, states and corporations come under increasing scrutiny as ecological rationality grows among the public and therefore must adopt more environmentally friendly practices for their own survival, which they accomplish through reform and technological innovation (Mol and Jänicke 2010). Concern for animal welfare is high and increasing in the United States (O'Gara 2019; George et al. 2016), and prior research shows that countries with higher per capita income express greater concern for animal welfare (Frank 2008). Animal related companies recognize this growing public concern and the need to address it either through internal practice and policy or through legislative reform. For example, United Egg Producers (the largest egg-related organization in the United States) teamed up with The Humane Society of the United States to develop legislative proposals that would allow farmers to continue to produce eggs in a cost-effective way while also improving the welfare of hens, thereby addressing growing concern from the public over the use of confinement methods such as battery cages – restrictive cages used to house large numbers of hens in smaller areas (Satran 2011). An example of technological innovation

that could potentially benefit both animal and economy in accordance with ecological modernization theory is automated milking systems on dairies. These robotic milking machines are made possible through continued economic growth and grant cows greater autonomy to choose when they are milked and may provide closer health monitoring of the animals (Driessen and Heutinck 2003). Other examples exist, but these cases illustrate ways in which human-animal relationships have modernized in a way that can potentially benefit both economy and animal welfare.

Corporations can choose to innovate on their own in ways that improve animal welfare while increasing economic profits, but ecological modernization sees governmental policy reform as an important tool in motivating this private innovation, as well as a modernization end itself (Mol and Jänicke 2010). This study analyzes the relationship between economic growth and state animal welfare legislation. According to ecological modernization theory, economic growth is hypothesized to be associated with higher overall animal welfare protection, as well as higher overall protection for farm, companion, lab, and wild animals.

TREADMILL OF PRODUCTION AND THE POLITICAL ECONOMY OF ANIMALS

In contrast to ecological modernization theory, treadmill of production theory sees economic growth as inextricably tied to environmental degradation (Gould, Pellow, and Schnaiberg 2008). Treadmill of production theory was developed by Schnaiberg (1980), who compared the relationship between economy as an accelerating treadmill that requires ever greater inputs (natural resources) and produces ever greater outputs

(pollution). Put simply, treadmill of production theory asserts that "as economic development intensifies, so does the degree of environmental degradation" (Pellow and Brehm 2013:232). Economic growth accelerates this treadmill because surplus capital is re-invested in technologies designed to produce more ad infinitum; "societies tend to use the surplus to *accumulate* still more economic surplus in future periods" (Schnaiberg 1980:19). As a sociological theory, treadmill of production theorists recognize the social costs of such a system – that as workers are replaced by more efficient technology and must either work harder to keep up or be displaced (Gould, Pellow, and Schnaiberg 2008).

Animals are also caught in the treadmill of production, which some argue contributes to decreased animal welfare as it accelerates. Gunderson and Stuart (2014) apply treadmill of production theory to the intensification of animal agriculture, which has resulted in increased animal suffering, and a weak welfare response from governments committed to maintaining economic expansion of agribusiness. This point is critical to treadmill of production theory, which sees *both* governments and corporations as committed to economic growth above environmental interests (Schnaiberg and Gould 1994). States may therefore enact some environmental or animal protections when public pressure mounts but will try to do so in a way that preserves economic growth. Collis' (2016) review of animal law in the United States reflects this point, concluding that "overall, laws affecting animals have been created for the purpose of giving humans the greatest possible utility of animals" (p.181). In sum, treadmill of production theory does not see economic growth as a tool to improve animal welfare under the current political

economic system, and in fact sees it as a driving force harming animals, the environment, and humans.

According to treadmill of production theory, governments value economic growth and will not pass laws that hinder this growth (Schnaiberg and Gould 1994). In contrast to ecological modernization theory then, treadmill of production theory forms the basis for the alternative hypotheses of this study - that economic growth is associated with decreased animal welfare protection overall and for farm, companion, research, and wild animals.

DATA AND METHODS

All 50 states in the United States are included in this analysis, with data covering the years 2012-2017, resulting in a total sample size of 300. In order to analyze animal welfare by state, this study uses administrative data from a combination of nonprofit and government sources. As such, the range of years included in this analysis is constrained to only those years where data are available across different measures.

Dependent Variables

This study analyzes five dependent variables: 1) overall animal welfare protection, 2) wildlife protection, 3) companion animal protection, 4) research animal protection, and 5) farm animal protection. Previous research suggests that changes in human-animal relationships vary based on the type of animal being considered (Frank 2008; Holst and Martens 2016). In some cases, companion animals such as dogs and cats

are granted a type of "flexible personhood" (Charles 2014; Shir-Vertesh 2012), while in other cases research and farm animals are explicitly excluded from animal welfare protections (Collis 2016). It is therefore insufficient to only study overall animal protection, just as studying overall environmental degradation would miss nuances involved with different types of pollutants or resource use. This study contributes to the literature on ecological modernization and treadmill of production by analyzing the relationship between economic growth and animal welfare protection by category: wildlife, companion, research, and farm.

The Humane State Ranking – overall animal protection

All dependent variables come from the Humane Society of the United States' *Humane State Ranking*, the overall score of which serves the first dependent variable. This ranking provides a percentage score based on which laws states have enacted based on 10 broad categories of animal welfare: animal fighting, animal cruelty, wildlife abuse, exotic pets, companion animals, animals in research, farm animals, fur and trapping, puppy mills, and equine protection (HSUS 2015). For instance, in 2017 Utah had implemented 28 out of 93 possible animal welfare protections measured by the Humane Society, and therefore has a score of 30%. By using a percentage score, the humane state ranking can better account for change over time, as well as regional differences. The average Humane State Ranking score between 2012-2017 is 42.5 with a standard deviation of 13.6.

Wildlife protection

The second dependent variable in this analysis is wildlife protection. The Humane state Ranking includes 21 measures of wildlife protection. Ten of these measures are prohibitions on hunting, five are prohibitions on certain types of sales or trade (e.g. the sale of ivory and rhino horn), and the remainder are about more specific practices such as whether the state is a member of the Interstate Wildlife Violator Compact or whether the state requires the use of non-lead ammunition. States without significant populations (populations of 100 or 200 animals, depending on the species) of hunted animals do not have their scores affected by prohibitions on hunting of those animals, since such laws would be irrelevant. The average wildlife protection score is 41.2 with a standard deviation of 13.4.

Companion animal protection

Companion animal protection, the third dependent variable, is measured with twelve items. Two of these items address euthanasia practices, two address spaying and neutering, and the rest are a mix of regulations such as prohibitions on greyhound racing, chaining of dogs, consumption of dog and cat meat, and protection for people who remove dogs from hot cars[2]. The average companion animal protection score is 45.8 with a standard deviation of 21.8.

[2] Dogs – companion animals – are also used in fighting, but animal fighting protections are not included in this measure of companion animal protection.

Research animal protection

The fourth dependent variable, research animal protection, is measured with four items. States are evaluated on whether they: grant students the right to choose an alternative to animal dissection in schools, prohibit research facilities from obtaining pets from animal shelters, prohibit the use of animals in product testing when an approved alternative is available, and require research facilities to offer dogs and cats for adoption prior to euthanasia. The average research animal protection score is 21.8 with a standard deviation of 27.6.

Farm animal protection

Farm animal protection is the fifth and final dependent variable included in this analysis. It is measured in the Humane State Ranking by 9 items. Four of these items deal with prohibitions on animal confinement practices including gestation crates, veal crates, and battery cages. Three items deal with farm practices such as tail-docking, force-feeding, and standards for sick or injured animals. The final measures are of state slaughter standards and restrictions on cruelty investigations into agricultural facilities. The mean farm animal protection score is 25.3 with a standard deviation of 21.8.

Table 3-1: Descriptive Statistics of Dependent and Independent Variables

Variable	Mean	Standard Deviation	Min	Max	Mean (Logged)	Standard Deviation (Logged)
Humane State Index	42.228	13.572	12	75	3.711	0.346
Wild Animal Protection	40.083	13.702	8	75	3.654	0.364
Companion Animal Protection	46.120	22.307	0	100	3.674	0.747
Research Animal Protection	22.030	28.498	0	100	1.724	1.921
Farm Animal Protection	22.990	22.088	0	100	2.537	1.404
GDP Per Capita (Thousands of Chained 2012 Dollars)	50.802	9.853	33.147	78.844	10.817	0.191
Research and Development as a % of GDP	2.202	1.476	.275	7.412	1.068	0.434
Percent with a Bachelor's Degree or Higher	28.209	4.840	17.5	41.2	3.361	0.166
State Environmentalism	45.896	30.797	0	100	3.508	0.985
Gini Coefficient	.461	.021	.408	.542	0.379	0.014
Agriculture, Forestry, Hunting and Fishing as a % of GDP	1.980	2.355	.148	11.892	.891	0.578

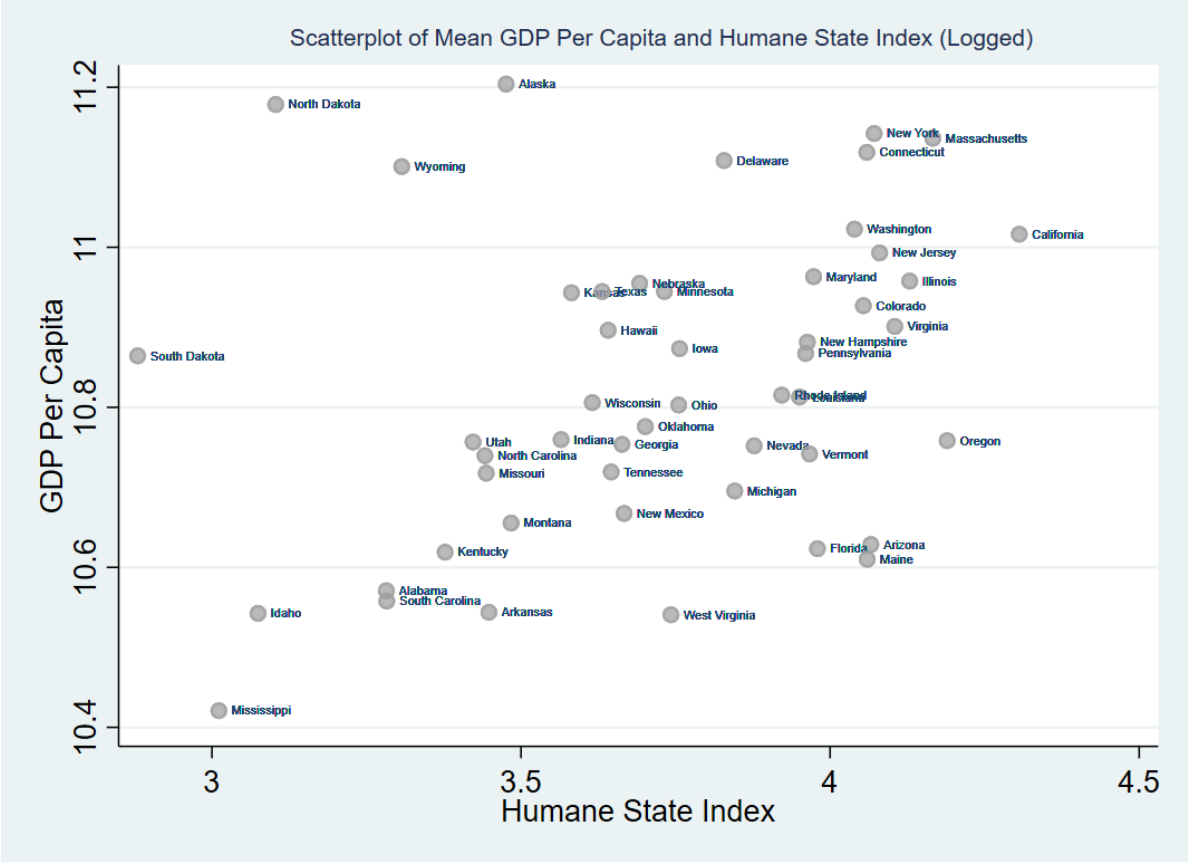
Table 3-1 presents descriptive statistics for all dependent and independent variables in this study. All independent and dependent variables in this analysis are logged which helps address issues with skewed data, and means that regression coefficients can be interpreted as elasticity coefficients meaning that a one percent change in the independent variable will be associated with a percentage change (the regression coefficient) in the dependent variable.

Independent Variables

In both treadmill of production and ecological modernization theories, the key independent variable of interest is economic growth. *GDP per capita* is used as a measure of economic growth, taken from the U.S. Bureau of Economic Analysis (US BEA 2020), and reported in thousands of chained 2012 dollars (using chained dollars

adjusts for inflation, a necessary step with longitudinal data). A scatterplot of GDP per capita and Humane State Ranking mean scores from 2012-2017 is shown in Figure 3-1.

Figure 3-1: Scatterplot of Mean GDP Per Capita and Humane State Index (Logged)



The second independent variable is *research and development as a percentage of GDP* from the National Science Foundation (2020). Treadmill of production and ecological modernization theories highlight the importance of technology in environmental degradation and, as with economic growth, arrive at different conclusions. Treadmill of production asserts that technology is used to enhance the production process

and therefore contributes to negative environmental outcomes, while ecological modernization defines the role of technology as a positive one in achieving desirable environmental outcomes. GDP is a central measure of modernization, but modernization also includes development of new technologies (York, Rosa, and Dietz 2010). This measure of research and development as a percentage of GDP then adds more information about the extent to which state economies have modernized. This measure is useful, but has several limitations that should be addressed. First, it does not address how much technology is actually in use. Second, it does not address whether the research and development being funded is more "production science", designed to increase efficiency and profits, or "impact science", designed with environmental and social impacts in mind (see Gould 2015; Thomas 2019). For treadmill of production theory this distinction is important, though for ecological modernization theory, such a distinction may be less relevant, as it asserts that part of modernization is the convergence of production and impact science – or rather that economic and environmental interests will converge (Mol and Jänicke 2010). In other words, ecological modernization asserts that as society modernizes, becoming more efficient will be beneficial for industry and the environment (Cohen 2006; Foster, Clark, and York 2011; Speth 2008).

Both treadmill of production and ecological modernization theory are concerned with the organization of economies, i.e. which industries are most influential for economic growth and policy reform. I account for this by including agriculture, hunting, fishing, and forestry as a percentage of GDP as an independent variable, provided by the U.S. Bureau of Economic Analysis (US BEA 2020). This measure is important because

according to treadmill of production theory, the state, along with private industry, prioritizes economic growth which produces environmental degradation (Obach 2004). In areas where agriculture, hunting, fishing, and forestry make a larger contribution to the economy, treadmill of production theory would assert that the state would be incentivized to impose less regulations on these industries.

Economic inequality has consistently been found to be associated with environmental degradation (Boyce 1994; Jorgenson et al. 2015; Jorgenson, Schor, and Huang 2017), and animal welfare (Morris 2013). Environmental sociologists have explained that in unequal societies those with economic power have political power and an interest in continued environmental exploitation while simultaneously being able to better shield themselves from environmental impacts (Boyce 1994; Boyce et al. 1999). Similar explanations have been offered for the relationship between economic inequality and animal welfare. According to Morris (2013) explanations for the effect of income inequality on animal welfare include feelings of distrust and alienation that come with inequality, as well as the factors that contribute to income inequality such as greater corporate power, which can contribute to environmental and animal welfare problems. Economic inequality can be measured in different ways, but one of the most common measures is the Gini coefficient, a measure of economic inequality that ranges from zero to one, with zero indicating perfect equality and one indicating perfect inequality. I use the Gini coefficient as a measure of income inequality in this analysis, but I also ran a sensitivity analysis using the income share of the top 10% as a measure of income inequality using data calculated by Mark W. Frank (2021). Results were not substantively

different when using the Gini coefficient compared to the income share of the top 10%. Data for the Gini coefficient by state come from the US Census Bureau's (2018) American Community Survey 1-year estimates.

An additional social indicator included in this analysis as a control variable is education, specifically the percentage of the population with a bachelor's degree or higher, which comes from the U.S. Census Bureau (2020). Higher educational attainment is associated with greater social and environmental sustainability, as measured with the carbon intensity of well-being (Jorgenson, Dietz, and Kelly 2018; Kelly 2020). Some research finds that higher educational attainment is associated with higher animal welfare concerns and behaviors (Alonso, González-Montaña, and Lomillos 2020; Cornish et al. 2020; Kellert 1998), but evidence of this relationship is still mixed (Toma et al. 2012).

Finally, I include state environmentalism. I calculated this measure using data from the League of Conservation Voters (2020) and following the method outlined by Dietz et al. (2015). The League of Conservation Voters (2020) provides a score based on the votes of House and Senate members from each state, and state environmentalism is an average of the scores for these two groups. Although concern for animals draws on values unique from environmentalism (Dietz, Allen, and McCright 2017), environmentalism and animal welfare interests and advocacy groups have worked together such as with wildlife protection, especially endangered species, and the use of animals in generating concern for environmental issues (Unti and Rowan 2001; Whitley, Kalof, and Flach 2020). Table 3-2 shows a correlation matrix of all independent and dependent variables.

Table 3-2: Correlation Matrix of All Dependent and Independent Variables

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Humane State Index	-										
2. Wild Animal Protection	.643	-									
3. Companion Animal Protection	.612	.322	-								
4. Research Animal Protection	.616	.506	.425	-							
5. Farm Animal Protection	.401	.138	.195	.228	-						
6. GDP Per Capita	.320	.144	.118	.219	.036	-					
7. Research and Development as a % of GDP	.401	.361	.233	.320	.229	.181	-				
8. Percent with a Bachelor's Degree or Higher	.548	.391	.259	.450	.173	.608	.524	-			
9. State Environmentalism	.578	.476	.318	.593	.109	.181	.480	.496	-		
10. Gini Coefficient	.278	.342	.244	.235	.121	-.027	.136	.012	.153	-	
11. Agriculture, Forestry, Hunting and Fishing as a % of GDP	-.529	-.521	-.478	-.497	-.069	-.120	-.239	-.240	-.384	-.264	-

Analytic Technique

To analyze animal welfare outcomes, I conduct two sets of analyses: a panel regression analysis using data from the years 2012 to 2017 and an OLS regression using data from the year 2017. As explained above, a primary motive of this study is to examine animal welfare protection differences by type of animal: wildlife, companion, research, and farm animal. Each analysis therefore presents five tables for each of these dependent variables.

I use the xtreg commands in Stata 14 to estimate models, a suite of commands used for regression analyses with panel data (Schmidheiny and Basel 2011; StataCorp

2019). For each of the five dependent variables, I run six models where each model adds one additional independent variable. Based on Hausman specification tests I use fixed effects models for all dependent variables. The xttest3 test, which calculates a modified Wald statistic (Baum 2000), and xtserial test, "which implements the Woodridge test for serial correlation in panel data (Drukker 2003), demonstrate the presence of heteroskedasticity and autocorrelation. Therefore, all models use robust standard errors, clustered by state. All independent and dependent variables are logged, meaning the coefficients presented here are elasticity coefficients. Years are also included as a dummy variable in all models.

In addition to the panel regression models, I include a cross-sectional ordinary least squares (OLS) regression analysis with data from 2017. This serves as a sensitivity analysis for the panel regression analyses, which cover a short time span (2012-2017). The OLS regression provides new information not only because of a different data structure, but also because the fixed effects panel regression models analyze within-case variation (Allison 2009), while the OLS analysis compares between cases. I include the same independent and dependent variables in the OLS regression, and following the method used by Givens and Jorgenson (2011) I also include a measure of percent change in per capita GDP from 2012-2017, which is another approach to measuring the effect of economic development.

RESULTS

Overall, the results indicate mixed support for ecological modernization theory and treadmill of production theory, with slightly more support for ecological modernization theory. Results from the panel regression models indicate that higher GDP is associated with lower farm animal protection (Table 3-7), though not quite at the .05 level of significance, and GDP is not significantly associated with other animal welfare protection. However, the cross-sectional analysis of farm animal protection suggests that higher GDP growth between 2012-2017 is associated with higher farm animal protection (Table 3-13). GDP growth is also associated with higher overall animal protection (Table 3-9), wildlife protection (Table 3-10), and companion animal protection (Table 3-11) in the OLS regression analyses. Higher GDP is associated with higher overall animal protection (Table 3-9), wildlife protection (Table 3-10), and research animal protection (Table 3-12).

Table 3-3: Summary of Results

Dependent Variable	Association with GDP	
	Fixed Effects Panel Regression	Ordinary Least Squares Regression
Overall Animal Welfare Protection	.260 .040	29.385** .129
Wildlife Protection	.632 .336	25.968* .108
Companion Animal Protection	2.114 .049	16.630 .001
Research Animal Protection	.500 .016	59.516** .132
Farm Animal Protection	-4.131# .444	16.384 .001
Line 1: Regression coefficient marked for significance (#p<.10 *p<.05 Line 2: R-Squared (r-squared within for fixed effects models and adjusted r-squared for OLS models)		

Table 3-3 presents a summary of the results from the analyses in this chapter, showing regression coefficients marked for significance (taken from Model 1 in each analysis) and r-squared statistics in these same models, with GDP as the predictor variable. This table helps highlight how the relationship between GDP and animal welfare protection outcomes differs based on animal type. Notably, GDP explains a great deal of the variance in farm animal welfare when using fixed effects models, which compare within cases over time rather than between them (Allison 2009). This finding about the relationship between GDP and farm animal protection is important because the number of animals used in farming outnumbers wildlife, companion, and research animals combined. When it comes to the association between GDP and research animal protection the effect size is nearly twice as large as for wildlife or overall, though the amount of variance in each variable explained by GDP is similar. Detailed results of the fixed effects panel regression and OLS regression analyses are presented below.

Fixed Effects Panel Regression Analysis

Table 3-4 presents fixed effects panel regression model results predicting *overall animal welfare protection* as measured by the Humane State Ranking. No independent variable is statistically significantly associated with overall animal welfare protection in any model. No year is statistically significantly associated with overall animal welfare protection.

Table 3-4: Fixed Effects Models Predicting Overall Animal Welfare Protection

		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	GDP per Capita	.260	.246	.239	.253	.257	.249
		(.264)	(.265)	(.282)	(.268)	(.273)	(.262)
	Research and Development		-.043	-.041	-.050	-.049	-.045
			(.053)	(.053)	(.061)	(.062)	(.060)
	Education			.085	.095	.095	.085
				(.314)	(.325)	(.328)	(.321)
	Environmentalism				-.007	-.007	-.005
					(.019)	(.019)	(.018)
	Gini					.107	.101
						(.353)	(.354)
	Agriculture, Hunting, Fishing, and Forestry % of GDP						-.061
							(.056)
	2012	Omitted					
	2013	-.010	-.010	-.011	-.012	-.012	-.007
		(.008)	(.008)	(.009)	(.010)	(.010)	(.009)
	2014	-.009	-.010	-.012	-.013	-.014	-.009
		(.014)	(.014)	(.014)	(.014)	(.014)	(.014)
	2015	-.013	-.013	-.010	-.012	-.013	-.007
		(.018)	(.018)	(.027)	(.023)	(.024)	(.023)
	2016	-.040	-.040	-.038	-.040	-.041	-.034
		(.022)	(.022)	(.025)	(.022)	(.022)	(.022)
	2017	-.011	-.011	-.011	-.015	-.016	-.010
		(.022)	(.023)	(.023)	(.021)	(.021)	(.020)
	Constant	.917	1.117	.908	.755	.667	.831
		(2.852)	(2.858)	(2.669)	(2.583)	(2.708)	(2.603)
R-sq	Within	.040	.042	.043	.045	.045	.049
	Between	.103	.024	.082	.037	.041	.222
	Overall	.100	.024	.080	.037	.041	.214
#p<.10, *p<.05, **p<.01, ***p<.001 Robust standard errors in parentheses.							

Fixed effects panel regression models predicting *wildlife protection* are presented in Table 3-5. No independent variable is statistically significantly associated with wildlife protection. However, several years (2014, 2016, and 2017) are associated with decreased wildlife protection. In the case of animal welfare protection, laws are typically not

repealed, so this decrease in wildlife protection is likely due to the way that the Humane Society of the United States tracks laws. As new laws are passed, the Humane Society notes which states have implemented these new protections. So, a state's laws may not actually change, but their Humane State Ranking may decline if they are not passing new laws passed by other states.

Table 3-5: Fixed Effects Models Predicting Wildlife Protection

		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	GDP	.632	.653	.628	.586	.599	.607
		(.470)	(.468)	(.480)	(.479)	(.485)	(.498)
	Research and Development		.063	.071	.099	.102	.098
			(.097)	(.102)	(.102)	(.100)	(.103)
	Education			.295	.262	.260	.271
				(.531)	(.537)	(.539)	(.538)
	Environmentalism				.019	.019	.018
					(.013)	(.013)	(.014)
	Gini					.285	.292
						(.545)	(.546)
	Agriculture, Hunting, Fishing, and Forestry % of GDP						.065
							(.108)
	2012	Omitted					
	2013	-.000	.000	-.004	-.002	-.002	-.008
		(.018)	(.018)	(.019)	(.019)	(.019)	(.018)
	2014	-.064*	-.064*	-.071*	-.066*	-.066*	-.071*
		(.025)	(.025)	(.029)	(.028)	(.028)	(.027)
	2015	-.065	-.064	-.051	-.042	-.043	-.049
		(.034)	(.033)	(.043)	(.043)	(.044)	(.048)
	2016	-.188***	-.188***	-.182***	-.175***	-.177***	-.184***
		(.034)	(.033)	(.035)	(.035)	(.035)	(.039)
	2017	-.169***	-.169***	-.169***	-.156***	-.158***	-.164***
		(.038)	(.038)	(.038)	(.039)	(.039)	(.041)
	Constant	-3.072	-3.365	-4.091	-3.638	-3.875	-4.050
		(5.073)	(5.076)	(5.333)	(5.321)	(5.384)	(5.489)
R-sq	Within	.336	.337	.338	.343	.344	.345
	Between	.051	.092	.149	.208	.212	.114
	Overall	.080	.119	.169	.223	.227	.137

#p<.10, *p<.05, **p<.01, ***p<.001
Robust standard errors in parentheses.

Table 3-6 shows fixed effects panel regression models predicting *companion animal protection.* GDP is not significantly associated with companion animal protection in the first four models but gains significance when the Gini coefficient is included in Models 5 and 6. In Model 5 a 1% increase in per capita GDP is associated with a 2.419% increase in companion animal welfare, and in Model 6 it is associated with a 2.410% increase. This result provides support for ecological modernization theory. Research and development, education, and environmentalism are not statistically significantly associated with companion animal protection in any model. Interestingly, the Gini coefficient is positively associated with companion animal protection, with a 1% increase in the Gini coefficient being associated with a 5.341% increase in companion animal protection in Model 5, and a 5.334% increase in Model 6. This finding contradicts previous research on income inequality and animal welfare (see Morris 2013), and possible explanations for this finding are presented in the discussion section.

Table 3-6: Fixed Effects Models Predicting Companion Animal Protection

		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	GDP	2.114	2.054	2.182	2.187	2.419*	2.410*
		(1.316)	(1.290)	(1.231)	(1.222)	(1.163)	(1.142)
	Research and Development		-.181	-.220	-.224	-.158	-.153
			(.230)	(.267)	(.256)	(.248)	(.262)
	Education			-1.474	-1.470	-1.515	-1.527
				(1.474)	(1.488)	(1.499)	(1.460)
	Environmentalism				-.003	-.008	-.007
					(.059)	(.055)	(.062)
	Gini					5.341*	5.334*
						(2.651)	(2.626)
	Agriculture % of GDP						-.071
							(.561)
	2012	Omitted					
	2013	-.052	-.053	-.032	-.032	-.038	-.033
		(.061)	(.060)	(.073)	(.074)	(.071)	(.060)
	2014	.049	.048	.085	.084	.077	.082
		(.070)	(.070)	(.095)	(.097)	(.095)	(.080)
	2015	.001	-.001	-.067	-.069	-.091	-.084
		(.090)	(.088)	(.083)	(.094)	(.087)	(.115)
	2016	-.007	-.008	-.038	-.038	-.066	-.058
		(.102)	(.101)	(.093)	(.101)	(.089)	(.116)
	2017	-.021	-.019	-.020	-.021	-.048	-.041
		(.111)	(.110)	(.107)	(.125)	(.113)	(.131)
	Constant	-19.201	-18.360	-14.729	-14.792	-19.219	-19.027
		(14.211)	(13.956)	(13.551)	(13.525)	12.790	(12.219)
R-sq	Within	.049	.051	.057	.057	.090	.091
	Between	.008	.001	.031	.032	.010	.001
	Overall	.009	.002	.020	.020	.004	.000
#p<.10, *p<.05, **p<.01, ***p<.001 Robust standard errors in parentheses.							

Table 3-7 presents results for the fixed effects panel regression analysis predicting research animal protection. No independent variable or year is significantly associated with research animal protection in any model.

Table 3-7: Fixed Effects Models Predicting Research Animal Protection

		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	GDP	.500	.472	.439	.369	.332	.302
		(1.015)	(1.087)	(1.011)	(.968)	(1.030)	(1.023)
	Research and Development		-.083	-.073	-.025	-.036	-.021
			(.362)	(.379)	(.402)	(.421)	(.417)
	Education			.376	.321	.328	.290
				(1.204)	(1.190)	(1.183)	(1.159)
	Environmentalism				.033	.034	.038
					(.028)	(.028)	(.029)
	Gini					-.853	-.875
						(2.005)	(2.022)
	Agriculture % of GDP						-.232
							(.178)
	2012	Omitted					
	2013	.029	.028	.023	.027	.028	.046
		(.018)	(.018)	(.027)	(.027)	(.027)	(.030)
	2014	.005	.005	-.004	.005	.006	.023
		(.061)	(.061)	(.048)	(.054)	(.054)	(.061)
	2015	.076	.075	.092	.108	.111	.131
		(.089)	(.087)	(.109)	(.118)	(.118)	(.130)
	2016	.061	.060	.068	.079	.083	.108
		(.089)	(.088)	(.093)	(.098)	(.100)	(.116)
	2017	.083	.083	.083	.106	.110	.133
		(.088)	(.091)	(.091)	(.097)	(.101)	(.114)
	Constant	-3.701	-3.313	-4.239	-3.466	-2.759	-2.135
		(11.002)	(12.016)	(14.437)	(13.983)	(15.131)	(15.027)
R-sq	Within	.016	.016	.016	.018	.018	.020
	Between	.046	.006	.088	.225	.214	.398
	Overall	.040	.007	.080	.199	.188	.371
#p<.10, *p<.05, **p<.01, ***p<.001 Robust standard errors in parentheses.							

Finally, Table 3-8 presents fixed effects panel regression results predicting farm animal protection. The association between GDP and farm animal protection does not reach .05 significance level but is marked for significance at the .1 level. These results should be interpreted with caution, but may be insightful for future analyses that use a larger sample size either based on more geographic locations or over a longer period of

time. At the .1 significance level GDP is negatively associated with farm animal protection in Models 1-5 (b= -4.131, -4.203, -4.071, -3.949, -3.573). Research and development, education, and environmentalism are not statistically significantly associated with farm animal protection. The Gini coefficient is statistically significantly associated with increased farm animal protection in Model 6, with a 1% increase in the Gini coefficient being associated with an 8.753% increase in farm animal protection. As with companion animal welfare, this finding is not consistent with previous research on animal welfare and potential reasons for the results are examined in the discussion section of this paper. Agriculture, hunting, fishing, and forestry is not associated with farm animal welfare.

Table 3-8: Fixed Effects Models Predicting Farm Animal Protection

		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	GDP	-4.131#	-4.203#	-4.071#	-3.949#	-3.573#	-3.458
		(2.172)	(2.197)	(2.113)	(2.099)	(2.084)	(2.248)
	Research and Development		-.214	-.255	-.338	-.231	-.287
			(.386)	(.391)	(.410)	(.394)	(.413)
	Education			-1.517	-1.421	-1.494	-1.348
				(2.245)	(2.253)	(2.220)	(2.284)
	Environmentalism				-.057	-.066	-.083
					(.074)	(.075)	(.082)
	Gini					8.667#	8.753*
						(4.391)	(4.351)
	Agriculture, Hunting, Fishing, and Forestry % of GDP						.878
							(.671)
	2012	Omitted					
	2013	1.242***	1.240***	1.262***	1.256***	1.246***	1.175***
		(.182)	(.182)	(.187)	(.189)	(.182)	(.188)
	2014	1.312***	1.311***	1.349***	1.333***	1.321***	1.255***
		(.177)	(.178)	(.192)	.251	(.191)	(.195)
	2015	1.353***	1.351***	1.283***	1.255***	1.220***	1.144***
		(.195)	(.196)	(.219)	(.220)	(.218)	(.230)
	2016	1.255***	1.254***	1.223***	1.205***	1.160***	1.066***
		(.203)	(.204)	(.208)	(.210)	(.210)	(.233)
	2017	1.298***	1.301***	1.300***	1.261***	1.218***	1.133***
		(.214)	(.217)	(.213)	(.223)	(.218)	(.241)
	Constant	46.454#	47.452#	51.186*	49.842*	42.657#	40.291
		(23.454)	(23.747)	(24.159)	(24.054)	24.141	26.583
R-sq	Within	.444	.445	.446	.447	.462	.469
	Between	.004	.009	.017	.023	.019	.042
	Overall	.022	.014	.004	.002	.005	.000
#p<.10, *p<.05, **p<.01, ***p<.001 Robust standard errors in parentheses.							

Ordinary Least Squares (OLS) Regression Analysis

In addition to the fixed effects panel regression analysis, I use ordinary least squares (OLS) linear regression to analyze state animal protection. Table 3-9 presents OLS regression results predicting overall animal protection as measured by the Humane State Ranking. GDP per capita is significantly associated with overall animal protection

in Model 1 (b=29.385, p<.01) and Model 2 (b=.402, p<.05), but loses significance in Model 4 when other independent variables are controlled for. Change in GDP is positively associated with overall animal protection in Model 3 (b=1.102, p<.01) but loses significance in Model 5 when other independent variables are controlled for. Research and development is associated with increased overall animal protection in Model 2 (b=2.936, p<.05) but not Model 5 or Model 6. Education is not significantly associated with overall animal protection, nor is the Gini coefficient or agriculture, forestry, fishing, and hunting as a percentage of GDP. State environmentalism is positively associated with overall animal protection in Model 5 (b=.148, p<.05), and Model 6 (b=.150, p<.05). These results lend support to ecological modernization theory – that increased GDP and research and technology are associated with increased animal welfare protection.

Table 3-9: OLS Regression Predicting Overall Animal Welfare, 2017

	Model 1	Model 2	Model 3	Model 4	Model 5
GDP Per Capita (Thousands of Dollars, Logged)	29.385**	.402*		.084	
	(10.222)	(.197)		(.187)	
GDP Change (%) from 2012 to 2017			1.102**		.224
			(.390)		(.271)
Research and Development % of GDP		2.936*		.170	.042
		(1.270)		(1.102)	(1.111)
Percent with Bachelor's				.708	.750
				(.468)	(.408)
State Environmentalism				.148*	.150*
				(.061)	(.061)
Gini x 100				1.075	1.021
				(.820)	(.818)
Agriculture, Forestry, Fishing, and Hunting % of GDP				-1.328	-1.456
				(.724)	(.742)
Constant	-275.779*	15.528	38.139***	-35.620	-30.797
	(110.93)	(10.042)	(2.575)	(41.467)	(41.422)
Adj R-Squared	.129	.190	.125	.524	.529
Beta coefficients marked for significance, standard errors in parentheses. ***p<.001 **p<.01 *p<.05					

Table 3-10 presents results for the OLS regression analysis predicting wildlife protection. GDP per capita is associated with higher wildlife protection in Model 1 (b=25.968, p<.05), but is not statistically significantly associated with wildlife protection in Model 2 or Model 4 where other independent variables are controlled for. GDP change is also positively associated with wildlife protection (Model 3, b=.876, p<.05), but this association loses statistical significance in Model 5 when other independent variables are added to the model. Research and development as a percentage of GDP is positively associated with wildlife protection in Model 2 (b=3.467, p<.01) but not Model 4 or Model 5. Education is not statistically significantly associated with wildlife protection in

any model. Higher state environmentalism is associated with higher wildlife protection in both Model 4 (b=.162, p<.01) and Model 5 (b=.161, p<.01). The Gini coefficient is positively associated with wildlife protection in Model 4 (b=1.577, p<.05), meaning that states with higher income inequality are more likely to have higher wildlife protection, but this association is not statistically significant in Model 5. Lastly, agriculture, forestry, fishing, and hunting as a percentage of GDP is not statistically significantly associated with wildlife protection in any model.

Table 3-10: OLS Regression Predicting Wildlife Protection, 2017

	Model 1	Model 2	Model 3	Model 4	Model 5
GDP Per Capita (Thousands of Dollars, Logged)	25.968*	17.774		8.781	
	(9.849)	(9.555)		(9.474)	
GDP Change (%) from 2012 to 2017			.876*		.336
			(.381)		(.262)
Research and Development % of GDP		3.467**		1.008	1.035
		(1.175)		(1.048)	(1.073)
Percent with Bachelor's				.144	.351
				(.451)	(.394)
State Environmentalism				.162**	.161**
				(.058)	(.059)
Gini x 100				1.577*	1.546
				(.781)	(.791)
Agriculture, Forestry, Fishing, and Hunting % of GDP				-.937	-.905
				(.689)	(.718)
Constant	-243.321*	-162.022	34.534***	-141.537	-51.068
	(106.887)	(102.975)	(2.513)	(104.504)	(40.037)
	.108	.232	.081	.524	.515

Beta coefficients marked for significance, standard errors in parentheses.
***p<.001 **p<.01 *p<.05

Table 3-11 presents the results of the OLS regression analysis predicting companion animal protection. GDP per capita is not associated with companion animal protection in any model. GDP change is positively associated with companion animal protection in Model 3 ($b=1.227$, $p<.05$) but not Model 5. Research and development, education, and state environmentalism are not statistically significantly associated with companion animal welfare in any model. A higher Gini coefficient is associated with higher companion animal protection in Model 4 ($b=3.021$, $p<.05$) and Model 5 ($b=2.976$, $p<.05$). Interestingly, agriculture, forestry, fishing, and hunting as a percentage of GDP is negatively associated with companion animal protection in Model 4 ($b=-3.338$, $p<.01$) and Model 5 ($b=-3.346$, $p<.01$). One possible explanation for this relationship is that people in these states have a more utilitarian view of companion animals, but more research on this point is needed.

Table 3-11: OLS Regression Predicting Companion Animal Protection, 2017

	Model 1	Model 2	Model 3	Model 4	Model 5
GDP Per Capita (Thousands of Dollars, Logged)	16.630	7.116		-12.708	
	(16.279)	(16.517)		(16.239)	
GDP Change (%) from 2012 to 2017			1.227*		.525
			(.601)		(.494)
Research and Development % of GDP		4.026		.824	.335
		(2.032)		(1.796)	(1.821)
Percent with Bachelor's				1.407	1.026
				(.772)	(.654)
State Environmentalism				.046	.049
				(.099)	(.099)
Gini x 100				3.021*	2.976*
				(1.338)	(1.331)
Agriculture, Forestry, Fishing, and Hunting % of GDP				-3.338**	-3.346**
				(1.181)	(1.171)
Constant	-134.655	-40.252	40.302***	6.003	-120.323
	(176.667)	(178.005)	(3.967)	(179.133)	(67.250)
	.001	.058	.061	.426	.433
Beta coefficients marked for significance, standard errors in parentheses. ***p<.001 **p<.01 *p<.05					

Results from the OLS regression analysis predicting research animal protection are presented in Table 3-12. Higher GDP per capita is associated with greater research animal protection in Model 1 (b=59.616, p<.01), and Model 2 (b=49.695, p<.05) when research and development is controlled for, but not in Model 4 when the other control variables are added to the model. GDP change is not statistically significantly associated with research animal protection in any model, nor are research and development or education. State environmentalism is positively associated with research animal protection in Model 4 (b=.468, p<.001) and Model 5 (b=.465, p.001). The Gini coefficient is also positively associated with research animal protection in Model 4

(5.089, p<.001) and Model 5 (b=5.095, p<.001). Agriculture, forestry, fishing, and hunting as a percentage of GDP is not associated with research animal protection.

Table 3-12: OLS Regression Predicting Research Animal Protection, 2017

	Model 1	Model 2	Model 3	Model 4	Model 5
GDP Per Capita (Thousands of Dollars, Logged)	59.516**	49.695*		17.709	
	(20.480)	(21.061)		(17.504)	
GDP Change (%) from 2012 to 2017			.748		-.328
			(.838)		(.540)
Research and Development % of GDP		4.156		-2.586	-2.212
		(2.591)		(1.936)	(1.989)
Percent with Bachelor's				.822	1.305
				(.832)	(.715)
State Environmentalism				.468***	.465***
				(.107)	(.108)
Gini x 100				5.089***	5.095***
				(1.442)	(1.455)
Agriculture, Forestry, Fishing, and Hunting % of GDP				.026	.099
				(1.273)	(1.280)
Constant	-623.312**	-525.862*	19.150	-444.155*	-265.427***
	(222.261)	(226.981)	(5.536)	(193.081)	(73.463)
	.132	.160	-.004	.634	.629
Beta coefficients marked for significance, standard errors in parentheses. ***p<.001 **p<.01 *p<.05					

Finally, Table 3-13 presents the results of the OLS regression analysis predicting farm animal protection. GDP per capita is not associated with farm animal protection in any model. GDP change is statistically significantly associated with farm animal protection with higher GDP growth being associated with higher farm animal protection in Model 3 (b=2.019, p<.001) and Model 5 (b=1.548, p<.001). Research and

development as a percentage of GDP is positively associated with farm animal protection in Model 2 (b=5.849, p<.01) but not Model 4 or Model 5 where other independent variables are controlled for. Education, state environmentalism, the Gini coefficient, and agriculture, forestry, fishing, and hunting as a percentage of GDP are not statistically significantly associated with farm animal protection in any model.

Table 3-13: OLS Regression Predicting Farm Animal Protection, 2017

	Model 1	Model 2	Model 3	Model 4	Model 5
GDP Per Capita (Thousands of Dollars, Logged)	16.384	2.562		-3.183	
	(16.022)	(15.435)		(19.736)	
GDP Change (%) from 2012 to 2017			2.019***		1.548**
			(.543)		(.556)
Research and Development % of GDP		5.849**		4.359	3.160
		(1.898)		(2.182)	(2.049)
Percent with Bachelor's				.009	-.252
				(.939)	(.737)
State Environmentalism				.112	.116
				(.121)	(.111)
Gini x 100				.209	-.002
				(1.626)	(1.499)
Agriculture, Forestry, Fishing, and Hunting % of GDP				-.784	-.570
				(1.436)	(1.319)
Constant	-152.542	-15.390	16.190***	36.982	14.782
	(173.884)	(166.347)	(3.587)	(217.704)	(75.699)
	.001	.151	.207	.125	.259
Beta coefficients marked for significance, standard errors in parentheses. ***p<.001 **p<.01 *p<.05					

DISCUSSION

In analyzing the relationship between economic growth and state animal welfare protection, this study finds mixed support for ecological modernization theory and treadmill of production theory. The OLS regression analysis finds that higher GDP is associated with higher overall animal welfare protection, wildlife protection, and research animal protection. Similarly, states that experienced higher GDP growth between 2012 and 2017 were also more likely to have higher overall animal welfare protection, wildlife protection, companion animal protection, and farm animal protection according to results from the cross-sectional analysis. These results support ecological modernization theory. Results from the panel regression analysis of GDP and farm animal welfare protection do not reach the .05 level of statistical significance but are close to this level. With more data it is possible that this negative association between GDP and farm animal welfare protection would be statistically significant – a finding that, if confirmed, would lend support to treadmill of production theory.

Overall, more than providing support for one theory or another, this study fails to reject the null hypothesis – finding no statistically significant relationship between GDP and animal welfare protection. This finding makes a contribution to environmental sociology by highlighting the potential limitations of two of its major theoretical traditions. Both ecological modernization theory and treadmill of production theory place a central emphasis on economic growth and development and its relationship with environmental degradation. When it comes to studies of the flow of energy and materials, inputs and outputs, there is a large body of literature finding significant relationships

between economic growth and environmental degradation. The human-animal relationships analyzed in this study address a different, though related, aspect of the society-environment relationship – the political more than the material, or de jure more than de facto. In other words, this analysis studies legal animal welfare protections, but not actual animal outcomes. This approach is useful, since political reform likely has some direct impact on environmental and animal outcomes, but also highlights a limitation with the data employed here.

The first question addressed in this study examines the relationship between GDP and animal welfare protection at the U.S. state level, and an important aspect of this analysis is how this relationship differs based on the category of animal considered. I analyzed outcomes for animals broadly as well as for wildlife, companion animals, research animals, and farm animals. The results suggest that the relationship between GDP and animal welfare protection varies based on animal category. For farm animals, there is mixed evidence based on the type of statistical analysis used, but the results of the of the panel regression suggest that increasing GDP may be associated with lower farm animal protection. For overall animal protection and wildlife protection GDP has the opposite effect. GDP is also associated with higher research animal protection, and has a larger effect on research animal protection than overall protection and wildlife protection.. These findings highlight the importance of species-specific future research on animal welfare, and caution against generalizations for a group as broad as "animals" – as social connections and influences on animals vary based on the categories and roles humans assign to them.

This study has two main limitations that should be considered when interpreting the results and designing future studies. The first limitation is the use of the Humane Society of the United States' Humane State Ranking. I selected this index because 1) it provided a thorough review of legislation and regulation for many different types of animal welfare, and 2) it provided data across multiple years for all 50 states. However, the Humane State Ranking is still somewhat subjective, and animal welfare categories are not weighted equally. For example, for the year 2017 there are 13 items included in the index related to animal fighting compared to nine for farm animals. The number of animals used in farming far exceeds the number of animals involved in fighting, yet in the final index regulations on fighting carry more weight. The second limitation is that although this study is longitudinal, the range of years is small (2012-2017). Legal processes often move at a slower pace, and so change in state policy during this time period is limited. Analyzing animal welfare protections over a longer period of time would provide further insights once data become available.

In addition to the findings related to economic growth and animal welfare protection this study's findings on economic inequality are interesting. Previous research on animal welfare has found economic inequality to be negatively associated with animal welfare (Morris 2013). This study finds the opposite – that states with higher income inequality are more likely to have higher companion and farm animal protections in the panel regression analyses. I used the Gini coefficient as a measure of income inequality but ran a sensitivity analysis using the income share of the top 10% as a measure of inequality and the results were not substantively different. There are several explanations

for this finding. The first is that rather than measuring direct animal welfare outcomes such as animals killed, as Morris (2013) does, this study analyzes animal welfare policy. The second explanation is that income inequality in this analysis may be capturing a variable not included in the analysis, such as political leanings in the state. States with higher and rising inequality are more likely to prefer Democrats (Galbraith and Hale 2008). A yearly, changing measure of political sentiment by state was not feasible in this study due to data limitations, but previous research suggests that Democrats are more likely to vote for farm animal welfare bills than Republicans (Tauber 2013). In this study, economic inequality may be picking up on these political differences and future research should include both measures.

Concern for animal welfare is growing and environmental sociology is uniquely positioned to analyze the relationships between social, environmental, and animal well-being. In this study, I have utilized ecological modernization theory and treadmill of production theory to attempt to better understand animal welfare protections in the United States. Overall, the results of fixed effects panel regression and OLS linear regression models show mixed support for both theories and illustrate the need for further longitudinal research on factors in addition to GDP that might predict animal welfare protection.

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CHAPTER 4 – ANIMAL WELFARE KUZNETS CURVE OR UNEQUAL EXCHANGE OF CRUELTY?: A GLOBAL ANALYSIS OF THE PRODUCTION, CONSUMPTION, AND SANCTIONING OF FARM ANIMAL CRUELTY

Current trends in the global production and consumption of animal food products threaten social and environmental sustainability, and directly affect the well-being of animals. Scientists are in agreement: something must change (Harwatt et al. 2019). What is unclear is the best way to change it. The economy is at the heart of this debate, with the animal welfare Kuznets curve hypothesis suggesting that the way to reduce animal impacts is to continue along a path of economic growth, while treadmill of production theory asserts that this path will continue to direct us in a way that harms animals, the environment, and society. Ecologically unequal exchange theorists also point out the importance of trade relationships in shaping social, environmental, and animal welfare outcomes at the global level.

This chapter analyzes the relationship between economic growth, global trade, and farm animal (animals raised for food – e.g. chickens, pigs, cows, etc.) well-being in three domains: production, consumption, and protection. I begin by discussing global trends of consumption and production of animal food products. Next, I review the origins of the Kuznets curve hypothesis and its application to environmental and now animal issues, and a counterview to the Kuznets curve hypothesis – treadmill of production theory. I also employ ecologically unequal exchange theory and test whether trade with high-income countries affects animal welfare in lower-income countries. I then present the methods used and the results of these analyses. I conclude by discussing these results

within the broader context of environmental sociology along with their implications for policymakers and future research.

Throughout this study I use the terms production, consumption, and sanctioning of farm animal cruelty. I use this language because these measures, taken from Voiceless: The Animal Protection Institute's (2017) Voiceless Animal Cruelty Index, go beyond simple measures of farm animal production and consumption. Production of farm animal cruelty captures both how many animals are slaughtered in a country as well as the welfare protections in place in that country. Consumption of farm animal cruelty is a measure of how many animals must be killed to meet demands weighted by the proportion of animal protein in a country's diet. Lastly, the term sanctioning can have dual and opposite meanings either of penalizing or approving, and in this case the term refers to approval of farm animal cruelty.

GLOBAL PRODUCTION AND CONSUMPTION OF ANIMALS

Animal food products are nutrient rich and high in protein, but intensive production and high levels of consumption of these products create social, environmental, and animal well-being issues. In terms of social issues, the consumption of animals is growing but uneven. Meat has historically held cultural significance in societies around the world and continues to do so today (Århem 1989; Chiles and Fitzgerald 2017; Ribeiro and Corção 2013; Schösler et al. 2015). The consumption of animal food products grew dramatically in the second half of the 1900s and is expected to continue to grow if this trend continues, particularly in the Global South, which has historically had lower levels

of consumption (Godfray et al. 2018; Milford et al. 2019). In lower income countries, meat can be a way to meet nutritional needs, but people in higher income countries often face health problems related to overconsumption such as increased risk of certain types of cancer, obesity, and heart disease (Daniel et al. 2010; Godfray et al. 2018). Intensive modes of meat production and processing can also have negative health impacts on the people who work in processing plants, who must perform dangerous tasks at increasingly fast speeds (Genoways 2014). Lastly, intensive animal production systems increase the occurrence of zoonotic disease as large numbers of animals are housed in close proximity, which facilitates the spread and mutation of viruses (Jones et al. 2013).

Intensive animal production affects the environment. Animal agriculture contributes to soil degradation, water use and pollution, and greenhouse gas emissions (Clark et al. 2019; Djekic 2015; Djekic and Tomasevic 2016). Estimates vary, but a report from the Food and Agriculture Organization of the United Nations concludes that livestock make up about 14.5% of global greenhouse gas emissions (Gerber et al. 2013). Compared to a plant-based diet, "the meat-based food system requires more energy, land, and water resources" (Pimentel and Pimentel 2003:660; see also Chai et al. 2019). Looking at a per animal basis, intensive production could be seen as having a lower environmental impact than conventional production because more meat and other animal products can be produced in a shorter time and requiring less inputs (Clark and Tilman 2016). When analyzed by kilogram of beef produced, modern agricultural systems use less animals, feed, water, and land, and produce less manure, methane, and nitrous oxide than conventional systems (Capper 2011). This is encouraging news, but with the

consumption of animal products increasing worldwide (Godfray et al. 2018), the negative environmental impacts associated with animal agriculture remain problematic. Continued and increased consumption of animal products is therefore not environmentally sustainable.

Finally, in addition to social and environmental impacts, animal agriculture directly affects animal well-being. For much of human history laws regarding the humane treatment of farm animals have been seen as unnecessary because animal welfare was seen as directly tied to income (Rollin 1995). In other words, treating animals poorly would go against a farmer's own interests, and thus regulating this illogical situation did not make sense. Intensive farming broke this logic, and practices that increased production sometimes led to decreased animal welfare: e.g. the use of confinement such as battery cages or farrowing crates[3] that severely restrict animal movement (Fraser, Mench, and Millman 2001). The 1965 Brambell Report attempted to address welfare issues associated with new farming methods by identifying five freedoms that animals should have to ensure their welfare: 1) freedom from hunger and thirst, 2) freedom from discomfort, 3) freedom from pain, injury or disease, 4) freedom to express normal behavior, and 5) freedom from fear and distress (McCausland 2014).

The focus of this study is the relationship between economic growth and animal welfare. Animal welfare is an important issue to study itself, and the interconnectedness

[3] Battery cages are housing used to keep a large number of chickens together. "A standard size of any battery cage is approximately 61 cm wide and 51 cm deep. Normally, each cage is occupied with six hens at a time" (Sheikh 2013). Farrowing crates contain sows until their piglets are weaned. They restrict pig movement so that they cannot turn around and "have also been correlated with some pig diseases, including dystocia, agalactia, and wasting disease" (Rollin 1995:91).

of social, environmental, and animal well-being outlined here serve to reinforce the importance of this research as well as connect it with the broader literature on sustainability. The United Nations' sustainable development goals do not explicitly address animal welfare, but goals such as eliminating poverty and hunger, promoting health and well-being, and responsible consumption and production are all closely tied to animal welfare (Keeling et al. 2019). Changes are clearly needed in animal agriculture to improve animal welfare and achieve sustainability goals, and this study serves to better understand which social factors – especially those related to the economy – affect animal welfare.

THE KUZNETS CURVE HYPOTHESIS

The Kuznets curve hypothesis can help theorize the expected relationship between economic growth and animal welfare. The Kuznets curve hypothesis has gone through several phases of popular usage in sociological and economic research. It was first developed by Simon Kuznets (1955), who suggested that as the economy grew income inequality would grow until a point after which this trend would reverse, with economic growth leading to a decline in income inequality. According to the Kuznets curve hypothesis then, the relationship between economic growth and income inequality was that of an upside-down "U" (Kuznets 1955). Environmental scholars became interested in this concept as they predicted a similar relationship between economic growth and environmental problems – the environmental Kuznets curve (EKC) (Dinda 2004; Grossman and Kreuger 1991; Panayotou 1993).

Rather than seeing the economy and environment as irreconcilable forces, the environmental Kuznets curve hypothesis sees the economy-environment relationship as shifting and changing over time. According to the theory, economic growth contributes to environmental degradation, but after a point, this relationship reverses, with continued economic growth leading to a reduction in environmental degradation (Dinda 2004). Economic growth is therefore seen as a pathway to greater sustainability, not a challenge to it. The mechanism for this change in the economy-environment relationship is shifting societal attitudes associated with growing income. "According to EKC theory, GDP growth creates the conditions for environmental improvement by raising the demand for improved environmental quality and offers the resources available, such as technical and socio-economic resources, for supplying it" (Vinnari, Vehmas, and Luukkanen 2005:248). As people's incomes rise the scope of their concern widens from individual or family issues to things like social equality (Kuznets 1955) or environmental quality (Dinda 2004).

One of the challenges with the environmental Kuznets curve hypothesis is that it is a theory of broad social change but environmental issues are wide ranging and vary based on context. As such, researchers have tested the environmental Kuznets curve hypothesis using different environmental outcomes including carbon emissions (Aslanidis and Iranzo 2009), deforestation (Koop and Tole 1999), and water and air quality (Dinda 2004). Overall analyses of the environmental Kuznets curve are somewhat mixed. For instance, Harbaugh, Levinson, and Wilson (2002) find no evidence for a Kuznets curve relationship for sulfur dioxide, smoke, or total suspended particles in a

global analysis, but recent studies conclude that a Kuznets curve exists for sulfur dioxide in China (Wang, Han, and Kubota 2016; Zhou, Ye, and Ge 2017). These mixed findings illustrate the need to analyze the Kunzets curve for different environmental outcomes and in different contexts.

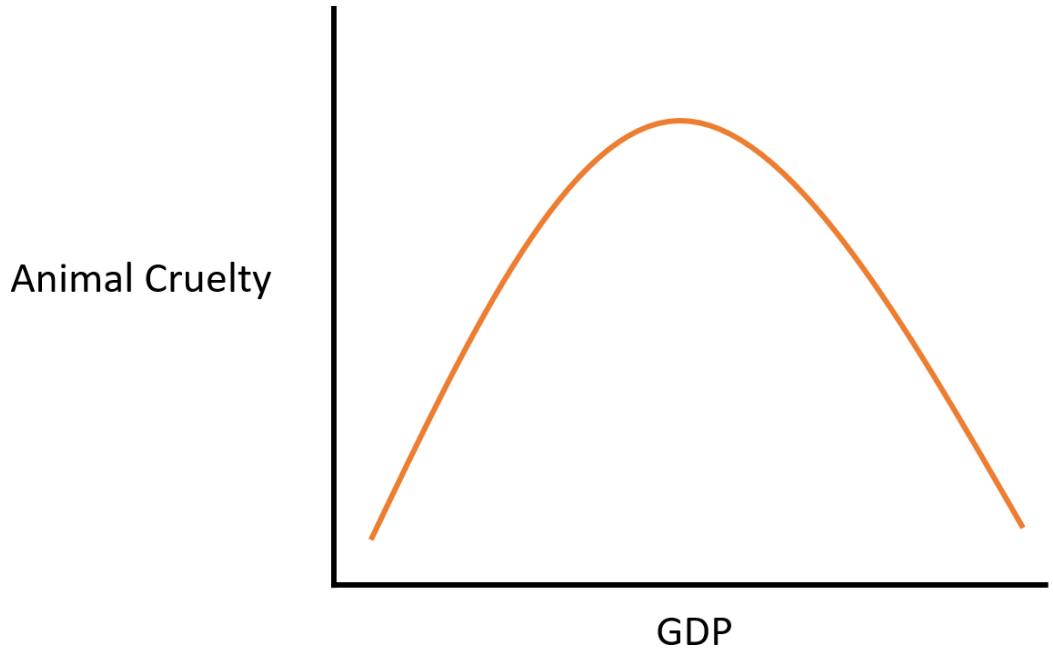
In addition to issues associated with spatial scale and types of environmental outcome, the temporal aspect of the Kuznets curve hypothesis creates issues because it can be unclear whether no such relationship between economy and environment exists, or whether we simply have not progressed far enough – incomes have not risen enough – to trigger the change in relationship. Longitudinal analyses can help address this to an extent but are still limited by data availability in many cases. Another method used for addressing this challenge is to conduct cross-sectional analyses between high- and low-income countries or regions (Dinda 2004), although this method assumes that countries will follow similar developmental trajectories. Additionally, just because a Kuznets curve exists at one point in time, there is no guarantee that this relationship will not change again. There is some evidence that in some cases the relationship between GDP and environmental degradation follows an inverted-U pattern but that this relationship then flips after a certain point where degradation begins to rise again with GDP (Borghesi 1999; Churchill et al. 2018; Pal and Mitra 2017). Figure 4-1 illustrates this pattern.

THE ANIMAL WELFARE KUZNETS CURVE

One of the most recent adaptations of the environmental Kuznets curve is the animal welfare Kuznets curve, which tests whether the relationship between animal cruelty and income follows the same inverted-U shaped pattern (Frank 2008).

Industrialization of animal agriculture led to negative environmental outcomes including greenhouse gas emissions and pollution of water and soil (Steinfeld et al. 2006) and has also led to a decrease in animal welfare (Linzey 2013) - itself an environmental outcome. However, according to the animal welfare Kuznets curve, this relationship will change as economies grow, with animal welfare rising in higher income countries.

Figure 4-1: The Animal Welfare Kuznets Curve



Like analyses of the environmental Kuznets curve, empirical evidence for the animal welfare Kuznets curve is mixed and depends on the animal welfare outcome measured and context. One policy analysis finds no relationship between GDP and global animal welfare legislation (Holst and Martens 2016). Other research finds evidence of an

animal welfare Kuznets curve measured with meat consumption (Vraken et al. 2014). Vinnari, Vehmas, and Luukkanen (2005) also find evidence for an animal welfare Kuznets curve in Europe measured with calories consumed from animal products. However, the authors point out that there has been a shift away from fat toward protein in animal products, so the overall consumption of animal products may not have declined, only the calories from these products (Vinnari, Vehmas, and Luukkanen 2005). Other analyses have found that income is linearly associated with increased animal cruelty. An analysis of the animal welfare Kuznets curve in Finland found that both animal product consumption and production rose with income (Lombardini et al. 2011). To add to the deterioration of farm animal welfare in Finland diets shifted from red meat to poultry – which requires the slaughter of a much higher number of birds, which also receive lower standards of care (Lombardini et al. 2011). There is also evidence that seafood consumption grows with per capita GDP (Clark et al. 2018).

The animal welfare Kuznets curve has frequently been used to analyze farm animal welfare issues but has also been applied other types of animals. For example, an analysis in the United States using hunting licenses as a measure of animal welfare finds that an animal welfare Kuznets curve exists in 21 states, but that in 24 others the opposite pattern exists, and in the remaining five the relationship between income and hunting licenses is monotonic (Kennedy 2011). Kennedy's (2011) application of the animal welfare Kuznets curve highlights a challenge associated with studying animal welfare – competing conceptualizations of welfare. For environmental ethicists hunting is not typically viewed as unethical and in fact may be beneficial for an ecosystem when done

properly, while for animal rights ethicists it usually is seen as a violation of ethics (Peterson 2013). Laboratory animal welfare and companion animal welfare have also been analyzed, with results showing little evidence for a Kuznets curve for laboratory animals, but stronger evidence of one for companion animals (Frank 2008). Frank (2008) explains how these findings fit into the logic of the Kuznets curve hypothesis; "if changing levels of public concern is the primary driver of the downward slope of the animal welfare Kuznets curve, then it makes sense for companion animal welfare to lead to other areas" (p.489). This prior research illustrates the multiple ways that the animal welfare Kuznets curve can be applied and analyzed, though competing values and definitions of animal welfare will have to be resolved by those with power to shape and influence policy. Whether discussing companion, wildlife, laboratory or farm animal welfare, these animal welfare issues are driven by social factors and warrant sociological investigation not only to analyze these relationships empirically, but also to situate them in a larger body of theory-driven work.

Animal welfare is tied to other social inequalities including the issue initially addressed by the Kuznets curve: income inequality. Income inequality is associated with environmental degradation (Boyce 1994; Jorgenson et al. 2015; Jorgenson, Schor, and Huang 2017), social well-being outcomes (Hill and Jorgenson 2018), and sustainability measures such as the carbon intensity of well-being which capture both environmental and social well-being (Givens 2015; Jorgenson 2015; Jorgenson, Dietz, and Kelly 2018). Similarly, income inequality is also associated with lower animal welfare outcomes (Morris 2013). As Morris (2013) summarizes, "previous research has strongly suggested

that social conditions for humans improve with greater equality. The same may be true for nonhuman animals" (p.272). If the logic of the animal welfare Kuznets curve is correct in asserting that animal welfare is a luxury good (see Frank 2008; Holst and Martens 2016), then we would expect countries with high GDP but high income inequality not to reflect the increase in animal welfare that might otherwise be associated with economic growth.

Lastly, at the global level gender inequalities may influence animal welfare. Research shows that women express greater concern for animal welfare compared to men (Cornish, Raubenheimer, and McGreevy 2016; Kendall, Lobao, and Sharp 2006; Peek, Bell, and Dunham 1996). Therefore, countries with a higher proportion of women in positions of power may implement more policies for animal welfare. On the other hand, previous research has found that countries with a higher proportion of women in the workforce consume more meat, which may be reflective of a shift in household diet toward fast-food or other convenient options that are often meat-based (Milford et al. 2019).

TREADMILL OF PRODUCTION THEORY

In contrast to the Kuznets curve hypothesis, treadmill of production theory sees economic growth as a driving force behind environment environmental degradation. Treadmill of production theory, first developed by Schnaiberg (1980), asserts that economic and environmental interests are in conflict with each other and will remain so. The treadmill of production describes a political economic system in which societies

prioritize continuous economic growth, and in this process, are required to make increasing extractions from environments and produce increasing wastes (Gould, Pellow, and Schnaiberg 2008; Schnaiberg 1980; Schnaiberg and Gould 1994). According to treadmill of production theory, states and corporations are both ultimately concerned with economic growth and expansion above all else, and transfer these values to the public (Schnaiberg and Gould 1994). "States will act to prevent environmental degradation only when their economic interests are shown to be directly affected" (Groves 1992:47). Treadmill of production theory therefore takes a more pessimistic view of the relationship between economic growth and the environment, seeing economic growth as a contributing factor to degradation.

Treadmill of production theory can also be applied to understand animal welfare, and in particular farm animal welfare - the focus of this study. According to treadmill of production theory, animal agribusiness is under the same pressures to continually expand economic profits that other businesses face, the result being continued intensification and growth of production systems that, as outlined above, contribute decreased animal welfare (Gunderson and Stuart 2014). Previous research applying the treadmill of production to animal food systems finds that economic development is associated with increased consumption of meat and fish (Clark et al. 2018). This is also consistent with other research analyzing the relationship between economic growth and meat and fish consumption (York and Gossard 2004). However, like research on the Kuznets curve, treadmill of production analyses are dependent on context. For instance, Clark et al. (2018) find that GDP is associated with seafood and meat consumption, but not livestock

production, and York and Gossard (2004) find that economic development is associated with increased meat consumption in Western nations but not Asian nations.

The concept of the treadmill of production has connections to critical animal studies (Taylor and Fitzgerald 2018). Critical animal studies scholars apply political economic perspectives to understand human-animal relationships and see the treadmill of production system as antithetical to animal welfare (Nocella et al. 2014). "In this type of system, the suffering of the animals becomes a concern only when it impacts productivity" (Fitzgerald and Pellow 2014:41). Additionally, treadmill of production theory draws connections between social impacts (displaced workers) and environmental impacts (resource depletion and pollution) of the treadmill (Gould, Pellow, and Schnaiberg 2008). Critical animal studies highlight these same connections between social, environmental, and animal justice and takes a political stance that single-issue advocacy is insufficient for structural change (Jenkins and Stănescu 2014; Nocella et al. 2014).

Political economic systems that prioritize the treadmill of production have existed for hundreds of years, but the treadmill has accelerated due to globalization (Gould, Pellow, and Schnaiberg 2008). The treadmill of production relies on cheap natural resources and labor (either though cheaper workers or through technological innovation), and therefore benefits from globalization in several ways. First, high-income nations benefit from cheap access to resources and labor from lower income nations that are now easily accessible through innovations in transportation (Bunker 2005). Second, competition for economic dominance is now expanded to a global level where any threat

to impose environmental or animal welfare regulations is a threat to economic growth because businesses can relocate (Gould, Pellow, and Schnaiberg 2008). Novek (2003) points to the hog industry as an example of a transnational treadmill of production, where neoliberal policies of deregulation intended to foster economic growth led to detrimental environmental and community impacts in Manitoba, Canada, including: strong odors, pollution of soil and water, and community polarization.

To summarize, the animal welfare Kuznets curve asserts that the relationship between economy and animal welfare changes over time and that the solution to improving animal welfare is increased affluence (Frank 2008). Treadmill of production theory sees economy and environment in conflict and asserts that states and corporations will not make any meaningful changes in environmental protection as long as these threaten economic growth (Schnaiberg and Gould 1994). The treadmill of production applies to animal agribusiness as well and is captured in critical animal studies scholarship that views the current political economic system captiously, asserting that it contributes to the expansion of animal cruelty (Fitzgerald and Pellow 2014; Nocella et al. 2014). Researchers employing treadmill of production theory would therefore anticipate that increasing economic development is positively associated with animal cruelty.

ECOLOGICALLY UNEQUAL EXCHANGE

Finding evidence of an animal welfare Kuznets curve might suggest that animal welfare is improving in higher-income countries, but it could also be the result of animal cruelty being displaced or externalized to another country in the global system. This trade

situation between high- and low-income nations is what environmental sociologists refer to as ecologically unequal exchange. Ecologically unequal exchange theory asserts that international trade relationships create a situation in which "Global North countries have greater access to both natural resources and the sink capacity for waste in countries within the Global South" (Givens, Huang, and Jorgenson 2019:2). Expressed differently, ecologically unequal exchange theory posits that high-income countries are able to maintain high levels of consumption while externalizing their environmental impacts to lower-income countries (Bai and Givens 2021). The power dynamics that allow for this ecologically unequal exchange are in part due to economic and political power (Jorgenson 2016; Roberts and Parks 2009). These trade relationships are environmental justice issues not only because of environmental inequalities, but also because of the social impacts associated with natural resource depletion and environmental pollution in lower-income countries as a result of ecologically unequal exchange (Givens, Clark, and Jorgenson 2016; Givens, Huang, and Jorgenson 2019; Roberts and Parks 2007).

Ecologically unequal exchange theory can address some of the limitations of the Kuznets curve hypothesis and treadmill of production theory and help avoid mistakes based on analyses with more limited context (Jorgenson 2016). In environmental sociology the "Netherlands Fallacy" refers to the idea that "domestic environmental conditions are not necessarily an accurate reflection of the environmental burdens engendered by domestic standards of living and rates of material consumption" (Rice 2007:63) – a mistake that ecologically unequal exchange theory can help avoid (Givens, Huang, and Jorgenson 2019). In other words, analyzed individually, high-income

countries may give the appearance of reducing their environmental impacts, but global analysis may show that these countries are still consuming at high rates and simply externalizing the environmental degradation to low-income countries (Givens 2018; Jorgenson 2003; Rice 2007).

Tests of hypotheses derived from ecologically unequal exchange theory can also give greater context to international animal production, consumption, and protection. Previous research shows that animal consumption rises with GDP (York and Gossard 2004), but that farm animal welfare protection is also associated with GDP (Morris 2021). It is possible that high-income nations are consuming meat at higher rates while simultaneously providing greater legal protections to the animals they consume, but ecologically unequal exchange theory draws attention to the international trade relationships that may be at play with these trends. Countries may be able to increase animal consumption while simultaneously improving animal welfare standards (which tend to increase production costs – see Matheny and Leahy 2007) because they are able to simultaneously import cheap meat from countries without as many legal protections. The ecologically unequal exchange in this case is of farm animal cruelty.

METHODS

Hypotheses

The animal welfare Kuznets curve asserts that the relationship between economic growth and animal welfare is curvilinear (Frank 2008; see Figure 4-1). In other words,

the animal welfare Kuznets curve asserts that as GDP per capita grows animal cruelty increases until a point at which this relationship reverses, with increased GDP leading to decreased animal cruelty. I therefore posit the first hypothesis:

H1: *The relationship between* ***GDP*** *and* ***production, consumption, and sanctioning (permitting) of farm animal cruelty*** *follow an inverted-U pattern.*

The alternative hypothesis in this study is rooted in treadmill of production theory, which asserts that economic growth in a capitalist system works to keep animal welfare regulation weak (Gunderson and Stuart 2014). Rather than expecting a curvilinear relationship, this theory predicts a linear relationship between economic growth and animal welfare, with greater economic growth being associated with worse animal welfare outcomes.

H2: The relationship between ***GDP*** and ***production, consumption, and sanctioning of farm animal cruelty*** is linear, and ***Higher GDP*** *is associated with higher* ***production, consumption, and sanctioning of farm animal cruelty.***

Finally, ecologically unequal exchange theory emphasizes the importance of analyzing global trade relationships when assessing environmental outcomes and asserts that high-income countries benefit from trade with lower-income countries (Dorninger et al. 2021; Givens, Huang, and Jorgenson 2019). In terms of farm animal cruelty, I apply ecologically unequal exchange theory to hypothesize:

H3: *Lower-income countries with a* ***higher percentage of exports sent to high-income countries*** *have higher* ***production, consumption, and sanctioning of farm animal cruelty.***

Dependent Variables

The key dependent variables in this analysis are 1) overall farm animal cruelty, 2) production of farm animal cruelty, 3) consumption of farm animal cruelty, and 4) sanctioning farm animal cruelty. These data come from Voiceless: The Animal Protection Institute's (VAPI 2017) voiceless animal cruelty index (overall farm animal cruelty) and its three sub-indices: producing, consuming, and sanctioning animal cruelty. The voiceless animal cruelty index focuses on farm animals, calculating its index scores publicly available data on animal agriculture and consumption of animals while taking into account existing farm animal welfare laws (VAPI 2017). This approach is beneficial because in a globalized economy countries may shift away from producing animal products but still consume at high levels.

The overall voiceless animal cruelty index is a combination of three sub-indices weighted equally: producing cruelty, consuming cruelty, and sanctioning cruelty. The *producing cruelty sub-index* calculated by VAPI (2017) is a per capita measure of farm animals killed for food weighted by counties' farm animal welfare laws. The *consuming cruelty sub-index* is "the proportion of plant to animal protein consumed, plus a weighted value representing the number of animals required to be slaughtered to meet the country's demand for meat, eggs, and dairy" (VAPI 2017). And lastly, the *sanctioning cruelty sub-*

index is a measure of farm animal legal protections, state accountability and reporting, and education on animal protection and care (VAPI 2017). Sanctioning has multiple and sometimes opposite meanings. In this case, higher sanctioning cruelty scores mean less legal protections for animals. Because overall farm animal cruelty is a combined measure of these sub-indices, farm animal legal protection has additional weight as it is accounted for in both the production and sanctioning sub-indices. So, while I include an analysis of overall farm animal cruelty, this additional weight given to legal protections should be kept in mind when interpreting the results. Table 4-1 shows descriptive statistics for these dependent variables as well as all independent variables.

Table 4-1: Descriptive Statistics for All Dependent and Independent Variables

Variable	Mean	Std. Deviation	Min	Max
1. VACI Overall	76.140	27.168	27.000	143.000
2. VACI Producing	8.921	5.912	0.410	32.160
3. VACI Consuming	51.000	27.015	3.000	98.000
4. VACI Sanctioning	23.280	8.485	7.000	40.000
5. GDP per Capita (in thousands of dollars)	20.610	22.060	0.428	86.606
6. Gini Coefficient	0.768	0.141	0.353	0.939
7. Legal Rights	5.040	2.927	1.000	12.000
8. Women in Parliament (%)	22.311	10.707	3.103	44.699
9. Export % to High-Income Countries	60.879	19.303	18.046	91.550
10. Exports as % of GDP	33.748	18.308	11.012	86.405

Independent Variables

I conduct two sets of analyses in this paper that use the same dependent variables outlined above but unique independent variables. The first set of analyses test H1 and H2 for the existence of an animal welfare Kuznets curve for farm animal cruelty versus the linear relationship suggested by treadmill of production theory. The second set of analyses tests hypotheses derived from ecologically unequal exchange theory – that trade with higher-income countries is associated with greater farm animal cruelty in lower-income countries. I organize the independent variables here according to the analysis in which they are included.

Animal Welfare Kuznets Curve / Treadmill of Production Analyses

The first key independent variable of in the analyses testing the animal welfare Kuznets curve is *gross domestic product (GDP) per capita*, taken from the World Bank's (2020) "World Development Indicators". The underlying explanation for the animal welfare Kuznets curve hypothesis asserts that as economies grow they shift away from animal cruelty through increased production efficiency and growing social concern for animal welfare (Frank 2008). This cross-sectional analysis cannot observe the effect of economic growth over time within specific countries, but the Kuznets curve can still be analyzed by observing countries with different levels of economic development (see Dinda 2004).

Legal rights is the second independent variable in this analysis. Democratic freedom is associated with political activism (Li and Reuveny 2006), which allows

activists to lobby for environmental and animal welfare changes (see also Holst and Martens 2016). An average of Freedom House's (2014) political rights and civil liberties scores is included as a single measure in this analysis which I refer to as "*legal rights*". The Freedom House scores rate countries on a scale of one to seven based on the United Nations' "Universal Declaration of Human Rights".

Gender differences exist in attitudes toward animal welfare (Cornish, Raubenheimer, and McGreevy 2016; Kendall, Lobao, and Sharp 2006; Peek, Bell, and Dunham 1996). I therefore include a variable called *women in power* that measures the proportion of seats held by women in national parliaments taken from the World Bank (2020).

The Gini coefficient is the final independent variable in the animal welfare Kuznets curve analysis. The Gini coefficient measures income inequality, with a score of 0 indicating perfect equality and a score of 1 indicating perfect inequality. Prior research finds that greater income inequality is associated with lower animal welfare (Morris 2013).

Ecologically Unequal Exchange Analyses

The first key independent variable in the analysis testing ecologically unequal exchange theory is GDP per capita. This measure is the same GDP measure used in the animal welfare Kuznets curve analysis. However, because of the necessity to include GDP^2 and GDP^3 in the Kuznets curve analysis GDP is not logged. In the ecologically unequal exchange analysis GDP is logged to account for the skewed distribution of GDP

at an international scale. This also allows this secondary analysis to serve as a type of sensitivity analysis.

The second key independent variable, and main variable of interest in testing ecologically unequal exchange theory, is the percent of merchandise exports sent to high-income countries, also taken from the World Bank (2020). Merchandise exports includes natural resources, manufactured goods, and food and live animals (Index Mundi 2021). This measure is commonly used in ecologically unequal exchange analyses to measure trade relationships between countries (Bai and Givens 2021; Jorgenson 2012; Givens 2018; Givens and Jorgenson 2014). Ecologically unequal exchange theory posits that uneven trade relationships between lower-income countries with high-income countries damages environmental and social well-being in those lower-income countries, and I apply the theory to hypothesize that it also increases farm animal cruelty in those countries. In this analysis I use World Bank (2020) income classifications to group low-, lower middle-, and upper middle-income countries as lower-income.

Lastly, I control for exports as a percentage of GDP. This measure is used to gauge countries' level of integration in the world economy (Givens 2018; Jorgenson 2012). Higher integration into the world economy could mean that a higher number of animals are slaughtered for export, but alternatively could mean that countries adopt higher welfare standards to maximize potential trade partners. Either way, exports as a percentage of GDP is an important variable to control for. All independent and dependent variables are presented in a correlation matrix in Table 4-2.

Table 4-2: Correlation Matrix of All Dependent and Independent Variables

	1	2	3	4	5	6	7	8	9	10
1. VACI Overall	-									
2. VACI Producing	.898	-								
3. VACI Consuming	.577	.540	-							
4. VACI Sanctioning	.320	.178	-.440	-						
5. GDP per Capita (in thousands of dollars)	.037	.096	.644	-.609	-					
6. Gini Coefficient	.336	.393	.783	-.503	.772	-				
7. Legal Rights	-.067	-.030	.276	-.438	.376	.250	-			
8. Women in Parliament (%)	-.172	-.141	.333	-.391	.455	.324	.128	-		
9. Export % to High-Income Countries	-.210	-.200	.206	-.335	.480	.456	.208	.467	-	
10. Exports as % of GDP	.055	.155	.154	-.170	.253	.318	.022	.203	.383	-

Sample

To analyze the relationship between economic growth and global farm animal cruelty, this study uses data from 50 countries. Table 4-3 lists these countries sorted by World Bank income classifications of low, lower middle, upper middle, and high. Figure 4-2 displays the sampled countries in blue. The World Animal Protection Institute identifies these 50 countries are the top producers of beef, poultry, pork, sheep and goat, milk, and eggs. This sample size is small, but similar samples have been used in other international research (Dzialo 2017; Holst and Martens 2016).

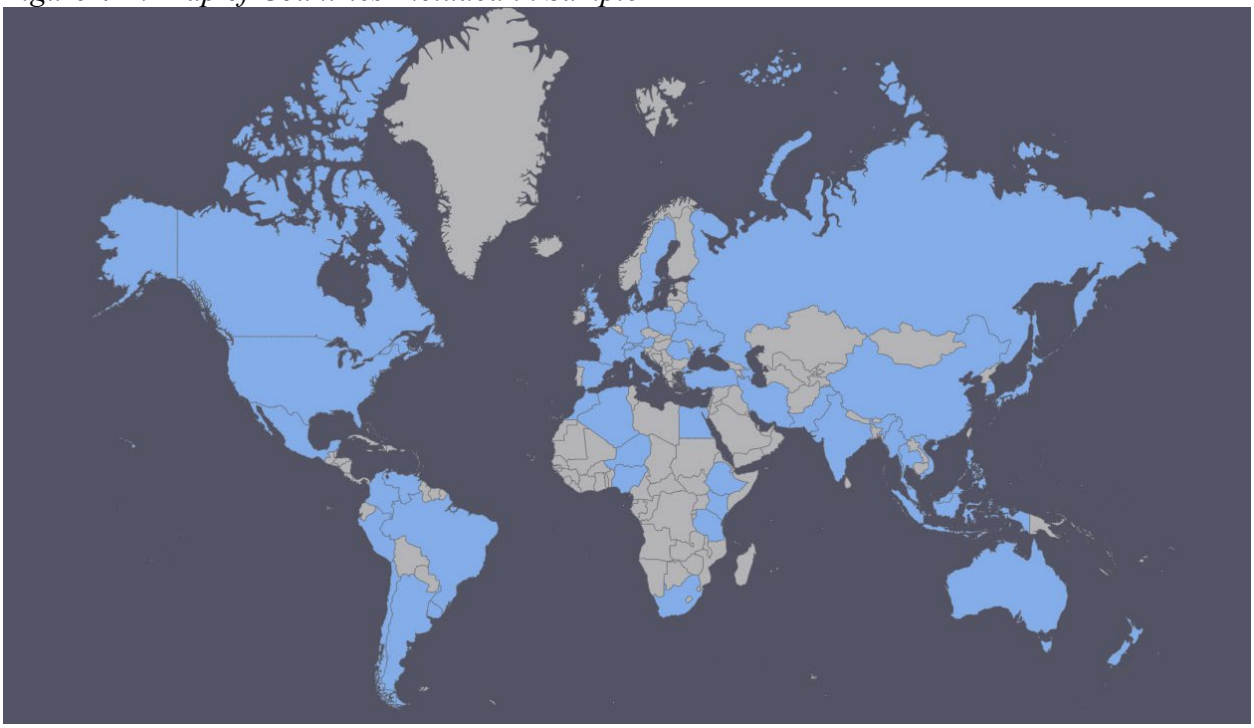
Voiceless: The Animal Protection Institute (VAPI) developed the "voiceless animal cruelty index" (VACI) that assigns a score to countries based on their production, consumption, and protection of farm animals based in part on the World Animal

Protection Institute's "animal protection index". This study relies on the VACI data and is therefore limited to the year 2014 and a cross-sectional analysis. These data have been recently used in similar research (Morris 2021).

Table 4-3: Countries by World Bank Income Classifications

Low	Lower Middle	Upper Middle	High
Ethiopia	Egypt	Algeria	Argentina
Niger	India	Azerbaijan	Australia
Tanzania	Indonesia	Belarus	Austria
	Kenya	Brazil	Canada
	Morocco	China	Chile
	Myanmar	Colombia	Denmark
	Nigeria	Iran	France
	Pakistan	Malaysia	Germany
	Philippines	Mexico	Italy
	Ukraine	Peru	Japan
	Vietnam	Romania	Netherlands
		South Africa	New Zealand
		Thailand	Poland
		Turkey	South Korea
			Spain
			Sweden
			Switzerland
			United Kingdom
			Uruguay
			United States
			Venezuela

Figure 4-2: Map of Countries Included in Sample



Blue countries are included in this sample. Grey countries are excluded.

In this global analysis, it could be argued that these 50 countries represent a population, not a sample. I am not trying to generalize beyond these 50 countries, which are the top 50 producers of animal agriculture products. There is a debate on the value of reporting p-values in cases like this (Bijak 2019; Green 2016; Rotham 2016). I include p-values to be consistent with similar prior research in comparative international and environmental sociology (Bai and Givens 2021; Givens 2018; Holst and Martens 2016; Jorgenson and Clark 2009), but also because the p-values help identify compatibility with statistical models (Wasserstein and Lazar 2020). This is particularly important in evaluating the animal welfare Kuznets curve, which compares models to determine whether the relationship between GDP and animal welfare is linear or follows the

predicted inverted-U, or even N-shaped curve. I also include Akaike's Information Criteria (BIC) and Bayesian Information Criteria (BIC) scores to help select the most parsimonious statistical model in the Kuznets curve analyses.

The VACI uses the language of "cruelty" to describe the systems in which farm animals are raised. The word cruelty has mixed meanings and raises some debates within the animal welfare literature. Current animal welfare legislation often ascribes cruelty to actions only when it is "unnecessary" or "unjustified" (Vining 2008). The debate then becomes a question of what is necessary and justified. Part of this debate boils down to philosophical differences: utilitarianism vs deontology (Herzog 2010; Szűcs et al. 2012). Herzog (2010) explains, "utilitarians believe that the morality of an act depends on its consequences. Deontologists, on the other hand, argue that the rightness or wrongness of an act is independent of its consequences" (p.252). Utilitarians therefore might endorse humane meat production if the benefits of consuming meat outweighed the harm done to the animals, whereas deontologists would assert that killing animals is wrong regardless of the justification. In practice, people often use a blend of these two ethics to navigate animal welfare issues (Szucs et al. 2012).

Regardless of ideological differences, it is unlikely that either orientation would assert that any animal- agricultural system is operating completely cruelty free. Cruelty is not a dichotomous variable that either exists or not, and the amount of cruelty involved in meat production varies based on how animals are raised and killed. The voiceless animal cruelty production recognizes this fact and measures cruelty along a scale. It is up to consumers and policymakers to determine what level of animal cruelty is necessary and

justified; this study's goal is to understand how factors such as economic growth are associated with this cruelty measure. It is important to recognize that the consumption sub-index is limited by not including the condition in which animals were raised in its calculation, since the animals produced in a country are not necessarily the same as those consumed in the country. Globalization of trade means that an animal could be raised in one country then exported and consumed in another. This paper does not attempt to change the language used by the voiceless animal cruelty index but acknowledges the limitations with and potential objections to it.

Analytic Technique

I present two sets of analyses. The first set of analyses tests H1 and H2 and analyzes whether a Kuznets curve relationship exists between GDP and farm animal cruelty or a linear relationship as posited by treadmill of production theory. These analyses are presented in Table 4-4, Table 4-5, Table 4-6, and Table 4-7. The second set of analyses tests H3, which is informed by ecologically unequal exchange theory, whether trade with high-income countries is associated with higher farm animal cruelty. I present results from these analyses in Table 4-8, Table 4-9, Table 4-10, and Table 4-11.

Animal welfare Kuznets curve.

The animal welfare Kuznets curve theorizes a non-linear relationship between economic growth and animal welfare. Morris (2021), one of the creators of the voiceless animal cruelty index, tests for the existence of an animal welfare Kuznets curve using Purchasing Power Parity and finds evidence of a Kuznets curve for production of farm

animal cruelty, consumption of farm animal cruelty, and overall farm animal cruelty, and a linear relationship between sanctioning farm animal cruelty and purchasing power parity.

My analysis builds on the work of Morris (2021) by testing the relationship between per capita GDP and farm animal cruelty using a different methodology – ordinary least squares (OLS) multiple regression, which also allows me to control for other variables that might explain these patterns. I use ordinary least squares multiple regression, but include GDP in quadratic (GDP^2) and cubic (GDP^3) form to test whether the relationship between GDP and animal cruelty follows a reverse linear, U-shaped, or N-shaped pattern. A significant association between only GDP and the dependent variable suggests a linear relationship, a significant association between GDP and GDP^2 and the dependent variable suggest an inverted-U Kuznets curve type relationship (see Figure 4-1), and a significant association between GDP, GDP^2, and GDP^3 and the dependent variable indicate an N-shaped relationship (see Figure 4-4).

For each dependent variable, the regression analysis presents six models in Table 4-4, Table 4-5, Table 4-6, and Table 4-7. The first three models introduce GDP, GDP^2, and GDP^3, and the final three independent variables: legal rights, women in power, and the Gini coefficient are introduced in Model 1D, Model 1E and Model 1F.

Unequal exchange of farm animal cruelty.

To test whether there is an unequal exchange of animal cruelty between lower-income countries I again use ordinary least squares multiple regression. Consistent with previous research on ecologically unequal exchange (Givens 2018; Hao 2020) I conduct

an analysis with the full sample of 50 countries, and then with subsamples of lower-income countries (n=27) and high-income countries (n=23, see Table 4-2). The idea behind ecologically unequal exchange is that lower-income countries are disadvantaged in trade relationships with high-income countries, and the effects of trade on animal cruelty between these two sub-samples would therefore be different. I present two models for the full sample and each of the subsamples in Table 4-8, Table 4-9, Table 4-10, and Table 4-11. The first model in each analysis' sample and subsample includes GDP and percent of exports to high-income countries, and the second model adds the control variable exports as a percentage of GDP.

RESULTS

I first present results from the analysis of the animal welfare Kuznets curve and treadmill of production theory, followed by the analysis of ecologically unequal exchange of animal cruelty. Each section is divided into subsections based on each dependent variable: 1) overall farm animal cruelty, 2) production of farm animal cruelty, 3) consumption of farm animal cruelty, and 4) sanctioning farm animal cruelty.

Animal Welfare Kuznets Curve Analysis

Overall, the results of this paper indicate some support for an animal welfare Kuznets curve and for economic growth as a pathway to reducing animal cruelty, but there is also an indication that this relationship can flip again among the highest earning countries where animal cruelty begins to be positively associated with GDP per capita

again. When it comes to overall farm animal cruelty, there is evidence of a Kuznets curve. Production of animal cruelty does not follow this pattern, and GDP per capita is not a good predictor of the dependent variable. Consumption of animal cruelty follows a Kuznets curve pattern but after a point begins to rise again in countries with the highest GDP per capita, a pattern that can be thought of as N-shaped rather than the traditional inverted U of the Kuznets curve. Finally, the relationship between GDP per capita and sanctioning of farm animal cruelty appears to be linear, with higher GDP per capita being associated with lower sanctioning of farm animal cruelty.

Overall farm animal cruelty.

Results of the regression analysis predicting overall farm animal welfare are presented in Table 4-4. GDP per capita is not significantly associated with overall farm animal cruelty in Model 1A, but is statistically significantly associated in Model 1B ($b=1.280$, $p<.05$) and Model 1C ($b=3.115$, $p<.05$). In these models GDP^2 is statistically significantly negatively associated with overall farm animal cruelty ($b=-.019^*$, $p<.05$; $b=-.079^*$). GDP^3 is not significantly associated with overall farm animal cruelty. These results suggest the existence of a Kuznets curve relationship between GDP per capita and overall farm animal cruelty. However, it should be noted that GDP per capita explains only a small amount of the variance in countries' overall farm animal cruelty (6.2% in Model 1B), and that GDP^2 loses significance in Model 1D and Model 1E when legal rights and women in power are controlled for. The relationship between GDP per capita and overall farm animal welfare is plotted in Figure 4-3. Legal rights and women in power were not statistically significantly associated with overall farm animal welfare in

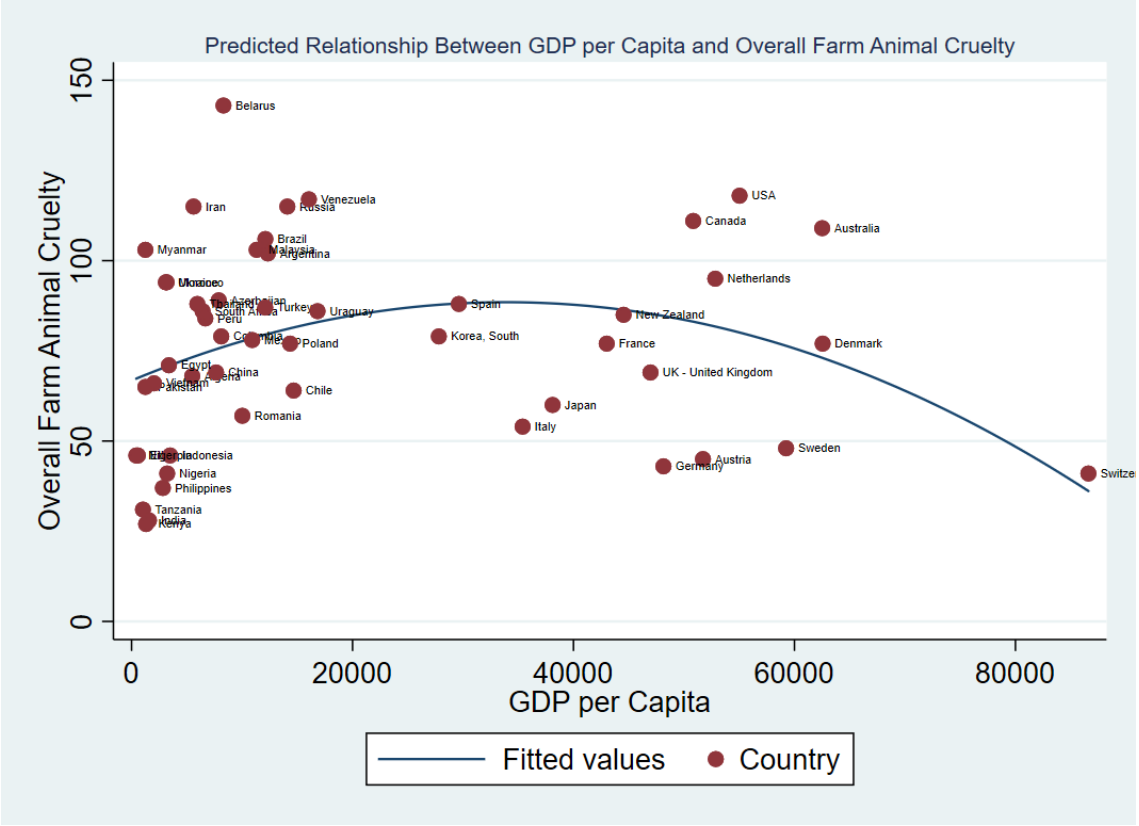
any model. The Gini coefficient is statistically significantly associated with overall farm animal cruelty (b=1.402, p<.05), meaning that countries with higher income inequality are more likely to have higher overall farm animal cruelty.

Table 4-4: OLS Regression Predicting Overall Farm Animal Cruelty - AWKC

	Model 1A	Model 1B	Model 1C	Model 1D	Model 1E	Model 1F
GDP per Capita (Thousands of Dollars)	.045	1.280*	3.115*	3.065*	2.96*	-.629
	(.178)	(.569)	(1.262)	(1.285)	(1.274)	(1.957)
GDP^2		-.019*	-.079*	-.077	-.069	.008
		(.008)	(.038)	(.039)	(.039)	(.050)
GDP^3			.000	.000	.000	-.000
			(.000)	(.000)	(.000)	(.000)
Legal Rights				-.421	-.581	-.732
				(1.404)	(1.395)	(1.329)
Women in Power					-.552	-.568
					(.392)	(.374)
Gini Coefficient x 100						1.402*
						(.600)
Constant	75.212***	66.765***	58.600***	60.610***	72.080***	-4.933
	(5.334)	(6.320)	(7.996)	(10.492)	(13.192)	(35.267)
AIC	475.022	471.795	471.012	472.912	472.707	468.728
BIC	478.846	477.531	478.660	482.472	484.179	482.112
Adjusted R2	-.020	.062	.094	.075	.095	.179

Beta coefficients marked for significance, standard errors presented in parentheses.
***p<.001 **p<.01 *p<.05

Figure 4-3: Predicted Relationship Between GDP per Capita and Overall Farm Animal Cruelty



Production of farm animal cruelty.

Table 4-5 presents the results of the regression analysis predicting production of farm animal cruelty. GDP per capita is not statistically significantly associated with production of farm animal cruelty in any model, nor are GDP^2 or GDP^3. Legal rights and women in power are not statistically significantly associated with production of farm animal cruelty. The Gini coefficient is positively associated with production of farm animal cruelty when it is included in Model 1F (b=.418, p<.01), consistent with previous research that finds income inequality and animal welfare are linked (Morris 2013).

Table 4-5: OLS Regression Predicting Production of Farm Animal Cruelty - AWKC

	Model 1A	Model 1B	Model 1C	Model 1D	Model 1E	Model 1F
GDP per Capita (Thousands of Dollars)	.256	.244	.563	.554	.531	-.538
	(.039)	(.126)	(.281)	(.287)	(.284)	(.415)
GDP^2		-.003	-.014	-.013	-.012	.011
		(.002)	(.008)	(.009)	(.009)	(.011)
GDP^3			.000	.000	.000	-.000
			(.000)	(.000)	(.000)	(.000)
Legal Rights				-.078	-.112	-.125
				(.313)	(.311)	(.079)
Women in Power					-.120	-.125
					(.088)	(.079)
Gini Coefficient x 100						.418**
						(.127)
Constant	8.394***	6.900***	5.478**	5.848*	8.349**	-14.590
	(1.156)	(1.395)	(1.784)	(2.341)	(2.947)	(7.478)
AIC	322.120	320.702	320.989	322.921	322.818	313.635
BIC	325.944	326.438	328.637	332.481	334.290	327.019
Adjusted R2	-.012	.035	.048	.028	.047	.220

Beta coefficients marked for significance, standard errors presented in parentheses.
***p<.001 **p<.01 *p<.05

Consumption of farm animal cruelty.

Table 4-6 presents the results of the regression analysis predicting consumption of farm animal cruelty. GDP per capita and its quadratic and cubic forms are associated with consumption of farm animal cruelty in Model 1C (b=-.092, p<.001; b=.001, p<.01), and remain statistically significantly associated when legal rights and women in power are controlled for. However, all measures of GDP lose significance in model 1F when the Gini coefficient is included. These results indicate that countries with higher GDP per capita are more likely to have higher consumption of animal cruelty, but after a point this

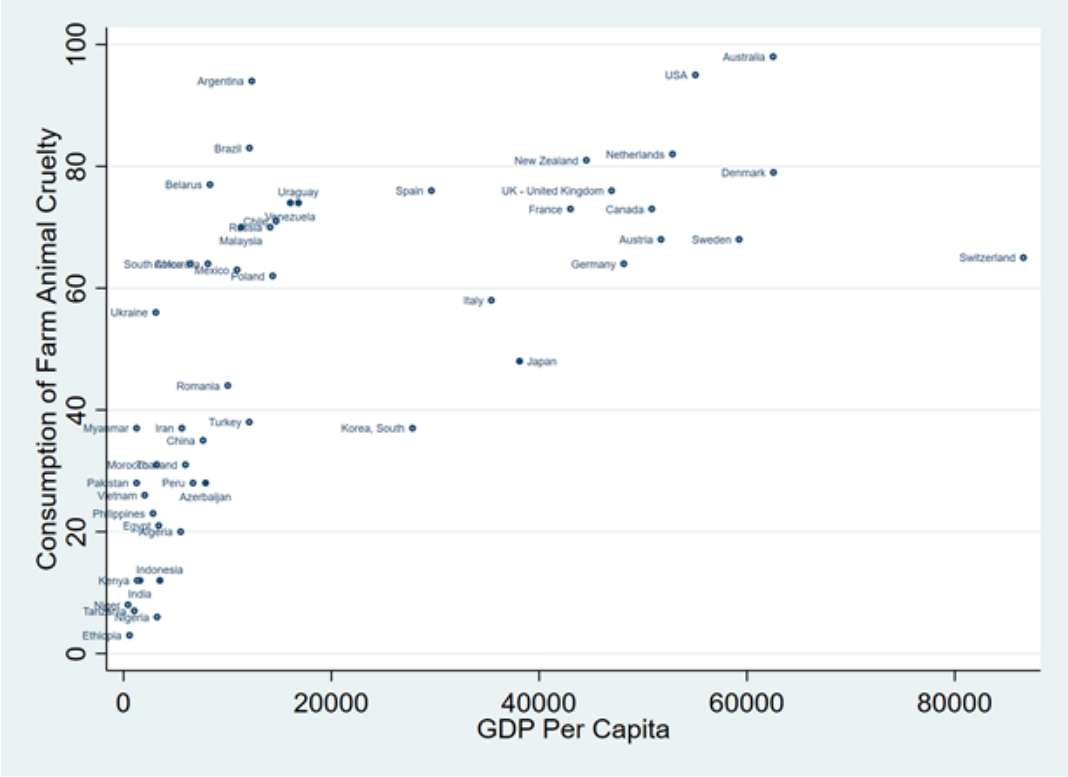
trend reverses, with higher GDP per capita countries having lower consumption of farm animal cruelty – a Kuznets curve. However, the cubic form of GDP per capita is also positively associated with consumption of farm animal cruelty, meaning that while this relationship may follow a Kuznets curve for a time, after a certain point consumption of farm animal cruelty begins to rise again in countries with the highest GDP per capita creating an N-shaped pattern. Figure 4-4 illustrates this pattern next to a scatterplot of GDP per capita and consumption of farm animal cruelty. Additionally, in all models GDP explains a high amount of variance in consumption of animal welfare (Model 1C r2 = .591). No other independent variable is statistically significantly associated with the consumption of farm animal cruelty.

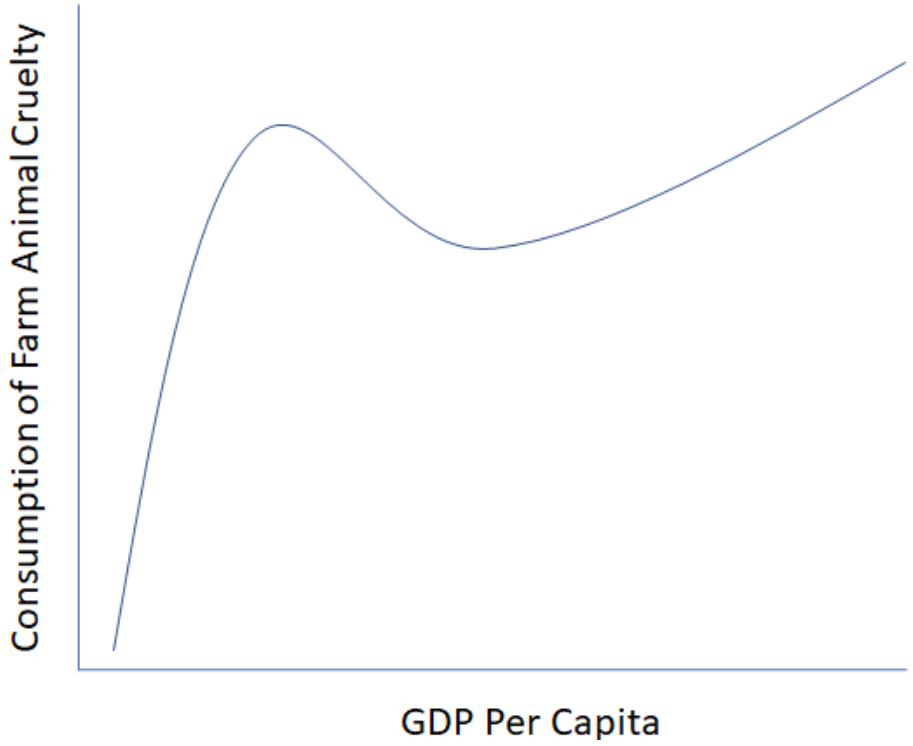
Table 4-6: OLS Regression Predicting Consumption of Farm Animal Cruelty - AWKC

	Model 1A	Model 1B	Model 1C	Model 1D	Model 1E	Model 1F
GDP per Capita (Thousands of Dollars)	.789***	2.219***	4.354***	4.467***	4.512***	2.582
	(.135)	(.400)	(.843)	(.850)	(.853)	(1.340)
GDP^2		-.022***	-.092***	-.097***	-.100***	-.059
		(.006)	(.025)	(.026)	(.026)	(.034)
GDP^3			.001**	.001**	.001**	.000
			(.000)	(.000)	(.000)	(.000)
Legal Rights				.944	1.013	.932
				(.928)	(.933)	(.910)
Women in Power					.239	.231
					(.262)	(.256)
Gini Coefficient x 100						.754
						(.411)
Constant	34.741***	24.963***	15.461**	10.956	5.984	-35.418
	(4.059)	(4.448)	(5.341)	(6.936)	(8.832)	(24.138)
AIC	447.716	436.668	430.659	431.521	432.585	430.812
BIC	451.540	442.404	438.307	441.082	444.057	444.197
Adjusted R2	.403	.530	.591	.591	.590	.611

Beta coefficients marked for significance, standard errors presented in parentheses.
***p<.001 **p<.01 *p<.05

Figure 4-4: Consumption of Farm Animal Cruelty and Illustrated N-Shaped Relationship with GDP per Capita





Sanctioning farm animal cruelty.

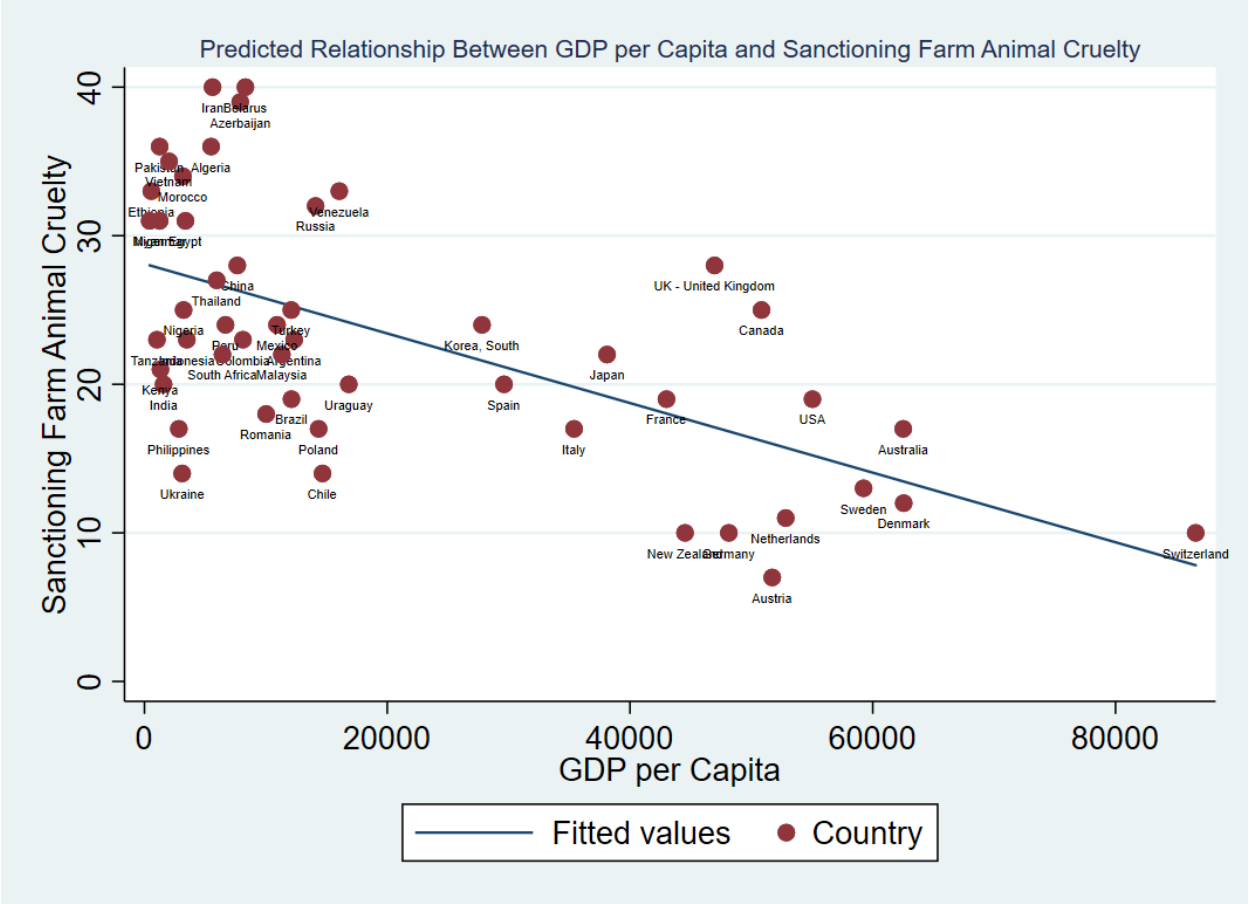
Finally, the regression analysis predicting sanctioning farm animal cruelty is presented in Table 4-7. GDP per capita is negatively associated with sanctioning farm animal cruelty in Model 1A (b=-.234, p<.001) and Model 1B (b=-.306, p<.05), but loses statistical significance in all other models. Figure 4-5 depicts a scatter plot of GDP per capita and sanctioning of farm animal cruelty with a fitted regression line. Legal rights is negatively associated with sanctioning farm animal cruelty in Model 1D (b=-.744, p<.05), Model 1E (b=-.783, p<.05), and Model 1F (b=-.782, p<.05). This association indicates that countries with higher legal rights are more likely to have more farm animal welfare protections. Legal rights and GDP per capita also explain a high degree of the variance in sanctioning farm animal welfare (Model 1D R2=.378). Women in power and the Gini coefficient are not associated with sanctioning farm animal cruelty.

Table 4-7: OLS Regression Predicting Sanctioning Farm Animal Cruelty - AWKC

	Model 1A	Model 1B	Model 1C	Model 1D	Model 1E	Model 1F
GDP per Capita (Thousands of Dollars)	-.234***	-.306*	-.330	-.419	-.444	-.424
	(.044)	(.148)	(.338)	(.329)	(.327)	(.534)
GDP^2		.001	.002	.006	.008	.007
		(.002)	(.010)	(.010)	(.010)	(.014)
GDP^3			.000	-.000	-.000	-.000
			(.000)	(.000)	(.000)	(.000)
Legal Rights				-.744*	-.783*	-.782*
				(.360)	(.358)	(.362)
Women in Power					-.134	-.134
					(.101)	(.102)
Gini Coefficient x 100						-.008
						(.163)
Constant	28.108***	28.597***	28.705***	32.254***	35.041***	35.468***
	(1.322)	(1.646)	(2.141)	(2.688)	(3.387)	(9.613)
AIC	335.542	337.271	339.264	336.724	336.744	338.741
BIC	339.366	343.007	346.912	346.284	348.216	352.125
Adjusted R2	.358	.348	.334	.378	.389	.374

Beta coefficients marked for significance, standard errors presented in parentheses.
***p<.001 **p<.01 *p<.05

Figure 4-5: Predicted Relationship Between GDP per Capita and Sanctioning Farm Animal Cruelty



Ecologically Unequal Exchange of Animal Cruelty Analyses

Overall farm animal cruelty.

Table 4-8 presents results from the ecologically unequal exchange OLS regression analysis predicting overall farm animal cruelty. In the full sample GDP per capita is associated with higher overall animal cruelty in Model 1A (b=9.711, p<.01), and Model 1B (b=9.525, p<.01). Exports to high-income countries is negatively associated with overall farm animal cruelty in Model 1A (b=-.629, p<.01), and Model 1B (b=-.691,

p<.01). Exports as a percentage of GDP is not statistically significantly associated with overall farm animal cruelty. These associations remain in the subsample of lower-income countries (Model 2A and Model 2B), and exports as a percentage of GDP is statistically significantly associated with overall farm animal cruelty for this subsample (b=.441, p<.05). No independent variable is statistically significantly associated with overall farm animal cruelty in the high-income country sample. These results, and particularly the negative association between exports to high-income countries and overall farm animal cruelty for lower-income countries is the opposite of what I hypothesized with ecologically unequal exchange. I discuss potential reasons for this in the discussion section of this paper.

Table 4-8: OLS Regression Predicting Overall Farm Animal Cruelty - EUE

	Model 1A	Model 1B	Model 2A	Model 2B	Model 3A	Model 3B
Sample	Full	Full	Low - Middle Income	Low - Middle Income	High Income	High Income
GDP per Capita	9.711**	9.525**	22.664***	20.997***	-4.329	-4.369
	(2.880)	(2.893)	(4.427)	(4.165)	(7.636)	(7.431)
Exports to HIC	-.629**	-.691**	-.581*	-.654**	-.349	-.101
	(.205)	(.217)	(.250)	(.233)	(.323)	(.358)
Export % of GDP		.187		.441*		-.521
		(.206)		(.197)		(.358)
Constant	25.046	24.197	-82.359*	-78.823*	148.565*	150.876*
	(23.501)	(23.564)	(35.647)	(33.039)	(66.408)	(64.647)
Adjusted R2	.198	.195	.492	.564	.093	.141
N	50	50	27	27	23	23
Beta coefficients marked for significance, standard errors presented in parentheses. ***p<.001 **p<.01 *p<.05						

Production of farm animal cruelty.

Table 4-9 presents results from the ecologically unequal exchange OLS regression analysis predicting production of farm animal cruelty. GDP per capita is positively associated with production of farm animal cruelty for the full sample (Model 1A b=2.262, p<.001; Model 1B b=2.186, p<.001). Exports to high-income countries is negatively associated with production of farm animal cruelty for the full sample (Model 1A b=-.139, p<.01; Model 1B b=-.164, p<.001). Exports as a percentage of GDP is not statistically significantly associated with production of farm animal cruelty for the full sample. As with overall farm animal cruelty, these associations remain for the analysis of the lower-income countries subsample, and exports as a percentage of GDP is statistically significantly associated with production of farm animal cruelty in this subsample (b=.104, p<.05). None of the independent variables were statistically significantly associated with production of farm animal cruelty with the high-income subsample. Again, these results are the opposite of what I hypothesized, and I discuss this further in the final section of this paper.

Table 4-9: OLS Regression Predicting Production of Farm Animal Cruelty - EUE

	Model 1A	Model 1B	Model 2A	Model 2B	Model 3A	Model 3B
Sample	Full	Full	Low - Middle Income	Low – Middle Income	High Income	High Income
GDP per Capita	2.262***	2.186***	5.456***	5.062***	-.426	-.430
	(.617)	(.605)	(1.032)	(.968)	(1.434)	(1.457)
Exports to HIC	-.139**	-.164***	-.177**	-.194**	-.050	-.029
	(.044)	(.045)	(.058)	(.054)	(.061)	(.070)
Export % of GDP		.076		.104*		-.043
		(.043)		(.046)		(.070)
Constant	-3.448	-3.794	-26.840**	-26.004**	17.403	17.594
	(5.037)	(4.931)	(8.12)	(7.681)	(12.474)	(12.677)
Adjusted R2	.221	.255	.525	.595	-.000	-.033
N	50	50	27	27	23	23

Beta coefficients marked for significance, standard errors presented in parentheses.
***p<.001 **p<.01 *p<.05

Consumption of farm animal cruelty.

Table 4-10 presents results from the ecologically unequal exchange OLS regression analysis predicting consumption of farm animal cruelty. GDP per capita is associated with consumption of farm animal cruelty in all models for all groups of countries. This is consistent with previous research on animal consumption (York and Gossard 2004), as well as the earlier Kuznets curve analysis in this paper that finds consumption of cruelty increases in in countries with higher GDP per capita, then begins to decline after a certain level of GDP per capita is reached, but finally changes directions again and continues to increase in countries with the highest GDP per capita. In the full sample exports to high-income countries is negatively associated with consumption of farm animal cruelty (Model 1A b=-.327, p<.05; Model 1B b=-.340, p<.05), but is not statistically significantly associated with consumption of farm animal cruelty in either of

the subsamples of countries. Exports as a percentage of GDP is not statistically significantly associated with consumption of farm animal cruelty in any model.

Table 4-10: OLS Regression Predicting Consumption of Farm Animal Cruelty - EUE

	Model 1A	Model 1B	Model 2A	Model 2B	Model 3A	Model 3B
Sample	Full	Full	Low - Middle Income	Low - Middle Income	High Income	High Income
GDP per Capita	17.929***	17.890***	19.092***	18.317***	10.684*	10.662*
	(1.835)	(1.858)	(3.503)	(3.523)	(4.643)	(4.572)
Exports to HIC	-.327*	-.340*	-.238	-.271	-.225	-.091
	(.131)	(.139)	(.198)	(.197)	(.197)	(.220)
Export % of GDP		.039		.205		-.281
		(.133)		(.167)		(.220)
Constant	-94.125***	-94.303***	-109.97***	-108.328***	-24.747	-23.500
	(14.974)	(15.133)	(28.207)	(27.945)	(40.383)	(39.775)
Adjusted R2	.671	.664	.517	.527	.141	.167
N	50	50	27	27	23	23

Beta coefficients marked for significance, standard errors presented in parentheses.
***p<.001 **p<.01 *p<.05

Sanctioning farm animal cruelty.

Finally, Table 4-11 presents results from the ecologically unequal exchange OLS regression analysis predicting sanctioning farm animal cruelty. As with the Kuznets curve analysis, GDP per capita is negatively associated with sanctioning farm animal cruelty in the full sample (Model 1A b=-3.137, p<.001; Model 1B b=-3.130, p<.001). Interestingly, this association remains statistically significant among high-income countries, but not lower-income countries. Exports to high-income countries is not statistically significantly associated with sanctioning farm animal cruelty in any model. Exports as a percentage of GDP is not statistically significantly associated with sanctioning farm animal cruelty in

the full sample or among lower-income countries but is negatively associated with sanctioning farm animal cruelty in the high-income country subsample (b=-.240, p<.05).

Table 4-11: OLS Regression Predicting Sanctioning Farm Animal Cruelty - EUE

	Model 1A	Model 1B	Model 2A	Model 2B	Model 3A	Model 3B
Sample	Full	Full	Low - Middle Income	Low - Middle Income	High Income	High Income
GDP per Capita	-3.137***	-3.130***	-.830	-1.158	-4.428*	-4.447*
	(.851)	(.862)	(1.670)	(1.691)	(2.048)	(1.763)
Exports to HIC	-.040	-.038	-.018	-.033	-.028	.086
	(.061)	(.065)	(.094)	(.095)	(.087)	(.085)
Export % of GDP		-.007		.087		-.240*
		(.062)		(.080)		(.085)
Constant	54.571***	54.601***	34.945*	35.640*	66.384***	67.449***
	(6.943)	(7.023)	(13.449)	(13.416)	(17.808)	(15.334)
Adjusted R2	.282	.267	-.067	-.059	.280	.467
N	50	50	27	27	23	23
Beta coefficients marked for significance, standard errors presented in parentheses. ***p<.001 **p<.01 *p<.05						

DISCUSSION

This paper addresses the issue of global farm animal cruelty and its relationship to economic growth and international trade. My hypotheses in this paper were derived from three theories: 1) the animal welfare Kuznets curve hypothesis, 2) treadmill of production theory, and 3) ecologically unequal exchange theory. The results of ordinary least squares linear regression provide support for the animal welfare Kuznets curve and treadmill of production theory, depending on the type of farm animal cruelty analyzed: production, consumption, or sanctioning. They also contribute to the literature on ecologically

unequal exchange theory. However, there are also limitations with each analysis that need to be considered when interpreting and generalizing these results.

The first hypothesis I test is derived from the animal welfare Kuznets curve hypothesis. I find that a Kuznets curve exists for overall farm animal cruelty, where increased GDP per capita is first associated with increased farm animal cruelty but then reverses and is associated with decreased cruelty. However, the effect of GDP^2 loses significance when controlling for legal rights and women in power in nations. This could be due to a loss of statistical power associated with the low sample size, or could reflect that GDP is associated with increased farm animal cruelty but that other factors in affluent nations explain the decline in cruelty. This possibility is also supported by the low amount of variance in farm animal cruelty explained by GDP and GDP^2 (6.2%). Interpretation of the finding of a Kuznets curve should therefore be cautious, and it may be more useful to consider the sub-indices of farm animal cruelty when drawing conclusions.

Overall farm animal cruelty follows a Kuznets curve pattern, but the farm animal cruelty sub-indices (production, consumption, and sanctioning of farm animal cruelty) do not. I find no statistically significant relationship between GDP and production of farm animal cruelty in the Kuznets curve analysis. Consumption of farm animal cruelty follows the Kuznets curve pattern, but GDP does not maintain its negative association with consumption of farm animal cruelty after its turning point. Rather, this relationship flips for a second time, with GDP again being associated with increased consumption of cruelty in the highest-income countries. Pursuing economic growth as a strategy to

reduce consumption of farm animal cruelty may therefore be a viable strategy for some lower-income countries, but not high-income countries. This association remains consistent when controlling for social-political variables, though not when controlling for other economic variables. Still, GDP, GDP^2, and GDP^3 explain a large amount of the variance in the consumption of farm animal cruelty (59.1%). This finding is similar to previous research that finds economic development is associated with increased meat consumption, but that these effects vary based on individual country's levels of affluence (Sans and Combris 2015; York and Gossard 2004). Lastly, the relationship between GDP and sanctioning farm animal cruelty does not follow a Kuznets curve pattern. This relationship is linear, with increased GDP being associated with lower sanctioning of farm animal cruelty. In other words, higher GDP is associated with higher legal protections for farm animals. Sanctioning of farm animal cruelty is likely a contributing factor to the finding of an animal welfare Kuznets curve for overall farm animal cruelty. The results the sanctioning farm animal cruelty analysis do not support the animal welfare Kuznets curve hypothesis for this one dependent variable, but are good news for countries that want to improve legal protections for animals while simultaneously pursuing economic growth.

The second hypothesis I test is derived from treadmill of production theory (supplemented by critical animal studies), which asserts that economic growth is tied to increased animal cruelty (Fitzgerald and Pellow 2014; Nocella et al. 2014). In the first set of analyses (Tables 4-4 to 4-7), I do not find evidence of a positive linear association between GDP per capita and any of the dependent variables: overall farm animal cruelty,

production, consumption, and sanctioning of farm animal cruelty. However, in the second set of analyses where I look for a linear relationship, (Tables 4-8 to 4-11), GDP per capita is associated with increased overall farm animal cruelty, production of farm animal cruelty, and consumption of farm animal cruelty, and negatively associated with sanctioning of farm animal cruelty. For overall farm animal cruelty and production of farm animal cruelty this association exists for the overall sample and in lower-income countries, but not high-income countries, possibly pointing to a decoupling of production of farm animal cruelty and GDP per capita. This makes sense given the Kuznets curve finding for overall farm animal cruelty. However, with consumption of farm animal cruelty, this association exists for all three groups of countries. This highlights one limitation with the Kuznets curve analysis. Any slight decoupling we see between GDP per capita and overall farm animal cruelty and production of farm animal cruelty could be a result of the outsourcing of production to middle and lower income countries, as is suggested by the theory of ecologically unequal exchange. Furthermore, the Kuznets curve analysis showed that the relationship between GDP per capita and consumption of farm animal cruelty was not a true, inverted U-shaped Kuznets curve but rather an N-shaped curve, demonstrating support for treadmill of production theory. In other words, although there are some countries with higher per capita GDP and lower consumption of farm animal cruelty, the overall trend once this data is normalized by logging GDP per capita is that higher GDP per capita is associated with higher consumption of farm animal cruelty. Lastly, I do not find support for treadmill of production theory when it comes to sanctioning farm animal cruelty. In fact, the opposite relationship is present in both sets

of analyses, with higher GDP per capita being associated with lower sanctioning of farm animal cruelty. Animal legal protections are important, but are not a direct measure of animal welfare or cruelty, and more research on the treadmill of production and animal cruelty is needed.

Finally, my third hypothesis is derived from ecologically unequal exchange theory: that increased exports to high-income countries are associated with higher animal cruelty in lower-income countries. Although the results described above related to decoupling suggest possible support for the outsourcing of farm animal production cruelty, using the standard indicator of ecologically unequal exchange, exports to high income countries, I do not find evidence of ecologically unequal exchange for overall farm animal cruelty, I find the opposite. Increased exports to high-income countries are associated with decreased overall farm animal cruelty in both the full sample and in lower-income countries. This may be the result of spillover effects. Although there are very limited international animal welfare standards, the European Union has implemented stronger animal welfare policies and communicated that they want high welfare standards in trade with lower-income countries (Fraser 2014). Lower-income countries that have stronger trade relationships with high-income (often European) countries may therefore implement these higher welfare standards.

In terms of production of farm animal cruelty, I again find the opposite of my hypothesis derived from ecologically unequal exchange. Increased exports to high-income countries are associated with lower production of farm animal cruelty in the full sample and in lower-income countries. In addition to this being the results of spillover

effects, this may also be due to the way that production of farm animal cruelty is calculated. The production of cruelty measure is calculated using the number of animals slaughtered in a nation weighted by the legislative protection provided to animals in that nation (VAPI 2017). However, production and processing of animal products are not limited to a single country. The number of live farm animals (pigs, chickens, cattle, sheep and goats) shipped around the world increased from 130 million in 1967 to 1.9 billion in 2017 (Levitt 2020). An animal may therefore spend the majority of its life in one nation, but shipped and slaughtered in another, in which case that animal would be counted in the second nation's production of farm animal cruelty score. Exports of merchandise to high-income countries includes live animals, and therefore these lower-income countries that trade with high-income countries may be exporting a larger number of live animals to high-income countries to be slaughtered and thereby lowering their production of farm animal cruelty score and increasing the score for high-income countries. In addition, this measure of merchandise exports to high income countries is broad and includes many types of merchandise traded, not only animals. This makes sense in other analyses of ecologically unequal exchange since nearly all manufacturing includes some carbon emissions, but in an analysis of animal cruelty it might make more sense to use a measure specifically focused on trade of animals. Future research should look specifically at the flows of live and butchered animals between countries.

Finally, in terms of consumption of farm animal cruelty exports to high-income countries is statistically significantly associated with decreased consumption of farm animal cruelty among the full population of 50 countries, but not for either of the

subsamples of lower-income or high-income countries. There is no statistically significant relationship between exports to high-income countries and sanctioning farm animal cruelty. Again, these 50 countries can be thought of as a population rather than a sample, since the results of this analysis would likely not be generalizable to other countries that do not produce many animal products. Statistical significance is therefore not the only criteria that should be examined when evaluating hypotheses. The adjusted r-squared scores seem to support the conclusions presented here, showing that for overall, production, and consumption of farm animal cruelty, GDP and exports to high-income countries explain a large amount of variance in the dependent variables in lower-middle income countries, but not in high-income countries.

There are several limitations with this study that I draw attention to. The first is that it is a cross-sectional analysis. This type of analysis is acceptable in Kuznets curve research (see Dinda 2004) but rests on the assumption that economic growth will have similar effects in different countries, which may not be true. A longitudinal analysis of these same questions if data become available in the future would be insightful.

Second, I use data from Voiceless: The Animal Protection Institute (VAPI 2017), which have some limitations in the way they are calculated. VAPI's (2017) animal cruelty index itself relies on data from World Animal Protection (WAP 2020) that assigns scores to countries based on their animal welfare legal protections. In designing their global animal protection index later used in part to calculate the sanctioning farm animal cruelty index, World Animal Protection (2020) consulted with leaders from each of the evaluated countries to ensure that their representation was fair and not missing any key

policies or pieces of legislation on animal welfare. Still, the index still has some limitations. For much of human history, farm animal welfare legislation was seen as unnecessary because farm production and animal welfare were linked. Industrialization of farming contributed to a decoupling of this relationship, where situations that decreased farm animal welfare could actually increase productivity, and thereby warranted government intervention. But industrialization of animal agriculture did not happen uniformly across the globe, and even now in many countries laws prohibiting certain cruel farming practices may be seen as unnecessary because animal agriculture has not industrialized to that point yet. The point is that developing global standards of animal welfare presents difficult challenges, and despite World Animal Protection's best efforts, there may still be a Western bias in the way that animal welfare protections are evaluated.

CONCLUSION

Farm animal cruelty remains an important question for sociologists to address. Here I have tested the animal welfare Kuznets curve hypothesis, treadmill of production theory, and ecologically unequal exchange theory to understand farm animal cruelty at a global scale. GDP per capita and overall farm animal cruelty follow a Kuznets curve pattern, but the relationship between GDP per capita and consumption of farm animal cruelty is more in line with treadmill of production theory. Taken together, these results make an interesting contribution to environmental sociology, highlighting the importance of context. Economic growth is not a panacea for farm animal cruelty, but it is not

inherently at odds with farm animal cruelty either. In terms of ecologically unequal exchange and global trade, the results indicate high-income countries are not simply externalizing animal cruelty to lower-income countries, although this may be part of the story in terms of consumption, but trade with high-income countries is actually associated with decreased overall farm animal cruelty and production of animal cruelty. Part of this finding is likely due to the way I measured farm animal cruelty in this study, but it could also be due to the key ecologically unequal exchange variable of merchandise exports to high-income countries. Merchandise does cover animal exports but also a wide variety of other exports as well, and it would therefore be insightful to conduct a similar analysis using a measure of only animal or animal product exports. More research on global farm animal cruelty (and other types of animal cruelty) is needed, and by applying the Kuznets curve hypothesis, treadmill of production theory, and ecologically unequal exchange theory in novel ways here I have demonstrated the utility of theories in environmental sociology to address these issues in future research and new contexts.

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CHAPTER 5 – CONCLUSION

This dissertation addresses how modernization (economic growth, technological innovation, globalization) affects human-animal relationships. I examine this relationship at three scales: farm, U.S. state, and globally. Human-animal relationships are important aspects of sustainability and are tied to social and environmental outcomes (Pinillos 2018). In this research I primarily focus on social and animal outcomes tied to the human-animal relationships. In the second chapter, I analyze dairy farmer alienation from their work and cows, as well as their overall life satisfaction. In the third and fourth chapters I analyze social factors that influence animal welfare outcomes on a broad scale. Here, I discuss how the findings of this research contribute to sociology, and environmental sociology in particular, the limitations associated with each study, and future research we need to better understand human-animal relationships.

ALIENATION AND MODERNIZATION

Human-animal relationships are shaped by social structures. I address these structural constraints on dairy farms in Chapter 2, specifically analyzing the relationship between farm size and technology use and farmer alienation from their work and cows, and how these types of alienation are associated with their overall life satisfaction. I use Nair and Vohra's (2009) definition of alienation from work in this analysis, "*estrangement or disconnect from work, the context or self* " (p.296). I use Hailwood's (2015) definitions of alienation from nature as estrangement from the natural world to

analyze farmer alienation from their cows. Overall, dairy farmers feel close to their cows and report that they enjoy their work. However, results from a survey and interviews with farmers in Washington show that increased farm size is associated with increased farmer alienation from their cows, while increased technology use is associated with decreased alienation from their cows. Additionally, both farmer alienation from work and from their cows are negatively associated with lower overall life satisfaction.

These findings contribute to sociology by giving insight into both concepts of alienation and modernization (economic growth, technological innovation, globalization). First, the results of this study show that alienation matters – it is negatively associated with overall life satisfaction. This is an important finding for farmers, who experience high levels of stress and mental health problems (Fraser et al. 2005; Widmar 2015), as well as policymakers who want to improve the situation of farmers. One farmer lamented the wide public concern for animal welfare but lack of concern for farmer well-being by saying "that cow has more rights than I do". This study focuses on farmer well-being and illustrates how it is connected to their relationship with their animals. Animal welfare and farmer well-being are not competing in a zero-sum game, and improving both along with the relationship between farmers and their animals is not just possible, but necessary. Reducing farmer alienation from their work and cows, although a daunting challenge, should be a goal of those who want to address the farming mental health crisis.

The second contribution I make with this study is a more nuanced view of alienation and modernization. Ecological modernization theory tends to portray modernization as a force contributing to increased ecological rationality and new, less

destructive relationships with nature (Frouws and Mol 1997), while metabolic rift theory sees modernization as a negative, alienating force (Foster 1999; McClintock 2010). This research shows that different aspects of modernization can be more alienating or less (at least when it comes to farmer alienation from cows). Broader political economic pressures push dairy farms to become larger, and farmers on these larger farms are more alienated from their cows. These same pressures, however, also push farmers to install labor-saving productive technologies and practices that according to this study are associated with less farmer alienation from their cows. The effects of modernization on human-animal relationships are not uniform, and theories in environmental sociology should continue to be applied in new contexts to better understand these nuances.

ANIMAL WELFARE AND ECONOMIC GROWTH

Chapter 2 analyzes the human outcomes associated with the human-animal relationship, while Chapter 3 and Chapter 4 address the animal outcomes of these relationships: animal welfare protection and farm animal cruelty. Specifically, Chapter 3 and Chapter 4 analyze the relationship between economic growth and animal welfare. Economic growth is at the center of multiple prominent theories in environmental sociology including ecological modernization theory, which sees it as a pathway to sustainability (Mol 1995), while treadmill of production theory sees it as a driver of environmental degradation (Schnaiberg 1980).

My dissertation contributes to this debate by examining the role of economic growth on animal welfare. Within the United States, I find some support for the positive

effect of economic growth on animal welfare outcomes, though this relationship is also dependent on the category of animal analyzed. My research also addresses the complex and changing role of economic growth in a global economy. The animal welfare Kuznets curve hypothesis asserts that the relationship between economic growth and animal welfare changes over time, initially contributing to increased animal cruelty, and then reversing and leading to decreased cruelty (Frank 2008). I find some support for this perspective at the global level for overall farm animal cruelty, and consumption of farm animal cruelty. However, when it comes to consumption, I also find that after a certain point the relationship between economic growth and farm animal cruelty reverses for a third time – being associated again with increased cruelty. Furthermore, I find that overall, there is evidence of a linear relationship, with higher GDP per capita being associated with increased consumption of farm animal cruelty. Some higher-income countries do have lower consumption of farm animal cruelty, but generally the results of these analyses suggest that higher GDP per capita is associated with higher consumption of farm animal cruelty.

More research in different contexts is needed to better understand the role of economic growth in shaping animal welfare, environmental, and social outcomes. My research makes a contribution to this literature by demonstrating how support for the competing theories of ecological modernization and treadmill of production can be found in the same analysis depending on how variables are operationalized and measured and the context in which they are analyzed. Environmental sociologists will likely need to

adopt a more complex and situational view of economic growth as they consider ways to improve animal welfare.

GLOBAL TRADE AND ECOLOGICALLY UNEQUAL EXCHANGE

In a global economy, production and consumption of animals does not happen within the borders of a single country. It is therefore important to study how trade relationships, particularly where there are differences in power, influence animal welfare outcomes. I test ecologically unequal exchange theory, which "contends that the unbalanced trade structure between developed countries and less-developed countries contributes to the externalization of environmental harms from developed countries to less-developed countries" (Bai and Givens 2021) and hypothesize that higher-income countries also externalize animal cruelty to lower-income countries. Contrary to my hypothesis, the results of Chapter 4 suggest that trade with high-income countries is associated with lower animal cruelty. This could be explained partially by the farm animal cruelty measures which are highly influenced by legal animal protections, or by the key independent variable – percent of merchandise exports sent to high-income countries. This is the measure typically used by ecologically unequal exchange research, but has some limitations, especially when looking at a narrower outcome like farm animal cruelty. Future research could use specific measures of trade of animals and animal products between high- and low-income countries.

The results of the ecologically unequal exchange of farm animal cruelty analysis could also be that this is the result of a spillover from high-income countries that are

more likely to have more animal welfare protections, which includes regulation on how food products are labelled and sold (see European Commission 2014). These findings contribute to other recent research on ecologically unequal exchange (see Bai and Givens 2021) that suggests a nuanced view of trade relationships is necessary. If environmental regulations shifted toward a consumption-based approach rather than production (requiring good sold in the country to meet certain requirements rather than those produced), could this reverse the externalization of environmental harms and encourage trading countries to reduce environmental harms associated with production? More research is needed, as well as more research on the ecologically unequal exchange of animal cruelty that uses different measures of animal cruelty as they are developed and become available. There is also a need for more work in this area.

LIMITATIONS: SUBJECTIVITY AND ANIMAL WELFARE

In the introductory chapter of this dissertation, I outlined three challenges in human-animal research that I addressed in my dissertation: subject, species, and scale. Now I want to address a fourth challenge: subjectivity. My dissertation addresses three dependent variables: alienation, animal welfare, and animal cruelty. With all three of these variables there is an issue with subjectivity and operationalization that I address here.

In Chapter 2, I asked dairy farmers in Washington to self-report on their feelings of alienation from their work and cows, as well as their overall life satisfaction. I measured alienation from work and alienation from cows using multi-item scales.

Farmers' responses to these scales are subjective. There are other ways that future research could analyze alienation. Alienation includes both psychological and physical estrangement, and these physical aspects of alienation could be observed directly in future research rather than relying on self-reported information from farmers. Among dairy farmers, similar measures are becoming commonplace in assessments within the industry to evaluate farmer-cow relationships. For example, avoidance distance tests look at the how close farmers can get to cows before they retreat (Windschnurer et al. 2008). These tests are really a measure of how cows perceive farmers rather than the other way around but are still relevant since relationships between two individuals are based on the perceptions of both. Still, perhaps future measures could be developed to determine dairy farmers' own level of comfort around their cows, whether they can tell individual cows apart, or how they react when a cow has a behavioral or health issue. These can help give another perspective to the complex issue of alienation, though because of the deeply personal nature of estrangement there will almost certainly still be some reliance on farmers to express their feelings themselves either through surveys or interviews as I have done here.

Animal welfare itself is a subjective and highly contested concept. Some researchers emphasize biological measures such as productivity and health (Broom 1991), while others emphasize animal freedom from pain, suffering, and stress in addition to biological measures (Fraser et al. 1997; Keeling et al. 2019). Hewson (2003) asserts that the more biological approach to animal welfare was common in the past for farmers and veterinarians but that modern conceptions tend to include animal feeling and

behavior as key aspects of welfare. Whether basing animal welfare definitions primarily on biological measures, animal feeling, or both, "scientists must be aware that scientifically based, operational definitions of animal welfare will necessarily be influenced strongly by a given society's moral understanding" (Ohl and van der Staay 2012:13). Even among professionals, understandings of welfare can vary. For instance, animal science college faculty view farm animal welfare needs as being met more often than veterinary faculty (Heleski, Mertig, and Zanella 2006). There may be increased agreement that animal suffering is an important aspect of animal welfare, but this only adds to the subjectivity and confusion over the concept (Stafleu, Grommers, and Vorsenbosch 1996).

In Chapter 3, I measured U.S. state animal welfare protection using the Humane Society of the United States' "Humane State Ranking". I chose to use these data as a measure of U.S. state animal welfare protection because they are available for multiple years and include legislation and policy on a broad list of topics including: animal fighting, animal cruelty, wildlife abuse, exotic pets, companion animals, animals in research, farm animals, fur and trapping, puppy mills, and equine protection. Still, this measure is a subjective one both in terms of the number and types of policies included. For instance, why should horses be granted their own category (equine protection) but chickens are lumped in with other farm animals? Also, each measure is weighted equally, though the actual welfare implications of a law banning poultry battery cages are very different than a law banning hog dog fights (where a feral pig is forced to fight a dog or dogs in a pen).

In Chapter 4, I used Voiceless: The Animal Protection Institute's "Voiceless Animal Cruelty Index" (VACI) to measure production, consumption, and sanctioning of farm animal cruelty for 50 countries. The VACI relies on a measure created by the Animal Protection Institute, the "Animal Protection Index", which has many of the same types of limitations as the Humane State Ranking as it assigns scores to countries based on welfare issues the Animal Protection Institute prioritizes. There is another aspect of subjectivity with this index as a global index: Western bias. Designing a global ranking of animal protection is extremely difficult because animal welfare and definitions associated with it are based on cultural values and assumptions. Improving this measure would be difficult, and World Animal Protection went to great lengths to ensure participation and input from each country included in the ranking. Still, this limitation should be considered when interpreting the results of Chapter 4.

Subjectivity is an issue in much sociological research. Individuals bring their biases, experiences, and unique perspectives with them while answering survey questions or interviews. Including measures of animal welfare only adds to these complexities because animals cannot communicate with humans perfectly. The result is that there can be significant differences when it comes to defining and operationalizing animal welfare in research. In this research I designed questions of my own to examine farmer relationships with their cows. I also used measures created by nonprofit animal organizations to measure animal protection and farm animal cruelty. In both cases, there is some subjectivity in the way variables are measured. Still, these data from non-profit animal organizations are arguably some of the most relevant and complete that are

readily available. Researchers, governments, and industry should take a more active role in collecting and publishing data to provide a more complete picture and alternative perspectives on animal welfare. Subjectivity will always be present in this type of research, but future analyses can refine these measures and use new measures to continue to study human-animal relationships.

FUTURE RESEARCH

I have outlined some of the limitations with the data used in this dissertation, which naturally includes the suggestion of how future studies could build on this research using alternative measures. Here, I suggest concrete areas of future research that I plan on pursuing that address the issues tackled in this dissertation: modernization, alienation, and the human-animal relationship.

I find in Chapter 2 that higher use of technology and modern practices on dairy farms is associated with lower alienation of farmers from their cows. I suggest, in line with previous research (Schewe and Stuart 2015; Wildridge et al. 2020), that these technologies may reduce the quantity of interactions with cows but increase their quality. Greater flexibility is one of the top reasons cited for installing new technologies on farms (Hogeveen, Heemskerk, and Mathijs 2004; Schewe and Stuart 2015; Stræte, Vik, and Hansen 2017), and the dairy farmers I interviewed echoed this sentiment. In this dissertation I studied the effect of technological adoption on alienation from work and cows, but I plan on analyzing its relationship to community engagement. If farm technologies grant farmers greater flexibility with work, are they using this to engage

more with their communities? Based on the interviews I conducted with farmers I suspect that the effects of modernization on farming communities have been mixed, just as they are for alienation. Some farmers mentioned that other local dairies had gone out of business because of pressures to expand to maintain economic profit, but they also talked about being able to attend local events like sports games after installing new milking technologies on their farm. As with alienation from cows, these responses from farmers suggest that the effect of modernization may be mixed when it comes to community impacts. The structure of their community may be changing. Whereas the community was once structured around farming, now new interests may dominate interactions and conversations, leading farmers to feel out of place or like they have lost their old communities. On the other hand, the new technologies associated with modernization may allow them to engage with their community in a way they have not previously been able to. I intend to study this relationship more closely using the same survey and interview data I collected from farmers in Washington, as well as in Idaho and Utah (where I also collected survey data), and ideally in broader regional or national contexts as well.

I conducted a global analysis of the animal welfare Kuznets curve for farm animal cruelty, but this only addresses one aspect of the human-animal relationship. Previous research suggests that Kuznets curves develop at different times for different types of animals (Frank 2008). For instance, in the United States concern over abuse toward companion animals gained public support before broad concern for farm animal welfare (Collis 2016). I plan on analyzing the animal welfare Kuznets curve globally by

analyzing the types of animal protection organizations that have emerged by country. This analysis will contribute to the animal welfare Kuznets curve literature, and will also contribute to the world polity theoretical perspective, which draws attention to the emergence of non-governmental organizations as part of a global culture and set of norms (Boli and Thomas 1997; Givens and Jorgenson 2013).

SUMMARY

In this concluding chapter I summarize the contributions and findings of my dissertation research, as well as its limitations and future directions. The overarching question addressed in this research is how does modernization affect the human-animal relationship? Here, I argue that my research gives new insights into alienation and modernization. Alienation is a complex phenomenon, and dairy farmers experience conflicting feelings of alienation from their work and their cows. Modernization includes multiple processes including economic growth, technological innovation, and globalization. Although these processes are thought of as a complete modernization package, they can have contradictory effects on social well-being and animal welfare. Even single-item measures like economic growth affect animal welfare differently in different contexts, at different scales, and depending on which welfare outcomes are measured and for which animals. I attempted to address these issues of species and scale in the preceding chapters, and in this final chapter address a fourth issue – subjectivity. Subjectivity in measures of animal welfare will always be an issue, but rather than only seeing this as a limitation I see this as an exciting call for new research.

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APPENDICES

APPENDIX A: SURVEY MEASURES

1. How long have you worked as a dairy farmer (including work on this or any other dairy)? Please report your answer in whole years and months.
2. Do you rent or own the property where you operate your dairy?
3. Please indicate your best estimate of how many people work at your dairy during the year (including family, full time, part time, and seasonal laborers).
4. What percentage of your animal feed do you buy from an outside source? Please give an estimated percentage from 0 to 100 percent.
5. On average, what percentage of your farm costs go to new machinery and/or technology each year? Please indicate a percentage from 0 to 100 percent.
6. On average, what percentage of your farm costs go to labor costs each year? Please indicate a percentage from 0 to 100 percent.
7. On average, how many weeks per year do your cows typically spend grazing on pasture?
8. On average, what percentage of manure do you keep on your dairy (either stored or applied to soil) rather than sending somewhere else?
9. When you think about manure on your farm, do you think of it more as a waste product, or a resource? Mark one circle. (Completely a waste product, mostly a waste product, equally a waste product and resource, mostly a resource, completely a resource)

10. Below is a list of dairy related issues. For each one, please indicate if you personally worry about this problem not at all, only a little, a fair amount, or a great deal.

    a. Maintaining economic profits.
    b. Having someone to take over the farm when I retire.
    c. Public opinion of farmers.
    d. Global trade competition.
    e. Current government regulation.
    f. Potential changes in government regulation.
    g. Animal welfare on the farm.
    h. Herd size on my dairy.
    i. Public demand for organic dairy.

11. How much Pressure do you feel to expand your herd size? (None, a little, a great deal).

12. Please take this space to elaborate on the dairy related concern(s) you worry about most frequently and/or other dairy-related concerns we haven't listed here.

13. How would you rate the overall quality of the environment in this country today? (Poor, fairy, good, excellent).

14. Below is a list of problems. For each one, please indicate if you personally worry about this problem not at all, only a little, a fair amount, or a great deal.

    a. Pollution of drinking water.
    b. Pollution of rivers, lakes, & reservoirs.
    c. Air pollution.
    d. The loss of natural habitat for wildlife.
    e. Urban sprawl & loss of open spaces.
    f. Global warming or climate change.
    g. Damage to the earth's ozone layer.
    h. Contamination of soil & water by toxic waste.

15. How many times in the past 12 months have you participated in a community improvement project where you live, such as a volunteer project or fund-raising effort?
16. How many times in the past 12 months have you attended a public meeting on town or school affairs?
17. In general, how would you describe your level of involvement in local community activities and events? (Not at all active, somewhat active, fairly active, very active).
18. Below are a list of questions related to the local community where you live. Please mark how much you agree or disagree with each statement. (Strongly disagree, disagree, neither agree nor disagree, agree, strongly agree).
    a. The longer I live in this community the more I feel I belong here.
    b. I feel I am fully accepted as a member of this community.
    c. If I was in trouble, most people in this community would go out of their way to help me.
    d. Most people in this community can be trusted.
    e. I feel this community is a real home to me.
19. In general, how would you describe your level of involvement in working with others to solve local community problems? (not at all active, somewhat active, fairly active, very active).
20. How has your relationship to your community changed over time since you first began working on dairies?
21. Below are a list of statements about your work experience. Please mark how much you agree or disagree with each statement. (Strongly disagree, disagree, neither agree nor disagree, agree, strongly agree).

a. I enjoy my work.
b. Facing my daily tasks is a painful and boring experience.
c. Work to me is more like a chore or burden.
d. I feel like putting in my best effort at work.
e. I feel estranged/disconnected from myself.
f. I feel connected to events at my workplace.
g. Over the years I have become disillusioned about my work.
h. I often wish I were doing something else.
i. I feel pressured to meet expectations of outside people/organizations.
j. I feel in control of how my dairy operates.
k. I am proud of my work.

22. Overall, how satisfied are you with your life nowadays? (Not at all satisfied, somewhat satisfied, satisfied, very satisfied, completely satisfied).

23. In general, how would you describe your work life and social life balance? Mark the circle that best represents your experience.

    a. Work takes up more time than I would like.

    b. I like the balance between my work and social life.

    c. Social activities take up more time than I would like.

24. Listed below are several statements related to the cows you manage. Please mark a circle to indicate the extent to which you agree or disagree with each statement. (Strongly disagree, disagree, neither agree nor disagree, agree, strongly agree).

    a. If my cows are doing well I am doing well.
    b. I feel attached to the cows I manage.
    c. I know my cows individually.
    d. I often feel unsure about my cows' needs.
    e. I frequently spend time physically near my cows.
    f. I wish I had more time to spend with the cows I manage.
    g. My cows have unique personalities.
    h. Technology on my farm improves my cows' lives.

25. Compared to other dairy farmers in Washington, would you say the quality of care your cows receive is: much worse, a little worse, about the same, a little better, much better.
26. Compared to other dairy farmers in China, would you say the quality of care your cows receive is: much worse, a little worse, about the same, a little better, much better.
27. Considering your experience as a dairy farmer in general, how has this experience changed since you first started working on a dairy?
28. Below is a list of technologies and practices. Please indicate which of the following are used on your dairy (check all that apply).
    a. Artificial insemination.
    b. Routine vet service.
    c. Nutritionist service.
    d. Replacement heifers raised off-farm.
    e. Robotic milkers (e.g. Lely or DeLaval).
    f. Robotic feed delivery.
    g. Robotic manure management.
    h. Forward contracts for inputs.
    i. 100% organic feed.
    j. Bovine growth hormone (rBST).
29. What is your sex? (Male, female).
30. Please indicate your race. (White, Black or African-American, American Indian or Alaska Native, Asian, Native Hawaiian or Pacific Islander, Other).
31. What is the highest level of education you have completed? (Les than high school, high school/GED, some college (associate's degree), bachelor's degree, graduate degree).
32. What is your age? (18-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75 or older).

33. Which of the following best represents your political ideology? (Very conservative, conservative, moderate, liberal, very liberal).
34. What is your political affiliation? (Democrat, Republican, Independent, other).
35. How many milking cows are on your dairy currently? (1-37, 38-199, 200-699, 700-1699, 1700-2699, 2700 or more).
36. What is your religious affiliation (if any)?
37. Is there anything you would like us to know about your life as a dairy farmer and issues facing dairy farms today?

APPENDIX B: INTERVIEW GUIDE

1. Please tell me about how you started working on a dairy.

- What year did you start working on a dairy?
- When did you first start managing?
- How have things changed since you first started compared to now?
- Did you ever take a break from dairy to try something else?

2. How has the covid-19 pandemic affected you and your dairy?

3. What does the future look like for your dairy (and for you as an operator)?

- What about for other dairy farmers of the industry in general?
    - Is there much variation by dairy? Why?
- What are the biggest risks / stresses facing your dairy and/or the industry in general?

4. Do you enjoy your work?

- What is the best part/worst part?
- Why do you do it / stick with it?
- Would you recommend dairy farming to other people?
- Will you ever leave?

5. What are the biggest misconceptions people may have about dairies?

- What do you think would surprise people if they learned this about dairies?

6. In the survey you and other farmers completed, nearly everyone mentioned that their personal well-being was tied to their cows, but operators of larger dairies may have a harder time staying connected to their cows (being able to spend time with them, getting to know their unique personalities). Do you think that is accurate? Why or why not?

- Has your relationship with your cows changed since you first started working on a dairy?
- How do you think about the lives of your cows?
- Do you see them as part of nature, or something else?
- Compared to other dairies (in Washington or elsewhere) do you think your cows have it better or worse?

7. In an ideal world, what would your dairy look like for you and for your cows?

8. Is there anything else I haven't asked about that you think would be important for me, the public, or specific groups like government regulators, environmentalists, or animal rights people to know?

CURRICULUM VITAE

MICHAEL D. BRISCOE

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EDUCATION

2021 Ph.D. Sociology, *Utah State University, Logan UT*

- Concentration Areas: Environment and Community and Social Inequality
- Graduate Certificate in Teaching Sociology

2017 M.A. Sociology, *University of Colorado Colorado Springs, Colorado Springs CO*

- Graduate Certificate in Advanced Research Methods
- Graduate Certificate in Sociology of Diversity

2014 B.S. Sociology, *Brigham Young University - Idaho, Rexburg ID*

RESEARCH & TEACHING INTERESTS

Environmental Sociology	Sustainability	Animals and Society
Community	Research Methods	Political Economy

PEER REVIEWED PUBLICATIONS

Briscoe, M. D., J. E. Givens, and M. Alder. 2021. "Intersectional Indicators: A Race and Sex-Specific Analysis of the Carbon Intensity of Well-Being, 1998-2009." *Social Indicators Research* https://doi.org/10.1007/s11205-021-02613-x

Givens, J. E., S. O. Hazboun, **M. D. Briscoe**, and R. S. Krannich. 2021. "Climate Change Views, Energy Policy Support, and Personal Action in the Intermountain West: The Anti-Reflexivity Effect.″ *Society & Natural Resources*, 1-23.

Olson-Hazboun, S., **M. Briscoe**, J. Givens, and R. Krannich. 2019. "Keep Quiet on Climate: Assessing Avenues of Support for Renewable Energy in the U.S. Mountain West: Results from a Five-state Survey." *Energy Research & Social Science* 57: 101243

Briscoe, M. D., J. E. Givens, S. O. Hazboun, and R. S. Krannich. 2019. "At Home, In Public, and in Between: Gender Differences in Public, Private, and Transportation Pro-Environmental Behaviors in the US Intermountain West." *Environmental Sociology* 5(2):1-19 DOI: 10.1080/23251042.2019.1628333

Givens, J. E., J. Padowski, C. D. Guzman, K. Malek, R. Witinok-Huber, B. Cosens, **M. Briscoe**, J. Boll, and J. Adam. 2018. "Incorporating Social System Dynamics in the Columbia River Basin: Food-Energy-Water Resilience and Sustainability Modeling in the Yakima River Basin." *Frontiers in Environmental Science*, *6*, 104.

Briscoe, M. D. 2015. "The Separation of Church and Mate: How Church Attendance Impacts Marital Satisfaction and Why." *Undergraduate Research Journal for the Human Sciences* (14).

PEER REVIEWED PEDAGOGICAL PUBLICATIONS

Briscoe, M. D. 2019. "SOC 4400/5400: Animals and Society." Syllabus published in *TRAILS: Teaching Resources and Innovations Library for Sociology.* Washington DC: American Sociological Association. (http://trails.asanet.org)

TECHNICAL REPORTS

Yorgey, G., S. A. Hall, J. C. Adam, J. C. Padowski, J. E. Givens, **M. D. Briscoe,** and S. Richey. 2019. "Looking Forward: Incorporating Advisory Feedback into the Columbia Food-Energy-Water Project." in Sonia A. Hall, Georgine Yorgey, Julie Padowski, and Jennifer C. Adam (eds.) *Food - Energy - Water: Innovations in Storage for Resilience in the Columbia River Basin 2019 Progress Report.*

Briscoe, M. D., and J.E. Givens. 2019. "Managing for Whom? Social Well-being and the Food, Energy, Water System of the Columbia River Basin." in Sonia A. Hall, Georgine Yorgey, Julie Padowski, and Jennifer C. Adam (eds.) *Food - Energy - Water: Innovations in Storage for Resilience in the Columbia River Basin 2019 Progress Report.*

Briscoe, M. 2019. "Establishing a Baseline: Safari Doctors Health Survey." Report to Safari Doctors. Lamu, Kenya. July.

Briscoe, M. 2018. "Sustainability Issues in San Mateo County: Ranching, Food-miles, Organic Farming, and Pest Management." Report to Sustainable San Mateo County. San Mateo, CA. August.

Briscoe, M., and N. Akinsoto. 2018. "Strategy and Innovation for Development Initiative (SI4DEV): 2018 Volunteer Application Report." Report to Strategy and Innovation for Development Initiative. Lagos, Nigeria. July.

Briscoe, M. 2017. "Back to the Classroom: Program Evaluation and Movement Toward Evidence-Based Practice." Report to Steered Straight Inc.. Vineland, NJ. August.

Briscoe, M. 2016. "Religious Awareness: Literature Review and Implementation into Therapeutic Programming at Excelsior." Report to Excelsior Youth Center. Aurora, CO. June.

Dukes, R., K. Becknell, **M. Briscoe**, D. Scahill, S. Shively, and C. Sziklas. 2015. "Toward the Evaluation of USADA Programs." Report to the United States Anti-Doping Agency. University of Colorado, Colorado Springs: Center for Social Science Research. October.

GRANTS & FUNDING

Research

2019 Graduate Research and Creative Opportunities Grant. *Utah State University Office of Research* ($990.14)

Travel

2019 Graduate Student Travel Grant. *Utah State University Department of Sociology, Social Work, and Anthropology* ($1000)
2019 Graduate Student Travel Grant. *Utah State University Research and Graduate Studies* ($300)
2018 Graduate Student Travel Grant. *Utah State University Research and Graduate Studies* ($300)

2018 Graduate Student Travel Grant. *Utah State University Department of Sociology, Social Work, and Anthropology* ($500)
2018 Student Travel Grant. *Pacific Sociological Association* ($100)

HONORS AND AWARDS

2019 Doctoral Student Researcher of the Year - Sociology, Social Work, and Anthropology. *Utah State University*

2017 Presidential Doctoral Research Fellowship - $20,000 per year for 4 years, with full tuition waiver and subsidized health plan. *Utah State University.*

2014 1st Place, Research and Creative Works Conference for Sociology - Social Issues. *BYU-Idaho.*

CONFERENCE PRESENTATIONS

Briscoe, M. D. 2020. "Community, Cats, and Cash: A Community Field Theory Case Study." Presentation (virtual), American Sociological Association Annual Meeting.

Briscoe, M. D., and Jennifer E. Givens. 2020. "'The Customer is the Forest': Nonhuman Natures in Food, Energy, and Water Research and Management in the Columbia River Basin." Presentation (virtual), International Symposium for Society & Resource Management (ISSRM)

Briscoe, M. D., and Jennifer E. Givens. 2019. "Inequality, Race, and Sex: An Intersectional Analysis of Carbon Intensity of Well-being." Presentation, American Sociological Association Annual Meeting, New York, NY.

Briscoe, M. D. 2019. "Emotional Labor, Gender, and Social Interaction in Animal Care." Presentation, Utah State University Student Research Symposium, Logan, UT.

Briscoe, M. D. 2018. "Stocks or Stakeholders: Nonhuman Animals in Natural Resource Management." Presentation, Utah State University Student Research Symposium, Logan, UT.

Briscoe, M. D. 2018. "Joe Swanson: Disability and the Discourse of Pity in Television's Family Guy." Presentation, Pacific Sociological Association Conference, Long Beach, CA.

Briscoe, M. D. 2017. "Cute Animals: Conflict, Sex, and Recognition in an Online Community". Presentation, Western Social Science Association Conference, San Francisco, CA.

Briscoe, M. D. 2016. "Microaggressions, Microinequities, and Vegetarians: A Quantitative Study." Presentation, Western Social Science Association Conference, Reno, NV.

COURSES AS INSTRUCTOR OF RECORD

Spring 2021

SOC 4620 Sociology of the Environment and Natural Resources Utah State University

Spring 2020

SOC 1010 Introductory Sociology Utah State University

COURSES AS TEACHING ASSISTANT

Summer 2016

SOC 3070/CJ 3100 Social Research Methods University of Colorado Colorado Springs

Spring 2016

SOC 3170/CJ 3150 Social Statistics University of Colorado Colorado Springs

SOC 3070/CJ 3100 Social Research Methods University of Colorado Colorado Springs

SOC 2500 Social Problems University of Colorado Colorado Springs

SOC 2200 Intro to Racial & Ethnic Groups University of Colorado Colorado Springs

Fall 2015

SOC 1110 Introduction to Sociology University of Colorado Colorado Springs

INVITED LECTURES

"Food and Population: The Social Consequences of Modernity." 2020. *College of Idaho.* Instructor: Dr. Brett Alan Miller.

SERVICE

Institutional

2020	Reviewer, Peak Undergraduate Summer Fellowship *Utah State University,* Logan, UT
2019 -2020	Treasurer, Sociology Graduate Student Association *Utah State University,* Logan, UT
2018 - 2019	Grant Reviewer, Undergraduate Research and Creative Opportunities Grant Program (URCO) *Utah State University*, Logan, UT
2018 - 2020	Presentation Judge, Undergraduate Student Research Symposium *Utah State University,* Logan, UT

Disciplinary

2019-Present	Ad Hoc Journal Reviewer for the following journals: *Environmental Sociology* *Sociological Focus* *Social Forces*

Community

2017 – Present	Research Consultant: *Steered Straight Inc.* Vineland, NJ - Developed program evaluation proposal for youth education program. *Strategy and Innovation for Development Initiative.* Lagos, Nigeria - Analyzed and synthesized survey data from volunteers in 28 countries Africa and their community development plans and goals, as well as needs.

Sustainable San Mateo County. San Mateo, CA.
- Synthesized research on sustainability issues to be used in larger report.

Safari Doctors. Lamu Island, Kenya.
- Analyzed survey data on reproductive health to serve as a baseline to which future data can be compared to evaluate effectiveness of health education.

2016-2017 Sanctuary Core Team Member, *Spring Creek Youth Services Center,* Colorado Springs, CO.
- Created and implemented new programming and resources focused on non-violence and trauma-informed care for incarcerated youth.
- Reduced fights and assaults by 70% during time of service on committee.

PROFESSIONAL MEMBERSHIPS

American Sociological Association
- Animals and Society Section
- Environmental Sociology Section

Council on Undergraduate Research

International Association for Society and Natural Resources

PROFESSIONAL DEVELOPMENT

2021 Data Science: R Basics (Dr. Rafael Irizarry, Harvard T.H. Chan School of Public Health). HarvardX, An Online Learning Initiative of Harvard University.

2020 Revamp Your Research Assignment: An Interdisciplinary Graduate Student Workshop (4 hours). Utah State University.

2020 Reimagine Teaching: Technology Professional Learning Program for Utah Educators (4 hours). Utah Education Network.

2019	Social Network Analysis Workshop (8 hours; Dr. Raeda Anderson, Georgia State University). Yun Kim Population Research Lab, Utah State University.
2017	Grant Writing Seminar (8 hours; Dr. M.S. AtKisson, AtKisson Training Group, LLC). Research and Graduate Studies, Utah State University.